FOOD AND NUTRITION

Don Ross

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Oxford Book Company
Jaipur , India

ISBN : 978-93-80179-13-1

Edition: 2010

Oxford Book Company

Regd. Off. 267-B, 10-B, Scheme, Opp. Narayan Niwas,
Gopalpura By Pass Road, Jaipur - 302018 Rajasthan (India)
Ph: 0141 - 2594705, Telefax: 2597527

B.O. 102, Ist Floor, Satyam House,
4327/3, Ansari Road,Darya Ganj,
New Delhi - 110002 (India)
Ph: 011-45652440
Email - oxfordbook@sify.com
Visit us at: oxfordbookcompany.com

Typeset by :
Shivangi Computers
267, 10-B-Scheme, Opp. Narayan Niwas,
Gopalpura By Pass Road, Jaipur-302018

Printed at :
Rajdhani Printers, Delhi

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Diet and Health

INTRODUCTION

The importance of diet to health, especially in the prevention and cure of illness, is slowly becoming apparent. I endeavour to provide you with more than the basic, and usually inaccurate information on diet and nutrition. So whether you are a registered dietitian and want to brush up on the immense amount of information, or whether you just want to find out, for the first time what you should be eating, then this site is for you.

First I would like to talk about a very contentious word - diet. Many people don't like using this word, when referring to their eating habits, because they feel that it is humiliating to be on a diet. I am the opposite, as I am always on diet. Whether underweight, overweight, sick or fit, diet, by its Greek definition means the food eaten by an animal to maintain its state of health. So, when I talk about a diet I don't mean that you must necessarily lose weight, what I am referring to is the food that you should generally be eating, be it to build muscles, put on weight, lose weight or get rid of a cold.

This topic is as arguable as religion, politics and sex. There are always many different opinions relating to diet and nutrition. I am only going to present facts on the subject of nutrition as affirmed by the mainstream diet and nutrition world. The fallacies of the fringe will not be proposed, although they have been investigated by myself, so I know what the quacks are telling "Joe Public".

It has become apparent that the overconsumption of certain dietary components is now a major concern to people in the Western World. Foremost among them is the disproportionate consumption of fats, sodium, and sugars, at the expense of foods that may be more conducive to good health, such as foods high in complex carbohydrates and fibre (vegetables, fruit, and whole grain products).

The usual approach of the orthodox medical circles, when dealing with a disease, is to treat the symptoms with a remedy rather than removing the cause. Yet, by following the dietary guidelines of the

nutrition and health authorities, that have been proven with epidemiologic studies to be scientifically correct, it is possible to achieve and maintain good health.

Dietary factors play a prominent role in five out of the ten leading causes of death for Americans. Thus, it is important to emphasize the relationship of diet to the occurrence of chronic disease and to understand how wholesome food is necessary for good health.

Foods contain nutrients essential for normal metabolic function. An imbalance in nutrient intake or the consumption of harmful substances is the underlying factor in many chronic diseases, such as coronary heart disease, diabetes, obesity, and some cancers.

To acquire these nutrients we have to eat foods that contain them and make choices about what foods shouldn't be eaten in excess. This is difficult and requires a comprehensive research base and much effort before it is possible to maintain good health.

Eating is a source of considerable pleasure and an important part of our lives. It is not necessary to lessen this pleasure by following a healthy diet plan. By knowing what nutrients are, how they relate to different diseases, and how to make choices in selecting and preparing foods, it is quite possible to feel good and enjoy life equally or more.

Better chance of Overcoming Obesity with a Secondary Medical Diagnoses

Evidence linking diet and chronic diseases has become more firmly established in recent years. In addition to obesity it is not rare for patients to have a secondary medical diagnosis with some relationship to obesity. Many health problems can be overcome by a successful weight loss programme.

It is interesting to note that, in comparing results of a weight loss programme, Medical Centre. Study from patients with multiple diagnoses demonstrated better results, at 1-year follow-up, than patients with obesity and only one other diagnosis. Diets for these patients with multiple diagnoses were more complex, but perhaps these patients felt more concerned about their health and thus were more motivated.

Heart disease and cancer are the leading causes of death in the United States. Healthful eating habits can help prevent those diseases. Studies have identified three major risk factors for coronary heart disease: smoking, hypertension, and elevated plasma or serum cholesterol. Other studies have shown that quitting smoking, and reducing blood pressure and blood cholesterol reduce the risk for heart disease. Thus, considerable effort has been devoted to the modification of these risk factors.

Recently, the results of the Lipid Research Clinics Coronary Primary

Prevention Trial prompted a nationwide effort to increase public awareness of cholesterol and coronary heart disease and to encourage the adoption of low-fat, low-cholesterol diets.

Table. Results at 1-year Follow-up of Secondary Diagnoses.

Diagnosis	No.	Maintained or lost weight	Success
Obesity alone	15	13	87%
Diabetes	11	9	82%
High cholesterol	12	6	50%
Hypertension	9	4	44%
Back pain	5	4	80%
Coronary artery disease	4	3	75%
Pulmonary disease	1	1	100%
Diabetes & hypertension	5	5	100%
Hypertension & high cholesterol	5	4	80%
Diabetes & high cholesterol	2	1	50%
Hypertension & arthritis	2	2	100%
Hypertension and lower back pain	1	1	100%
Hypertension and coronary artery disease	1	1	100%

To implement a cholesterol-lowering diet effectively, a patient must acquire a substantial body of knowledge. The basic components of a diet to lower blood lipids include reducing total fat, particularly saturated fat, maintaining or increasing polyunsaturated fat and changing sources of monounsaturated fat, decreasing dietary cholesterol, and increasing carbohydrate and fibre.

In practical terms, this means that individuals must learn to identify major sources of these macronutrients in foods available for their consumption. It is not sufficient for patients to know that they must avoid saturated fats and cholesterol. You need to be able to implement changes when shopping, preparing food, or eating away from home. The knowledge required to implement a cholesterol-lowering diet is outlined as follows:

General knowledge: Understanding the relationship of blood cholesterol and dietary factors. Processing realistic expectations regarding the effects of diet. Knowing the effects of dietary lapses on blood lipids. Understanding genetic influences on blood lipids.

Fats: Understanding the difference between saturated and polyunsaturated fats. Knowing how to read product labels to determine appropriateness of fat content. Possessing sufficient knowledge to interpret ambiguous and sometimes misleading information on product labels, such

as "may contain one of the following..." or "contains no cholesterol" (just lots of saturated fats).

Cholesterol: Understanding the difference between other fats and cholesterol. Awareness of which foods are high in cholesterol, including some awareness as to the amount of cholesterol present in various foods.

Fibre: Knowledge about which foods are high in fibre. Understanding the importance of soluble versus insoluble fibre.

Cooking techniques: Ability to identify cooking techniques that are least likely to contribute to high fat content in food. Ability to execute the appropriate cooking techniques.

Eating in restaurants and Purchasing prepared food: Ability to recognize which of a variety of food choices is lowest in fat and cholesterol and higher in fibre. Understanding which questions to ask the food preparer in order to make the best choices possible.

Eating is a social activity, and is one of the behaviours related to cardiovascular disease that is influenced by the social environment. Variability in blood lipids can also be attributed to the environment; there is evidence that spouses' cholesterol and triglyceride levels are similar and that husbands and wives consume similar quantities of eggs and whole milk.

Table. Estimated Total Deaths for the 10 Leading Causes of Death; United States, 1987.

Rank	Cause of Death	Number	%
1*	Heart diseases	759,400	35.7
	(Coronary heart disease)	(511,700)	(24.4)
	(Other heart disease)	(247,700)	(11.6)
2*	Cancers	476,700	22.4
3*	Strokes	148,700	7.0
4	Unintentional injuries	92,500	4.4
	(Motor vehicle)	(46,800)	(2.2)
	(All others)	(45,700)	(2.2)
5	Chronic obstructive lung diseases	78,000	3.7
6	Pneumonia and influenza	68,600	3.2
7*	Diabetes mellitus	37,800	1.8
8	Suicide	29,600	1.4
9	Chronic liver disease and cirrhosis	26,000	1.2
10*	Atherosclerosis	23,100	1.1
	All causes	2,125,100	100.0

* Causes of death in which diet plays a part.

The importance of including a patient's spouse or family in counselling to reduce the risk of cardiovascular disease has been

recognized and has received some attention in the literature on weight loss. Including a spouse or other partner is advocated in obesity treatment programs. Although application to cholesterol-lowering diets is limited, there is some empirical evidence that inclusion of the spouse facilitates weight loss in the treatment of obesity.

Mere inclusion of the spouse as an observer may not be sufficient to enhance treatment effectiveness and may even be counterproductive. Spouses should be encouraged to assume an active role in assisting with adherence to low-fat, low-cholesterol diets.

Coronary Heart Disease: Despite the recent sharp decline in death from this condition, CHD still accounts for the largest number of deaths in the United States. In 1985, illness and deaths from CHD cost Americans an estimated $49 billion in direct health care expenditures and lost productivity.

Stroke: Strokes occur in about 500,000 persons per year in the United States, resulting in about 150,000 deaths. Approximately 2 million living Americans suffer from stroke-related disabilities, at an estimated annual cost of more than $11 billion.

High Blood Pressure (Hypertension): Hypertension is a major risk factor for both heart disease and stroke. About 58 million people in the United States have hypertension. The occurrence of hypertension increases with age and is higher for black Americans (of which 38 percent are hypertensive) than for white Americans (2 percent).

Cancer: More than 475,000 persons died of cancer in the United States in 1987. During the same period, more than 900,000 new cases of cancer occurred. In 1985 the total costs for direct health care and lost productivity due to cancer was estimated to be $72 billion.

Diabetes Mellitus: Approximately 11 million Americans have diabetes. In addition to the nearly 38,000 deaths in 1987 attributed directly to this condition, diabetes also contributes to an estimated 95,000 deaths per year from associated cardiovascular and kidney complications. In 1985, diabetes was estimated to cost $13.8 billion per year.

Obesity: Obesity affects approximately 34 million adults in the United States. Obesity is a risk factor for coronary heart disease, high blood pressure, diabetes, and possibly some types of cancer as well as other chronic diseases.

Osteoporosis: Approximately 20 million Americans are affected by osteoporosis, which contributes to some 1.5 million bone fractures per year in persons 45 years and older. The total costs of osteoporosis to the U.S. economy were estimated to be $10 billion in 1983.

Dental Diseases: Although dental caries among children, as well as some forms of adult periodontal disease, appear to be declining, the overall

prevalence of these conditions imposes a substantial burden on Americans. The costs of dental care were estimated at $21.3 billion in 1985.

Diverticular Disease: Because most persons with diverticular disease do not have symptoms, the true prevalence of this condition is unknown. In 1980, diverticulosis was accountable for some 200,000 hospitalizations.

In assessing the role that diet might play in prevention of these conditions it must be understood that they are caused by a combination of multiple environmental, behavioural, social, andgenetic factors. The exact proportion that can be attributed directly to diet is uncertain. Although some experts have suggested that dietary factors overall are responsible for perhaps a third or more of all cases of cancer, and coronary heart disease, such suggestions are based on interpretations of research studies that cannot completely distinguish dietary from genetic, behavioural, or environmental causes.

Nonetheless, it is now clear that diet contributes in substantial ways to the development of these diseases and that modification of diet can contribute to their prevention. The magnitude of the health and economic cost of diet-related disease suggests the importance of the dietary changes suggested.

Clearly emerging as the primary priority for dietary change is the recommendation to reduce intake of total fats, especially saturated fat, because of their relationship to several chronic disease conditions. Because excess body weight is a risk factor for several chronic diseases, maintenance of desirable weight is also an important public health priority. Evidence further supports the recommendation to consume a dietary pattern that contains a variety of foods, provided that these foods are low in calories, fat, cholesterol, and sodium.

Taken together these recommendations promote a dietary pattern that emphasizes consumption of vegetables, fruits, and whole grain products - foods that are rich in complex carbohydrates and fibre and relatively low in calories. And of fish, poultry, prepared without the skin, lean meats, and low-fat dairy products selected to minimize consumption of total fat, saturated fat, and cholesterol.

The evidence presented here suggests that such overall dietary changes will lead to substantial improvements in the nutritional quality of the diet.

The evidence also suggests that most people generally need not consume nutrient supplements. Although nutrient supplements are usually safe in amounts corresponding to the Recommended Dietary Allowances, there are no known advantages to healthy people consuming excess amounts of any nutrient, and amounts greatly exceeding RDAs can be harmful. Toxicity has been reported for most minerals and trace

elements, as well as some vitamins, indicating that excessive supplementation with these substances can be hazardous.

Nutrition Fads and Frauds

The folklore and superstition of cultures throughout history have attributed healing or harmful properties to certain foods. This tendency has not disappeared with the advent of the sciences of nutrition and medicine. Food folklore continues today, although in many instances it is inconsistent with scientific evidence.

Nutrition fraud is a comprehensive term used by the US Food and Drug Administration (FDA) to describe the abuses that occur as a result of the misleading claims for traditional foods, dietary supplements, and dietary products and of the deceptive promotion of other food substances, processes, and devices.

Food faddism is a dietary practice based upon an exaggerated belief in the effects of food or nutrition on health and disease.

Food fads derive from three beliefs:

- That special attributes of a particular food may cure disease.
- That certain foods should be eliminated from the diet because they are harmful.
- That certain foods convey special health benefits.

Food faddists are those who follow a particular nutritional practice with zeal and whose claims for its benefits are substantially more than science has substantiated.

Until Einstein's equation, E = mc, which may also be written Calories = mc is invalidated the only way to reduce weight (m) is to reduce the amount of calories consumed (E). In other words, to lose weight it is necessary to eat less calories each day than you burn up, and the only way to gain weight is to eat each day more calories than you use.

Food quackery, which involves the exploitive, entrepreneurial aspects of food faddism, is the promotion for profit of special foods, products, processes, or appliances with false or misleading health or therapeutic claims. A food quack is one who pretends to have medical or nutritional knowledge and who promotes special foods, products, or appliances with false or misleading claims, usually for personal financial gain.

Nutrition fraud flourishes today because of the diversity of cultures, the historical tradition of concern for health and the use of natural remedies, and the introduction of advanced communication technologies.

Food faddism has its roots in Great Britain, where patent medicines were advertised and sold by everyone from hawkers to goldsmiths. In the colonies, legal protection of consumers against fraudulent claims was first recorded in Massachusetts Bayin 1630. Nicholas Knopp, was whipped

and fined five pounds for selling a cure for scurvy that had "no worth nor value" and was "solde att a very deare rate".

One of the earliest nutrition faddists was Sylvester Graham, a "back to nature" reformer who was suspicious of any food altered from its "natural" condition, such as white flour. His legacy continues among those who question whether processed food of any type can provide adequate nutrition.

Although, it must be noted that processed foods should not necessarily be eliminated from a persons diet because of this belief, it is true that without fortification the more a food is processed and thus differs from its natural form the less nutrient dense it will be.

Some groups such as fruitarians actually go a step further, they don't eat processed or cooked foods. The reason being that when a food is cooked it is not able to be digested and becomes toxic. There is no scientific evidence to back this argument to its fullest extent.

Popular interest in nutrition, coupled with concern about food shortages during World War I, was fostered by the increasing promotion of the health properties of foods in the early 20th century. Vitamins, by the very nature of their discovery, became associated with the prevention or cure of disease and were soon promoted as curative agents.

Today the travelling patent medical man has been largely replaced by the highly skilled and organized use of electronic means to promote fraudulent marketing - computers, customized mailing lists, national advertisements, and other mass media. The medium and the details have changed, but the message and the goals remain. It is difficult for consumers to evaluate the validity of the health claims perpetrated by quacks and faddists.

Purveyors of nutrition fraud capitalize on people's desire to be healthy and on the lack of certainty in many areas of nutrition and health. No writer for a lay audience has any special insights into nutrition which are not known by a substantial part of the scientific community. Magic and sensational diets are nothing more than exaggerations of one facet of nutrition at the expense of another, often to the detriment of the willing victims.

Regulation of Nutrition Fraud

The first Federal legislation, the Pure Food and Drug act of 1906, made it unlawful to manufacture or introduce into interstate commerce adulterated or misbranded food or drug products.

Currently, numerous Government, medical and consumer-oriented organizations are responsible for preventing and controlling fraud. These agencies work cooperatively, and their antifraud activities have become

more visible in recent years. Private agencies and organizations such as the American Dietetic Association, the American Cancer Society, the American Medical Association, the National Council Against Health Fraud, and other health professional groups are also active against food fraud.

The Federal Food, Drug and Cosmetic Act empowers the FDA to prohibit the introduction of any food, drug, device or cosmetic that is adulterated or misbranded. Only factual and nonmisleading information is allowed on food labels. Most false promotional claims, therefore, are not made on labels. Instead, they appear in books, lectures, and mass media that are protected by constitutional rights. The FDA has the authority to use its food additive and drug approval processes to control food products allowed on the market and to remove fraudulent products.

Most fraudulent food products are classified as foods, but when therapeutic claims are made for them, they are also considered to be drugs. If a food product is also classified as a drug and is considered by the FDA to be ineffective for its claimed use, it will not have an approved New Drug Application. For example, if it is promoted for treating a disease that is not amenable to lay diagnosis, it cannot have adequate directions for use and will not be approved.

Health Consequences of Fraud

Nutrition fraud may lead to deleterious health consequences, caused by the failure to seek legitimate medical care, by potentially toxic components of foods and products, by nutrient toxicities and deficiencies, by diversion of monies from essential treatments, and by interference with sound nutrition education.

Public health and safety can be jeopardized by false promises that divert or deter individuals from pursuing sound forms of medical treatment or that encourage them to abandon beneficial therapy for a disease. Fraud may encourage people to reject legitimate medical advice and to practice inappropriate self-medication that is less likely to be helpful, and more likely to be directly harmful, than the medical technology based on a sound understanding of human biology and nutrition.

The FDAs annual reports document numerous instances of fraud-induced failure to obtain appropriate health care. Because early detection and treatment improve prognosis for many illnesses, unproven "nutritional" therapies may unnecessarily delay beneficial intervention. Some diet regimens recommended by health faddists to treat cancer, for example, are so nutritionally deficient or toxic that adherence to them has caused death or serious illness.

Public injury can occur when foods and unproven remedies are toxic. Just because a substance occurs naturally in food does not mean that it is necessarily safe. Many of the chemicals known to be present in herbs have never been tested for safety. Some plant foods contain potentially unsafe pharmacologically active ingredients such as aflatoxin, one of the most potent carcinogens known.

There has been a substantial increase in the use of herbal products that contain pharmacologically active ingredients that can possibly produce undesirable effects such as an increase in blood pressure. Occasional poisonings and clinical intoxications are reported after the use of herbal tea products. Ginseng, one of the most popular herbs, has been reported to produce oestro-like effects in some people. From present evidence, it cannot be concluded that all herbal products can be consumed safely over extended periods of time.

Potentially harmful ingredients have been identified in samples of other food supplements, such as an oestroic hormone in commercial alfalfa tablets, arsenic in kelp tablets, and cadmium in dolomite have caused the FDA to caution against use of these products, particularly by pregnant women and children.

Frauds and fads may induce nutrient toxicities or deficiencies. Many people take vitamins as self-medication for the prevention or treatment of health problems. The use of these products varies with such demographic factors as geographic region, education, income, and race. Women are more frequent consumers than men. Intakes range widely, extending up to 50 times the Recommended Dietary Allowance (RDA) for individual nutrients.

Nutrient supplements are usually safe in amounts corresponding to the RDA, but the RDA's are already set to provide maximum benefit consistent with safety. Thus, there is no reason to think that larger doses will improve health in already healthy people, and excess intake can be harmful. Mega-dose intakes can have seriously harmful effects. The toxicity of high dosages of vitamin A and D is well established. Because the margin is narrow between a safe and a toxic dose of most trace elements, excessive supplementation with these substances may be particularly hazardous.

Excessively restrictive dietary practices can also induce serious medical problems or even death. Popular weight reduction products often provide very low calorie intakes. Because such products have been associated with the deaths of some young women, the FDA now requires warnings on labels to alert consumers of such products.

Many popular diets are potentially harmful because they eliminate food groups or severely limit food variety. Examples include those that

drastically reduce carbohydrate intake, or advocate excessive fruit consumption, and those that claim that a person cannot digest protein and carbohydrates at the same time. This is not true, as can be seen in the Chapter - The Digestive System, different parts of the digestive tract deal with different nutrients and will absorb those nutrients, besides most foods usually contain both protein and carbohydrates (eg. legumes which are often 50% protein and 50% carbohydrate).

Fad diets seldom produce long-lasting weight control. Highly restricted diets, such as the more extreme forms of Zen macrobiotics, have led to nutritional deficiencies, starvation, and even death in a few individuals. Such diets have also been associated with retarded fetal development and childhood growth or other nutritional problems in young children.

Commercial interests have capitalized on a heightened public awareness of nutrition and health issues, but much of the public cannot evaluate the validity of available weight reduction schemes, supplements, and services. Self-appointed health and nutrition advisors have expressed distrust of proven public health measures such as fluoridation and pasteurization and, instead, have promoted treatment alternatives that are not supported by accepted medical practice. The public also may be misled by extravagant claims of health benefits from the use of certain foods or nutrient supplements.

Economic Consequences of Fraud

People experience economic injury when purported remedies and cures do not work, are untrue, or are greatly exaggerated or when purchased products are not needed. Fraudulent products are known to be extremely profitable to those who sell them. Quackery has become big business and costs the deluded consumers in excess of $10 billion a year!

Most fraudulent products and services can be very costly yet are promoted as having nutritional or health benefits that have not been substantiated in scientific literature.

A vast array of substances are available for a variety of different purposes. some of them may even appear to work owing to the power of the placebo effect - if you expect product X will make you feel better, then it probably will. But these supplements must not be dismissed as placebos in the sense of being inert pieces of chalk. These substances are what they say they are, and many of them have powerful pharmacological effects (though not necessarily those claimed for them). The dangers of hypervitaminosis is an obvious example. The effects of excess quantities of isolated amino acid supplements, minerals such asselenium and substances such as ginseng have never been fully explored and may be

no less hazardous. Even if consumed at a level which is not harmful, their use is still undesirable.

In most instances they are unnecessary; either providing nutrients which are surplus to requirements or supposed nutrients which are probably not needed at all.

Furthermore, those who are most susceptible to health food claims are perhaps those who can least afford to be.

Table. Health Food Supplements and Remedies

Product	Reason foruse	Comments
Vitamins Minerals Kelp Spirulina Aloe vera	To correct dietary	Surplus to requirements in most cases. Considerable dangers with over use
Vitamins - B13, B15, B17 Flavonoids Inositol Selenium Lecithin	To supply "nutrients" deficientina normal diet	No evidence that suplements of these are necessary. B17 (laetrile) has now been banned from sale in the U.K.
Ginseng Honey Kelp Pollen Bee's royal-jelly Spirulina	To restore vigour, induce feelings of well-being	Ginseng has certain pharmacologic effects although these are variable and unpredictable. Extremely expensive. Problems with over-use have been reported. May provide traces of vitamins and minerals (at a price) but little in the way of magic
DNA and RNA	Rejuvenation and retard	The body makes all the DNA andj RNA it needs. Dietary excess can cause hyper-uricaea
Cider vinegar Garlic	To "cleanse' the body of toxins	In the absence of severe liver of renal disease, the body is quite capable of doing this for itself
Enzymes	To aid digestion or metabolism	Cannot possibly actin this way. Are denatured on reaching the stomach and then treated as any other protein
Spirulina Cider vinegar Honey Lecithin	As a slimming aid	Claims that substances can burn up fat or stimulate metabolism are nonsense; if true obesity would be a thing of the past, Honey and Lecithin are significant sources of calories

Aloe vera Green lipped-mussel Kelp	As a cure for arthritis and rheumatism.	It should be noted that chronic disorders such as rheumatism and arthritis have periods of partial remission in any case.
Herbal remedies	Healing	A skilled herbalist may well be able to relieve minor ailments via the pharmacologic effects of some plants. But these effects can be powerful, and some times toxic, indiscriminate use of htese remedies by the uninformed can be dangerous

The public incurs other costs because many products labelled as "natural" or "organic" sell for higher prices than their "regular" counterparts, although their special benefits are not generally demonstrable. "Natural" vitamins often sell at double the price of synthetic products even though they are chemically identical. In some products labelled as "natural," only a minor fraction of the vitamin is actually derived from natural sources.

What is also very difficult to understand is why more natural foods, like whole wheat bread or unpolished rice, often cost more than their refined counterparts, white bread or par-boiled white rice, that have undergone costly processing and packaging which should make them more, not less expensive.

Drugs Effecting your Health

Prescription drugs may interfere with nutrient absorption, digestion, metabolism, utilization, or excretion. Similarly, both nutritional status and diet can affect the action of drugs by altering their metabolism and function, and various dietary components can have pharmacologic activity under certain circumstances.

Drugs may act centrally or peripherally to decrease appetite or may reduce appetite as a result of side effects. Drugs that act centrally include catecholaminergics, dopaminergics such as levodopa for Parkinson's disease, serotoninergics, and endorphin modulators such as naloxone. Peripherally acting agents include those that inhibit gastric emptying, and bulking agents.

The emetic centre, located in the brain stem, is easily stimulated by the action of many drugs. Almost all drugs have the potential to alter gastrointestinal function, causing nausea, vomiting, diarrhoea, and constipation. Any drug causing nausea, especially alcohol, can decrease appetite. For instance, it has been well documented that digitalis toxicity

leads to anorexia, nausea, weight loss, and wasting. Narcotics, analgesics, and clofibrate are also commonly associated with nausea and vomiting. Cancer chemotherapeutic drugs such as methotrexate have a strong anoretic effect and can cause gastroenterologic toxicity.

In addition, drugs may alter nutritional status, which in turn can result in anorexia and weight loss. High doses of aluminum or magnesium hydroxide antacids can cause phosphate depletion, leading to muscle weakness, anorexia, and even congestive heart failure. Thiazide and furosemide diuretics can cause sodium, potassium, and magnesium depletion, resulting in anorexia and muscle weakness. Commonly used folate antagonists include methotrexate, a cancer chemotherapeutic agent; triamterene, a diuretic; trimethoprim, an antibacterial agent; phenytoin, an anticonvulsant; and sulphasalazine, an anti-inflammatory agent. Sulphasalazine and phenytoin are competitive inhibitors of folate transport in addition to being folate antagonists. Folate deficiency can lead to weight loss and anorexia. Penicillamine induces zinc depletion, which may cause a loss of taste acuity and possibly decreased food intake. Alcohol abuse also commonly results in deficiencies of thiamin, folate, vitamin B_6, vitamin A, and zinc.

Antacids

About a billion dollars is spent each year in the United States on antacids, making these products among the most popular over-the-counter (OTC) drugs. These tablets and liquids are gulped down for the relief of heartburn, sour stomach, and indigestion. Antacids may also be prescribed to treat stomach ulcers.

Although many consumers take antacids almost casually, these drugs are not as harmless as they may seem. Antacids can effect the way other drugs behave in the body. They can speed the absorption of some prescription drugs, possibly causing an overdose, or slow it for others, thus reducing their effectiveness.

Because of concerns about known interactions between antacids and other prescription drugs, FDA is proposing to change that label warnings read:

"Antacids may interact with certain prescription drugs. If you are presently taking a prescription drug, do not take this product without checking with your physician."

Effects of Diet on Drug Metabolism

Dietary factors can decrease, delay or enhance the absorption of drugs, primarily by altering their availability, their solubility, or the amount of time they spend in the stomach or intestine. Calcium, for example, can

bind tetracycline antibiotics and form a complex that renders both the drug and nutrient unavailable. The acidity of the gastrointestinal tract also affects drug disposition. A more acidic environment reduces the bioavailability of penicillin and isoniazid but increases the absorption of tetracyclines. Food decreases, delays, or enhances the absorption of certain antibiotics.

Instructions to take drugs with or between meals, or the coating of drugs to prevent dissolution, attempt to take advantage of these gastric properties, but it is uncertain how well patients adhere to such instructions.

The effects of drugs are modulated by their rates of metabolism by the liver and other tissues. Drugs are metabolized by two basic processes. The first (Phase I) metabolic step is usually an oxidation reaction that alters a functional group in the drug. This alteration may either activate the drug or deactivate it. The second step (Phase II) conjugates the oxidized drug to an inactive, water-soluble form that can be readily excreted.

The rate of drug metabolism by mixed-function oxidase systems can be accelerated by the drugs themselves as well as by a variety of dietary factors. Such factors include protein, cruciferous vegetables (broccoli or cabbage), and charcoal-broiled meats.

On the other hand, low-protein, high-carbohydrate diets and deficiencies of several vitamins and minerals reduce levels of drug-metabolizing enzymes and consequently the rate of drug metabolism, so that the drug concentrations may decline slowly. thus, in many cases the net effect of nutritional deficiency is to increase drug potency.

Certain drugs can interfere with specific nutrients or non-nutrient components in foods to cause acute adverse reactions. Such reactions can be prevented by avoiding the foods when taking the medication. Examples include interactions between monoamineoxidase inhibitors and foods containing tyramine, and between alcohol and disulphiram, hypoglycaemic agents, and many other drugs.

Effects of Pharmacologic Doses of Nutrients

Nutrients are sometimes used in unusually high doses for their pharmacologic effect. Niacin, for example is used pharmacologically to reduce blood cholesterol levels. Retinoid derivatives of vitamin A have been used successfully to treat severe acne and other conditions.

All pharmacologic therapies induce side effects, and high-dose nutritional therapies are no exception. Although excess water-soluble vitamins are excreted and usually cause little difficulty, side effects have been reported in cases of excessively high doses.

High dose niacin induces flushing, and neurologic symptoms have been reported from excessive intake of vitamin B_6. Excessive intake of fat-

soluble vitamins or their derivatives is well known to induce toxic symptoms. Excess vitamin A, for example, causes birth defects in animals, and possibly, in humans. Caution has been urged in its use for women who are pregnant or likely to become pregnant.

Individuals who are born without the genes to produce key functional enzymes may require amounts of certain nutrients greatly in excess of those required by most people. Such inborn metabolic errors have been identified for enzymes necessary for absorption, metabolism, or storage of nearly all of the vitamins.

n some cases, higher than normal intake of the vitamin will restore activity. A classic example of such a vitamin-responsive syndrome is pernicious anaemia, a condition of impaired absorption of vitamin B_{12}. Patients with this condition must have exceedingly high doses of the vitamin from food supplements, or lower doses by injection.

In other conditions, certain metabolic products cannot be degraded and, therefore, accumulate to toxic levels. In some cases, such disorders can be treated with carefully designed dietary preparations having a very low content of the poorly metabolized nutrient. An example of this type of condition is phenylketonuria, a genetic lack of the enzyme that converts the amino acid phenylalanine to tyrosine. Patients with phenylketonuria accumulate phenylalanine and other metabolites that at high levels, are toxic and cause mental retardation and other neurologic damage. Dietary treatment is designed to reduce the phenylalanine content of the diet to levels below those that cause symptoms.

Treatment and Recovery from Chemical Dependency

It is the position of the American Dietetic Association that nutrition intervention, planned and provided by a qualifiednutrition professional, is an essential component of the treatment and recovery from chemical dependency.

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American consumers tend to be surprisingly conservative in their responses to common illnesses. More than a third do not treat their ailments at all, but they are becoming more knowledgeable about the effects of Over-the Counter remedies.

The severity of malnutrition and the need for nutrition therapy in addiction vary. Mind altering substances (eg. alcohol) are toxic to the body, causing physical adaption, damage, and malnutrition.

Abuse of drugs accelerates nutrition needs beyond normal, so that

even a well-balanced diet may be inadequate. Nutritional problems are also caused by an increased nutrient requirement to detoxify and metabolize drugs, inactivation of vitamins and coenzymes needed to metabolize energy, inadequate nutrient storage in the liver, malabsorption, poor utilization of nutrients, breakdown of organs, and increased loss of nutrients through diuresis and diarrhoea.

Table. Estimated Sales of Over-the-Counter Internal Medications (Millions of dollars)

Category of Medications	1982	1985	1990
Analgesics	1484	1844	2490
Cough, cold, allergy, sinus	1269	1659	2241
Digestive aids	1228	1393	1654
Motion sickness	25	33	43
Sleep aids/sedatives	41	50	66
Appetite suppressants*	229	280	350
Vitamins and minerals*	1031	1509	2176
	$5307	$6768	$9020

Figures are for estimated retail sales through retail outlets.

Nutrition care is defined to include an elevation of the addict's nutritional status at detoxification, supervision of nutritional rehabilitation through delivery of palatable, nourishing meals and supplements that encourage normal eating patterns, and provision of nutritional counselling to help the addict develop an eating plan supportive of stable recovery.

Chemical dependence is a bio-psychosocial disease. Patients with a compromised liver function have a narrow therapeutic window for iron or fat-soluble vitamin supplements and may even be in a condition of iron overload. Therefore the use of high-potency vitamin or mineral supplements should be discouraged unless clinical evidence of nutritional deficiency is present.

The majority of abusers have suppressed immune status, which is compounded by an inadequate diet. Abusers exposed to the human immunodeficiency virus (HIV) are thus at greater risk for contracting HIV infection. Unless rectified, a poor diet may be one factor in stimulating propagation of the virus toward more severe stages of HIV infection.

If AIDS is diagnosed in the patient in treatment, nutrition monitoring is essential. Adequate-calorie, nutrient-dense diets, with supportive or aggressive supplementation if indicated, are essential.

Nutritional recovery is a component of the physical foundation for rehabilitation that precedes healthy mental, emotional, and spiritual recovery. Patients need to eat regularly and prudently. An eating pattern that emphasizes complex carbohydrates, moderate amounts of protein,

and conservative quantities of dietary fats and emphasizes balance, variety, caloric appropriateness, and regularity will be conducive to progress in recovery. A high-protein, high-fat diet has been reported to increase the incidence of drinking.

The menu planner should recognize that the stay of the average addict in treatment is lengthy. Food offerings should be designed to maximize attractive appearance and palatability to stimulate appetite and willingness to eat regular meals as well as to support general morale. The patient should be encouraged to choose foods freely in a cafeteria or family-style setting. Social interaction during mealtime facilitates treatment goals of resocialization without drugs.

Substance substitution, such as the replacement of sugar, caffeine, or nicotine for the drug of choice, often occurs during recovery.

Substance substitution compromises the quality of nutritional rehabilitation and perpetuates the behavioural aspect of addiction. The recovering addict needs to learn how to cope with substitution patterns.

Irregular meals, snacking, and consequent blood sugar fluctuations, along with a stressful environment, may stimulate cravings that make the recovering addict susceptible to relapsing.

Addicts have been reported to believe that consumption of sweets helped them maintain sobriety.

Eating disorders are common in chemically dependant women. Current theories of addiction suggest that compulsive eating, like alcoholism, is rooted in similar issues of codependency that form the addictive personality. Eating disorders may involve an addiction that occurred long before alcohol or other drugs were abused. However, as chemical dependency develops, the eating disorder may go into remission, only to reappear during abstinent recovery. In other patients the abuse of alcohol and drugs suchas amphetamine and cocaine alters normal appetite, digestion, and metabolic regulatory systems, stimulating the development of an eating disorder.

Nutrition counselling should include specific food-related emotional issues. Self-esteem, responsibility, and socialization skills should be addressed to change eating habits. Because the family is intimately involved in the success of recovery, the family member involved with meal preparation should also receive counselling to prevent the use of food as a weapon of sabotage.

Besides the usual presentation of nutritional consequences of drug abuse and food sources for nutrient needs, the dietitian should discuss practical ways to handle stress and cravings, how to integrate healthy life-style choices into daily recovery principals, weight management and eating disorder risks, and avoidance of substance substitutions such as

sugar, caffeine, and nicotine. The dietitian should also counter nutrition myths touted in the popular literature and circulated among people.

Many debilitating nutritional consequences result from drug and alcohol abuse. Chronic nutrition impairment causes serious damage to the liver and the brain, which reinforces the craving for more drugs and alcohol, and perpetuates the phycological aspect of addiction. During treatment efforts are concentrated on physical recovery, which prepares individuals to function at a higher level in treatment - cognitivaly, mentally, and socially.

Improved nutritional status can make treatment more effective, while reducing drug and alcohol craving, thereby preventing relapse. Nutrition professionals should take aggressive action to ensure involvement in treatment and recovery programs. In addition they are encouraged to participate in nutrition research activities to strengthen the knowledge base in this area.

Table. Biological, Psychological, and Social Factors of Chemical Dependence Disease.

Biological	Brain and liver dysfunction caused by chronic alcohol and drug poisoning.
Psychological	Personality disorganization created by progressive brain dysfunction (often alluded to as the addictive personality).
Social	Secondary relationship problems that interfere with the functioning and support systems at home, on the job, and with friends.

Guidelines for a Healthy Diet

The Dietary Guidelines published by the USDA and Human Services recommend that people maintain desirable weight, limit intake of fat and cholesterol, and consume adequate amounts of starch and fibre.

Although these guidelines are developed by the US Department of Agriculture and the Department of Health and Human Services for healthy Americans, they have received the consensus by most authorities, and can be used by *healthy people throughout the world.

*Healthy refers to people who do not suffer from malnutrition or any other condition that requires a change in dietary guidelines or nutrient allowances

People should focus on their total diet in a more positive way, especially with respect to fat and cholesterol. Most people following a Western type diet are consuming far too much fat and cholesterol, and not enough carbohydrate and fibre.

The easy way to overcome this problem is to eat moderate amounts

of foods from all the different food groups, and avoid dietary extremes that include an excess of fatty foods, cholesterol, or sugars.

Eat a Variety of Foods

All foods that supply calories and essential nutrients, potentially, can be included in an adequate diet. In some cases, certain groups of people (eg. pregnant women, vegetarians) should eat foods to obtain a greater amount of a particular nutrient (eg. calcium-rich foods, iron-rich foods).

But, when choosing a greater variety of foods from the different food groups, choose low-calorie foods, especially for elderly persons and persons who are sedentary or trying to loose weight.

No single food can supply all the nutrients in the amounts you need. To make sure you eat all the nutrients and other substances needed for health, choose the recommended number of servings from each of the food groups displayed in the Food Guide Pyramid.

Maintain Healthy Weight:

A healthy weight is the weight a person should be to live a healthy life, and reduce the chances of conditions that are associated with either obesity or malnutrition caused from hunger and starvation.

"Too lean" is a health problem often found in young women, too easily influenced by the peer pressure of modern living. They strive to loose weight even when they are under-weight.

A healthy weight can be calculated by considering body mass index and waist-to-hip ratio.

If a person is over-weight, and this is not caused by a weight-related disease, the importance of following one of the many weight reduction strategies and the necessity to exercise and increase the amount of energy expended, is paramount.

To maintain weight you must balance the energy in food with the amount of energy your body uses.

Table. Body Mass Index Used to Define Desirable Weight and Overweight for "Ideal" Reference Populations

Mean		Overweight		Severe Overweight	
Men	Women	Men	Women	Men	Women
22.0	21.5	26.4	25.8	30.8	30.1

Physical activity is an important way to use up food energy. To use up dietary energy spend more time being physically active, like walking the dog, and less time being inactive, like watching television.

Ratios of weight to height estimate total body mass rather than fat mass, but they correlate highly with the amount of body fat. The most

commonly used ratio is known as Quetelet's index, or the BMI, and is usually defined as body weight in kilograms divided by the square of the height in meters (wt/ht^2)

A reasonable weight reduction programme should have a goal of ï¿½ to 1 pound per week. Loosing more than 1 pound a week is not recommended, nor should drugs or other extreme means of weight reduction be used (See chapter on Dietary Fads and Frauds).Extreme approaches to weight loss, such as self induced vomiting or the use of laxatives, amphetamines, or diuretics, are not appropriate and can be dangerous to health.

Table. Lists Healthy Weight Ranges for Adults.

Height	Weight (in Pounds)
4′ 10″	91 - 119
4′ 11″	94 - 124
5′ 0″	97 - 128
5′ 1″	101 - 132
5′ 2″	104 - 137
5′ 3″	107 - 141
5′ 4″	111 - 146
5′ 5″	114 - 150
5′ 6″	118 - 155
5′ 7″	121- 160
5′ 8″	125 - 164
5′ 9″	129 - 169
5′ 10″	132 - 174
5′ 11″	136 - 179
5′ 0″	140 - 184
6′ 1″	144 - 189
6′ 2″	148 - 195
6′ 3″	152 - 200
6′ 4″	156 - 205
6′ 5″	160 - 211
6′ 6″	164 - 216

The higher values in the weight range apply to people with more muscle and bone. Weights above this range are less healthy for most people.

Choose a Diet Low in Fat, Saturated Fat and Cholesterol

As already stated, there is a need for people following a Western Diet to reduce the amount of fat, saturated fat and cholesterol that they consume. Only about 25 percent of calories should come from fats, and

no more than 10 percent from saturated fats.

Risk for heart disease is increased among people with elevated blood cholesterol levels. It is important to get your blood cholesterol checked regularly. If blood cholesterol is above 5.2 mmol/L, follow the advice of health professionals about diet and if necessary medication.

Fat, whether from plant or animal sources, contains more than twice the number of calories as an equal amount of carbohydrate or protein. Each gram of fat contains 9 calories. Some foods and food groups are higher in fat than others. This guideline emphasizes the continued importance of choosing a diet with less total fat, saturated fat, and cholesterol.

Choose a Diet with Plenty of Vegetables, Fruits and Grain Products

Foods that provide complex carbohydrates, dietary fibre, and other components are linked to good health, mainly by lowering the fat content in the diet. This guideline is consistent with the scientific evidence that supports the health benefits of diets with more complex carbohydrates and a variety of fibre-rich foods. Most of the calories in your diet should come from grain products, fruits and vegetables.These include bread, cereals, pasta, rice and potatoes. Dry beans are included in the meat group but can also count as servings of vegetables. Plant foods are generally low in fats, depending on how they are prepared and what is added to them. Fibre is found only in plant foods. Eating a variety of fibre-containing foods is important for proper bowel function and can reduce the risk of chronic constipation, diverticular disease, heart disease and some cancers.

Use Sugars in Moderation

Sugars include all simple carbohydrates, such as sucrose, glucose and lactose, and foods containing them such as candies, honey, and chocolate.

Sugars and foods containing them in large amounts supply energy but are limited in nutrients. Furthermore, sugars and starches, which break down in the mouth, can contribute to tooth decay. The importance of fluoride and dental hygiene in the prevention of tooth decay is also stressed.

Sugar substitutes do not provide significant calories and may be used to reduce calorie intake. However, foods containing sugar substitutes may not always be lower in calories than similar products that do contain sugar. Unless you reduce the total calories you eat, the use of sugar substitutes will not cause you to lose weight.

Use Salt and Sodium in Moderation

Sodium plays an essential role in regulating fluids and blood pressure.

However many studies have shown that a high sodium intake is associated with high blood pressure. Eating foods high in potassium helps to counter the effects of high sodium consumption on blood pressure.

Using less salt and sodium than is normally used will benefit those people whose blood pressure goes up with salt intake. Hereditary factors as well as excessive drinking have also been shown to be related to high blood pressure. Adults are encouraged to get their blood pressure checked and, if it is high, to consult a physician about diet.

It is easy to reduce sodium intake by using less salt in cooking and on the table, but when eating processed foods it is important to look on the label for sodium substances, as these are used excessively in many types of sauces and condiments.

If You Drink Alcoholic Beverages, Do So in Moderation:

Alcohol has no net benefit to health and is not an essential nutrient in any way. If you can not avoid drinking, do so in moderation. One or two drinks per day are not usually associated with health risks.

Inflammation of the pancreas and damage to the heart and brain are some of the complications of drinking. Studies have shown that alcohol is linked to risks of heart attacks, hypertension, haemorrhagic stroke, cirrhosis of the liver, inflammation of the pancreas, violence, suicide, birth defects and overall mortality.

Table. A Comparison of Recent Government Dietary Recommendations for Some Nutrients

Surgeon General's Report on Nutrition and Health.	National Research Council's Diet and Health.
Fat and cholesterol	
Reduce consumption of fat (especially saturated fat) and cholesterol.	Reduce total fat intake to 30% or less. Reduce saturated fatty acid intake to less than 10% of total calories, and intake of cholesterol to less than 300mg daily.
Energy and weight control	
Achieve and maintain a desirable body weight. To do so, choose a diet in which caloric intake is consistent with energy expenditure.	Balance food intake and physical activity to maintain appropriate body weight.
Complex carbohydrate and fibre	
Increase consumption of whole grain foods and	Everyday eat five or more servings of a combination of vegetables and fruits,

cereal products, vegetables (including dried beans and peas), and fruits.	especially green and yellow vegetables and citrus fruits. Increase intake of starches and other complex carbohydrates by eating six or more daily servings of a combination of breads, cereals, and legumes.
Sodium	
Reduce intake of sodium by choosing foods low in sodium and limiting the amount of salt added in food preparation and at the table.	Limit total daily intake of salt ot 6gm or less. Limit salt in cooking and avoid adding it to foods at the table.
Calcium	
Adolescent girls and adult women should increase consumption of foods high in calcium, including low-fat dairy products.	Maintain adequate calcium intake.

Calorie Requirements

In addition to requiring a certain amount of nutrients, your body also requires a certain amount of calories daily.

Total energy expenditure includes the energy expended in rest, in physical activity, and as a result of thermogenisis.

These components, in turn, are affected by several variables, including age, sex, body size and composition, genetic factors, energy intake, physiologic state (eg. growth, pregnancy, lactation), coexisting pathological conditions, and ambient temperature.

Table. Daily Calorie Allowance.

MEN		WOMEN
Activity level	Calories required	
Resting	12 per lb. body weight	13 per lb. body weight
Sedentary	16 per lb. body weight	14 per lb. body weight
Light	18 per lb. body weight	16 per lb. body weight
Moderate	21 per lb. body weight	18 per lb. body weight
Active	26 per lb. body weight	22 per lb. body weight

- Resting Metabolic Rate represents the minimum energy needs of the body, for day and night with no exercise or exposure to cold.
- Sedentary includes occupations that involve sitting most of the

day, such as office work and studying.

- Light includes activities which involve standing most of the day, such as teaching or laboratory work.
- Moderate may include walking, gardening, and housework.
- Active includes dancing, skating, and manual labour such as farm or construction work.

Using the chart you can determine the amount of calories you require daily, depending on your activity level . For example a 130 pound male waiter requires 2730 calories. (Moderate activity level 21 × 130 lb = 2730 Cal.)

The following table indicates the approximate number of calories used by the body during a half-hour of the activity.

Table. Energy Expenditure

ACTIVITY	ENERGY (Kcal per 12 hours)
Badminton	220
Basketball	400
Cleaning	95
Cooking, active	110
Cycling, morderate	150
Disco	250
Driving	75
Gardening	150
Golf	170
Jogging	300
Marathon running	495
Sitting	45
Skiing (Nordic)	540
Sleeping	30
Squash	325
Studying	50
Swimming	300
Tennis	250
Walking	160
Watching Television	45

Metabolism

The person who can eat and eat and never gain a pound probably does not exist, according to a recent US Department of Agriculture study.

The study should help resolve two conflicting schools of thought on

whether a person's metabolism automatically gears up to prevent weight gain when eating extra calories day after day. The findings show very little change in metabolism.

For three weeks, seven men consumed 1000 kcal more each day than they would normally eat. All of them gained weight, on average a Â¼ lb per day.

After the men stopped overeating, they dropped weight rapidly, even though they were told not to diet. They unconsciously chose fewer calories than they would normally eat, primarily by avoiding high-fat foods.

This supports the hypothesis that successful body weight regulation might be associated with body fat and carbohydrate levels rather than by a single factor such as total energy level. The men had plenty of fat reserves, so they selected less fat.

While it's not uncommon for a persons' caloric intake to vary 1000 kcal from day to day, it's not easy to eat an extra 1000 kcal day after day. The men consumed all the extra food they were given.

A greater potential for error lies in incorrectly estimating the number of calories needed to maintain weight. It is very difficult to make an accurate estimate. If researchers underestimate, then some of the "extra" calories they feed the subjects are not really extra, and the subject does not gain weight.

New Food Technology and Its Effects on Eating a Hhealthy Diet

Clearly, food and dining will mean different things in the future than they do today. Because of an emphasis on diet and well-being, a need for quick and convenient meals, and a surge in the synthetic food market. The dietitian of the future faces uncharted challenges, including:

- The mounting concern among consumers over food safety issues, ranging from fat substitutes to artificial sweeteners, may result in unbalanced eating habits. Overall nutrition could be compromised as consumers become issue-focused eaters and unknowingly avoid nutrients that are essential to their well-being.
- Nutritionists and dietitians will have to reacquaint the public with the idea that food choices can be based on a search for positive nutrition and taste values, not only on nutrient and additive avoidance.
- As consumers become selectively educated about the nutrient content of foods, they may adopt the "save and splurge" approach to eating. That is, skipping meals or entries to "pig out" on a favourite rich dessert. Moderation, balance, and variety will emerge as the theme of the 1990s.

- Nutritional labeling will become widespread as food manufacturers bow to the health concerns of consumers and respond to strong directives. Food processors and distributors will find that products not labelled will become suspect. Nutrition labelling will spur interest in nutrition and make possible the tailoring of individual diets.

In the future, dietitians will have to keep up with a rapidly changing food supply to meet the challenges of the marketplace. Because of the extraordinary variety in food choices and eating habits that will be possible, they will be in demand to individualize diets.

Fat and Cholesterol

According to the 1989 Prevention Index report on the nation's health, only a small number of adults are conscious of all aspects of diet and nutrition. One area of marked gain from previous reports is cholesterol. Forty-eight percent of adults say they "try a lot" to avoid eating to many high-cholesterol foods. And, nearly half of the households purchased low-fat or low-cholesterol foods.

Table. Below Food technologies and Products Related to Low-fat and Low-cholesterol Foods.

TECHNOLOGIES	PRODUCTS
DAIRY	
Simple substitution of low-fat mild for whole milk Ultrafiltration, a high pressure microfiltration process. Converting cholesterol to its metaboloc by-products through enzymes. Supercritical fluid extraction, a cholesterol removing process.	Low-fat and/or low-cholesterol sour cream, butter spreads, ice milk, yogurt and cheese.
LIVESTOCK	
Selection and breeding of genetically lean animals. Hormonal treatment to induce leanness. Feeding practices to reduce total fat and saturated fat. Trimming visible fat to less than 1/4 inch.	Reduced fat and reduced cholesterol fresh meat.

PROCESSED FOODS	
Extrusion, a high temperature and high pressure cooking process. Hihg-amylose, film-forming starch, which reduces oil absorption in fried foods. Steam stripping to remove cholesterol from fats and oils. Functional soy proteins and casein extenders. Fat substitutes.	Potato chips and peanuts with less oil. Luncheon meats made with soy protein and casein meat extenders. Cholesterol-free "eggs". Low-fat, Low-cholesterol baked goods. Reduced-fat table spreads and salad dressings. Tofu mayonnaise and dips.

Fat Substitutes

Many new food products are being developed to replace the use of fats in hot and cold foods. Simple pleasures is a frozen dessert made with Simplese, the first fat substitute approved by the FDA.

Simplese is made from egg white and milk protein blended and heated in a process called microparticulation, in which the protein is shaped into microscopic round particles that role easily over one another. The aim of the process is to create the feel of a creamy liquid with the texture of fat.

NutraSweet estimates that the full use of Simplese has the potential to decrease total dietary fat consumption by 14 percent and dietary cholesterol intake by 5 percent.

Procter and Gamble's fat substitute Olestra is a different matter. Developed for use in hot foods as well as cold, it is a new substance, that according to the company, is "almost a carbon copy of regular fat, but with a molecule of sugar at its core instead of glycerine."

Fat Substitutes

- Sucrose polyester or Olestra (by Proctor & Gamble Company),
  A noncaloric fat replacement that is totally nonabsorbable. Proposed uses include margarine, butter spreads, beverages, baked goods, dressings and frying.
- Simplese (by The NutraSweet Company),
  Based on milk and/or egg white protein, with only 1 calories per gram. Simplese, recently approved by the FDA, can be used in products that do not require cooking, such as dressings, mayonnaise, margarine, butter, ice cream, dips and cheese spreads.
- Trailblazer (by Kraft Inc.),
  Made from "all natural ingredients", (specifics are unknown but

it appears to be an egg white and skim milk derivative.) Proposed uses include frozen desserts.

Sweeteners

The solution to balancing our tastes with our waists was thought to be a large selection of low-calorie and reduced-calorie food products containing artificial sweeteners. More than 78 million people use low-calorie foods and beverages today, and they continue to generate demands for new high-intensity sweeteners.

Table Below Food Technologies and Their Application to Low-calorie Sweeteners.

SWEETENER	PRODUCT
Aspartame and saccharin are widely used today.	Low-calorie carbonated soft drinks, milkshakes, juices, yogurt and reduced-calorie chocolate milk.
Acesulfame K is the latest non-nutritive sweetener to be approved. Alitame may be among the next sweeteners to be approved for use. It is a high intensity, noncaloric sweetener (2000 × sucrose). Chlorosucrose (sucralose) may also be among the next sweeteners to be approved. Cyclamate.	Unlike aspartame it can be used in baked goods.
	Potential uses: beverages, baked goods, toiletries and pharmaceuticals.
	Potential uses: beverages, baked goods, milk products, fruit spreads, toppings, tabletop sweetener.
	Beverages, baked goods, fruitspreads, tabletop sweetener.

Dietary Fibre

Table Below Applications of Dietary Fibre Products with Cholesterol lowering Characteristics.

PRODUCTS	APPLICATIONS
Chitosan, a natural polymer found in shellfish and fungi, may have strong cholesterol lowening activity when consumed at 8 to 15 mg per day.	High-energy food hars with multiple wources of dietary fibre.
Rice bran and rice bran oil can reduce blood cholesterol levels. They may taste better, cost less, and be more efficient than oat bran.	Oat bran breads, muffins, and cereals.
	High-fibre and whole-grain crackers and breads.
Psyllium can also effectively reduce serum cholesterol.	Microwaveable, high-fibre, low fat snack pellets made from grains and potatoes.
	Psyllium cereals.

Bowel cancer, elevated blood cholesterol and glucose levels, constipation, and weight control are influenced by dietary fibre. The number and types of products with extra fibre continue to proliferate.

Salt

Salt consumption continues to be a health issue, especially to those who are prone to sodium-induced hypertension. The low-sodium market is growing rapidly. Approximately 182 products introduced in 1987 featured reduced sodium content. There is also an increasing demand for salt substances without sodium. According to Frost and Sulliva, the salt substitute and "lite salt" category is a $40 million market, constituting 30% of the table salt sector.

Table Food Technologies and Products, and the Development of Sodium Replacements.

TECHNOLOGIES	PRODUCTS
Noninvasive tests to identify salt-sensitive individuals are currently under development. Salt substitutes and replacers include: ï¿½ potassium chloride	Salt substitute with 30% less sodium per teaspoon. Sodium-free spices and herb mixes.
ï¿½ Magnesium chloride and calcium chloride	Low-salt canned luncheon meat.
ï¿½ L-ornithylaturine (a synthetic "salty" peptide that is sodium free)	Low-sodium commercial souds. Reduced-sodium ham and bacon.

Eating A Balanced Diet

Eating a balanced diet means eating a wide variety of foods. A traditional way of getting a balanced diet has been to eat a certain number of portions from certain food groups, as defined by the US Department of Agriculture.

The five basic groups are vegetables; fruit; bread and cereal; dairy; and meat, poultry, fish, and legumes (dry beans, lentils and peas).

It's recommended that you have four servings from the fruit and vegetable group, and should include one good source of vitamin C each day, such as citrus fruit, and a good source of vitamin A, usually deep-yellow or dark-green vegetables. From the bread and cereals group, it is recommended that you get six basic servings including some whole-grain bread or cereals.

The recommended servings from the milk and cheese group vary with age, the highest recommendations for teens and nursing mothers (four

servings). Two basic servings from the meat, poultry, fish and bean group are recommended. Then there's the sixth group: fats, sweets, and alcohol. It's a group you want to avoid getting too many servings from. Foods in this group have plenty of calories and not a fair balance of other nutrients.

Eggs, as a protein source, are included in the same group as meat, poultry, fish and beans. One egg is considered a serving in that group. So if you eat two eggs for breakfast you have obtained your recommendations from the protein group and should have no more egg, meat, poultry or fish that day.

Table Daily Food Choices

FOOD GROUP	SUGGESTED DAILY SERVINGS	ONE SERVING
Breads, Cereals, and Grain Products	6 - 11	1 slice of bread • hamburger bun or english muffin a small roll, biscuit, or muffin 2 large crackers • cup cooked cereal, rice, or pasta 1 ounce of ready-to-eat breakfast cereal
Fruits	2 - 4	a whole fruit such as an apple, banana, or ornge a melon wedge a small cup of juice • cup of beries • cup cooked or canned fruit • cup dried fruit
Vegetables	3 - 5	• cup of cooked vegetables • cup of chopped raw vegetables 1 cup of leafy raw vegetables (lettuce or spinach)
Meat, Poultry, Fish, and Alternatives	2 - 3	amounts should total no more than 7 ounces of cooked lean meat, poultry, or fish a day 1 egg • cup cooked beans
Milk, Cheese, and Yogurt	2	1 cup of milk 8 ounces of yogurt • ounces of natural cheese 2 ounces of process cheese

The Importance of Diet to Health

The importance of diet to health, especially in the prevention and cure of illness, is slowly becoming apparent. We endeavour to provide you with more than the basic, and usually inaccurate information on diet and nutrition. So whether you are a registered dietitian and want to brush up on the immense amount of information, or whether you just want to find out, for the first time what you should be eating. This topic is as arguable as religion, politics and sex. There are always many different opinions relating to diet and nutrition.

Misleading Food Labels

With increasing consumer awareness of nutrition, and the influence of nutrients on dietary related diseases, the need for accurate and standardization of nutrition labeling is apparent.

The eating habits of Americans have changed extensively since the turn of the century. Changes have occurred in the composition of foods because of improved production methods, new varieties, and advances in food processing.

The primary changes in the past 70 years have been an increase in the percentage contributed by fats, oils, sugars, and sweeteners and a decrease in the percentage contributed by grain products. Although no change has occurred in the amount of protein consumed, a greater proportion now comes from animal sources. Dietary fibre is considerably below the recommended level. In general, intakes of vitamins and minerals are adequate in the United States today.

From a general marketing standpoint, it is readily apparent that nutrition "sells" to today's consumer, making nutrition an integral part of product development and promotion. Consumer feedback is a powerful mechanism for manufacturers in developing new products that provide the health and nutrition characteristics sought by the public. Food marketers guard a product's front panel with fervour for the purpose of promotion and competition, they oppose any labeling proposals that threaten their control of this part of food packages.

Americans are increasingly aware of health risks associated with sodium, fat, and cholesterol and report eating less salt, red meat, butter, whole milk, and eggs.

Studies on the use of food labels reveal that consumers want comprehensive nutrition information. About half of consumers report that labels fail to provide all the information they desire and that more information should be provided on caloric, fat, and sodium content.

Laboratory analysis provides quantitative nutrient information for nutrition labeling of food products. Considerable improvement is needed

to validate and standardize analytical methods for use in nutrition labeling. Particular problems exist in the measurement of dietary fibre and many vitamins, and in databases used for foods for which direct laboratory analysis is impractical.

If consumers are to make the dietary adjustments recommended by health experts, they must be able to make informed choices in food selection, preparation, and consumption. Although about half of packaged foods currently carry nutrition labeling, the lack of relevant and consistent information on all food products is a major deterrent to consumers who wish to make informed choices.

The Committee on the Nutrition Components of Food Labeling, National Academy of Sciences, Washington D.C., recommends that nutrition labeling be made mandatory on most packaged foods. There is no longer a plausible excuse for packaged foods not to provide nutrient information.

Current dietary recommendations advise consumers to modify their intake of certain food constituents. In considering those dietary recommendations, the committee believed that more categories of food should be required to carry nutrition labeling. That nutrition labeling be provided at the point of purchase for produce, seafood, meats, and poultry. In addition restaurants should make information on the nutrient content of menu items available to consumers on request.

Growing public interest in nutrition has led manufacturers to characterize their products as nutritionally beneficial through widespread use of principal display descriptors; this practice has drawn considerable attention from regulatory bodies and groups concerned with health.

Despite the high popularity of terms such as "low-calorie", "fat free", "no cholesterol", "fibre rich", and "lite", the potential for confusion, exaggeration, and deception has prompted proposals that these descriptors be prohibited. Although it may be truthful to label a food "no cholesterol", that descriptor would mislead someone if the food also contains substantial amounts of total fat and saturated fatty acids.

Nutrition information on food labels is a mechanism to provide information and facilitate behaviour modification. The government should allow the information to appear and regulate content, format, and placement. Although information campaigns to promote health are generally aimed at enhancing knowledge, changing attitudes, and improving skills, changes in consumer knowledge and attitudes do not directly result in adoption of health-promoting practices. Consumers need information to make long-term dietary changes, yet more than just information is necessary to achieve this goal.

Dietitians are the health professionals most involved in educating

consumers about the use of food labels in selecting foods to meet dietary goals. Most diet-related health problems develop gradually, without immediate or dramatic symptoms. Risk factor reduction and disease prevention through dietary change require individuals to make long-term and often arduous changes in food habits.

For the food industry, health professionals, and consumer groups, it will be of interest in terms of their own objectives in promoting nutrition labeling changes that are in line with current dietary recommendations and in product development.

The rules of labeling are set out by the Food and Drug Administration (FDA). The following are excerpts from comments presented to the Advisory Committee on the FDA's Subcommittee on Food and Veterinary Medicine, on September 6, 1990, by Nancy S. Wellman, PhD, RD, President of The American Dietetic Association. FDA needs independence from politics, particularly in regard to rulemaking. FDA autonomy is essential to its mission. It has been dismaying for dietitians to see rulemaking proposals stalled and/or overturned as has happened in the past for health claims, cholesterol, and various food safety issues such as food colors. Food labeling is an example where FDA suffers from the lack of overarching government-wide policy. FDA must be allowed to make decisions independent of current Administration bias.

Dietitians believe Americans want a stronger, yet reasonable FDA - an FDA in tune with the times, an FDA with the autonomy to fulfill its mandate. The FDA must take a more contemporary, broader role in not only safeguarding, but improving the nutritional status of Americans.

D's have seen FDA's stature diminish in the eyes of consumers because food labeling reform is overdue. Labeling regulations have not kept pace with contemporary food and nutrition science or with consumer demand for more nutrition information. RD's use food labels in everyday work as teaching tools to help consumers make life-saving or life-lengthening food choices. RDs are, therefore, keenly aware of the shortcomings of today's food labeling system.

FDA should use its range of legitimate justifications including public safety, prevention of consumer confusion, and interstate commerce concerns. No time resources should be devoted to determining who has authority. Action should be the goal.

A comprehensive nutrition education programme will be needed to educate consumers regarding the availability and appropriate use of improved food labeling. FDA should work to maximize the impact of food labeling reform on the nutritional status of Americans. A strong commitment to nutrition education through resource allocation and advocacy by FDA is essential.

Food Labeling Legislation

The Nutrition Labeling and Education Act of 1989, was the main food labeling bill in the 101st Congress. The House passed it and the Senate passed the same bill with some minor amendments.

The legislation includes the following:-

- Mandatory labeling is required for most foods under the jurisdiction of the Food and Drug Administration but not those covered by the US Department of Agriculture (i.e.. meat and poultry). The label would include:
  - Serving size, in standard, common household measures
  - Number of servings per container
  - Total calories
  - Total fat, saturated fat
  - Cholesterol
  - Sodium
  - Total carbohydrates, complex carbohydrates, and sugar
  - Total protein, and
  - Dietary fibre.
- The Secretary of Health and Human Services must provide voluntary nutrition guidelines for fruits, vegetables and raw fish. The guidelines will apply to 20 varieties of vegetables, fruit and raw fish most frequently consumed during a year, and the secretary will decide which foods will come under this requirement.
- There are exemptions for foods sold in restaurants, infant formula, foods with insignificant amounts of the nutrients required to be listed on the label, such as spices, and some other minor exemptions.
- It also addresses the issue of claims that may be made about the nutrients in the food. First, content claims, such as "low salt", or "light" would have to be consistent with terms defined by the Secretary. Second, there would be a process for the orderly regulation of disease claims such as "fibre. prevents cancer". FDA would review the scientific evidence and decide whether a claim is valid. A disease claim may not be made unless it is consistent with a final regulation issued by the FDA. Also, a claim may not be made if it is misleading in light of the level of another nutrient in the food; it must be based on the totality of scientific evidence on which there is significant scientific agreement.
- The Secretary will establish a system that evaluates the validity of health claims for dietary supplements.

- Some descriptors such as "light" or "lite" and "low" will have standard definitions.

Cholesterol Labeling Rule

The Food and Drug Administration's final rule on Food Labeling: Definitions of the terms Cholesterol Free, Low Cholesterol, and Reduced Cholesterol, were published in the July 19, 1990, Federal Register.

Cholesterol Free

- Less than 2 mg of cholesterol per serving; and
- 5 gram or less total fat per serving; and
- 20% or less total fat on dry weight basis; and
- 2 gram or less saturated fatty acids per serving; and
- 6% or less saturated fatty acids on a dry weight basis.

Low Cholesterol

- 20 mg or less cholesterol per serving; and
- 0.2 mg or less cholesterol per gram food; and
- 5 gram or less total fat per serving; and
- 20% or less total fat on dry weight basis; and
- 2 gram or less saturated fatty acids per serving; and
- 6% or less saturated fatty acids on a dry weight basis.

Reduced Cholesterol

The American Dietetic Association (ADA) believes that the descriptor "reduced cholesterol" should be removed from this regulation as it would be misleading to the consumer. The average consumer could read the "reduced cholesterol" label and think that, like the other terms used for cholesterol, it also applies to foods allowed in a diet to reduce serum cholesterol. The positive consumer impact from the use of this term is negligible.

If this term is to be kept in the regulations, ADA believes its use should definitely be conditioned to specific levels of total fat and saturated fat. The purpose of this rule is to protect the consumer from misleading food labels. If consumers are encouraged to reduce their cholesterol intake, but not told to reduce their intake of total fat and saturated fat, the first advice would be useless. FDA needs to be consistent in its application of cholesterol terminology.

Comparative claims

The ADA endorses FDA's decision not to allow terms such as "lowered" and "less" as food descriptors for foods with a 25 percent or

more reduction of cholesterol. These terms can only be used in comparative statements. Comparative claims should also be conditioned to specific levels of total fat and saturated fat to maintain consistency in cholesterol terminology.

Consumers need to learn to make comparisons among food products when making purchasing decisions. Allowing manufacturers to make cholesterol comparisons on labels would benefit consumers.

Fatty Acid Declaration

The FDA requires that saturated and unsaturated fatty acids be declared in nutrition labeling whenever cholesterol information is provided, regardless of whether a cholesterol claim is made on the principal display panel. This is necessary to prevent consumer deception.

Omega-3 and Omega-6 Fatty Acids

Voluntary differentiation of polyunsaturates into omega-3 or omega-6 fatty acids is not allowed. There has been little research done in this area and it would have the potential for confusing the consumer.

Information on Cholesterol

The National Cholesterol Education Programme (NCEP) encourages physicians to prescribe stringent dietary therapy of hyper cholesterolemia for at least 6 months before initiating drug therapy. Physicians should also be cautioned about premature use of hypercholesterolemic medications: no known study has demonstrated decreased mortality in recipients of such medications. Dietary therapy should strongly be encouraged, and physicians should adopt mandatory referral to a registered dietitian or other qualified nutrition professional before dietary therapy is declared a failure and drug therapy is started.

Lowering cholesterol levels decreases the incidence of heart disease. In fact, several studies have convincingly shown that adequate hypercholesterolemic treatment can not only prevent CHD, but can also reverse it. Recently these topics have been comprehensively reviewed. Dietary therapy is the cornerstone of all hypercholesterolemic therapy, and it has been estimated that 60 million adult Americans may be candidates for dietary instruction.

Findings suggest that blood lipid cholesterol levels predict subsequent mortality in men, especially those with preexisting cardiovascular disease. Those with high blood cholesterol levels have a risk of death from cardiovascular disease, including coronary heart disease, that was 3 times higher than that for men with a "desirable" blood cholesterol level.

Familial hypercholesterolemia carries a marked increase in the risk

of coronary heart disease (CHD), but there is considerable variation in susceptibility to CHD between individuals. Results indicate that an elevated level of lipoprotein is a strong risk factor for CHD in these individuals; the risk is independent of age, sex, smoking status, and serum levels of total cholesterol, triglyceride, or HDL-cholesterol. The higher level of lipoprotein observed in patients with CHD is the result of genetic influence.

The efficacy of hypercholesterolemic diets lowering cholesterol and in some cases, in preventing CHD, has been convincingly demonstrated. Such efficacy does depend, however, on the vigour which the physician and dietitian support dietary therapy. Many physicians have declared dietary therapy a failure without providing their patients with real dietary advice and support.

Two factors that probably contribute to physicians disinterest in dietary therapy are extensive advertising of hypercholesterolemic drugs compared with the little advertisingof dietary therapy and patient reluctance to alter diet and life-style. Getting patients to alter their life-style is often a challenging task. A recent surveysuggests, however, that the public is ready and able to embrace dietary therapy as the primary solution to hypercholesterolemia.

To further facilitate dietary therapy, recent research suggests that certain forms of fat (eg. fish and monounsaturated fatty acids) may be hypocholesterolemic, especially if they replace saturated fatty acids in the diet. Food technology is improving daily in palatably, removing fat from items like cheese, chips, and crackers. Frozen yogurt has become a popular replacement for ice cream. Fat substitutes, as they become available, may also facilitate compliance with a low-fat diet.

Psyllium is an especially attractive hybrid intervention in that it is well tolerated, lowers LDL-cholesterol by 10% to 20%, has no adverse effects on triglycerides, high-density-lipoprotein (HDL) cholesterol, or serum glucose, and is readily available and fairly inexpensive. It has a long history of use without any evidence of long-term adverse effects.

It is estimated that oat bran supplementation (90 gm per day) was a much more cost-effective method of lowering serum cholesterol than either cholestyramine or colestipol. In addition, high-fibre diets may decrease risk of colon cancer, improve glucose tolerance, lower blood pressure, and assist in weight loss.

Many physicians think that they or their staff can tell the patient everything he or she needs to know about hypercholesterolemic diets by issuing the usual, though imprecise, dietary admonitions (eg. avoid red meat, whole fat dairy products, and egg yolks) and by photocopying a few sample menus. Without explanation and reinforcement, the patient

is unlikely to achieve the dietary goals. Even if the patient does reduce intake of fat and cholesterol from the obvious dietary sources, he or she may continue to eat other notable, but perhaps somewhat hidden, sources of saturated fat (eg. baked goods, tropical oils, organ meats).

An additional advantage of dietary over drug therapy is that diet simultaneously ameliorates several cardiovascular risk factors (hyperlipidemia, hypertension, obesity, and diabetes) whereas drug therapy usually deals with only one. In fact, drug therapy for one risk factor often exacerbates another (eg. beta blockersfor hypertension may increase serum lipids, and niacin may accentuate glucose intolerance).

Dietitians are the best-qualified health professionals to help patients lower their cholesterol levels. With the impetus of the NCEP behind them, RDs should be aggressively promoting their services to physicians and the public, devising methods to obtain reimbursement, and making themselves visible as the best-qualified authorities on diet.

The public is increasingly interested in dietary control of hypercholesterolemia, as evidenced by the widespread media attention devoted to cholesterol. A major, but clearly surmountable, obstacle is inadequate referral to dietitians by physicians in their communities, about their knowledge, skills and availability to counsel clients on the dietary treatment of hypercholesterolemia. Via these mechanisms, dietitians will become increasingly recognized as the best sources of nutrition information, with ultimate benefit to the public.

Fig. Food Guide Pyramid

Information on Vegetarian Diets

"Nothing will benefit human health and increase chances for survival of life on Earth as much as the evolution to a vegetarian diet."

- Albert Einstein

This site covers the nutritional and dietary guidelines presented by the mainstream to the general population. So when vegetarian diets have a direct effect on a persons state of health, it has been noted. For example in the Vitamins chapter there is mention of the fact that a strict vegetarian may need to supplement B12.

Although it is becoming more popular, either for moral or health reasons, a vegetarian diet still seems to have a strange stigma attached to it.

Hundreds of millions of people are vegetarian (eg. Hindus for religious reasons); more health professionals are discouraging the consumption of animal fats and red meats, that have been shown to increase the chance of obesity, cancer and other diseases; and the environmentalists who know that much of the limited resources, on Planet Earth, are wasted by converting them to meat.

- It takes 2,500 gallons of water, 12 pounds of grain, 35 pounds of topsoil and the energy equivalent of one gallon of gasoline to produce one pound of feedlot beef.
- 70% of US grain production is fed to live stock.
- 5 million acres of rain forest are felled every year in South and Central America alone to create cattle pasture.
- Roughly 20% of all currently threatened and endangered species in the US are harmed by livestock grazing
- Animal agriculture is a chief contributor to water pollution. America's farm animals produce 10 times the waste produced by the human population.
- There are sound reasons for health, ethically, and ecologically to be vegetarian. There is nothing strange about being vegetarian.

Definition

Vegetarian, the belief in and practice of eating exclusively vegetable foods and abstaining from any form of animal food.

To what extent this definition applies, in reality varies, what it refers to is a strict vegetarian or a vegan.

Lacto-vegetarians include milk and other dairy products in their diet. Lacto-ovovegetarians eat milk, dairy products and eggs. Those who eat fish are not vegetarian.

A vegan, excludes animal flesh (meat, poultry, fish and seafood), animal products (eggs, dairy and honey), and the wearing and use of animal products (eg. leather, silk, wool, lanolin, gelatin). The vegan diet consists totally of vegetables, vegetable oils, and seeds.

vegan 've-gen also 've-jen or -,jan\ n [by contr. fr. vegetarian] (1944) : a strict vegetarian who consumes no animal food or dairy products; also

: one who abstains from using animal products (as leather) _ veganism 've-ge-,ni-zem, 'va-ge-, 've-je-\ n .

Partial vegetarians exclude some groups of animal foods but not others. A diet that excludes red meat but includes fish is often adopted for health not moral reasons.

Zen macrobiotic diets. This is a Japanese way of eating based on the 'Yin Yang' theory. It aims to keep the balance between Yin and Yang (positive and negative) aspects of life for optimal spiritual, mental and physical welfare. Foods are divided into Yin and Yang, and a spiritual goal is aimed for by working through ten levels of diet. These gradually eliminate all animal produce, fruit and vegetables towards the final goal which is only cereal (brown rice). Fluids are also severely restricted. Many nutritional deficiencies may develop and death can result. Infants and children subject to these restrictions are particularly at risk [Thomas et al., 1988]

This is extreme, not all macrobiotic diets are so extreme and are often equivalent to a balanced vegan diet. It is important to eat as much variety of food as possible and not limit it to one group of foods.

If you are vegetarian or want to become one, start off by giving up one kind of animal food, the one that offends you most. Once you are used to supplementing this food with another of vegetable origin, tackle the next. Progressively reaching the level of vegetarianisim you desire, slowly over a period of time. This progressive vegetarian is one who changes their eating habits / lifestyle at a positive rate, by doing so you allow your body to adjust to the eating of new types of foods or foods that may have given you troubles before (beans). It also gives you time to learn more about nutrition and increase your pool of knowledge on the subject. Thus it is not a fad diet that you will give up the next day but a progressive change towards a healthy lifestyle.

History

Vegetarianism is an ancient custom. It has long existed among certain Hindu and Buddhist sects that consider all animal life sacred, and it was advocated zealously by numerous philosophers and writers of ancient Greece and Rome. In the Roman Catholic church, it has been practised monastically by Trappists since 1666, and among Protestants more recently by Seventh-Day Adventists. As an active Western movement, it originated in 1809 near Manchester, England, among members of the Bible Christian Church. In 1847 the Vegetarian Society, a nonreligious organization, was founded. The movement spread to continental Europe and the U.S. (1850), and in 1908 the International Vegetarian Union was founded. Today the union holds congresses every two years in different countries.

Vegetarian Arguments

Although vegetarianism originated as a religious or ethical practice, it has also gained acceptance among many for aesthetic, nutritional, and economic reasons. Humanitarian vegetarians refuse meat because they believe that the killing of animals is unnecessary or cruel, or that such a practice can conceivably lead to a disregard for human life; the trades that the slaughter of animals supports, such as butchering, are considered degrading. People who adhere to vegetarianism for health reasons believe that meat is harmful to the human body and that a purely vegetable diet is more nutritious.

Evolution

Some people believe that humans were originaly vegetarian through the evolutionary process. It is not in the scope of this book to get into a complex discussion of evolution, but here are a few background notes covering the subject

Primates evolved from ancestral mammals more than 60 million years ago, during the Palaeocene Era. The first known primates resembled small rodents or tree shrew. Like tree shrews, they probably had huge appetites and foraged at night for insects, seeds, buds and eggs on the forest floor.

The Hominids probably emerged between 10 million and 5 million years ago, during the late Miocene. There appear to have been many varieties of early hominids, but many had three features in common:

- Bipedalism
- Omnivorous feeding patterns
- Further brain expansion and elaboration.

Monkeys have long canines and rather rectangular jaws. Human teeth are smaller and more uniform in length, and the jaw is bow-shaped. The jaws and teeth became less specialized during the evolution of forms leading to humans. Beginning with the earliest primates, there was a shift from eating insects, then fruit and leaves, and on to a mixed diet.

pe, any member of the primate families Hylobatidae (the lesser apes), which includes the gibbons (Hylobates), and Pongidae (the great apes), which includes the orangutan, the chimpanzees, and gorilla. They belong to the superfamily Cercopithecoidea, the Old World monkeys and apes. Apes, or anthropoids, are distinguished from other primates by their complex brains and hence intelligence, their large size, and their lack of tails. They are mainly vegetarian but, except for the gorilla, occasionally eat small animals.

Remains of skeletons from 4 million old australopiths were found. They were transitional between the Miocene apes and later hominids.

Unlike apes, their jaw was slightly bow-shaped. And their dentition suggests that some were omnivores and others, vegetarians.

The omnivores were slightly built and the vegetarians, heavyset hominids (genus Australopithecus and esp. A. robustus and A. boisei) were heavily built, taller, and muscular, characterized by heavy molars and small incisors adapted to a vegetarian diet. A. robustus had strong jaw muscles and large, heavily cusped molars. This hominid may have specialized in chewing seeds, nuts, and other tough plant material.

A.africanus was probably omnivorous. It's cheek teeth formed a platform that could grind plants, but its incisors were relatively large, as in the case for carnivores.

By about 2.5 million years ago, hominids started making stone tools and are referred to as the "early Homo". Compared to the australopiths, these "early Homo's", had a smaller face, more generalized teeth, and a larger brain. This hominid apparently was a scavenger and gatherer of plant material, small animals, and insects. And it may have been ancestral to modern humans.

The Protein Myth

It is incredible how often a vegetarian is asked "...so where do you get your protein from?" Why is this such a major concern to the majority of lay people and health professionals? When one considers all the healthy benefits of a meat-free diet it is sad to see people responding with this irrelevant concept. It would be like asking meat eaters where do you get your carbohydrates from? Duh!

The question of protein intake has been raised so often with vegetarians that it has become a depressingly boring subject. There is no protein problem, studies consistently show that vegetarians and vegans have a satisfactory protein intake. An extensive study of several thousand vegetarian foodstuffs reveal that the following are good sources of protein:

One Cup of Food	Grams of Protein
Pumpkin and squash seed kernels, roasted	74.8
soy Flour	47.0
Tofu raw, firm, prepared w/calcium sulphate	39.9
Almonds, blanched	29.6
Oats	26.4
Lentils cooked	
Rice brown, long grain, raw	14.7
Chickpeas cooked	14.5

The 1993 position paper of the authoritative and respected American

Dietetic Association summarized its views even more strongly: Plant sources of protein alone can provide adequate amounts of essential and nonessential amino acids assuming that dietary protein sources from plants are reasonably varied and that caloric intake is sufficient to meet energy needs. Whole grains, legumes, vegetables, seeds, and nuts all contain essential and nonessential amino acids. Conscious combining of these foods within a given, as the complementary protein dictum suggests, is unnecessary.

Additionally, soya protein has been shown to be nutritionally equivalent in protein value to proteins of animal origin and, thus, can serve as the sole source of protein intake if desired.

Although most vegetarian diets meet or exceed the Recommended Dietary Allowances for protein, they often provide less protein than nonvegetarian diets. This lower protein intake may be associated with better calcium retention in vegetarians and improved kidney function in individuals with prior kidney damage. Further, lower protein intakes may result in a lower fat intake with its inherent advantages, because foods high in protein are frequently also high in fat.

So, how has this myth of deficiency arisen? Early research (circa 1914) into protein consisted of experiments on rats. These animals were found not to grow as quickly when fed plant protein as when given animal protein.

Hence the idea arose that plant protein was second class, and animal protein superior. There are a few reasons as to why this happens. The weaning rat grows at as much faster rate than the human infant and thus requires a much more concentrated source of nutrients, including protein. Human breast milk, for example, contains about 7 per cent of caloric content as protein, while rat milk contains 20 per cent protein.

If rats were fed solely human milk, they would not thrive. Using this logic one could argue that human breast milk is an inferior protein source. Obviously this is not true to humans. Humans are not rats, and results of dietary studies on rat can therefore not be equated to humans.

The second 'protein myth' arose from an unexpected quarter, a book written in the late 1960s which exposed the terrible wastes inherent in a meat-centered diet.

Diet for a Small Planet sold over 3 million copies, and popularized the idea of 'protein complementarity'.

Written with best intentions, its effect was to make plant sources of protein again seem second class, unless carefully combined with each other, and to make the whole subject of protein nutrition seem vastly complex and fraught with danger.

In subsequent editions of the book, this mistake was corrected. But

still the myth lives on, no doubt due in part to the zealous promotional efforts of the meat industry.

The truth of the vegetarian diet is that if the proper amino acids are eaten daily or over a few days there is no need to fear that vegetable protein is inferior. Protein is protein and amino acids are amino acids whether they come from a cow or a soy bean.

Guidelines for formulating nutritionally balanced vegetarian and vegan diets

A wide variety of foods should be chosen from the following groups.

- Milk. 1 pint (children) 1 pint (adults) or other dairy products (cheese or yoghurt). Strict vegetarians can use dairy substitutes such as soy milk or tofu.
- Proteins. 2 - 3 portions daily of any of the following: pulses and beans - in casseroles, stews and soup; nuts - in salads, rissoles and roasts; T.V.P., tofu and other soy products - in casseroles, stir fry and curries.
- Cereals. 3 - 5 portions daily of any of the following: bread, breakfast cereals, rice, pasta, flour, crackers, or other cereals such as millet, bulghar wheat, wheat grain and buckwheat.
- Fruit. 2 - 3 portions daily of: fruits, fresh, dried or juice. This should include 1 serving of citrus fruit or juice daily.
- Vegetables. 2 - 5 portions daily, lightly cooked or raw, of a variety that include both dark green leafy and root vegetables.
- Fats. Margarine and oils should be consumed as required. In contrast to most of the population the diets of vegetarians and vegans are naturally low in fat. It is therefore unnecessary to restrict the amounts of fats and oils used in cooking or to recommend the use of low fat spreads. Furthermore, some vegetarians may need to increase their consumption of fats and oils in order to meet their energy requirements.

Nutritional deficiencies can occur, particularly when an individual decides to become vegetarian and simply stops eating meat or animal products, without considering what can be eaten instead.

Vegetarian or vegan infants and children

Breast milk or modified baby milk should provide sufficient nutrients for the baby until the age of 4 - 6 months. Solid foods should then be introduced gradually. Vitamin drops should be given from the age of one month to two years and preferably until five years of age.

If no foods of animal origin are to be eaten, either vitamin B12 supplement or a food fortified with vitamin B12 (soy milk) should be given.

Weaning at 4 – 6 Months

Foods should be introduced one at a time, and the quantities gradually increased. Suitable first foods include:

- Baby rice and water or baby milk.
- Smooth puree of vegetables, eg. carrots.
- Smooth puree of fruit, eg. apple, pear or apricot.

If the baby is thirsty it can be given boiled cold water or very dilute unsweetened fruit juice. No sugar or salt should be added to babies food.

Continue Weaning 5 – 7 Months

New foods can be introduced one at a time. Suitable foods include:

- Well cooked, pureed pulses, eg. lentils and split peas.
- Pureed root vegetables.
- Pureed brown rice, brown rice flour and water or baby rice.
- Mixtures of pulses, vegetables and/or rice puree.
- Pureed stewed fruit or well mashed banana.

No sugar or salt should be used added to food and salt free stock should be used in cooking.

At about six months the baby, under close supervision, can be given wedges of apple, sticks of carrot or baked wholemeal bread to encourage chewing.

Some commercial baby foods are suitable for vegetarian or vegan babies. These are fortified with some vitamins and minerals.

7 - 9 Months

The baby should still be having 1 pint of milk or equivalent each day. If cows' milk is not taken, boiled goats' milk or a soy milk substitute may be used, but not until the baby is eating a variety of other foods and not without consulting a doctor or health visitor. Foods can now be minced or finely chopped and new foods can be introduced. Suitable foods include:

- Wholegrain breakfast cereals and porridge.
- Cheese (grated or finely chopped, cottage), yoghurts and eggs (if eaten).
- Wholemeal bread.
- Brown rice.
- Well cooked pasta.
- A variety of vegetables.
- Fruit (grated, chopped or stewed, including cooked dried fruit).
- Tofu
- Pulses and beans - well cooked and mashed or pureed, given with cereal food such as rice or bread.

9 - 12 Months

At this stage most babies will be eating three meals a day. Most of the family's foods will be suitable and a wide variety of foods, flavors and textures should be encouraged. However, spicy, fatty foods and whole nuts should be avoided. At least 1 pint of milk or milk substitute should be consumed daily.

In order to get the best nutritional value from foods, it is essential that a mixture of foods is eaten at each meal.

Breakfast

Wholegrain breakfast cereal
And milk or milk substitute
And wholemeal bread or toast and margarine.

Lunch

Mashed bean stew and rice
or lentil and vegetable soup and bread
or mashed nut roast
And vegetables, cooked or raw
And fruit, yoghurt or milk pudding.
Dinner.
Wholemeal bread and margarine
And cheese, lentil pate or peanut butter
And vegetable or bean soup
And salad, vegetables
And fruit, yoghurt or milk pudding.

Planning Your Diet

The fact that more than 20% of the United States adult population is obese presents a major public health concern. However, the failure to follow through and maintain weight loss on their own, after termination of counselling, makes the long-term success of weight loss programs difficult to achieve.

Health professionals often assume that patients will dutifully comply with recommendations simply because they are urged to do so. The magnitude of noncompliance has been well documented. Adherence to dietary programs is thought to be poorer than to medication regimens. Dietary regimens are often restrictive, require changes in life-style and behaviours, interfere with family habits and customs, and are of long duration.

Weight control methods are considered a success if weight loss is maintained without expense to overall health. A goal of any successful

weight reduction programme is to promote permanent life-style changes. The physical and psychological consequences of repeated weight fluctuations may be more harmful than maintaining some degree of overweight.

The ultimate goal of all weight loss programs is to reduce nutritional risk factors associated with chronic diseases by increasing consumer awareness of healthy food choices.

In 1992 over 49 million people were dieting. The National Council Against Fraud estimates that quackery costs consumers between $25 billion and $50 billion a year - and nutrition fraud is the most common type.

Therefore to identify a quality weight loss programme, and not to be misled by a "fad diet", the following indicators must be considered:

- A variety of foods. Weight control programs should be individualized to fit people's life-styles and food preferences. Individualization diminishes feelings of deprivation, which lead to discouragement, bingeing, and rebound weight gain - all hallmarks of the yo-yo diet syndrome.
- Enough calories to maintain good health. Consuming less than 1200 kcal a day may result in loss of muscle instead of fat and may compromise nutritional status as a result of deficient nutrient intakes.
- Realistic weight loss goals. To lose body fat and not just water, a maximum weight loss of 2 pounds per week is advised.
- Regular exercise. Especially as we age, exercise can be the key to weight loss and maintenance of a desirable weight.
- Behaviour modification. Registered dietitians counsel people to keep lost weight off by helping them alter their eating behaviour and responses to foods for the rest of their lives.

Unfortunately, a current trend toward the view that a single food is either a panacea or a poison is being gradually adopted by major health associations. This "good food/bad food" dichotomy ignores the consensus among nutritionists that all foods can be compatible with health when used in moderation as part of a balanced, varied diet.

Over the past decade people have become obsessed with the nutritional value of the food they eat. Time and again, nutrition ranks high among consumer concerns, along with food safety, convenience, quality, and value. In the United States sales in the "healthy foods" category accounted for $65 billion in 1985, but are expected to reach $98 billion by 1995.

Consumers are asking for specific information about which foods and, in particular, which brands of packaged foods to choose from when they

eat or purchase foods. For example the broad guideline to avoid to much fat, saturated fat and cholesterol require specific behaviour implementations that include:

- Eat more fresh fruits and vegetables, whole grain breads and cereals, potatoes, rice noodles, dried beans, peas, and lentils.
- Choose low fat dairy products, including skim, 1%, and 2% milk, low-fat cheeses, and low-fat yogurt.
- Choose lean meats, fish, chicken and turkey.

Very Low Calorie Weight Loss Diets (VLCD)

It is the position of the American Dietetic Association that while VLCD's promote rapid weight loss and may be beneficial for certain individuals, such diets have health risks and should be undertaken only with the supervision of a multidisciplinary health team with monitoring by a physician and nutrition counselling by a registered dietitian. Side effects that have been associated with VLCD's are cold intolerance, fatigue, light-headedness, nervousness, euphoria, constipation or diarrhoea, dry skin, thinning of hair, anaemia, and menstrual irregularities.

Low Body Weight and Weight Loss

Excessive concern about weight may cause or lead to such unhealthy behaviors as excessive exercise, self-induced vomiting, and the abuse of laxatives or other medications. These practices may only worsen the concern about weight. Excessive exercise may also affect hormone production, increase the loss of calcium from the bones, and increase the risk of fractures.

Low body weight and rapid unintentional weight loss are highly predictive of mortality, especially in the elderly population. Weight loss is frequently reported in elderly patients.

Acute and chronic diseases are leading causes of involuntary weight loss. Whereas physical disease probably accounts for a majority of cases of involuntary weight loss, psychiatric disorders such as dementia and depression also may result in severe nutritional deficiencies.

Energy requirements decrease because of the lower basal metabolic rate and reduced physical activity. These low energy requirements make it more difficult for the elderly to obtain adequate amounts of required nutrients. Health care professionals must monitor body weight in elderly persons and carefully evaluate any cases of rapid, unintentional weight loss to prevent further deterioration of health status.

Weight loss generally consists of both lean body mass and body fat. Contributions of lean body mass and fat to total weight loss is a function of body fat content. Excessive loss of lean body mass will result in skeletal

and cardiac muscle wasting and loss of visceral protein. Because lean body mass declines with age, elderly individuals who are at average or slightly above average weight may be better able to tolerate weight loss that occurs with aging or disease than underweight individuals.

It has been well documented that physical disease can lead to weight loss. Disease may limit dietary intake or may alter physiological processes, resulting in decreased nutrient digestion or absorption, increased nutrient excretion, or increased nutrient requirements.

Cancer is the most frequently cited cause of involuntary weight loss, and weight loss may occur during early stages of tumour growth before other symptoms emerge. The anorexia of malignancy has been related to taste alterations; changes in gastrointestinal tract contraction and secretion; metabolic disturbances resulting in changes of circulating glucose, amino acid, fatty acid, or lactic acid levels; changes in hypothalamic function; and weakness leading to decreased motor activity.

In addition to cancer, gastrointestinal disease, uncontrolled diabetes, and cardiovascular disorders such as congestive heart failure, alcohol abuse, pulmonary disease, and infection are major causes of involuntary weight loss. Less common, but still a cause of notable weight loss, is hyperthyroidism.

Specific nutrient deficiencies and low nutrient intakes, which may contribute to weight loss, have been documented in patients with dementia. Deficiencies of folate, thiamin, niacin, riboflavin, and vitamin B_{12} and electrolyte imbalance may impair cognitive function and mimic dementia.

Some nutrient deficiencies that alter mental status may be present in the elderly population. Altered mental states attributable to nutrient deficiencies and weight loss can be corrected. Several studies have shown that folate deficiency leads to confusion and signs of dementia in elderly individuals, but can be reversed with appropriate supplementation. If confusion and dementia caused by nutrient deficiencies are not diagnosed and corrected, they may lead to even lower nutrient intakes and more severe alterations in mental status.

Chapter 2

Nutrients

Nutrients are substances derived from food during the process of digestion. There are three main groups of nutrients contained in food which are needed by the body in differing amounts. They are carbohydrates, proteins, and fat.

These major nutrients are needed by the body for growth, repair, maintenance and energy.

In addition, the body requires fibre, vitamins and minerals which are present in varying quantities in different types of food. Good nutrition requires a balance of the right nutrients, that is, getting the proper amount, or proportion, of each one.

Our diet should provide adequate amount of all nutrients to maintain good health and physical efficiency.

Daily food intake should be such that of the total consumption, about 15 to 20% is protein, 40 to 50% is complex Carbohydrates and 20 to 30% is fat.

Types of Nutrient

Macronutrients are defined in several different ways.

- The chemical elements humans consume in the largest quantities are carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
- The classes of chemical compounds humans consume in the largest quantities and which provide bulk energy are carbohydrates, proteins, and fats. Water and atmospheric oxygen also must be consumed in large quantities, but are not always considered "food" or "nutrients".
- Calcium, salt (sodium and chloride), magnesium, and potassium (along with phosphorus and sulfur) are sometimes added to the list of macronutrients because they are required in large quantities compared to other vitamins and minerals. They are sometimes referred to as the macrominerals.

The remaining vitamins, minerals, or elements, are called micronutrients because they are required in relatively small quantities.

Substances that Provide Energy

- Carbohydrates are compounds made up of sugars. Carbohydrates are classified by their number of sugar units: monosaccharides (such as glucose and fructose), disaccharides (such as sucrose and lactose), oligosaccharides, and polysaccharides (such as starch, glycogen, and cellulose).
- Proteins are organic compounds that consists of the amino acids joined by peptide bonds. The body cannot manufacture some of the amino acids (termed essential amino acids); the diet must supply these. In nutrition, proteins are broken down through digestion by proteases back into free amino acids.
- Fats consist of a glycerin molecule with three fatty acids attached. Fatty acids are unbranched hydrocarbon chains, connected by single bonds alone (saturated fatty acids) or by both double and single bonds (unsaturated fatty acids). Fats are needed to keep cell membranes functioning properly, to insulate body organs against shock, to keep body temperature stable, and to maintain healthy skin and hair. The body does not manufacture certain fatty acids (termed essential fatty acids) and the diet must supply these.

Fat has an energy content of 9 kcal/g (~37.7 kJ/g); proteins and carbohydrates 4 kcal/g (~16.7 kJ/g). Ethanol (grain alcohol) has an energy content of 7 kcal/g (~29.3 kJ/g).

Substances that support metabolism

- Dietary minerals are generally trace elements, salts, or ions such as copper and iron. Some of these minerals are essential to human metabolism.
- Vitamins are organic compounds essential to the body. They usually act as coenzymes or cofactors for various proteins in the body.
- Water is an essential nutrient and is the solvent in which all the chemical reactions of life take place.

Nutrients and Plants

The chemical elements consumed in the greatest quantities by plants are carbon, hydrogen, and oxygen. These are present in the environment in the form of water and carbon dioxide; energy is provided by sunlight. Nitrogen, phosphorus, potassium, and sulfur are also needed in relatively large quantities. Together, these are the elemental macronutrients for plants, often represented by the acronym CHNOPS. Usually they are sourced from inorganic (e.g. carbon dioxide, water, nitrate, phosphate, sulfate) or organic (e.g. carbohydrates, lipids, proteins) compounds,

although elemental diatomic molecules of nitrogen and (especially) oxygen are often used.

Other chemical elements are also necessary to carry out various life processes and build structures; see fertilizer and micronutrient for more information.

Some of these are considered macronutrients in certain organisms. The acronym C. HOPKiN'S CaFe Mg (to be used as C. Hopkins coffee mug) is used by some students to remember the list as: Carbon, Hydrogen, Oxygen, Phosphorus, Potassium (K), Nitrogen, Sulfur, Calcium, Iron (Fe), and Magnesium (Mg). Silicon, chloride, sodium, copper, zinc, and molybdenum are sometimes also included, but are in other cases considered micronutrients.

Oversupply of plant nutrients in the environment can cause excessive plant and algae growth. Eutrophication, as this process is called, may cause imblances in population numbers and other nutrients that can be harmful to certain species.

For example, an algal bloom can deplete the oxygen available for fish to breathe.

Causes include water pollution from sewage or runoff from farms (carrying excess agricultural fertilizer). Nitrogen and phosphorus are most commonly the limiting factor in growth, and thus the most likely to trigger eutrophication when introduced artificially.

Essential and non-essential nutrients

Nutrients are frequently categorized as essential or nonessential. Essential nutrients are unable to be synthesized internally (either at all, or in sufficient quantities), and so must be consumed by an organism from its environment.

For humans, these include essential fatty acids, essential amino acids, vitamins, and certain dietary minerals. Oxygen and water are also essential for human survival, but are generally not considered "food" when consumed in isolation.

Humans can derive energy from a wide variety of fats, carbohydrates, proteins, and ethanol, and can synthesize other needed amino acids from the essential nutrients.

Non-essential nutrients can still have a significant impact on health, whether beneficial or toxic.

For example, most dietary fibre is not absorbed by the human digestive tract, but is important in digestion and absorption of otherwise harmful substances. Interest has recently increased in phytochemicals, which include many non-essential nutrients which may have health benefits.

Carbohydrates

Carbohydrates are sources of energy for vital metabolic processes and also are constituents of cellular substances such as nucleic acids, and are enzyme cofactors and structural components of cell walls and cell membranes.

The digestive system breaks down the carbohydrates into *simple sugars* and ultimately absorbs glucose into the bloodstream. Any excess glucose is converted into glycogen which is then stored around the body. Thus an excess of carbohydrates can lead to an increase in body fat and a gain in weight.

Carbohydrates are conveniently classified into three major groups *polysaccharides* (complex carbohydrates), *monosaccharides* and *disaccharides* (simple carbohydrates).

Complex carbohydrates contain many more nutrients than simple carbohydrates.

These complex carbohydrates, such as whole wheat bread, potatoes and rice have a high *nutrient density* and are a good source of dietary fibre, and should be a major ingredient in any persons diet. Between 55% and 75% of calories should come from carbohydrates.

They have a low fat content, but are usually consumed with meat, cheese, oil or butter, all of which are very fattening. It is a good idea to try and limit the amount of fatty foods and protein rich foods combined with carbohydrates. For instance a pasta dish with a garlic, chili or tomato sauce is far healthier than a similar pasta covered in a cream, cheese or meat topping.

Simple carbohydrates are usually refined foods such as white sugar, white bread or cola. These foods contain little else besides energy (ie. empty calories). Any food that does not have a large variety of nutrients is considered to have a low nutrient density. Foods that have low nutrient densities should be limited to small portions and only eaten as a special treat if the bulk of your diet consists of nutrient dense, natural, wholefoods (eg. bananas, fruit juice, nuts, granola, beans and green vegetables).

Monosaccharides

Monosaccharides are simple sugars (glucose, fructose, and galactose) that do not need to be further digested to be absorbed. The most important dietary monosaccharide is glucose, also called dextrose. It constitutes about 0.1% of the blood of mammals and is essential to life. Glucose, either free or combined with other molecules, is probably the most abundent organic compound. It is the ultimate hydrolysis product of starch and cellulose.

Fructose, also known as fruit sugar, occurs free, along with glucose and sucrose, in many fruits, vegetables, and honey.

Disaccharides

Are sugars formed from two monosaccharides. Ordinary cane sugar (sucrose) is a disaccharide composed of glucose and fructose monosaccharide units. Sucrose is the most important disaccharide, it occurs in all photosynthetic plants where it appears to serve as an easily transported energy source. Its two main commercial sources are sugar beets and sugar cane. The juices, which contain about 20% sucrose, are put through a rather extensive purification process to remove impurities.

Maltose is a disaccharide of two glucose molecules and is found in beer and cereals. It is formed by the action of an enzyme from malt on starch, further hydrolysis of maltose, catalyzed by the enzyme maltase (from yeast) gives only glucose. Lactose is the sugar present in milk, human milk contains five to eight percent and cow's milk, four to six percent. It is composed of one molecule of glucose and one of galactose.

Polysaccharides

Starch, glycogen, cellulose and most types of fibre are polysaccharides. Starch is the reserve carbohydrate in many plants and comprises large percentages of cereals, potatoes, corn, and rice. Under the microscope, the appearance of the granules of starch from these different sources varies both in shape and size. Chemically, however, they are similar.

Complete hydrolysis of starch yields glucose but partial hydrolysis gives maltose as well. Partial hydrolysis of starch transforms it into dextrins, polysaccharides of smaller molecular weight than starch. They are more readily digested than starch and are used, mixed with maltose, in infant foods.

A dried mixture of dextrins, maltose, and milk is the preparation used for making malted milk. Dextrins are sticky when wet and are used in manufacturing mucilage (gum) for postage stamps and envelopes. In laundries, starched materials become stiff and shiny due to the transformation of the starch to dextrins by the heat of the iron.

When starch is ingested, it is hydrolyzed enzymatically in a stepwise fashion. Initiated in the mouth by the enzyme amylase, present in saliva, hydrolysis is continued by additional amylase in the pancreatic juices. The maltose produced in this way is, in turn, hydrolyzed to glucose with the aid of an enzyme present in the intestines. The glucose is absorbed from the intestines into the blood and transported to the liver, muscles, and other sites where it is converted to another glucose polymer, glycogen, and stored.

Glycogen, the reserve carbohydrate of animals, is found mainly in the liver and muscles. Glycogen helps maintain the proper amount of glucose in the blood by removing and storing excess glucose derived from

ingested food or by supplying it to the blood when it is needed by the body cells for energy.

Cellulose is the main structural material of plant life, being the chief ingredient of cell walls of cotton, wood pulp, straw, corn cobs, and many other materials. Fibre includes a variety of carbohydrates and other components.

The chemical linkages in starch and glycogen can be split by the human intestinal enzymes, but those of polysaccharides found in fibre are indigestible, although some fibre components can be broken down by enzymes released by intestinal bacteria *to short-chain fatty acids that can be reabsorbed.*

Proteins

Proteins are the structural components of the body forming the basis of cells, tissues and organs. They are a large group of organic compounds consisting of carbon, hydrogen, nitrogen and oxygen atoms. Some contain sulphur and phosphorus also. When the proteins are digested they break down into smaller units called amino acids. Of the 20 basic amino acids 12 can be manufactured by the body and the rest, called the 'essential amino acids' must be obtained from food.

Proteins help to repair worn out or diseased tissues and to build new ones. It is used in the formulation of hormone, enzymes, red blood cells and antibodies. It also provides amino acids necessary for growth of fetus in pregnancy and for the production of milk proteins during lactation. Proteins are widely found in foods derived both from plant and animal sources. Plant sources include beans, peas, pulses, whole grains, nuts and oil seeds; while red meat, poultry, fish, milk, cheese, yogurt and eggs are obtained from animals. Red meat is a good source of essential amino acids and iron and is traditionally regarded as 'first class' protein. But too much consumption of red meat may be harmful as it is a major source of undesirable saturated fat. One can eat more fish or chicken without the fatty skin instead of excess red meat. Vegetarians can obtain plenty of both from plant sources, whole grain cereals and from low fat diary products. A protein deficiency especially in infants and growing children can cause growth retardation, severe wasting of muscle etc.

The dietary requirements of protein depend on age and physiological state. A part of the dietary protein is utilised or wasted to meet the energy requirements. So calorie intake should be adequate enough to meet the protein need or its maximum utilisation, taking into account the above factor.

Fats

Fats, oils, and waxes belong to the group of naturally occuring organic

materials called lipids. Lipids are those constituents of plants or animals which are insoluble in water but soluble in other organic solvents.

Amongst the various foodstuffs, fats provide the body with maximum energy (9 kcal per gram), approximately twice that for an equal amount of protein or carbohydrates.

Lipids are concentrated sources of energy as well as structural components of cell membranes. Everybody needs a certain amount of dietary fat for normal body functions. When fats are digested, emulsified, and absorbed, they facilitate the intestinal absorption and transport of fat soluble vitamins A, D, E, and K. They are also used to cushion and protect the heart, kidneys and liver. In certain climates subcutaneous body fat helps to insulate the body from the cold and prevent heat loss through the skin. These functions can be met by a daily intake of 15 to 25 grams of fat.

Lipids enter the body through the mouth and pass to the stomach, but are little affected by its acidic environment. They are absorbed primarily in the small intestines, where they are emulsified by salts of the bile acids and are hydrolyzed to fatty acids and glycerol by various water-soluble enzymes (lipases). From the intestines, the hydrolyzed lipids enter the bloodstream and are transported to other organs, mainly the liver, for further metabolism. Ultimately the fatty acids may be degraded to carbon dioxide and water to furnish energy.

There are many types of fatty acids, but they can be grouped into three divisions - saturated fats, monounsaturated fats and polyunsaturated fats. Polyunsaturated fats consist of two classes, omega-3 and omega-6.

Saturated fats have a profound *hypercholesterolemic* (increase blood cholesterol levels) effect. They are found predominantly in animal products (butter, cheese and meat) but coconut oil and palm oil are common vegetable sources. Saturated fat raises blood cholesterol levels more than anything else in the diet, even more than dietary cholesterol.

Intake of monounsaturated fats in oils such as olive oil is thought to be preferable to consumption of polyunsaturated fats in oils such as corn oil because the monounsaturated fats apparently do not lower high-density-lipoprotein (HDL) cholesterol levels. Evidence for this belief is derived primarily from metabolic ward studies of relatively short duration.

Unsaturated fats come primarily from vegetable oils (safflower, corn, soyabean, cottonseed, sesame, and sunflower oils), nuts and seeds, although fish is a good source of unsaturated fatty acids. Most of the essential fatty acids are found in unsaturated fat, so foods high in saturated fat and cholesterol (animal fat, dairy products and eggs) should be eaten sparingly.

Fats should make up only 10 to 25 percent of the calories (not weight) in your diet. There is an overwhelming consumption of fats in the average Western Diet, this has lead to a huge health problem among population groups with a diet high in animal fats (ice-cream, chocolates, fast foods and desserts). There are many diet related human disorders that are found almost exclusively in the Western World, Coronary Heart Disease (CHD) and cancer of the colon, are a few of the more severe.

Cholesterol

Cholesteryl esters are composed of a single fatty acid esterfied to cholesterol, in which the polar component is an alcohol.

Cholesterol is a major component of all cell membranes. It is required for synthesis of sex hormones, bile acids, and vitamin D. It is also a precursor of the steroid hormones produced by the adrenal cortex and gonads.

Dietary cholesterol is found only in foods derived from animals (meat, fish, poultry, eggs and dairy products); it is not present in plants.

Table. Sources of Dietary Cholesterol

Richest	All offal, egg yolk, fish roes, mayonnaise and shell fish.
Moderate	Fat on meat, duck, goose, cold cuts, whole milks, cream, ice cream, cheese, butter and most commercially made cakes, biscuits and pastries.
Poor	All fish and fish canned in vegetable oil, very lean meats, poultry without skin, skimmed milk, low fat yoghurt and cottage cheese.
Cholesterol	All vegetables, and vegetable oils, fruit (including avocados and olives), nuts, rice, egg white and sugar.

The amount of cholesterol synthesized and metabolized by the body is far greater than the amount usually consumed in the diet. It must also be noted that in healthy people little correlation has been found between the intake of cholesterol and blood cholesterol levels. Yet the level of cholesterol in the blood is increased with high intakes of dietary saturated fat and can be lowered by increasing the intake of linoleic acid and fibre, which leads to a reduction of cholesterol absorption from the intestine and an increased faecal excretion of dietary cholesterol.

There is some evidence indicating that other nutrients can lower blood cholesterol levels. Choline emulsifies cholesterol thus helps to control a build up. Inositol metabolizes fats and cholesterol. Vanadium inhibits the formation of cholesterol in the blood vessels and aids in preventing heart attacks. Zinc also helps to decrease cholesterol levels.

If you are on a cholesterol reducing drug, you will suffer a decrease

in the absorption of Vitamin A, thus needing to increase the amount available in your diet.

The Food and Nutrition Board's Committee on Diet and Health recommend that dietary cholesterol should be less than 300 milligrams per day.

Linoleic Fatty Acid

Linoleic acid is an omega-6, polyunsaturated fatty acid, can not be produced by the body and must be consumed in the diet, it is thus an essential fatty acid. A minimal adult intake of 3 to 6 grams per day is sufficient to prevent both biochemical and clinical evidence of deficiency.

It is important for maintaining the structure and function of cellular and subcellular membranes. Linoleic fatty acid lowers cholesterol levels in the blood and helps in the prevention of heart disease.

A deficiency has been associated with scaly skin, hair loss, and impaired wound healing in hospital patients.

The best natural sources are vegetable oils, wheat germ, sunflower, peanuts, pecans, almonds, avocados and eggs.

Omega 3 Fatty Acids

Emerging research has suggested possible health benefits associated with moderate increases in dietary alpha-linolenic acid, including, reduced blood clotting tendency and reduced blood pressure. Data from the first prospective intervention trial to investigate the effects of dietary fat, fish and fibre, which was conducted in Cardiff, Wales, supported the idea that omega-3 fatty acids have a positive effect on reducing mortality from cardiovascular disease.

The principal sources of the omega-3 fatty acid alpha-linolenic acid are salad and cooking oil, salad dressing, shortening, margarine and products made from canola or soybean oils.

Vitamins

Vitamins are organic substances functioning to facilitate an essential biochemical reaction necessary for growth, vitality and the normal functioning of our bodies. We must obtain them from our diet or take them in the form of dietary supplements, that are usually derived from plant and animal products. Crucial to the definition of a vitamin is that lack of it produces a specific deficiency syndrome, and supplying it cures that deficiency.

It is almost impossible to sustain a healthy way of life by taking only synthetic supplements and not following a good eating plan. Supplements should be taken only with some nutrition knowledge or the guidance of a

nutritionist and dietitian. Many vitamins and minerals can be toxic if taken in excess. Often there are sufficient vitamins in your diet, thus by taking supplements toxicity may occur. Symptoms include hair loss, blurred vision, bone pain, fatigue and headaches.

The best way of obtaining a healthy balance of vitamins is by eating a large variety of different foods. One should try not to limit their diet to a few delicacies. Try out new dishes, be adventurous.

Fat-Soluble Vitamins. The fat-soluble vitamins are vitamins A, D, E, and K. These vitamins are absorbed, transported, metabolized and stored along with fat. The fat soluble vitamins function as regulators for specific metabolic activity.

Water-soluble Vitamins. The water-soluble vitamins include vitamin C, and those of the B-complex group: biotin, folate, niacin, pantothenic acid, riboflavin, thiamin, vitamin B_6, and vitamin B_{12}. They function mainly as *coenzymes*.

Vitamin Supplements

No data have yet been published to demonstrate that healthy people eating a well balanced diet need any vitamin supplements. A well balanced diet means that what one has eaten during the day should include a wide variety of foods from each of the five food groups (fruit, vegetables, bread and grains, meat and milk).

Except in pregnancy, where supplementation of certain vitamins may be recommended, there are no reports of normal persons eating a well balanced diet developing vitamin deficiency diseases. The proper role of vitamin supplementation is in the treatment of deficiency in patients who have inadequate intake, disturbed absorption, or increased requirements because of an increased destruction or excretion.

Mega-dose therapy is the treatment with daily quantities of a vitamin or vitamins substantially above the Recommended Dietary Allowances (RDA) of the Food and Nutrition Board. The RDAs are the levels of intake of essential nutrients considered to be adequate to meet the known nutritional needs of all healthy persons.

Vitamins, like many other substances, may be toxic when taken in large quantities. Large doses of nicotinic acid frequently cause flushing and itching, liver damage, dermatoses, elevations of serum glucose concentration and peptic ulceration may occur. Prolonged excessive intake of vitamin D can cause anorexia, nausea, weakness, weight loss, hypertension, anemia, hypercalcemia, irreversible renal failure, and death. Vitamin E in large doses antagonises the action of vitamin A and also causes headaches, nausea, fatigue, blurred vision, inflammation of the mouth, chapping of the lips, gastrointestinal disturbances, muscle

weakness, low blood sugar, increased bleeding tendency, and degenerative changes.

The comments that vitamin doses in excess of the RDA may produce "optimal" health are pure speculation, unsupported by any facts in human metabolism, and contradicted by the toxicity of vitamin and mineral doses in excess of the RDA. "More is better" is a slogan, not science. More is sometimes better, sometimes worse, but always costlier.

Vitamin A (Retinol, Carotene)

Vitamin A is fat soluble, it is an antioxidant and occurs in two forms - retinol and carotene. The RDA [Food and Nutrition Board, National Academy of Sciences - National Research Council - Recommended Dietaty Allowances.] for adults is 1000 micrograms RE (Retinol Equivalents. 1 RE = 1 microgram retinol or 6 micrograms carotene).

The allowances, expressed as average daily intakes over time, are intended to provide for individual variations among most normal persons as they live in the United States under usual environment stresses. The RDA's given are the higher of adult males or females, for more precise data refer to the RDA tables.

Because vitamin A and carotene exist in more than one chemical form, and because they are not equally active, it is usual to give the name retinol to the pure vitamin A. Thus the total vitamin A activity of a food, its retinol equivalent, is determined by how much it contains of retinol, chemicals very similar to retinol but not as active, and a range of carotenes also of varying activity.

Vitamin A maintains the skin and mucous membranes. Promotes growth, strong bones, healthy skin, hair, teeth and gums. Builds up resistance to respiratory infections and shortens the duration of diseases. It counteracts night blindness and aids in the treatment of many eye disorders. Night blindness is an early symptom of a deficiency of vitamin A.

In a dozen case-control and cohort studies, intakes of fruits and vegetables containing carotenoids has been associated with a reduced risk of lung cancer. In contrast little relationship has been found between intake of preformed vitamin A (retinol) and this disease.

Available data thus strongly support the hypothesis that dietary carotenoids reduce the risk of lung cancer, but the data also are compatible with the possibility that some other factor in these foods is responsible for the lower risk. The recommendation to eat a variety of fruits and vegetables is reasonable, but leaves much to chance; if carotene is the anticancer agent, intake of specific fruits and vegetables should be advised. [Willett, W.C., Vitamin A and lung cancer , Nutrition Reviews, 48:201,

1990]. The best natural sources are green leafy vegetable tops, carrots, red peppers, sweet potatoes, yellow fruits, apricots, fish-liver oil and eggs.

Vitamin A is one of the few vitamins in which excess produces definite and severe effects.

Toxic symptoms can occur with intake exceeding 100 000 IU's daily. Hypervitaminosis A leads to loss of appetite, a dry, itchy skin often with peeling, intense headaches and an enlarged liver. Recovery is fairly rapid when intake is reduced.

Vitamin B_1 (Thiamine)

Vitamin B_1 is water soluble like all the B vitamins. It is easily lost and must be replaced daily. The RDA for adults is 1.5 milligrams.

Thiamine prevents and cures beriberi, a disease of the nervous system. It aids growth, maintains normal carbohydrate metabolism and nervous system functioning. It helps alleviate stress conditions, anxiety and trauma.

The best natural sources are dried yeast, spirulina, whole wheat, oats, peanuts, soybeans, green vegetables and milk.

This vitamin is not toxic, it is easily excreted from the body and not stored. It is destroyed by heat, caffeine, alcohol and cigarette smoke.

Vitamin B_2 (Riboflavin)

Vitamin B_2 is not stored and must be replaced daily. The RDA for adults is 1.7 milligrams.

Essential for normal cell growth, helps to metabolize carbohydrates, fats and proteins. Benefits vision and eye fatigue, promotes healthy skin, nails and hair. Eliminates sores in mouth, on lips and tongue.

The best natural sources are milk, yeast, cheese, sea vegetables, leafy green vegetables, mushrooms, fish and eggs.

There are no known toxic effects. It is destroyed by light, alcohol and sulfur drugs.

Vitamin B_3 (Niacin, Nicotinic Acid)

Niacin is a component of an enzyme *and can be produced by the body, some of the amino acid tryptophane is converted into niacin. The RDA for adults is 19 milligrams.*

It is necessary for a wide variety of body processes, reduces high blood pressure, lowers cholesterol levels and prevents pellagra. Without niacin, thiamine and riboflavin cannot function properly.

The best natural sources are lean meat, whole wheat, tuna, anchovy, yeast, eggs, peanuts and avocados.

Niacin is not toxic but people with peptic ulcers or diabetes should consult a doctor before taking supplements greater than 100 milligrams.

Vitamin B_5 (Pantothenic Acid)

Vitamin B_5 is known in other forms - Calcium Pantothenate and Panthenol. The RDA for adults is 7 milligrams.

It is necessary for the utilization of other nutrients and maintaining normal growth and development of the nervous system, as well as for the metabolism of fat and sugars.

The best natural sources are fish, whole grains, wheat germ, green vegetables and brewers yeast.

There are few known toxic effects, but very large doses have been known to produce lack of co-ordination in movement and impairment of sensation. It is destroyed by heat, caffeine and alcohol.

Vitamin B_6 (Pyridoxine)

B_6 has three metabolic forms pyridoxine, pyridoxal and pyridoxamine. The RDA for adults is 2.0 milligrams.

It is essential in amino acid metabolism, is required for the absorption of B_{12} and for the production of antibodies and red blood cells.

The best natural sources are bananas, brewer's yeast, wheat germ, green and red peppers, nuts, molasses and eggs.

Intake should be increased with diets high in protein. Daily doses of over 500 mg should be avoided. Doses over 2 g can lead to neurological disorders. Food processing techniques, canning and alcohol can deplete vitamin B_6.

Vitamin B_{12} (Cyancobalimin, Cobalamin)

B_{12} contains mineral elements - cobalt. The RDA for adults is 2.0 micrograms.

Cobalamins are necessary for protein and fatty acid metabolism and the production of red blood cells. It maintains a healthy nervous system and improves concentration and memory.

The best natural sources are clams, oysters, beef, eggs and dairy products.

It is not found in many plant products except certain soya products, tempeh and sea vegetables. If you are a strict vegetarian you will need to take B_{12} supplements. Although, people who have diets high in protein need more B_{12}. A deficiency can cause pernicious anemia.

B_{12} is not easily absorbed and needs to be combined with calcium for proper absorption. It is destroyed by sunlight, alcohol and sleeping pills. There have been no reports of B_{12} toxicity.

Vitamin B_{15} (Pangamic Acid, Pangamate, Calcium Pangamate)

Pangamic acid has not had much research done on it in the USA, but

has been approved in Russia and used by athletes to enhance performance. Pangamic acid is a label not a product. The pills contain anything the seller chooses to put in them.

The Food and Drug Administration contend that "B_{15}" is essentially an untested food additive which is not generally recognized by the scientific experts as safe for human consumption. Pangamate was prohibited within Canada for almost two decades. Because of these facts, any physician who prescribes it should first get informed consent from his or her patients after informing them that it is not a vitamin, has no known nutrient value, no known value in the long-term treatment of any disease, that its safety has not been established, and that it may be mutagenic (cancer causing).

The allegations that pangamic acid is an antioxidant, protects against pollutants, increases the life span of cells, relieves symptoms of asthma and lowers blood cholesterol levels, as well as that it stops the craving for alcohol and protects the liver from cirrhosis are anecdotal and testimonial stories rather than studies.

The authors often claim spectacular results from "pangamic acid" without identifying which of the many chemicals and chemical combinations which go by that name they are using. Without distinguishing drug effect from the placebo, and without reporting any evaluation of patients for short-term or long-term toxic effects.

Vitamin B_{17} (Laetrile)

Laetrile is the trademark of a compound of two parts glucose and one part cyanide. There is no vitamin B_{17}, "B_{17}" is a tradename created for laetrile by a laetrile proponent. It is naturally present in the kernels of apricot pits and a number of other stone fruits and nuts. There is no RDA but doses vary from 0.25 g to 1.0 g a day.

It is believed to have cancer controlling and preventative properties. Apparently normal cells can tolerate small quantities of cyanide but cancer cells succumb to it.

Cyanide has no value in sustaining human life. In small amounts it injures, in larger amounts it kills. No law prevents promoters from trade-naming nutritionally worthless or poisonous substances.

Cyanide is rapidly absorbed from the intestine and diffuses throughout the body, knocking out respiration in cells. Eating about 25 apricot kernels can cause headaches, dizziness, nausea, drowsiness, a sharp fall in blood pressure, breathing difficulties, coma and death.

There have been documented cases of people dying after taking as few as five laetrile tablets. Not more than 1.0 gram should be taken at any one time.

Vitamin C (Ascorbic Acid)

Ascorbic acid is water soluble and is easily lost from the body. The RDA for adults is 60 milligrams.

It is important for the growth and repair of body tissue cells, bones, gums and teeth. It fights bacterial infections, protects Vitamin A, some of the B vitamins and vitamin E from oxidation and is necessary for the use of iron and oxygen in the body. People who lack this vitamin may have sore gums and bleeding under the skin.

It helps to reduce blood cholesterol levels, aids in preventing bacterial and viral infections, and prevents and cures scurvy.

The best natural sources are citrus fruits, hot chili peppers, broccoli, tomatoes, green leafy vegetables, and sweet potatoes.

Vitamin C is non toxic but people with peptic ulcers, might hemorrhage and should consult a doctor before taking supplements. It is lost through water, destroyed by cooking, heat, light and smoking.

Vitamin D (Calciferol)

Vitamin D is a fat soluble vitamin and can be produced in the skin with exposure to sunlight. The RDA for adults is 10 micrograms or 400 IU. (as cholecalciferol. 10 micrograms cholecalciferol = 400 IU of vitamin D.]

It regulates calcium and phosphate metabolism. Aids the assimilation of vitamin A and helps the treatment of conjuctivites and rickets.

The best natural sources are sardines, herring and dairy products. It is produced by interaction with sunlight and oils (cholesterol) in the skin.

It can be toxic with doses of over 5000 IU daily. In smog conditions or when activities reduce exposure to sunlight vitamin D intake should be increased.

Vitamin E (Tocopherol)

Vitamin E is the term used for eight naturally occurring, fat-soluble nutrients called tocopherols - alpha, beta, gamma, delta, epsilon, zeta, eta and theta. Alpha-Tocopherol is essential, has the highest biological activity, and predominates in many species. The RDA for adults is 10 IU. (Designated according to its biological activity in International Units (IU). With this vitamin 1 IU = 1 mg Alpha Tocopherol Equivalents).

In human beings, vitamin E is the most important fat-soluble antioxidant. It prevents the potentially harmful oxidation of fat compounds and enhances the functioning of vitamin A. It is an antipollutant for the lungs. It helps the healing of scar tissue when taken internally and also when applied externally.

The best natural sources are wheat germ, whole grains, vegetable oils,

soya beans, nuts, apples, apricots and green vegetables. Vitamin E deficiency may cause anemia, as a result of red blood cell destruction and neurological dysfunction, myopathies, and diminished erythrocyte life span. New clinical evidence from heavy drinkers suggests that alcohol may increase oxidation of Alpha-Tocopherol. Increased demand has also been observed in premature infants and patients with malabsorption.

It is generally non toxic but some evidence suggests that large intakes may cause increased levels of blood cholesterol and lipids. It can oxidize within a few months of being manufactured, so supplements should not be stored for more than a few months. It is destroyed by heat, freezing, food processing, chlorine and iron.

Vitamin K (Menadione)

Vitamin K is a fat soluble vitamin usually formed in the body by *intestinal bacteria* but also available from some plant and animal sources. The RDA for adult males is 80 micrograms.

Its primary function is to control the rate of blood clotting and prevent internal bleeding.

The best natural sources are all leafy green vegetables, cauliflower, brussel sprouts, broccoli, soybean oil, kelp, cereal grain products, fruits and yoghurt.

Vitamin K deficiency has been reported in patients treated with antibiotics and placed on poor diets after surgery. A deficiency can cause bleeding disorders. Doctors sometimes give women vitamin K before childbirth to prevent bleeding in the newborn baby. Babies do not have enough intestinal bacteria to produce adequate amounts of the vitamin until they are about 2 weeks old.

No toxicity symptoms have been recorded from natural forms but supplementation of synthetic vitamin K exceeding 500 mcg is not recommended as it can cause anemia and kernicterus, a condition characterized by jaundice.

Biotin

Biotin is a member of the B complex family and is water soluble. The RDA for adults is 100 micrograms.

It is essential for the metabolism of fats and the synthesis of ascorbic acid. It maintains a healthy skin and helps prevent baldness and hair from turning grey.

The best natural sources are soya beans, brown rice, nuts, fruit, brewer's yeast and milk. It can be synthesized by intestinal bacteria.

It is not toxic. Avidin, a substance found in egg white prevents biotin absorption. Sulfur drugs, food processing and alcohol destroy biotin.

Choline

Choline is a cofactor of the B vitamins. There is no RDA but the average adult diet contains between 500 milligrams to 900 milligrams a day.

Choline exists in combination with phospholipids which make up part of the brain and spinal cord tissue. These compounds are called lecithins. It is essential for growth and is involved in fat transport and in carbohydrate and protein metabolism. It participates in the metabolism of fat and emulsifies cholesterol, helping to control the build up in arteries. It aids in the treatment of Alzheimer's disease and helps to remove drugs and poisons from your system. It is also the precursor of acetylcholine, which is involved in the transmission of nerveimpulses. It is crucial for normal brain functioning and memory. It goes directly into the brain cells and produces a chemical that aids memory.

The best natural sources are soya lecithin, green leafy vegetables, yeast and wheat germ.

There is no known toxicity. It is destroyed by sulfur drugs, food processing and alcohol.

Folic Acid (Folate, Folacin)

Folic acid is a cofactor of the B complex vitamins. The RDA for adults is 200 micrograms.

Folate is essential for cell growth because of its involvement in nucleic acid and protein synthesis, and for the formation of red blood cells and protein metabolism. It protects the body against intestinal parasites and food poisoning. Maintains a healthy skin and helps in the treatment of anemia.

Megaloblastic anemia caused by folate deficiency is a major problem in world health, especially among pregnant women and patients with malabsorption or alcoholism.

The best natural sources are raw leafy vegetables, fruit, carrots, torula yeast, avocados, beans and whole wheat. Consumption of fresh fruit and green leafy vegetables daily will ensure against dietary folate deficiency.

In doses of up to 5 mg a day there has been no sign of toxicity.

It is easily lost in boiling water, sunlight, food processing, heat and by taking sulfur drugs. A heavy drinker also needs to increase folic acid intake.

Inositol

Inositol is a cofactor of the B complex vitamins. There is no RDA but the average adult gets about 1 gram per day in their diet.

It works with choline in the metabolism of fat and cholesterol. It is

essential for the proper conduction of nerve impulses, lowers cholesterol levels, promotes healthy hair and prevents balding.

The best natural sources are lecithin, brewer's yeast, lima beans, peanuts, raisins, wheat germ, cabbage, cantaloupe, grapefruit and molasses.

It is not toxic but is destroyed by sulfur drugs, food processing, alcohol and coffee.

PABA (Para-aminobenzoic Acid)

PABA is another member of the B complex family of vitamins. There is no RDA but about 100 milligrams is usually included in B complex supplements.

It helps in the assimilation of protein and pantothenic acid. It is important for normal skin and hair growth. It can protect you against sunburn, prevent wrinkles, reduce the pain of burns and restore grey hair to its natural colour.

The best natural sources are whole grains, wheat germ, brewer's yeast, rice and molasses.

Non toxic, but high doses over a long period of time may cause nausea and vomiting.

Minerals

Much attention is given to the necessities of vitamins for good health, but the role of minerals is as important. Even if one mineral is lacking the body can not function properly.

Minerals are divided into two groups - macro elements and trace elements. They combine with vitamins, form enzymes and are necessary for almost every physiological process. Minerals are found in a broad range of plant and animal foods, as well as in drinking water.

It is not always apparent what the function of minerals are and year by year new minerals are being included in the list of essentials. Like vitamins the best way to overcome this problem is by including a very wide range of foods in your diet.

Calcium

Calcium is the most abundant mineral in the body. The RDA for adults is 1200 milligrams.

About 99% is found in the bones and teeth. Calcium also has a role to play in the regulation of various body functions including the cardiovascular and nervous systems. It keeps your heart beating regularly, alleviates insomnia and helps to metabolize iron.

The best natural sources are sea vegetables Wakame: 1300, Arame:

1170, Kelp: 1093, (Mg per 100g). low-fat yogurt, skim milk, beans, tofu, sesame seeds, nuts, sardines with bones, salmon and green vegetables.

Calcium absorption is hindered by the presence of oxalate is in the food. Calcium absorbability of kale (a low-oxalate vegetable) was compared with that of milk in 11 normal women. Absorption of calcium was excellent in all subjects. In 9 of the 11 women, kale calcium absorbability was higher than that of milk calcium.

For optimal calcium absorption, a proper amount of vitamin D is needed each day. This can be obtained from fortified milk and cereals, or 15 minutes to an hour of midday sunshine.

It appears there is a threshold of calcium intake, below which skeletal reserves may be used to meet daily calcium needs. Studies show that loss of estro prompts rapid loss of bone mineral, especially from the spine, regardless of calcium intake.

Intakes over 2000 milligrams per day may lead to hypercalcemia, induce constipation, and inhibit the intestinal absorption of iron, zinc, and other essential minerals.

Chromium

It is difficult to estimate the chromium requirement, but a range of 50 micrograms to 200 micrograms per day is tentatively recommended.

Trivalent chromium is required for maintaining normal glucose metabolism. Evidence shows that chromium improves glucose tolerance [Riales, R., & Albrink, M. J., American J. Clin. Nutr., Vol. 34, pg 2670] . Diabetes and coronary heart disease are associated with low chromium concentrations in human tissue.

The chemical forms of chromium in foods are not known with certainty, but the bioavailability of chromium compounds has been found to be high in brewer's yeast, shell fish, whole wheat bread and mushrooms.

An increased incidence of bronchial cancer has been associated with exposure to dusts containing chromate. But the carcinogenicity of certain chromates bears no relevance to the nutritional role of non toxic trivalent chromium.

Copper

Because of the uncertainty of quantitive human requirements, it is not possible to establish an RDA. 1.5 milligrams to 3.0 milligrams per day has been recommended as a safe and adequate range of dietary copper intake for adults.

Copper is an essential nutrient, necessary for extensive body functions. It converts iron to hemoglobin , is essential for the utilization of vitamin C and stops the degeneration of the nervous system. In a study

of 10 men who got less than half the suggested copper intake for 6 weeks, four of them responded with a significant increase in cholesterol. [Journal American Dietetic Association, July 1990. Pg 96. response to low-copper diet ... according to researchers with USDA's Agricultural Research Service]

The best natural sources are shell fish, sea vegetables, nuts, seeds, beans and peas. It is found abundantly in tap water because of contamination from copper pipes.

Toxicity from dietary sources is extremely rare, but supplementation should be avoided as an excess can lower zinc levels, produce insomnia, hair loss and depression.

Iodine

Approximately 1 mcg per kilogram of body weight is required. The RDA for adults is 150 micrograms.

Iodine is an essential component of the thyroid hormones thyroxine and triiodothyronine. It is almost entirely used by the thyroid gland. The thyroid gland controls metabolism, proper growth, helps burn up excess fat and gives you more energy.

Deficiency of dietary iodine may result in decreased synthesis of the iodine-containing thyroid hormones. This can lead to cretinism and mental retardation. Iodine intake consistently lower than 50 mcg per day usually leads to thyroid hypertrophy (ie. endemic goiter). In addition, epidemiological and experimental studies suggest that endemic goiter predisposes to cancer of the thyroid.

The best natural sources are seafoods and sea vegetables (kelp, arame and kombu). Iodized salt is a regular source, providing about 75 mcg per gram.

Individuals who are sensitive to iodine may react to excessive exposure with iododerma, fever, salivary gland enlargement, visual problems and/or other symptoms. Death from severe forms of iododerma has been reported. Acute responses to the ingestion or injection of large doses of an iodine-containing solution include cardiovascular collapse, convulsions, and asthma attacks.

Adverse effects of iodine have also been reported from dietary supplements, including seaweed extracts, vitamin and mineral preparations. Goiter caused by high iodine intakes has been registered in Japan

The response to excess iodine is variable. Some individuals tolerate large intakes without side effects, whereas others may respond adversely to levels close to recommended intakes. Those who are most likely to respond adversely are those living in endemic goiter areas or for other

reasons have habitually had a low intake of iodine, and those who are sensitive to iodine.

The maximum tolerable level of iodine appears to range from 200 mcg per day to 1000 mcg per day. These levels of intake are possible from diets that include milk, iodized salt, seaweed and products containing the red food coloring erythrosine which has high levels of iodine.

Generally, iodine intakes by the majority of the population in the USA is considered safe and adequate.

Iron

Iron is a constituent of hemoglobin. Body iron content is regulated by the amount absorbed. The absorption is influenced by body stores and by the amount and type of iron in ingested foods. The RDA for adults is 15 milligrams.

It is a vital component of many enzymes, it can promote resistance to disease and prevent fatigue. A trend toward reduced risk of melanoma was observed by Stryker et al when iron intake was increased (not including supplements). [Styker, W.S., Stampfer, M.J., Stein, E.A., Kaplan, L., Louis, T.A., Sobre, A., and Willet, W.C.: Diet, plasma levels of beta-carotene and alphatocopherol, and risk of malignant melanoma. American Journal of Epidemiology, Vol. 131:612 1990]

A deficiency can cause anemia, resulting in impaired concentration, reduced physical performance and work capacity, and decrease immune function. Ascorbic acid is necessary for the proper assimilation of iron.

The best natural sources of iron are sea vegetables, clams, cockles, mussels, oysters, yeast, molasses, beans, nuts, seeds and cereals.

Tea, coffee, bran and phytates *decrease iron absorption.*

There are no reported cases of toxicity from foods but iron poisoning may occur from ingesting large amounts of medicinal iron supplements.

Magnesium

Magnesium is known as the antistress mineral. The RDA for adults is 350 milligrams.

Many biochemical and physiological processes require magnesium. It is necessary for vitamin C and calcium metabolism. It keeps teeth healthy, brings relief from indigestion and can aid in fighting depression. More than 300 enzymes are known to be activated by magnesium. It controls cellular metabolism and maintains electrical potentials of nerve and muscle membranes for the transmission of impulses across junctions.

The best natural sources are whole seeds, nuts, legumes, unmilled grains, green vegetables and bananas.

Phytate or fibre may reduce magnesium absorption. Alcohol acts as

a diuretic, causing vast quantities to be lost in the urine. There is no evidence that large dietary intakes of magnesium are harmful to people with normal renal function. In cases of impaired renal function and use of magnesium-containing drugs hypermagnesemia may occur. Symptoms include nausea, vomiting and hypotension. As conditions worsen respiratory depression, coma and asystolic arrest may occur.

Manganese

Because of the lack of manganese deficiency in adults, the current dietary intakes satisfy the needs for this mineral. A provisional daily dietary intake of 5.0 milligrams is recommended.

It is necessary for the use of biotin, B_1 and C, by the body. It can help eliminate fatigue, improve memory, reduce nervous irritability and assure the proper digestion and utilization of food. A deficiency can cause poor reproductive performance, growth retardation, abnormal formation of bone and cartilage, and an impaired glucose tolerance.

The best natural sources are whole grains, cereal products, nuts and green leafy vegetables. Dairy products, meat, fish, and poultry are poor sources.

Toxicity has only been observed with workers exposed to high concentrations of manganese dust or fumes in the air.

Nickel

Nickel is now quite firmly established as an essential nutrient, but no Recommended Dietary Allowance (RDA) or Estimated Safe and Adequate Intake (ESADI) has yet been set for nickel.

Research showed that nickel was to be found in blood and tissues at quite consistent levels, that it is associated with DNA and RNA in amounts that suggest physiological significance, and that it occurs also in blood in amounts which appear biologically meaningful. Nickel is required for normal growth and reproduction in animals, and presumably in human beings as well. It appears to have a role in the modulation of the immune system and in development of the brain. Since brain is depleted in deficiency more than other tissues, the brain and immune system should receive attention in future studies of nickel deficiency.

The best sources of nickel include oatmeal, legumes, nuts, cocoa, whole wheat bread, and some leafy vegetables such as kale and lettuce.

The danger of nickel toxicity from food appears to be very low, since large amounts of nickel are required to produce any toxic effects through ingestion. But in susceptible people, contact with nickel or nickel salts cause skin irritations.

Chronic exposure at lower levels can cause cancer. Workers exposed

to nickel compounds have a higher than normal incidence of cancer of the respiratory tract, particularly of the nasal cavities and lungs. Nickel released from burning tobacco isthought to be responsible for at least part of the carcinogenicity of tobacco smoke. There is no indication of cancer arising from ingestion of the nickel in food.

Phosphorus

The precise requirement for phosphorus is unknown, but a 1 to 1 ratio of calcium to phosphorus will provide sufficient phosphorus for most age groups. The RDA for adults is 1200 milligrams.

Phosphorus is an essential component of bone mineral and is necessary for normal bone and tooth structure. It is involved in almost all physiological chemical reactions. It aids in growth and can lessen the pain of arthritis.

The best natural sources are cereal grains, nuts, seeds, meat, poultry and fish.

Aluminum hydroxide binds phosphorus, making it unavailable for absorption. An excess of iron and magnesium have the same effect. Phosphorus deficiency results in bone loss and is characterized by weakness, anorexia and pain.

Potassium

Potassium is the principal intercellular *cation*. There is no RDA but a minimum requirement of 1600 milligrams per day would be adequate.

Potassium is of great physiological importance, contributing to the transmission of nerve impulses, the control of skeletal muscle contractility, and the maintenance of normal blood pressure. Deficiency symptoms include weakness, anorexia, nausea, drowsiness and irrational behaviour.

Potassium is found in most foods since it is an essential constituent of all living cells. The richest dietary sources are unprocessed beans, nuts, leafy green vegetables and fruit.

Low blood sugar levels (hypoglycemia), alcohol or smoking cause potassium loss.

Acute intoxication (hyperkalemia) can cause cardiac arrest and prove fatal.

Selenium

The RDA is 70 micrograms for male adults, 55 micrograms for females.

Selenium plays a role in pancreatic function, in hepatic heme metabolism, and in the immune response. It has a close metabolic interrelationship with the antioxidant vitamin E. Deficiency only occurs simultaneously with a deficiency of vitamin E and can be cured by

supplementation of either. It can neutralize certain carcinogens so possibly provide protection from some cancers.

The best natural sources of selenium are seafoods, eggs and depending on the selenium content of the soils in which they are grown, grains and seeds.

Sodium

Sodium is the principal cation of extracellular fluid. As the rate of sodium loss can vary under different conditions there is no official RDA, but the minimum daily requirement for healthy adults is 500 milligrams.

Sodium is crucial for regulating the membrane potential of cells and is involved in active transport across cell membranes, it is pumped out in exchange for potassium. It helps the nerves and muscles function properly.

Sodium is found in abundance in most processed foods thus there is very little chance of a deficiency occurring with the average Western Diet. The best natural sources are salt, shellfish, anchovy, lox, spirulina, wakame, cheese and red or green peppers.

The body may be depleted of sodium under extreme conditions of sweating or chronic diarrhea.

Excessive intake of sodium can result in edema and hypertension.

Sulfur

Sulfur is used to treat many kinds of skin disorders. Sulfur cream, lotion, ointment, and bar soap are used to treat acne. Sulfur ointment is used to treat seborrheic dermatitis and scabies. Sulfur may also be used for other conditions as determined by your doctor.

Zinc

The RDA is 15 milligrams per day for men and 12 milligrams per day for women. Recent research suggests that men have a higher need for zinc than do women. Thus, it is appropriate that the RDA is sex-specific for zinc.

Zinc is an essential trace element that must be supplied in the diet of human beings so that growth and health can be maintained. It is necessary for protein synthesis and the metabolism of vitamin A, it helps the healing process of internal and external wounds, decreases cholesterol deposits and promotes mental awareness. A deficiency can cause loss of appetite, growth retardation and immunological abnormalities.

The best natural sources are oysters, nuts, wheatgerm, whole grain products, brewers yeast, meat, eggs, legumes and seeds.

Zinc is more easily absorbed in small amounts than large amounts. Human studies have shown that milk apparently inhibits zinc absorption.

Because cow's milk and milk products are the major sources of calcium and higher levels of calcium have been recommended in women to protect against bone loss, this could be a matter for concern.

Its bioavailability is reduced by protein or fibre. Smoking and alcohol also decreases the absorption of zinc. Ingestion of zinc supplements exceeding 15 mg per day is not recommended. Toxicity can cause gastrointestinal irritation and vomiting.

Dietary Fibre

Dietary fibre, sometimes called "roughage", is the indigestible portion of plant foods that pushes food through the digestive system, absorbing water and easing defecation. It was discovered in 1949.

Chemically, dietary fibre consists of non-starch polysaccharides such as cellulose and many other plant components such as dextrins, inulin, lignin, waxes, chitins, pectins, beta-glucans and oligosaccharides. The term "fibre" is somewhat of a misnomer, since many types of so-called dietary fibre are not fibers at all.

Dietary fibre can be soluble (able to dissolve in water) or insoluble (not able to dissolve in water). Soluble fibre, like all fibre, cannot be digested.

But it does change as it passes through the digestive tract, being transformed (fermentated) by bacteria there. Soluble fibre also absorbs water to become a gelatinous substance that passes through the body Insoluble fibre, however, passes through the body largely unchanged

Food sources of dietary fibre are often divided according to whether they provide (predominantly) soluble or insoluble fibre. To be precise, both types of fibre are present in all plant foods, with varying degrees of each according to a plant's characteristics.

Potential advantages of consuming fibre are the production of health-promoting compounds during the fermentation of soluble fibre, and insoluble fiber's ability (via its passive water-attracting properties) to increase bulk, soften stool and shorten transit time through the intestinal tract.

Sources of Fibre

Dietary fibre is found in plants. While all plants contain some fibre, plants with high fibre concentrations are generally the most practical source.

Fibre-rich plants can ue eaten directly. Or, alternatively, they can be used to make supplements and fibre-rich processed foods, such as those made by the All Bran, Fibre One and Quaker Oats companies. For example,

Fibre One's granola-bar like "chewy bars" contain 9 grams of dietary fibre and have chickory root, a fibre-rich plant, as their main ingredient.

Plant Sources of Fibre

Some plants contain significant amounts of soluble and insoluble fibre. For example plums (or prunes) have a thick skin covering a juicy pulp. The plum's skin is an example of an insoluble fibre source, whereas soluble fibre sources are inside the pulp. Soluble fibre is found in varying quantities in all plant foods, including:

- Legumes (peas, soybeans, and other beans)
- Oats, rye, chia, and barley
- Some fruits and fruit juices (including prune juice, plums, berries, bananas, and the insides of apples and pears)
- Certain vegetables such as broccoli, carrots and Jerusalem artichokes
- Root vegetables such as potatoes, sweet potatoes, and onions (skins of these vegetables are sources of insoluble fibre)
- Psyllium seed husk (a mucilage soluble fibre).

Sources of insoluble fibre include:

- Whole grain foods
- Wheat and corn bran
- Nuts and seeds
- Potato skins
- Flax seed
- Lignans
- Vegetables such as green beans, cauliflower, zucchini (courgette), and celery, nopal
- The skins of some fruits, including tomatoes

The five most fibre-rich plant foods, according to the Micronutrient Centre of the Linus Pauling Institute, are legumes (15-19 grams of fibre per US cup serving, including several types of beans, lentils and peas), wheat bran (17 grams per cup), prunes (12 grams), Asian pear (10 grams each, 3.6% by weight), and quinoa (9 grams)

Remarkable among plant foods, the Amazonian palmberry, açaí (*Euterpe oleracea* Mart.), has been analyzed by two research groups reporting its content of dietary fibre is 25-44% of total mass in *freeze-dried powder.*

Rubus fruits such as raspberry (8 grams of fibre per serving) and blackberry (7.4 grams of fibre per serving) are exceptional sources of fibre.

Fibre Supplements

These are a few example forms of fibre that have been sold as

supplements or food additives. These may be marketed to consumers for nutritional purposes, treatment of various gastrointestinal disorders, and for such possible health benefits as lowering cholesterol levels, reducing risk of colon cancer, and losing weight.

Soluble fibre supplements may be beneficial for alleviating symptoms of irritable bowel syndrome, such as diarrhea and/or constipation and abdominal discomfort. Prebiotic soluble fibre products, like those containing inulin or oligosaccharides, may contribute to relief from inflammatory bowel disease,[12] as in Crohn's disease, ulcerative colitis and *Clostridium difficile*, due in part to the short-chain fatty acids produced with subsequent anti-inflammatory actions upon the bowel. Fibre supplements may be effective in an overall dietary plan for managing irritable bowel syndrome by modification of food choices.

Psyllium Husk

Psyllium seed husk may reduce the risk of heart disease by lowering cholesterol levels, and is known to help alleviate the symptoms of irritable bowel syndrome, though it often causes uncomfortable bloating. Psyllium husk may be used as a bulk-forming laxative.

In clinical studies approved by the FDA, the cholesterol-lowering benefit of soluble fibre from psyllium, when taken as directed and combined with a low-fat, low-cholesterol diet, was 4 to 6 percent for total blood cholesterol and 4 to 8 percent for LDL (bad) cholesterol vs. a low-fat diet alone.

Inulins

Chemically defined as oligosaccharides occurring naturally in most plants, inulins have nutritional value as carbohydrates, or more specifically as fructans, a polymer of the natural plant sugar, fructose. Inulin is typically extracted by manufacturers from enriched plant sources such as chicory roots or Jerusalem artichokes for use in prepared foods. Subtly sweet, it can be used to replace sugar, fat, and flour, is often used to improve the flow and mixing qualities of powdered nutritional supplements, and has significant potential health value as a prebiotic fermentable fibre.

Inulin is advantageous because it contains 25-30% the food energy of sugar or other carbohydrates and 10-15% the food energy of fat. As a prebiotic fermentable fibre, its metabolism by gut flora yields short-chain fatty acids (discussed above) which increase absorption of calcium, magnesium, and iron, resulting from upregulation of mineral-transporting genes and their membrane transport proteins within the colon wall. Among other potential beneficial effects noted above, inulin promotes an

increase in the mass and health of intestinal *Lactobacillus* and *Bifidobacterium* populations.

Vegetable Gums

Vegetable gum fibre supplements are relatively new to the market. Often sold as a powder, vegetable gum fibers dissolve easily with no aftertaste. They are effective for the treatment of irritable bowel syndrome (Parisi, 2002).[*verification needed*] Examples of vegetable gum fibers are guar gum (example brand Benefiber reformulated to wheat dextrin in 2006) and acacia gum.

Fibre Intake

Current recommendations from the United States National Academy of Sciences, Institute of Medicine, suggest that adults should consume 20-35 grams of dietary fibre per day, but the average American's daily intake of dietary fibre is only 12-18 grams.

The American Dietetic Association (ADA) recommends a minimum of 20-35 g/day for a healthy adult depending on calorie intake (e.g., a 2000 cal/8400 kJ diet should include 25 g of fibre per day). The ADA's recommendation for children is that intake should equal age in years plus 5 g/day (e.g., a 4 year old should consume 9 g/day). No guidelines have yet been established for the elderly or very ill. Patients with current constipation, vomiting, and abdominal pain should see a physician. Certain bulking agents are not commonly recommended with the prescription of opioids because the slow transit time mixed with larger stools may lead to severe constipation, pain, or obstruction.

The British Nutrition Foundation has recommended a minimum fibre intake of 12-24 g/day for healthy adults

Water

About 70% of the non-fat mass of the human body is made of water. To function properly, the body requires between one and seven liters of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factorsWith physical exertion and heat exposure, water loss will increase and daily fluid needs may increase as well.

It is not clear how much water intake is needed by healthy people, although some experts assert that 8–10 glasses of water (approximately 2 liters) daily is the minimum to maintain proper hydration. The notion that a person should consume eight glasses of water per day cannot be traced back to a scientific source. The effect of water intake on weight loss and on constipation is also still unclear Original recommendation for

water intake in 1945 by the Food and Nutrition Board of the National Research Council read: "An ordinary standard for diverse persons is 1 milliliter for each calorie of food. Most of this quantity is contained in prepared foods."[10] The latest dietary reference intake report by the United States National Research Council in general recommended (including food sources): 2.7 liters of water total for women and 3.7 liters for men. Specifically, pregnant and breastfeeding women need additional fluids to stay hydrated. According to the Institute of Medicine—who recommend that, on average, women consume 2.2 litres and men 3.0 litres—this is recommended to be 2.4 litres (approx. 9 cups) for pregnant women and 3 litres (approx. 12.5 cups) for breastfeeding women since an especially large amount of fluid is lost during nursing.

For those who have healthy kidneys, it is rather difficult to drink too much waterbut (especially in warm humid weather and while exercising) it is dangerous to drink too little. People can drink far more water than necessary while exercising, however, putting them at risk of water intoxication, which can be fatal. In particular large amounts of de-ionized water are dangerous.

Normally, about 20 percent of water intake comes in food, while the rest comes from drinking water and assorted beverages (caffeinated included). Water is excreted from the body in multiple forms; including urine and feces, sweating, and by water vapour in the exhaled breath.

Energy

For every physical activity, the body requires energy and the amount depends on the duration and type of activity. Energy is measured in Calories and is obtained from the body stores or the food we eat. Glycogen is the main source of fuel used by the muscles to enable you to undertake both aerobic and anaerobic exercise. If you train with low glycogen stores, you will feel constantly tired, training performance will be lower and you will be more prone to injury and illness.

A calorie (cal) is the amount of heat energy required to raise the temperature of 1g of water 1°C from 14° to 15°C. A kilocalorie (kcal) is the amount of heat required to raise the temperature of 1000g of water 1°C.

Daily Energy Requirements

Personal energy requirement = basic energy requirements + extra energy requirements

Basic energy requirements (BER) includes your basal metabolic rate (BMR) and general daily activities

- For every Kg of body weight 1.3 Calories is required every hour.

(An athlete weighing 50Kg would require 1.3 × 24hrs × 50Kg = 1560 Calories/day)

- For a calculation of your BMR, see the calculator on the Resting Daily Energy Expenditure (RDEE) page

Extra energy requirements (EER)

- For each hours training you require an additional 8.5 Calories for each Kg of body weight. (For a two hour training session our 50Kg athlete would require 8.5 × 2hrs × 50Kg = 850 Calories)

An athlete weighing 50Kg who trains for two hours would require an intake of approximately 2410 Calories (BER + EER = 1560 + 850)

Energy Fuel

Like fuel for a car, the energy we need has to be blended. The blend that we require is as follows:

- 57% Carbohydrates (sugar, sweets, bread, cakes)
- 30% Fats (dairy products, oil)
- 13% Protein (eggs, milk, meat, poultry, fish)

The energy yield per gram is as follows: Carbohydrate - 4 Calories, Fats - 9 Calories and Protein - 4 Calories.

What does a 50 kg athlete require in terms of carbohydrates, fats and protein?

- Carbohydrates - 57% of 2410 = 1374 Calories - at 4 Calories/gram = 1374 ÷ 4 = 343 grams
- Fats - 30% of 2410 = 723 Calories - at 9 Calories/gram = 723 ÷ 9 = 80 grams
- Protein - 13% of 2410 = 313 Calories - at 4 Calories/gram = 313 ÷ 4 = 78 grams

Our 50kg athlete requires 343 grams of Carbohydrates, 80 grams of Fat and 78 grams of Protein

Eating and Competition

What you eat on a day-to-day basis is extremely important for training. Your diet will affect how fast and how well you progress, and how soon you reach competitive standard. The page on Nutritional Tips provides some general nutritional advice to help you manage your weight and body fat. Once you are ready to compete, you will have a new concern: your competition diet. Is it important? What should you eat before your competition? When is the best time to eat? How much should you eat? Should you be eating during the event? In addition, what can you eat between heats or matches? A lot of research has been done in this area, and it is clear that certain dietary approaches can enhance competition performance.

Sources and Requirement of nutrients

Nutrients	Requirements Children 1200-2100 kcal	Adults 1900-3900 kcal	Sources
Carbohydrate	40-60g/100g of calories	50-70 g/100g of calories	Glucose (its basic form) and sweets, biscuits, chocolates, pastries, honey, fruits, cereals, grains, pulses, bread, beans, potatoes, other vegetables and
Protein	20-33g	45-55g	Legumes, grains, nuts and seeds; dark leafy greens; eggs; dairy products
Fat	15g	15g	Vegetable oils like soya bean, mustard, sunflower, ground nut, olive etc and corn, peanuts, seeds, olive, oily fish etc
		Vitamins	
Vitamin A			
Vitamin A	300-600µg	750µg	Fish liver oils, liver of
Carotine	1200-2400µg	3000µg	animals, diary products like butter, ghee, milk and eggs, green leafy vegetables, red palm oil, carrot, pumpkin and ripe mango
Vitamin D	400 I.U	200 I.U	Fiosh liver oils (of cod, halibut, shark), fat fish (sardine, salmon, Herring), egg yolk and dairy products (butter, ghee, milk).
Vitamin E	10-20mg	20-25mg	Wheat germ oil, corn germ oil, vegetable oils (Soy bean, cottonseed, sunflower, ground nut, mustard, coconut etc) cereals and eggs.
Vitamin K	Not known	Not known	Green leafy vegetables (spinach, cabbage, kale), vegetables (cauliflower, soybean, carrots, potatoes), wheat bran, wheat germ etc
Vitamin B			
Thiamine	03-1.1mg	1.2-2mg	Mried yeast, rice polishings,

Riboflavin	0.5-1.2mg	1.3-2.2mg	wheat germ, whole cereals,
Nicotinic Acid	12-17mg	19-26mg	liver, fruits, vegetables, milk,
Vitamin B6	0.8-1.4mg	2.0mg	peanut, meat, fish, eggs,
Vitamin B12	0.5-1.0µg	1µg	legumes (pulses) and dhals, leafy vegetables.
Vitamin C	25mg	40mg	Citrus fruits and green leafy vegetables (drumstick leaves, coriander leaves, cabbage), Gooseberry, Guava, Pineapple, Cashew fruit, ripe mango, papaya and tomato.
Vitamin P	Not known	Not known	Fresh fruits (orange, apple, blackberry, cherry, plum) and vegetables (spinach, tomato, lettuce, cabbage, carrot, cauliflower, pea etc.).
		Minerals	
Calcium	400mg	600mg	Dairy products; dark, leafy greens, legumes; most nuts and seeds; molesses; figs, apricots; dates
Iron	20-28mg	28-30mg	Legumes (especially soybeans and soy products other than oil); dark, leafy greens; dried fruits; whole and enriched grains; molasses
Zinc	10-15mg	15mg	Eggs, cheese, legumes, nuts, wheat germ, whole grains, some kinds of brewer's yeast
Sodium	5-10g	10-15g	Salt

Chapter 3

Function of Food

Body Composition, the Functions of Food, Metabolism and Energy

The phrase "we are what we eat" is frequently used to signify that the composition of our bodies is dependent in large measure on what we have consumed.

The many chemical elements in the human body occur mainly in the form of water, protein, fats, mineral salts and carbohydrates, in the percentages shown in Table 8. Each human body is built up from food containing these five constituents, and vitamins as well.

Food serves mainly for growth, energy and body repair, maintenance and protection. Food also provides enjoyment and stimulation, since eating and drinking are among the pleasures of life everywhere. Truly food nourishes both the body and soul. Even if technology could produce a perfect diet in terms of content, such a diet could still lack, for example, the aroma and flavour of a curry, or the stimulating taste of hot coffee.

What controls appetite or the feeling of hunger is not fully understood. The hypothalamus in the brain has a role, as do other central nervous system sites. Other probable factors include blood sugar levels, body hormones, body fat, many diseases, emotions and of course food type and availability, personal likes and dislikes and the social setting where food is to be consumed.

Dietary Constituents and the Functions of Food

Human beings eat food, and not individual nutrients. Most foods, including staples such as rice, maize and wheat, provide mainly carbohydrate for energy but also significant quantities of protein, a little fat or oil and useful micronutrients. Thus cereal grains provide some of the constituents needed for energy, growth and body repair and maintenance. Breastmilk provides all the macro- and micronutrients necessary to satisfy the total needs of a young infant up to six months of age including those for energy, growth and body repair and maintenance. Cows' milk has the balance of nutrients for all the requirements of a calf.

Water

Water can be considered the most important dietary constituent. A normal man or woman can live without food for 20 to 40 days, but without water humans die in four to seven days. Over 60 per cent of human body weight is made up of water, of which approximately 61 per cent is intracellular and the rest extracellular. Water intake, except under exceptional circumstances (e.g. intravenous feeding), comes from the food and fluids consumed. The amount consumed varies widely in individuals and may be influenced by climate, culture and other factors. Often as much as 1 litre is consumed in solid food, and 1 to 3 litres as fluids drunk. Water is also formed in the body as a result of oxidation of macronutrients, but the water thus obtained usually constitutes less than 10 per cent of total water.

Water is excreted mainly by the kidneys as urine. The kidneys regulate the output of urine and maintain a balance; if smaller amounts of fluid are consumed, the kidneys excrete less water, and the urine is more concentrated. While most water is eliminated by the kidneys, in hot climates as much or more can be lost from the skin (through perspiration) and the lungs. Much smaller quantities are lost from the gut in the faeces (except in the presence of diarrhoea, when losses may be high).

Table. Chemical Composition of a Human Body Weighing 65 kg

Component	Percentage of body weight
Water	61.6
Protein	17
Fats	13.8
Minerals	6.1
Carbohydrate	1.5

Table. Simple classification of dietary constituents

Constituent	Use
Water	To provide body fluid and to help regulate body temperature
Carbohydrates	As fuel for energy for body heat and work
Fats	As fuel for energy and essential fatty acids
Proteins	For growth and repair
Minerals	For developing body tissues and for metabolic processes and protecfion
Vitamins	For metabolic processes and protection
Indigestible and unabsorbable particles, including fibre	To form a vehicle for other nutrients, add bulk to the diet, provide a habitat for bacterial flora and assist proper elimination of refuse

Metabolism of sodium and potassium, which are known as electrolytes, is linked with body water. The sodium is mainly in the extracellular water and the potassium in the intracellular water. Most diets contain adequate amounts of both these minerals. In fluid loss caused, for example, by diarrhoea or haemorrhage, the balance of electrolytes in the blood may become disturbed. Water intake and electrolyte balance are particularly important in sick infants. In healthy infants, breastmilk alone from a healthy mother provides adequate quantities of fluids and electrolytes without additional water for the first six months of life even in hot climates. Infants with diarrhoea and disease, however, may require additional fluids.

While food intake is largely regulated by appetite and food availability, fluid intake is influenced by the sensation termed thirst. Thirst may arise for various reasons. In dehydration it may be caused by drying of the mouth but also by signals from the same satiety centre in the hypothalamus that controls hunger sensations. Dehydration, an important feature of diarrhoea.

The phenomenon of water accumulation in the body is manifested in the condition known as oedema, when disease causes an excess of extracellular fluid. Two important deficiency diseases in which generalized oedema is a feature are kwashiorkor and wet beriberi. The excess fluid may result from electrolyte disturbances and accumulation of water in the extracellular compartment. A person can have oedema and still be dehydrated from diarrhoea; this condition is a form of heart failure. Water can also collect in the peritoneal cavity, in the condition known as ascites, which may be caused by liver disease.

Body Composition

The human body is sometimes said to be divided into three compartments, accounting for the following shares of the total body weight of a well-nourished healthy adult male:

- Body cell mass, 55 per cent.
- Extracellular supporting tissue, 30 per cent.
- Body fat, 15 per cent.

The body cell mass is made up of cellular components such as muscle, body organs (viscera, liver, brain, etc.) and blood. It comprises the parts of the body that are involved in body metabolism, body functioning, body work and so on.

The extracellular supporting tissue consists of two parts: the extracellular fluid (for example, the blood plasma supporting the blood cells) and the skeleton and other supporting structures.

Body fat is nearly all present beneath the skin (subcutaneous fat) and

around body organs such as the intestine and heart. It serves in part as an energy reserve. Small quantities are present in the walls of body cells or in nerves.

Physiologists and those interested in metabolism have developed various ways to estimate body composition, including the amount of fluids in the body and body density. A common determination is to estimate lean body mass (LBM) or the fat-free mass of the body. These measures vary from the very simple to the very difficult. The simpler ones are of course less precise. Anthropometry using weight, height, skinfold thickness and body circumferences is relatively easy and very cheap to undertake, and does provide some estimate of LBM and body composition. In contrast, methods using, for example, bioelectrical impedance, computerized axial tomography (CAT scans) and nuclear magnetic resonance require expensive apparatus and highly trained staff.

The fluid in the cells (intracellular fluid) has mainly potassium ions, and the extracellular fluid is mainly a solution of sodium chloride. Both also have other ions. Total body water can be estimated using different methods including dilution techniques to measure, for example, plasma volume.

Body fat is estimated using different methods. Because a large portion of adipose tissue is present beneath the skin, it can be estimated by using a skinfold calliper to measure skinfold thickness in different sites. Another method is to weigh the person both in air and under water using a special apparatus and tank. This method really provides an estimate of body density.

The various methods of determining body composition are described in detail in textbooks of physiology or nutrition.

Body composition is much influenced by nutrition. The two extremes are the wasting of nutritional marasmus and starvation and the overweight of obesity. Body composition differs between the genders and, perhaps only slightly, among races. African Americans have been shown to have heavier skeletons than whites of the same body build in the United States. In females pregnancy and lactation influence body composition.

The body composition of children is influenced by their age and growth. Disturbances of growth resulting from nutritional deficiencies influence body composition, including the eventual size of the body and of body organs.

Metabolism and Energy

The general term for all the chemical processes carried out by the cells of the body is "metabolism". Chief among these processes is the oxidation (combustion, or burning) of food which produces energy. This

process is analogous to a car engine burning petrol to produce the energy that makes it run. In most forms of combustion, be it in the car or in the human, heat is produced as well as energy.

Classical physics taught that energy can be neither created nor destroyed. Although this law of nature is not completely correct (as the conversion of matter to energy in a nuclear reactor shows), it is still true in most instances. All three macronutrients in food - carbohydrate, protein and fat provide energy. Energy for the body comes mainly from food, and in the absence of food it can be produced only by the breakdown of body tissues.

All forms of energy can be converted into heat energy. It is possible to measure the heat produced by burning a litre of petrol, for example. Food energy can also be and is expressed as heat energy. The unit of measurement used has been the large calorie (Cal) or kilocalorie (kcal) (which is 1 000 times the small calorie used in physics), but this measure is increasingly being replaced by the joule (J) or kilojoule (kJ). The kilocalorie is defined as the heat necessary to raise the temperature of 1 litre of water from 14.5° to 15.5°C. Whereas the kilocalorie is a unit of heat, the joule is truly a unit of energy. The joule is defined as the amount of energy used when 1 kg is moved 1 m by 1 newton (N) of force. In nutrition the kilojoule (1000 J) is used. The equivalent of 1 kcal is 4.184 kJ. These are units of measurement in the same way that litres and pints are measures of quantity, and metres and feet are measures of length. In many scientific journals the joule is being introduced in place of the kilocalorie, but the general public and most health workers still prefer to express food energy in kilocalories rather than joules..

The human body requires energy for all bodily functions, including work, the maintenance of body temperature and the continuous action of the heart and lungs In children energy is essential for growth Energy is also needed for breakdown, repair and building of tissues. These arc metabolic processes. The rate at which these functions are carried out while the body is at rest is the Basal metabolic rate (BMR).

Basal Metabolic Rate

BMR for an individual person is usually defined as the amount of energy [expressed in kilocalories or megajoules (MJ, per day] expended when the person is al complete rest, both physical (i.e. lying down) and psychological. It can also be expressed as kilocalories per hour or per kilogram of weight. BMR provides the energy required by the body for maintenance of body temperature; for the work of body organs such as the beating heart and the muscles working for normal, at rest, breathing; and for the functioning of other organs such as the liver, kidneys and brain.

BMR varies from individual to individual. Important general factors influencing BMR are the person's weight, gender, age and state of health. BMR is also influenced by the person's body composition, for example the amounts of muscle and adipose tissue and therefore the amounts of protein and fat in the body.

In broad terms, bigger people with more muscle and larger body organs have higher BMR than smaller people.

Elderly people tend to have lower BMR than they had when they were young, and females tend to have lower BMR than males even on a per kilogram body weight basis. There are exceptions, however, to all these generalizations.

BMR is important as a component of energy requirements. Table 10 shows BMR of adult men and women according to height and weight, both per kilogram body weight and as total energy per day.

The table shows, for example, that in females aged 30 to 60 years BMR ranges from 1 190 to 1 420 kcal per day.

This is the amount of energy required by a woman at complete rest for 24 hours. Of course many adult females in developing countries are smaller than 1.4 m in height and 41 kg in weight; their BMR might then be a little lower than 1 190 kcal per day.

Energy Requirements

The mean daily energy requirements of adult men and women doing work classified as light, moderate and heavy are given in table, expressed as multiples of BMR.

The table shows, for example, that a woman doing heavy work requires energy equal to 1.32 times her BMR. If the woman is aged 25 years, is 1.4 m tall and weighs 41 kg, according to Table her BMR would be 1100 kcal per day. Thus her daily requirements are: 1 100 kcal × 1.32 = 2 002 kcal.

It is often useful to estimate energy needs for various activities that a person may do for particular lengths of time.

The energy expenditure is usually calculated by multiplying an activity factor or metabolic constant, which varies according to the activity, by the individual's BMR.

Table gives the activity factors for calculating gross energy expenditure of various activities for adult males and females.

The average human burns energy at his or her BMR only when at complete rest. All ordinary movements require additional energy, and physical work, of course, requires more still. For a healthy male with BMR of 1 kcal/min, an average day may involve the energy expenditure shown in Table.

Table. Average Daily Energy Requirements of Adults by Category of Occupational Work Expressed as a Multiple of BMR

Classification of work	Men	Women
Light	1.55	1.56
Moderate	1.78	1.64
Heavy	2.10	1.82

Table. Activity factors for calculating gross energy expenditure (multiply by BMR)

Activity	Adult males	Adult females
Sleeping	1.0	1.0
Lying	1.2	1.2
Sitting quietly	1.2	1.2
Standing quietly	1.5	1.5
Walking slowly	2.8	2.8
Walking at normal pace	3.2	3.3
Walking fast uphill	7.5	6.6
Cooking	1.8	1.8
Office work (moving around)	1.6	1.7
Driving lorry	1.4	1.4
Labouring	5.2	4.4
Cutting sugar cane	6.5	-
Pulling loaded cart	5.9	-
Playing soccer	6.6	6.3
Fetching water from well	-	4.1
Pounding grain	-	4.6

Note: These values apply only as approximate mean values for the time actually spent on the activity. They do not allow for rests. In heavy work individuals usually take frequent pauses or rests.

If the person in this example did instead of eight hours of light work - five hours of herding and three hours of heavy work, hoeing hard ground at 8 kcal/min, then his output of energy would be as shown in Table.

If the individual undertaking the activities in the first example gets exactly 2 640 kcal in his food, his weight will be steady, and he will be functioning normally.

However, if he then undertakes the activities in the second example and eats no extra food, his weight will gradually drop, because he will have to burn up his fuel reserve, which forms part of his own body. He would fairly soon, however, begin to limit his activities in order to stop this process.

He would therefore probably work much less hard at hoeing, so that instead of burning 8 kcal/min he might use only, say, 3.2 kcal/min; he

would also tend to be tired at the end of the day, and might well increase his period of complete rest (at 1 kcal/min) by reducing the period of minor activities. He would therefore have reduced his energy requirements to 2 646 kcal, as shown in Table 15.

This is just an example. In most in stances, when people increase their output of energy, including work, they feel more hungry and increase their consumption of their staple food, be it rice, millet, maize wheat, cassava or anything else.

The energy requirements of a human being are affected by several factors. The important ones are:

- *Body size: A* small person needs less energy than a large person.
- *Basal metabolic rate:* BMR varies and can be affected by factors such as disease of the thyroid gland.
- *Activity:* The more physical work or recreation performed, the more energy is required.
- *Pregnancy:* A woman requires extra energy to develop the foetus and to carry its additional weight.
- *Lactation:* The lactating mother needs additional energy to produce energy-containing milk for the suckling baby. The relatively long duration of breastfeeding among most Asians and Africans results in a large proportion of women requiring extra energy.
- *Age:* Infants and children need more energy, for growth and activity, than adults. In older persons, the need for energy is sometimes reduced because there is a decline in activity and because their BMR is usually lower.
- *Climate:* In warm climates, i.e. in most of the tropics and subtropics, less energy is necessary to keep the body at its normal temperature than in cold climates.

Macronutrients: Carbohydrates, Fats and Proteins

Carbohydrates

The main source of energy for most Asians, Africans and Latin Americans is carbohydrates in the food they eat. Carbohydrates constitute by far the greatest portion of their diet, as much as 80 per cent in some cases. In contrast, carbohydrates make up only 45 to 50 per cent of the diet of many people in industrialized countries.

Carbohydrates are compounds containing carbon, hydrogen and oxygen in the proportions 6:12:6.

They are burned during metabolism to produce energy, liberating carbon dioxide (CO_2) and water (H_2O). The carbohydrates in the human

diet are mainly in the form of starches and various sugars. Carbohydrates can be divided into three groups:

- Monosaccharides, e.g. glucose, fructose, galactose;
- Disaccharides, e.g. sucrose, lactose, maltose;
- Polysaccharides, e.g. starch, glycogen (animal starch), cellulose.

Monosaccharides

The simplest carbohydrates are the monosaccharides, or simple sugars. These sugars can pass through the wall of the alimentary tract without being changed by the digestive enzymes. The three most common are glucose, fructose and galactose.

Glucose, sometimes also called dextrose, is present in fruit, sweet potatoes, onions and other plant substances. It is the substance into which many other carbohydrates, such as the disaccharides and starches, are converted by the digestive enzymes. Glucose is oxidized to produce energy, heat and carbon dioxide, which is exhaled in breathing.

Because glucose is the sugar in blood, it is most often used as an energy-producing substance for persons fed intravenously. Glucose dissolved in sterile water, usually in concentrations of 5 or 10 per cent, is frequently used for this purpose.

Fructose is present in honey and some fruit juices. Galactose is a monosaccharide that is formed, along with glucose, when the milk sugar lactose is broken down by the digestive enzymes.

Disaccharides

The disaccharides, composed of simple sugars, need to be converted by the body into monosaccharides before they can be absorbed from the alimentary tract.

Examples of disaccharides are sucrose, lactose and maltose. Sucrose is the scientific name for table sugar (the kind that is used, for example, to sweeten tea).

It is most commonly produced from sugar cane but is also produced from beets. Sucrose is also present in carrots and pineapple. Lactose is the disaccharide present in human and animal milk. It is much less sweet than sucrose. Maltose is found in germinating seeds.

Polysaccharides

The polysaccharides are chemically the most complicated carbohydrates. They tend to be insoluble in water, and only some can be used by human beings to produce energy. Examples of polysaccharides are starch, glycogen and cellulose.

Starch is an important source of energy for humans. It occurs in cereal

grains as well as in root foods such as potatoes and cassava. Starch is liberated during cooking when the starch granules rupture because of heating.

Glycogen is made in the human body and is sometimes known as animal starch. It is formed from monosaccharides produced by the digestion of dietary starch. Starch from rice or cassava is broken down in the intestines to form monosaccharide molecules, which pass into the bloodstream. Those surplus monosaccharides that are not used to produce energy (and carbon dioxide and water) are fused together to form a new polysaccharide, glycogen. Glycogen is usually present in muscle and in the liver, but not in large amounts.

Any of the digestible carbohydrates when consumed in excess of body needs are converted by the body into fat which is laid down as adipose tissue beneath the skin and at other sites in the body.

Cellulose, hemicellulose, lignin, pectin and gums are sometimes called unavailable carbohydrates because humans cannot digest them. Cellulose and hemicellulose are plant polymers that are the main components of cell walls.

They are fibrous substances. Cellulose, which is a polymer of glucose, is one of the fibres of green plants. Hemicellulose is a polymer of other sugars, usually hexose and pentose. Lignin is the main component of wood.

Pectins are present in plant tissue and sap and are colloidal polysaccharides. Gums are also viscous carbohydrates extracted from plants. Pectins and gums are both used by the food industry. The human alimentary tract cannot break down these carbohydrates or utilize them to produce energy. Some animals, such as cattle, have microorganisms in their intestines that break down cellulose and make it available as an energy-producing food. In humans, any of the unavailable carbohydrates present in food pass through the intestinal tract. They form much of the bulk and roughage evacuated in human faeces, and are often termed "dietary fibre".

There is increasing interest in fibre in diets, because high-fibre diets are now considered healthful. A clear advantage of a high-fibre diet is a lower incidence of constipation than among people who consume a low-fibre diet. The bulk in high-fibre diets may contribute a feeling of fullness or satiety which may lead to less consumption of energy, and this may help reduce the likelihood of obesity. A high-fibre diet results in more rapid transit of food through the intestinal tract and is thus believed to assist normal and healthy intestinal and bowel functioning. Dietary fibre has also been found to bind bile in the intestines.

It is now recognized that the high fibre content of most traditional

diets may be an important factor in the prevention of certain diseases which appear to be much more prevalent in people consuming the low-fibre diets common in industrialized countries. Because it facilitates the rapid passage of materials through the intestine, fibre may be a factor in the control of diverticulitis, appendicitis, haemorrhoids and also possibly arteriosclerosis, which leads to coronary heart disease and some cancers.

Frequent consumption of any sticky fermentable carbohydrates, either starch or sugar, can contribute to dental caries, particularly when coupled with poor oral hygiene. Adequate intake of fluoride and/or a topical application is the best protection against caries .

Fats

In many developing countries dietary fats make up a smaller part of total energy intake (often only 8 or 10 per cent) than carbohydrates. In most industrialized countries the proportion of fat intake is much higher. In the United States, for example, an average of 36 per cent of total energy is derived from fat.

Fats, like carbohydrates, contain carbon, hydrogen and oxygen. They are insoluble in water but soluble in such chemical solvents as ether, chloroform and benzene. The term "fat" is used here to include all fats and oils that are edible and occur in human diets, ranging from those that are solid at cool room temperatures, such as butter, to those that are liquid at similar temperatures, such as groundnut or cottonseed oils. (In some terminologies the word "oil" is used to refer to those materials that are liquid at room temperature, while those that are solid are called fats.)

Fats (also referred to as lipids) in the body are divided into two groups: storage fat and structural fat. Storage fat provides a reserve storehouse of fuel for the body, while the structural fats are part of the essential structure of the cells, occurring in cell membranes, mitochondria and intracellular organelles.

Cholesterol is a lipid present in all cell membranes. It has an important role in fat transport and is the precursor from which bile salts and adrenal and sex hormones are made.

Dietary fats consist mainly of triglycerides, which can be split into glycerol and chains of carbon, hydrogen and oxygen called fatty acids. This action, the digestion or breakdown of fats, is achieved in the human intestine by enzymes known as lipases, which are present primarily in the pancreatic and intestinal secretions. Bile salts from the liver emulsify the fatty acids to make them more soluble in water and hence more easily absorbed.

The many fatty acids in human diets are divided into two main groups: saturated and unsaturated. The latter group includes both

polyunsaturated and mono-unsaturated fatty acids. Saturated fatty acids have the maximum number of hydrogen atoms that their chemical structure will permit. All fats and oils eaten by humans are mixtures of saturated and unsaturated fatty acids. Broadly speaking, fats from land animals (i.e. meat fat, butter and ghee) contain more saturated fatty acids than do those of vegetable origin. Fats from plant products and to some extent those from fish have more unsaturated fatty acids, particularly polyunsaturated fatty acids (PUFAs). There are exceptions, however. For example, coconut oil has a large amount of saturated fatty acids.

These groupings of fats have important health implications because excess intake of saturated fats is one of the risk factors associated with arteriosclerosis and coronary heart disease. In contrast, PUFAs are believed to be protective.

PUFAs also include two unsaturated fatty acids, linoleic acid and linolenic acid, which have been termed "essential fatty acids" (EFAs) as they are necessary for good health. EFAs are important in the synthesis of many cell structures and several biologically important compounds. Recent studies have also shown the benefits of other longer-chain fatty acids in the growth and development of young children, and arachidonic acid and docosa-hexaenoic acid (DHA) should conditionally be considered essential during early development. Experiments with animals and studies in humans have shown definite skin and growth changes and abnormal vascular and neural function in the absence of these fatty acids, and there is no doubt that they are essential for the nutrition of individual cells and tissues of the body.

Fat is desirable to make the diet more palatable. It also yields about 9 kcal/g, which is more than twice the energy yielded by carbohydrates and proteins (about 4 kcal/g); fat can therefore reduce the bulk of the diet. A person doing very heavy work, especially in a cold climate, may require as many as 4 000 kcal a day. In such a case it is highly desirable that a good proportion of the energy should come from fat; otherwise the diet would be very bulky. Bulky diets can be a particularly serious problem in young children as well. A reasonable increase in the fat or oil content of the diets of young children raises the energy density of predominantly bulky carbohydrate diets and is highly desirable.

Fat also functions as a vehicle that assists the absorption of fat-soluble vitamins.

Thus fats, and even specific types of fat, are essential to health. However, practically all diets provide the small amount required.

Fat deposited in the human body serves as a reserve fuel. It is an economic way of storing energy, because, fat yields about twice as much energy, weight for weight, as does carbohydrate or protein. Fat is present

beneath the skin as an insulation against cold, and it forms a supporting tissue for many organs such as the heart and intestines.

All fat in the body is not necessarily derived from fat that has been eaten. However, excess calories from the carbohydrate and protein in, for example, maize, cassava, rice or wheat can be converted into fat in the human body.

Proteins

Like carbohydrates and fats, proteins contain carbon, hydrogen and oxygen, but they also contain nitrogen and often sulphur. They are particularly important as nitrogenous substances, and are necessary for growth and repair of the body. Proteins are the main structural constituents of the cells and tissues of the body, and they make up the greater portion of the substance of the muscles and organs (apart from water). The proteins in different body tissues are not all exactly the same. The proteins in liver, in blood and in specific hormones, for example, are all different.

Proteins are necessary

- For growth and development of the body;
- For body maintenance and the repair and replacement of worn out or damaged tissues;
- To produce metabolic and digestive enzymes;
- As an essential constituent of certain hormones, such as thyroxine and insulin.

Although proteins can yield energy, their main importance is rather as an essential constituent of all cells. All cells may need replacement from time to time, and their replacement requires protein.

Any protein eaten in excess of the amount needed for growth, cell and fluid replacement and various other metabolic functions is used to provide energy, which the body obtains by changing the protein into carbohydrate. If the carbohydrate and fat in the diet do not provide adequate energy, then protein is used to provide energy; as a result less protein is available for growth, cell replacement and other metabolic needs. This point is especially important for children, who need extra protein for growth. If they get too little food for their energy requirements, then the protein will be diverted for daily energy needs and will not be used for growth.

Amino Acids

All proteins consist of large molecules which are made of amino acids. The amino acids in any protein are linked together in chains, called peptide linkages. The various proteins are made of different amino acids linked

together in different chains. Because there are many different amino acids, there are many different possible configurations, so there are many different proteins.

During digestion proteins break down to form amino acids much as complex carbohydrates such as starches break down into simple monosaccharides and fats break down into fatty acids. In the stomach and intestines various proteolytic enzymes hydrolyse the protein, releasing amino acids and peptides.

Plants are able to synthesize amino acids from simple inorganic chemical substances. Animals do not have this ability; they derive all the amino acids necessary for building their protein from consumption of plants or animals. As the animals eaten by humans initially derived their protein from plants, all amino acids in human diets have originated from this source.

Animals have differing abilities to convert one amino acid into another. In the human this ability is limited. Conversion occurs mainly in the liver. If the ability to convert one amino acid into another were unlimited, then the question of the protein content of diets and the prevention of protein deficiency would be simple. It would be enough merely to supply sufficient protein, irrespective of the quality or amino acid content of the protein supplied.

Of the large number of amino acids, 20 are common in plants and animals. Of these, eight have been found to be essential for the adult human and have thus been termed "essential amino acids" or "indispensable amino acids", namely: phenyl-alanine, tryptophan, methionine, lysine, leucine, isoleucine, valine and threonine. A ninth amino acid, histidine, is required for growth and is essential for infants and children; it may also be necessary for tissue repair. Other amino acids include glycine, alanine, serine, cystine, tyrosine, aspartic acid, glutamic acid, proline, hydroxyproline, citrulline and arginine. Each protein in a food is composed of a particular mixture of amino acids which might or might not contain all eight of the essential ones.

Protein Quality and Quantity

To assess the protein value of any food it is useful to know how much total protein it contains, which amino acids it has and how many essential amino acids are present and in what proportion. Much is now known about the individual proteins present in various foods, their amino acid content and therefore their quality and quantity. Some have a better mixture of amino acids than others, and these are said to have a higher biological value. The proteins albumin in egg and casein in milk, for example, contain all the essential amino acids in good proportions and

are nutritionally superior to such proteins as zein in maize, which contains little tryptophan or lysine, and the protein in wheat, which contains only small quantities of lysine. It is not true, however, to say that the proteins in maize and wheat are not valuable. Although they contain less of certain amino acids, they do contain some amount of all the essential amino acids as well as many of the other important ones. The relative deficiency of maize and wheat proteins can be overcome by providing other foodstuffs containing more of the limited amino acids. It is therefore possible for two foods with low-value protein to complement each other to form a good protein mixture when eaten together.

Humans, especially children on diets deficient in animal protein, require a variety of foods of vegetable origin, not just one staple food. In many diets, pulses or legumes such as groundnuts, beans and cowpeas, though short of sulphur-containing amino acids, supplement the cereal proteins, which are often short of lysine. A mixture of foods of vegetable origin, especially if taken at the same meal, can serve as a substitute for animal protein.

FAO has produced tables showing the content of essential amino acids in different foodstuffs, from which it can be seen which foods best complement each other. It is also necessary, of course, to ascertain the total quantity of protein and amino acids in any food.

The quality of the protein depends largely on its amino acid composition and its digestibility. If a protein is deficient in one or more essential amino acids, its quality is lower. The most deficient of the essential amino acids in a protein is called the "limiting amino acid". The limiting amino acid determines the efficiency of utilization of the protein present in a food or combination of foods. Human beings usually eat food in meals which contain many proteins; they seldom consume just one protein. Therefore nutritionists are interested in the protein quality of a person's diet or meals, rather than just one food. If one essential amino acid is in short supply in the diet, it limits the use of the other amino acids for building protein.

Readers who wish to become familiar with the methods used for determining protein quality are advised to consult comprehensive textbooks on nutrition, which describe them in detail. One method uses experiments on growth and nitrogen retention in young rats. Another involves determination of the amino acid or chemical score, usually by examining the efficiency of utilization of proteins in the foods consumed by comparing their amino acid composition with that of protein known to be of high quality, such as that in whole eggs.

The chemical score may thus be defined as the efficiency of utilization of food protein in comparison with whole egg protein. Net protein

utilization (NPU) is a measure of the amount or percentage of protein retained in relation to that consumed. As an example, Table 16 gives the chemical score and NPU of the protein in five foods.

It is not usual or easy to obtain NPU values in people, and in most studies rats are used. Table 16 suggests that there is a good correlation between the values in rats and in children, and that chemical score provides a reasonable estimate of protein quality.

For the professional involved in nutritional activities to help people - be it a dietitian in a health facility, an agricultural extension worker or a nutrition educator what is important is that the protein value differs among foods and that mixing foods improves the protein quality of the meal or the diet. Table 17 gives the protein content and the limiting amino acid score of some commonly eaten plant-based foods. Because lysine is most commonly the limiting amino acid in many foods of plant origin, the lysine score is also given.

Protein Digestion and Absorption

Proteins consumed in the diet undergo a series of chemical changes in the gastrointestinal tract. The physiology of protein digestion is complicated; pepsin and rennin from the stomach, trypsin from the pancreas and erepsin from the intestines hydrolyse proteins into their component amino acids. Most of the amino acids are absorbed into the bloodstream from the small intestine and thus travel to the liver and from there all over the body. Any surplus amino acids are stripped of the amino (NH_2) group, which goes to form urea in the urine, leaving the rest of the molecule to be transformed into glucose. There is now some evidence that a little intact protein is taken up into certain cells lining the intestines. Some of this protein in the infant may have a role in the passive immunity conveyed from the mother to her newborn child.

A little of the protein and amino acids released in the intestines is not absorbed. The unabsorbed amino acids, plus cells shed from the intestinal villi and acted upon by bacteria, together with gut organisms, contribute to the nitrogen found in faeces.

Table. Chemical Score and Net Protein Utilization in Selected Foods

Food	Chemical score	NPU determined in children	NPU determined in rats
Eggs (whole)	100	87	94
Milk (human)	100	94	87
Rice	67	63	59
Maize	49	36	52
Wheat	53	49	48

Table. Protein content, Limiting Amino Acid Score and Lysine Score of Selected Plant Foods

Food	Protein content (%)	Limiting amino add score	Lysine score
Cereals			
Maize	9.4	49 (Lys)	49
Rice (white)	7.1	62 (Lys)	62
Wheat flour	10.3	38 (Lys)	38
Millet	11.0	33 (Lys)	33
Legumes			
Kidney beans	23.6	100	118
Cowpea	23.5	100	117
Groundnut	25.8	62 (Lys)	62
Vegetables			
Tomato	0.9	56 (Leu)	64
Squash	1.2	70 (Thr)	95
Pepper,sweet	0.9	77 (Lys Leu)	77
Cassava	1.3	44 (Leu)	56
Potato	2.1	91 (Leu)	105

Much of the protein in the human body is present in muscle. There is no true storage of protein in the body as there is with fat and to a small extent glycogen. However, there is now little doubt that a well-nourished individual has sufficient protein accumulated to be able to last several days without replenishment and to remain still in good health.

Protein Requirements

Children need more protein than adults because they need to grow. Infants in the first few months of life require about 2.5 g of protein per kilogram of body weight. This requirement drops to about 1.5 g/kg at nine to 12 months of age. Unless energy intakes are adequate, however, the protein will not all be used for growth. A pregnant woman needs an additional supply of protein to build up the foetus inside her. Similarly, a lactating woman needs extra protein, because the milk she secretes contains protein. In some societies it is common for women to breastfeed their babies for as long as two years. Thus some women need extra protein for two years and nine months for every infant they bear.

Protein requirements and recommended allowances have been the subject of much research, debate and disagreement over the past 50 years. FAO and the World Health Organization (WHO) periodically assemble experts to review current knowledge and to provide guidelines. The most

recent guidelines were the outcome of an Expert Consultation held jointly by FAO, WHO and United Nations University (UNU) in Rome in 1981 (WHO, 1985). The safe level of intake for a one-year-old child was put at 1.5 g per kilogram of body weight. The amount then falls to 1 g/kg at age six years. The United States recommended dietary allowance (RDA) is a little higher, namely 1.75 g/kg at age one year and 1.2 g/kg at age six years. In adults the FAO/WHO/UNU safe intake of protein is 0.8 g/kg for females and 0.85 g/kg for males.

The safe levels of intake of protein by age and gender, including those for pregnant and lactating women, are given in Annex 1. Values are provided both for a diet high in fibre, comprising mainly cereals, roots and legumes with little food of animal origin, and for a mixed balanced diet with less fibre and plenty of complete protein. As an example, a non-pregnant adult woman weighing 55 kg requires 49 g of protein per day for the first diet and 41 g per day for the second. Fibre reduces protein utilization.

Inadequate protein intake jeopardizes growth and repair in the body. Protein deficiency is especially dangerous for children because they are growing and also because the risk of infection is greater during childhood than at almost any other time of life. In children inadequate energy intake also has an impact on protein., in the absence of adequate energy some protein needs to be diverted and therefore will not be used for growth.

In many developing countries (though not all), the intake of protein is relatively low and of predominantly vegetable origin. The paucity of foods of animal origin in the diet is not always a matter of choice. For example, many low-income Africans and Latin Americans like animal products but find them less freely available, more difficult to produce and store and more expensive than most vegetable products. Diets low in meat, fish and dairy products are very common in countries where most people are poor.

Infections lead to an increased loss of nitrogen from the body, which has to be replaced by proteins in the diet. Therefore children and others who have frequent infections will have greater protein needs than healthy persons. This fact must constantly be borne in mind, for in developing countries many children suffer an almost continual series of infectious diseases; they may frequently get diarrhoea, and they may harbour intestinal parasites.

Minerals

Minerals have a number of functions in the body. Sodium, potassium and chlorine are present as salts in body fluids, where they have a physiological role in maintaining osmotic pressure. Minerals form part

of the constitution of many tissues. For example, calcium and phosphorus in bones combine to give rigidity to the whole body. Minerals are present in body acids and alkalis; for example, chlorine occurs in hydrochloric acid in the stomach. They are also essential constituents of certain hormones, e.g. iodine in the thyroxine produced by the thyroid gland.

The principal minerals in the human body are calcium, phosphorus, potassium, sodium, chlorine, sulphur, copper, magnesium, manganese, iron, iodine, fluorine, zinc, cobalt and selenium. Phosphorus is so widely available in plants that a shortage of this element is unlikely in any diet. Potassium, sodium and chlorine are easily absorbed and are physiologically more important than phosphorus. Sulphur is consumed by humans mainly in the form of sulphur-containing amino acids; thus sulphur deficiency, when it occurs, is linked with protein deficiency. Copper, manganese and magnesium deficiencies are not believed to be common. The minerals that are of most importance in human nutrition are thus calcium, iron, iodine, fluorine and zinc, and only these are discussed in some detail here. Some mineral elements are required in very tiny amounts in human diets but are still vital for metabolic purposes; these are termed "essential trace elements".

The table giving the nutrient content of selected foods shows the relative content of some important minerals in different foods.

Calcium

The body of an average-sized adult contains about 1 250 g of calcium. Over 99 per cent of the calcium is in the bones and teeth, where it is combined with phosphorus as calcium phosphate, a hard substance that gives the body rigidity. However, although hard and rigid, the skeleton of the body is not the unchanging structure it appears to be. In fact, the bones are a cellular matrix, and the calcium is continuously taken up by the bones and given back to the body. The bones, therefore, serve as a reserve supply of this mineral.

Calcium is present in the serum of the blood in small but important quantities, usually about 10 mg per 100 ml of serum. There are also about 10 g of calcium in the extracellular fluids and soft tissues of the adult body.

Properties and Functions

In humans and other mammals, calcium and phosphorus together have an important role as major components of the skeleton. They are also important, however, in metabolic functions such as muscular function, nervous stimuli, enzymatic and hormonal activities and transport of oxygen. These functions are described in detail in textbooks of physiology and nutrition.

The skeleton of a living person is physiologically different from the dry skeleton in a grave or museum. The bones are living tissues, consisting mainly of a mineralized protein collagen substance. In the living body there is continuous turnover of calcium. Bone is laid down and resorbed all the time, in people of all ages. Bone cells called osteoclasts take up or resorb bone, while others, termed osteoblasts, lay down or form new bone. The bone cells in the mineralized collagen are called osteocytes.

Up to full growth or maturity (which has usually taken place by age 18 to 22 years), new bone is formed as the skeleton enlarges to its adult size. In young adults, despite bone remodelling, the skeleton generally maintains its size. However, as persons get older there is some loss of bone mass.

A complex physiological system maintains proper calcium and phosphorus levels. The control involves hormones from the parathyroid gland, calcitonin and the active form of vitamin D (1,25-dihydroxy-cholecalciferol).

Small but highly important amounts of calcium are present in extracellular fluids, particularly blood plasma, as well as in various body cells. In serum most of the calcium is in two forms, ionized and protein bound. Laboratories usually measure only total plasma calcium; the normal range is 8.5 to 10.5 mg/dl (2.1 to 2.6 mmol/litre). A drop in the level of calcium to below 2.1 mmol/litre is termed hypocalcaemia and can lead to various symptoms. Tetany (not to be confused with tetanus resulting from the tetanus bacillus), characterized by spasms and sometimes fits, results from low levels of ionized calcium in the blood.

Dietary Sources

All the calcium in the body, except that inherited from the mother, comes from food and water consumed. It is especially necessary to have adequate quantities of calcium during growth, for it is at this stage that the bones develop.

The foetus in the mother's uterus has most of its nutritional requirements satisfied, for in terms of nutrition the unborn child is almost parasitic. If the mother's diet is poor in calcium, she draws extra supplies of this mineral from her bones.

An entirely breastfed infant will obtain adequate calcium from breastmilk as long as the volume of milk is sufficient. Contrary to popular belief, the calcium content of human milk varies rather little; 100 ml of breastmilk, even from an undernourished mother on a diet very low in calcium, provides approximately 30 mg of calcium (Table 18). A lactating mother secreting 1 litre will thus lose 300 mg of calcium per day.

Cows' milk is a very rich source of calcium, richer than human milk.

Whereas a litre of human milk contains 300 mg of calcium, a litre of cows' milk contains 1200 ma. The difference arises because a cow has to provide for her calf, which grows much more rapidly than a human infant and needs extra calcium for the hardening of its fast-growing skeleton. Similarly, the milk of most other domestic animals has a higher calcium content than human milk. This does not mean, however, that a child would be better off drinking cows' milk rather than human milk. Cows' milk yields more calcium than a child needs. A child (or even a baby) who drinks large quantities of cows' milk excretes any excess calcium, so it is of no benefit; it does not increase the child's growth rate beyond what is optimal.

Milk products such as cheese and yoghurt are also rich sources of calcium. Small saltwater and freshwater fish such as sardines and sprats supply good quantities of calcium since they are usually eaten whole, bones and all. Small dried fish known as *dagaa* in the United Republic of Tanzania, *kapenta* in Zambia and *chela* in India add useful calcium to the diet. Vegetables and pulses provide some calcium. Although cereals and roots are relatively poor sources of calcium, they often supply the major portion of the mineral in tropical diets by virtue of the quantities consumed.

Table. Calcium content of Various Milks Commonly Used in Developing Countries

Source of milk	Calcium content *(mg/100 ml)*
Human	32
Cow	119
Camel	1 20
Goat	1 34
Water buffalo	169
Sheep	1 93

The calcium content of drinking-water varies from place to place. Hard water usually contains high levels of calcium.

Absorption and Utilization

The absorption of calcium is variable and generally rather low. It is related to the absorption of phosphorus and the other important mineral constituents of the bones. Vitamin D is essential for the proper absorption of calcium. Thus a person seriously deficient in vitamin D absorbs too little calcium, even if the intake of calcium is more than adequate, and could have a negative calcium balance. Phytates, phosphates and oxalates in food reduce calcium absorption.

Persons customarily consuming diets low in calcium appear to have

better absorption of calcium than those on high-calcium diets. Unabsorbed calcium is excreted in the faeces. Excess calcium is excreted in the urine and in sweat.

Requirements

It is not easy to state categorically the human requirements for calcium, because there are several factors influencing absorption and considerable variations in calcium losses among individuals.

Needs for calcium are increased during pregnancy and lactation, and children require more calcium because of growth. Those on high-protein diets require more calcium in the diet.

The following are recommended levels of daily calcium intake:

- adults, 400 to 500 mg;
- children, 400 to 700 mg;
- pregnant and lactating women, 800 to 1 000 mg.

Deficiency States

Disease or malformation caused primarily by dietary deficiency of calcium is rare. There is little convincing evidence to show that the many diets of adults in developing countries supplying perhaps only 250 to 300 mg of calcium daily are harmful to health. It is assumed that adults achieve some sort of balance when intakes of calcium are low. Females who go through a series of pregnancies and long lactations may lose calcium and be at risk of osteomalacia. However, vitamin D deficiency, not calcium deficiency, is more often implicated in this condition. In children the development of rickets results from vitamin D deficiency, not from dietary lack of calcium, in spite of increased calcium requirements in childhood. Calcium balance in childhood is generally positive, and calcium deficiency has not been shown to have an adverse influence on growth.

Osteoporosis is a common disease of ageing, especially in women . The skeleton becomes demineralized, which leads to fragility of bones and commonly to fractures of the hip, vertebrae and other bones, particularly in older women. High calcium intake is often recommended but has not been proved effective in prevention or treatment.

Exercise appears to reduce the loss of calcium from bones; this may explain, in part, why osteoporosis is less prevalent in many developing countries, where women work hard and are very active. There is now clear evidence that providing the female hormone oestrogen to women after menopause reduces bone loss and osteoporosis.

Iron

Iron deficiency is a very common cause of ill health in all parts of the

world, both South and North. The average iron content in a healthy adult is only about 3 to 4 g, yet this relatively small quantity is vital.

Properties and Functions

Most of the iron in the body is present in the red blood cells, mainly as a component of haemoglobin. Much of the rest is present in myoglobin, a compound occurring mainly in muscles, and as storage iron or ferritin, mainly in the liver, spleen and bone marrow. Additional tiny quantities are found binding protein in the blood plasma and in respiratory enzymes.

The main, vital function of iron is in the transfer of oxygen at various sites in the body. Haemoglobin is the pigment in the erythrocytes that carries oxygen from the lungs to the tissues. Myoglobin in skeletal and heart muscle accepts the oxygen from the haemoglobin. Iron is also present in peroxidase, catalase and the cytochromes.

Iron is an element that is neither used up nor destroyed in the properly functioning body. Unlike some minerals, it is not required for excretion, and only very small amounts appear in urine and sweat. Minute quantities are lost in desquamated cells from the skin and intestine, in shed hair and nails and in the bile and other body secretions.

The body is, however, efficient, economical and conservative in the use of iron. Iron released when the erythrocytes are old and broken down is taken up and used again and again for the manufacture of new erythrocytes. This economy of iron is important. In normal circumstances, only about 1 mg of iron is lost from the body daily by excretion into the intestines, in urine, in sweat or through loss of hair or surface epithelial cells.

Because iron is conserved, the nutritional needs of healthy males and postmenopausal females are very small. Women of child-bearing age, however, must replace the iron lost during menstruation and childbirth and must meet the additional requirements of pregnancy and lactation. Children have relatively high needs because of their rapid growth, which involves increases not only in body size but also in blood volume.

Dietary Sources

Iron is present in a variety of foods of both plant and animal origin. Rich food sources include meat (especially liver), fish, eggs, legumes (including a variety of beans, peas and other pulses) and green leafy vegetables. Cereal grains such as maize, rice and wheat contain moderate amounts of iron, but because these are often staple foods and eaten in large quantities, they provide most of the iron for many people in developing countries. Iron cooking pots may be a source of iron.

Milk, contrary to the notion that it is the "perfect food", is a poor

source of iron. Human milk contains about 2 mg of iron per litre and cows' milk only half this amount.

Absorption and Utilization

Absorption of iron takes place mainly in the upper portion of the small intestine. Most of the iron enters the bloodstream directly and not through the lymphatic system. Evidence indicates that absorption is regulated to some extent by physiological demand. Persons who are iron deficient tend to absorb iron more efficiently and in greater quantities than do normal subjects.

Several other factors affect iron absorption. For example, tannins, phosphates and phytates in food reduce iron absorption, whereas ascorbic acid increases it. Studies have indicated that egg yolk, despite its relatively high iron content, inhibits absorption of iron - not only the iron from the egg yolk itself, but also that from other foods.

Healthy subjects normally absorb only 5 to 10 per cent of the iron in their foods, whereas iron-deficient subjects may absorb twice that amount. Therefore, on a diet that supplies 15 mg of iron, the normal person would absorb 0.75 to 1.5 mg of iron, but the iron-deficient person would absorb as much as 3 mg. Iron absorption generally increases during growth and pregnancy, after bleeding and in other conditions in which the demand for iron is enhanced.

Of greatest importance is the fact that the availability of iron from foods varies widely. Absorption of the haem iron in foods of animal origin (meat, fish and poultry) is usually very high, whereas the non-haem iron in foods such as cereals, vegetables, roots and fruits is poorly absorbed.

However, people usually eat meals, not single individual foods, and a small amount of haem iron consumed with a meal where most of the iron is non-haem iron will enhance the absorption of all the iron. Thus the addition of a quite small amount of haem iron from perhaps fish or meat to a large helping of rice or maize containing non-haem iron will result in much greater absorption of iron from the cereal staple. If this meal also includes fruits or vegetables, the vitamin C in them will also enhance iron absorption. However, if tea is consumed with this meal, the tannin present in the tea will reduce the absorption of iron.

Requirements

The dietary requirements for iron are approximately ten times the body's physiological requirements. If a normally healthy man or post-menopausal woman requires 1 mg of iron daily because of iron losses, then the dietary requirements are about 10 mg per day. This recommendation allows a fair margin of safety, as absorption is increased

with need. Menstrual loss of iron has been estimated to average a little less than 1 mg per day during an entire year. It is recommended that women of child-bearing age have a dietary intake of 18 mg per day.

During pregnancy, the body requires on average about 1.5 mg of iron daily to develop the foetus and supportive tissues and to expand the maternal blood supply. Most of this additional iron is required in the second and third trimesters of pregnancy.

Breastfeeding women use iron to provide the approximately 2 mg of iron per litre of breastmilk. However, during the first six to 15 months of intensive breastfeeding they may not menstruate, so they do not lose iron in menstrual blood.

Newborn infants are born with very high haemoglobin levels (a high red blood cell count), termed polycythaemia, which provides an extra store of iron. This iron, together with that present in breastmilk, is usually sufficient for the first four to six months of life, after which iron from other foods becomes necessary.

Premature and other low-birth-weight infants may have lower iron stores and be at greater risk than other infants.

An excess intake of iron over long periods can lead to the disease siderosis or haemachromatosis. This disease is reported to occur most commonly where beer or other alcoholic beverages are brewed in iron cooking pots, particularly in South Africa. In alcoholics siderosis leading to iron deposits in the liver may be associated with cirrhosis.

Average safe levels of iron intake are provided in Annex 1.

Deficiency States

Consideration of the iron requirements and the iron content of commonly eaten foods might suggest that iron deficiency is rare, but this is not the case. Food iron is poorly absorbed. Iron is not readily excreted into the urine or the gastro-intestinal tract; thus severe iron deficiency is usually associated with an increased need for iron resulting from conditions such as pregnancy, blood loss or expansion of the total body mass during growth. Iron deficiency is most common in young children, in women of child-bearing age and in persons with chronic blood loss. The end result of iron deficiency is anaemia.

Hookworm infections, which are extremely prevalent in many countries, result in loss of blood which may cause iron deficiency anaemia. In some parts of the tropics schistosomiasis is also common, and this disease also causes blood loss.

Iodine

The body of an average adult contains about 20 to 50 mg of iodine,

much of it in the thyroid gland. Iodine is essential for the formation of thyroid hormones secreted by this gland.

Properties and Functions

In humans iodine functions as an essential component of the hormones of the thyroid gland, an endocrine gland situated in the lower neck. Thyroid hormones, of which the most important is thyroxine (T4), are important for regulating metabolism.

In children they support normal growth and development, including mental development.

Iodine is absorbed from the gut as iodide, and excess is excreted in the urine. The adult thyroid gland, in a person consuming adequate iodine, traps about 60 μg of iodine per day to make normal amounts of thyroid hormones. If there is insufficient iodine, the thyroid works harder to trap more; the gland enlarges in size (a condition known as goitre), and its iodine content might become markedly reduced.

Thyroid stimulating hormone (TSH) from the pituitary gland influences thyroxine secretion and iodine trapping. In severe iodine deficiency, TSH levels are raised and thyroxine levels are low.

Dietary Sources

Iodine is widely present in rocks and soils. The quantity in different plants varies according to the soil in which they are grown. It is not meaningful to list the iodine content of foodstuffs because of the large variations in iodine content from place to place, depending on the iodine content of the soil. Iodine tends to get washed out of the soil, and throughout the ages a considerable quantity has flowed into the sea. Sea fish, seaweed and most vegetables grown near the sea are useful sources of iodine. Drinking-water provides some iodine but very seldom enough to satisfy human requirements.

In many countries where goitre is prevalent the authorities have added iodine to salt, a strategy which has successfully controlled iodine deficiency disorders (IDD). Iodine has usually been added to salt in the form of potassium iodide, but another form, potassium iodate, is more stable and is better in hot, humid climates. Iodated salt is an important dietary source of iodine.

Deficiency States

A lack of iodine in the diet results in several health problems, one of which is goitre, or enlargement of the thyroid gland. Goitre is extremely prevalent in many countries. There are other contributing causes of goitre, but iodine deficiency is by far the most common. Iodine deficiency during

pregnancy may lead to cretinism, mental retardation and other problems, which may be permanent, in the child. It is now known that endemic goitre and cretinism are not the only problems caused by iodine deficiency. The decrease in mental capacity associated with iodine deficiency is of particular concern.

IDD, although previously prevalent in Europe, North America and Australia, is now seen predominantly in developing countries. The greatest prevalence tends to be in mountainous areas such as the Andes and the Himalayas and in plateau areas far from the sea. For example, an investigation carried out by the author in the Ukinga Highlands of Tanzania revealed that 75 per cent of the population had some enlargement of the thyroid.

Fluorine

Fluorine is a mineral element found mainly in the teeth and skeleton. Traces of fluorine in the teeth help to protect them against decay. Fluorides consumed during childhood become a part of the dental enamel and make it more resistant to the weak organic acids formed from foods that adhere to or get stuck between the teeth. This strengthening greatly reduces the chances of decay or caries developing in the teeth. Some studies have suggested that fluoride may also help strengthen bone, particularly later in life, and may thus inhibit the development of osteoporosis.

Dietary Sources

The main source of fluorine for most human beings is the water they drink. If the water has a fluorine content of about one part per million (1 ppm), then it will supply adequate fluorine for the teeth. However, many water supplies contain much less than this amount. Fluorine is present in bone; consequently small fish that are consumed whole are a good source. Tea has a high fluorine content. Few other foods contain much fluorine.

Deficiency

If the fluoride content of drinking-water in any locality is below 0.5 ppm, dental caries will probably be much more prevalent than where the concentration is higher.

The recommended level of fluoride in water is between 0.8 and 1.2 ppm. In some countries or localities where the content of fluorine in the water is less than 1 ppm, it has now become the practice to add fluoride to the water supply.

This practice is strongly recommended, but it is only practicable for large piped-water supplies; in some developing countries where most people do not have piped water, it is not feasible. The addition of fluoride

to toothpaste also helps reduce dental caries. Fluorine does not totally prevent dental caries, but it can reduce the incidence by 60 to 70 per cent.

Excess

An excessively high intake of fluoride causes a condition known as dental fluorosis, in which the teeth become mottled. It is usually caused by consuming excessive fluoride in water supplies that have high fluoride levels. In some parts of Africa and Asia, natural waters contain over 4 ppm of fluoride. Very high fluorine intakes also cause bone changes with sclerosis (added bone density), calcification of muscle insertions and exostoses. A survey carried out by the author in Tanzania revealed a high incidence of fluorotic bone changes (as shown by X-ray) in older subjects who normally drank water containing over 6 ppm of fluoride. Similar findings have been well described in India. Skeletal fluorosis can cause severe pain and serious bone abnormalities.

Zinc

Zinc is an essential element in human nutrition, and its importance to human health has received much recent attention. Zinc is present in many important enzymes essential for metabolism. The body of a healthy human adult contains 2 to 3 g of zinc and requires around 15 mg of dietary zinc per day. Most of the zinc in the body is in the skeleton, but other tissues (such as the skin and hair) and some organs (particularly the prostate) have relatively high concentrations.

Dietary Sources

Zinc is present in most foods both of vegetable and of animal origin, but the richest sources tend to be protein-rich foods such as meat, seafoods and eggs. In developing countries, however, where most people consume relatively small amounts of these foods, most zinc comes from cereal grains and legumes.

Absorption and Utilization

As with iron, absorption of zinc from the diet is inhibited by food constituents such as phytates, oxalate and tannins. No simple tests of human zinc status are known, however. Indicators used include evidence of low dietary intake, low blood serum zinc levels and low quantities of zinc in hair specimens.

Much research on this mineral has been undertaken in the last two decades, and a great deal of knowledge concerning zinc metabolism and zinc deficiency in animals and humans has been gathered. Nonetheless, there is little evidence to suggest that zinc deficiency is an important public

health problem for large numbers of people in any country, industrialized or developing. However, research now under way may show that poor zinc status is responsible for poor growth, reduced appetite and other conditions; in this way zinc deficiency may contribute especially to what is now called protein-energy malnutrition (PEM).

Zinc deficiency is responsible for a very rare congenital disease known as acrodermatitis enteropathica. It responds to zinc therapy. Some patients receiving all of their nutrients intravenously have developed skin lesions which also respond to zinc treatment. In the Near East, particularly in the Islamic Republic of Iran and Egypt, a condition has been described in which adolescent or near-adolescent boys are dwarfed and have poorly developed genitalia and delayed onset of puberty; this condition has been said to respond to zinc treatment.

Zinc deficiency has also been reported as secondary to, or as a part of, other conditions such as PEM, various malabsorption conditions, alcoholism including cirrhosis of the liver, renal disease and metabolic disorders.

Other Trace Elements

Numerous minerals are present in the human body. For most of the trace elements, there is no evidence that deficiency is responsible for major public health problems anywhere. Some of these minerals are very important in metabolism or as constituents of body tissues. Many of them have been studied, and their chemistry and biochemistry have been described. Experimental deficiencies have been produced in laboratory animals, but most human diets, even poor diets, do not appear to lead to important deficiencies. These minerals therefore are not of public health importance. Other trace elements are present in the body but do not have any known essential role. Some minerals, for example lead and mercury, are of great interest to health workers because excess intake has commonly resulted in toxic manifestations.

Cobalt, copper, magnesium, manganese and selenium deserve mention because of their important nutritional role, and lead and mercury because of their toxicity. These minerals are considered in detail in large comprehensive textbooks of nutrition.

Cobalt

Cobalt is of interest to nutritionists because it is an essential part of vitamin B_{12} (cyanocobalamin). When isolated as a crystalline substance, the vitamin was found to contain about 4 per cent cobalt. However, cobalt deficiency does not play a part in the anaemia that results from vitamin B_{12} deficiency.

Copper

Copper deficiency is known to cause anaemia in cattle, but no such risk is known in adult humans.

Some evidence suggests that copper deficiency leads to anaemia in premature infants, in people with severe PEM and in those maintained on parenteral nutrition. An extremely rare congenital condition known as Menkes' disease is caused by failure of copper absorption.

Magnesium

Magnesium is an essential mineral present mainly in the bones but also in most human tissues. Most diets contain adequate dietary magnesium, but under some circumstances, such as diarrhoea, severe PEM and other conditions, excessive body losses of magnesium occur. Such losses may lead to weakness and mental changes and occasionally to convulsions.

Selenium

Both deficiency and excess of selenium have been well described in livestock. In areas of China where the soil selenium, and therefore the food selenium, is low, a heart condition has been described; termed Keshan's disease, it is a serious condition affecting heart muscle. Chinese researchers believe it can be prevented by providing dietary selenium. Selenium deficiency has also been associated with certain cancers.

Lead

Lead is of great public health importance because it commonly causes toxicity. Human lead deficiency is not known. Lead poisoning is especially an urban problem and is most important in children. It may lead to neurological and mental problems and to anaemia. Excess lead intake may result from consumption of lead in the household (from lead-based paint or water pipes containing lead) and from intake of atmospheric lead (from motor vehicle emissions).

Mercury

Mercury deficiency is not known in humans. The concern is with excessively high intakes of mercury and the risks of toxicity. Fish in waters contaminated with mercury concentrate the mineral. There is a danger of toxicity in those who consume fish with high mercury content.

Mercury poisoning resulting from consumption of seeds coated with a mercury-containing fungicide has been described in Asia, Latin America and the Near East. The effects include severe neurological symptoms and paralysis.

Vitamins

Vitamins are organic substances present in minute amounts in foodstuffs and necessary for metabolism. They are grouped together not because they are chemically related or have similar physiological functions, but because, as their name implies, they are vital factors in the diet and because they were all discovered in connection with the diseases resulting from their deficiency.

Moreover, they do not fit into the other nutrient categories (carbohydrates, fats, protein and minerals or trace metals).

When vitamins were first being classified, each was named after a letter of the alphabet. Subsequently, there has been a tendency to drop the letters in favour of chemical names. The use of the chemical name is justified when the vitamin has a known chemical formula, as with the main vitamins of the B group. Nevertheless, it is advantageous to include certain vitamins under group headings, even if they are not chemically related, since they do tend to occur in the same foodstuffs.

In this only vitamin A, five of the B vitamins (thiamine, riboflavin, niacin, vitamin B_{12} and folic acid), vitamin C and vitamin D are described in detail. Other vitamins known to be vital to health include pantothenic acid (of which a deficiency may cause the burning feet syndrome mentioned below), biotin (vitamin H), para-aminobenzoic acid, choline, vitamin E and vitamin K: (antihaemorrhagic vitamin). These vitamins are not described in detail here for one or more of the following reasons:

- deficiency is not known to occur under natural conditions in humans;
- deficiency is extremely rare even in grossly abnormal diets;
- lack of the vitamin results in disease only if it follows some other disease process that is adequately described in textbooks of general medicine;
- the role of the vitamin in human nutrition has not yet been elucidated.

None of the vitamins omitted from discussion is important from the point of view of workers studying nutrition as community health problems in most developing countries. Those wishing to learn more about these vitamins are referred to textbooks of general medicine or more detailed textbooks of nutrition.

Vitamin A (Retinol)

Vitamin A was discovered in 1913 when research workers found that certain laboratory animals stopped growing when lard (made from pork fat) was the only form of fat present in their diet, whereas when butter was supplied instead of lard (with the diet remaining otherwise the same)

the animals grew and thrived. Further animal experiments showed that egg yolk and cod-liver oil contained the same vital food factor, which was named vitamin A.

It was later established that many vegetable products had the same nutritional properties as the vitamin A in butter; they were found to contain a yellow pigment called carotene, some of which can be converted to vitamin A in the human body.

Properties

Retinol is the main form of vitamin A in human diets. (Retinol is the chemical name of the alcohol derivative, and it is used as the reference standard.) In its pure crystalline form, retinol is a very pale yellow-green substance. It is soluble in fat but insoluble in water, and it is found only in animal products. Other forms of vitamin A exist, but they have somewhat different molecular configurations and less biological activity than retinol, and they are not important in human diets.

Carotenes, which act as provitamins or precursors of vitamin A, are yellow substances that occur widely in plant substances. In some foodstuffs their colour may be masked by the green plant pigment chlorophyll, which often occurs in close association with carotenes. There are several different carotenes. One of these, beta-carotene, is the most important source of vitamin A in the diets of most people living in non-industrialized countries. The other carotenes, or carotenoids, have little or no nutritional importance for humans. In the past, food analyses have often failed to distinguish beta-carotene from other carotenes.

Vitamin A is an important component of the visual purple of the retina of the eye, and if vitamin A is deficient, the ability to see in dim light is reduced. This condition is called night blindness. The biochemical basis for the other lesions of vitamin A deficiency has not been fully explained. The main change, in pathological terms, is a keratinizing metaplasia which is seen on various epithelial surfaces. Vitamin A appears to be necessary for the protection of surface tissue.

Several studies have shown that adequate vitamin A status reduces infant and child mortality in certain populations. Vitamin A supplementation reduces case fatality rates from measles. In other illnesses such as diarrhoea and respiratory infections, however, there is not strong evidence that the prevalence or duration of morbidity is reduced by vitamin A dosing.

Calculalating vitamin A content in foods

1 IU retinol = 0.3 μg retinol = 0.3 RE

1 RE = 3.33 IU retinol

1 RE = 6 μg beta-carotene

Since pure crystalline vitamin A, which is termed retinol alcohol, is now available, the vitamin A activity in foods is now widely expressed and measured using retinol equivalents (RE) rather than the international units (IU) previously used. One IU of vitamin A is equivalent to 0.3 1 μg retinol.

Humans obtain vitamin A in food either as preformed vitamin A (retinol) or as carotenes which can be converted to retinol in the body. Beta-carotene is the most important in human diets and is better converted to retinol than other carotenes. It has been determined that six molecules of beta-carotene are needed to produce one molecule of retinol; thus it takes 6 μg of carotene to make 1 μg of retinol, or 1 RE.

Dietary Sources

Vitamin A itself is found only in animal products; the main sources are butter, eggs, milk, meat (especially liver) and some fish. However, most people in developing countries rely mainly on beta-carotene for their supply of vitamin A. Carotene is contained in many plant foods. Dark green leaves such as those of amaranth, spinach, sweet potato and cassava are much richer sources than paler leaves such as those of cabbage and lettuce. Various pigmented fruits and vegetables, such as mangoes, papayas and tomatoes, contain useful quantities. Carotene is also present in yellow varieties of sweet potatoes and in yellow vegetables such as pumpkins. Carrots are rich sources. Yellow maize is the only cereal that contains carotene. In West Africa much carotene is obtained from red palm oil, which is widely used in cooking. The cultivation of the very valuable oil palm has spread to other tropical regions. In Malaysia it is widely cultivated as a cash crop, but its products are mainly exported rather than consumed locally.

Both carotene and vitamin A withstand ordinary cooking temperatures fairly well. However, a considerable amount of carotene is lost when green leaves and other foods are dried in the sun. Sun-drying is a traditional method of preserving wild leaves and vegetables often used in arid regions. Since serious disease from vitamin A deficiency is common in these areas, it is important that other methods of preservation be established.

Absorption and Utilization

The conversion of beta-carotene into vitamin A takes place in the walls of the intestines. Even the most efficient intestine can absorb and convert only a portion of the beta-carotene in the diet; therefore 6 mg of beta-carotene in food is equivalent to about 1 mg of retinol. If no animal products are consumed and the body must rely entirely on carotene for

its vitamin A, consumption of carotene must be great enough to achieve the required vitamin A level.

Carotene is poorly utilized when the diet has a low fat content, and diets deficient in vitamin A are often deficient in fat. Intestinal diseases such as dysentery, coeliac disease and sprue limit the absorption of vitamin A and the conversion of carotene. Malabsorption syndromes and infections with common intestinal parasites such as roundworm, which are prevalent in the tropics, may also reduce the ability of the body to convert carotene into vitamin A.

Bile salts are essential for the absorption of vitamin A and carotene, so persons with obstruction of the bile duct are likely to become deficient in vitamin A. Even in ideal circumstances, infants and young children do not convert carotene to vitamin A as readily as adults do.

The liver acts as the main store of vitamin A in the human and most other vertebrates, which is why fish-liver oils have a high content of this vitamin. Retinol is transported from the liver to other sites in the body by a specific carrier protein called retinol binding protein (RBP). Protein deficiency may influence vitamin A status by reducing the synthesis of RBP.

Storage in the Body

The storage of vitamin A in the liver is important, for in many tropical diets foods containing vitamin A and carotene are available seasonally. If these foods are eaten in fairly large quantities when available (usually during the wet season), a store can be built up which will help tide the person over the dry season, or at least part of it. The short mango season provides an excellent opportunity for youngsters, who may happily spend their leisure hours foraging for this fruit, to replenish the vitamin A stored in the liver.

Toxicity

If taken in excess, vitamin A has undesirable toxic effects. The most marked toxic effect is an irregular thickening of some long bones, usually accompanied by headache, vomiting, liver enlargement, skin changes and hair loss. Cases of vitamin A toxicity from dietary sources are rare, but toxicity can be a serious problem with supplemental doses of vitamin A. A high risk of birth defects is associated with supplements given before or during pregnancy.

Human Requirements

The intake recommended by FAO and the World Health Organization (WHO) is 750 μg of retinol per day for adults; lactating mothers need 50

per cent more, and children and infants less. It should be noted that these figures are based upon mixed diets containing both vitamin A and carotene. When the diet is entirely of vegetable origin, larger amounts of carotene are suggested, because the conversion from carotene to retinol is not very efficient.

Deficiency

Deficiency results in pathological drying of the eye, leading to xerophthalmia and sometimes keratomalacia and blindness. Other epithelial tissues may be affected; in the skin, follicular keratosis may be the result. These conditions are described in detail in Chapter 15.

Thiamine (Vitamin B_1)

During the 1890s in Java, Indonesia, Christiaan Eijkman of the Netherlands noticed that when his chickens were fed on the same diet as that normally consumed by his beriberi patients, they developed weakness in their legs and other signs somewhat similar to those of beriberi. The diet of the beriberi patients consisted mainly of highly milled and refined rice (known as polished rice). When Eijkman changed the diet of the chickens to whole-grain rice, they began to recover. He showed that there was a substance in the outer layers and germ of the rice grain that protected the chickens from the disease.

Researchers continued to work on isolating the cause of the different effects of diets of polished and whole-grain rice, but despite many attempts it was not until 1926 that vitamin B_1 was finally isolated in crystalline form. It was synthesized ten years later, and now the term thiamine is used, rather than vitamin B_1.

Properties

Thiamine is one of the most unstable vitamins. It has a rather loosely bound structure and decomposes readily in an alkaline medium. Thiamine is highly soluble in water. It resists temperatures of up to 100°C, but it tends to be destroyed if heated further (e.g. if fried in a hot pan or cooked under pressure).

Much research has been carried out on the physiological effects and biochemical properties of thiamine. It has been shown that thiamine has a very important role in carbohydrate metabolism in humans. It is utilized in the complicated mechanism of the breakdown, or oxidation, of carbohydrate and the metabolism of pyruvic acid.

The energy used by the nervous system is derived entirely from carbohydrate, and a deficiency of thiamine blocks the final utilization of carbohydrate, leading to a shortage of energy and lesions of the nervous

tissues and brain. Because thiamine is involved in carbohydrate metabolism, a person whose main supply of energy comes from carbohydrates is more likely to develop signs of thiamine deficiency if his or her food intake is decreased. For this reason, thiamine requirements are sometimes expressed in relation to intake of carbohydrate.

Thiamine has been synthesized in pure form and is now measured in milligrams.

Dietary Sources

Thiamine is widely distributed in foods of both vegetable and animal origin. The richest sources are cereal grains and pulses. Green vegetables, fish, meat, fruit and milk all contain useful quantities. In seeds such as cereals, the thiamine is present mainly in the germ and in the outer coats; thus much can be lost during milling. Bran of rice, wheat and other cereals tends to be naturally rich in thiamine. Yeasts are also rich sources. Root crops are poor sources. Cassava, for example, contains only about the same low quantity as polished, highly milled rice. It is surprising that beriberi is not common among the many people in Africa, Asia and Latin America whose staple food is cassava.

Because it is very soluble in water, thiamine is liable to be lost from food that is washed too thoroughly or cooked in excess water that is afterwards discarded. For people on a rice diet, it is especially important to prepare rice with just the amount of water that will be absorbed in cooking, or to use water that is left over in soups or stews, for this water will contain thiamine and other nutrients.

Cereals and pulses maintain their thiamine for a year or more if they are stored well, but if they are attacked by bacteria, insects or moulds the content of thiamine gradually diminishes.

Absorption and Storage in the Body

Thiamine is easily absorbed from the intestinal tract, but little is stored in the body. Experimental evidence indicates that humans can store only enough for about six weeks. The liver, heart and brain have a higher concentration than the muscles and other organs. A person with a high intake of thiamine soon begins to excrete increased quantities in the urine. The total amount in the body is about 25 mg.

Human Requirements

A daily intake of 1 mg of thiamine is sufficient for a moderately active man and 0.8 mg for a moderately active woman. Pregnant and lactating women may need more. FAO and WHO recommend an intake of 0.4 mg per 1 000 kcal for most persons.

Deficiency

Deficiency of thiamine leads to the disease beriberi, which in advanced forms produces paralysis of the limbs. In alcoholics thiamine deficiency leads to a condition termed Wernicke-Korsakoff syndrome. These disorders are described in Chapter 16.

Riboflavin (Vitamin B_2)

Early work on the properties of vitamins in yeast and other foodstuffs showed that antineuritic factors were destroyed by excessive heat, but that a growth-promoting factor was not destroyed in this way. This factor, riboflavin, was later isolated from the heat-resistant portion. It was synthesized in 1935.

Properties

Riboflavin is a yellow crystalline substance. It is much less soluble in water and more heat resistant than thiamine. The vitamin is sensitive to sunlight, so milk, for example, if left exposed may lose considerable quantities of riboflavin. Riboflavin acts as a coenzyme involved with tissue oxidation. It is measured in milligrams.

Dietary Sources

The richest sources of riboflavin are milk and its non-fat products. Green vegetables, meat (especially liver), fish and eggs contain useful quantities.

However, the main sources in most Asian, African and Latin American diets, which do not contain much of the products, are usually cereal grains and pulses. As with thiamine, the quantity of riboflavin present is much reduced by milling. Starchy foods such as cassava, plantains, yams and sweet potatoes are poor sources.

Human Requirements

Approximately 1.5 mg of riboflavin per day is an ample amount for an average adult, but rather more may be desirable during pregnancy and lactation. The FAO/WHO requirement is 0.55 mg per 1 000 kcal in the diet.

Deficiency

In humans a deficiency of riboflavin is termed ariboflavinosis. It may be characterized by painful cracking of the lips (cheilosis) and at the corners of the mouth (angular stomatitis). The clinical manifestations are described in Chapter 22. Ariboflavinosis is common in most countries but is not life threatening.

Niacin (Nicotinic Acid, Nicotinamide, Vitamin PP)

As the history of thiamine is linked with the disease beriberi, so the history of niacin is closely linked with the disease pellagra. beriberi is associated with the East and a rice diet, and pellagra with the West and a maize diet.

Pellagra was first attributed to a poor diet over 200 years ago by the Spanish physician Gaspar Casal. At first, it was believed that pellagra might be caused by a protein deficiency, because the disease could be cured by some diets rich in protein. Later it was shown that a liver extract almost devoid of protein could cure pellagra. In 1926 J. Goldberger, in the United States, demonstrated that yeast extract contained a pellagra-preventing (PP) non-protein substance. In 1937 niacinamide or nicotinamide (nicotinic acid amide) was isolated, and this was found to cure a pellagra-like disease of dogs known as black tongue.

Because pellagra was found mainly in those whose staple diet was maize, it was assumed that maize was particularly poor in niacin. It has since been shown that white bread contains much less niacin than maize. However, the niacin in maize is not fully available because it is in a bound form.

The discovery that the amino acid tryptophan prevents pellagra in experimental animals, just as niacin does, complicated the picture until it was shown that tryptophan is converted to niacin in the human body. This work vindicated and explained the early theories that protein could prevent pellagra. The fact that zein, the main protein in maize, is very deficient in the amino acid tryptophan further explains the relationship between maize and pellagra. It has also been shown that a high intake of leucine, as occurs with diets based on sorghum, interferes with tryptophan and niacin metabolism and may cause pellagra.

Properties

Niacin, a derivative of pyridine, is a white crystalline substance, soluble in water and extremely stable. It has been synthesized. The main role of niacin in the body is in tissue oxidation. The vitamin occurs in two forms, nicotinic acid and nicotinamide (niacinamide). Niacin is measured in milligrams.

Dietary Sources

Niacin is widely distributed in foods of both animal and vegetable origin. Particularly good sources are meat (especially liver), groundnuts and cereal bran or germ. As for other B vitamins, the main source of supply tends to be the staple food. whole-grain or lightly milled cereals, although not rich in niacin, contain much more than highly milled cereal grains.

Starchy roots, plantains and milk are poor sources. Beans, peas and other pulses contain amounts similar to those in most cereals.

Although the niacin in maize does not seem to be fully utilizable, treatment of maize with alkalis such as lime water, which is a traditional method of processing in Mexico and elsewhere, makes the niacin much more available.

Cooking, preservation and storage of food cause little loss of niacin.

Human Requirements

An adequate quantity for any person is 20 mg per day. Niacin requirements are affected by the amount of tryptophan containing protein consumed and also by the staple diet (i.e. whether it is maize-based or not). The FAO/WHO requirement is 6.6 mg per 1000 kcal in the diet.

Deficiency

A deficiency of niacin leads to pellagra, the "disease of the three Ds": dermatitis, diarrhoea and dementia. Initially manifested as skin trouble, pellagra, if untreated, can continue for many years, growing steadily worse.

Vitamin B_{12} (Cyanocobalamin)

Pernicious anaemia, so named because it invariably used to be fatal, was known for many years before its cause was determined. In 1926 it was found that patients improved if they ate raw liver.

This finding led to the preparation of liver extracts, which controlled the disease when given by injection. In 1948 scientists isolated from liver a substance they called vitamin B_{12}. When given in very small quantities by injection, this substance was effective in the treatment of pernicious anaemia.

Properties

Vitamin B_{12} is a red crystalline substance containing the metal cobalt. It is necessary for the production of healthy red blood cells. A small addition of vitamin B_{12} or of foods rich in this substance to the diet of experimental animals results in increased growth. It is measured in micrograms.

Dietary Sources

Vitamin B_{12} is present only in foods of animal origin. It can also be synthesized by many bacteria. Herbivorous animals such as cattle get their vitamin B_{12} from the action of bacteria on vegetable matter in their rumen. Humans apparently do not obtain vitamin B_{12} by bacterial action in their

digestive tracts. However, fermented vegetable products may provide vitamin B_{12} in human diets.

Human Requirements

The human daily requirement of this vitamin is quite small, probably around 3μg for adults. Diets containing smaller amounts do not seem to lead to disease.

Deficiency

Pernicious anaemia is not caused by a dietary deficiency of vitamin B_{12} but by an inability of the subject to utilize the vitamin B_{12} in the diet because of a lack of an intrinsic factor in gastric secretions. It may be that an autoimmune reaction limits absorption of vitamin B_{12} In pernicious anaemia the red blood cells are macrocytic (larger than normal) and the bone marrow contains many abnormal cells called megaloblasts. This macrocytic or megaloblastic anaemia is accompanied by a lack of hydrochloric acid in the stomach (achlorhydria). Later, serious changes take place in the spinal cord, leading to progressive neurological symptoms. If left untreated, the patient dies.

Treatment consists of injection of large doses of vitamin B_{12} When the blood characteristics have returned to normal, the patient can usually be maintained in good health if given one injection of 250 mg of vitamin B_{12} every two to four weeks.

Vitamin B_{12} will also cure the anaemia accompanying the disease sprue. This is a tropical condition in which the absorption of vitamin B_{12}, folic acid and other nutrients is impaired.

The tapeworm *Diphyllobothrium latum,* acquired from eating raw or undercooked fish, lives in the intestines and has a propensity for removing vitamin B_{12} from the food of its host. This results in the development in humans of a megaloblastic anaemia which can be cured by injection of vitamin B_{12} and treatment to rid the patient of the tapeworm.

Some medicines interfere with absorption of vitamin B_{12}.

Except in the deficiency of vitamin B_{12} is likely to occur only in those on a vegetarian diet. Deficiency causes macrocytic anaemia and may produce neurological symptoms; however, even though strict vegetarians get very little vitamin B_{12} in their diet, it appears that macrocytic anaemia due to vitamin B_{12} deficiency is not prevalent and is not a major public health problem.

Folic Acid or Folates

In 1929 Lucy Wills first described a macrocytic anaemia (an anaemia in which the red cells are abnormally large) commonly found among

pregnant women in India. This condition responded to certain yeast preparations even though it did not respond to iron or any known vitamin. The substance present in the yeast extract that cured the macrocytic anaemia was at first called "Wills' factor". In 1946 a substance called folic acid, which had been isolated from spinach leaves, was found to have the same effect.

Properties

Folic acid is the group name (also termed folates or folacin) given to a number of yellow crystalline compounds related to pteroglutamic acid. Folic acid is involved in amino acid metabolism. The folic acid in foodstuffs is easily destroyed by cooking. It is measured in milligrams.

Dietary Sources

The richest sources are dark green leaves, liver and kidney. Other vegetables and meats contain smaller amounts.

Human Requirements

The recommended daily intake for adults has been set at 400 μg in the United States.

Deficiency

Folate deficiency is most commonly due to poor diets, but it may result from malabsorption. It can be induced by medicines such as those used in treatment of epilepsy. A deficiency leads to the development of macrocytic anaemia. Anaemia resulting from folate deficiency is the second most common type of nutritional anaemia, after iron deficiency.

Folic acid deficiency during pregnancy has been found to cause neural tube defects in newborn babies. The role of folic acid in prevention of ischaemic heart disease has also recently received increased attention.

The main therapeutic use of folic acid is in the treatment of nutritional macrocytic or megaloblastic anaemias of pregnancy and infancy and for the prevention of neural tube defects. A dose of 5 to 10 mg daily is recommended for an adult.

Although administration of folic acid will improve the blood picture of persons with pernicious anaemia, the nervous system symptoms will neither be prevented nor improved by it. For this reason, folic acid should never be used in the treatment of pernicious anaemia, except in conjunction with vitamin B_{12}.

Vitamin C (Aascorbic Acid)

The discovery of vitamin C is associated with scurvy, which was first

recorded by seafarers who made prolonged journeys. In 1497 Vasco da Gama described scurvy among the crew of his historical voyage from Europe around the southern tip of Africa to India; more than half the crew died of the disease.

It gradually became apparent that scurvy occurred only in persons who ate no fresh food. It was not until 1747, however, that James Lind of Scotland demonstrated that scurvy could be prevented or cured by the consumption of citrus fruit. This finding led to the introduction of fresh food, especially citrus products, to the rations of seafarers. Subsequently scurvy became much less common.

In the nineteenth century, however, scurvy began to occur among infants receiving the newly introduced preserved milk instead of breastmilk or fresh cows' milk. The preserved milk contained adequate carbohydrate, fat, protein and minerals, but the heat used in its processing destroyed the vitamin C, so the infants got scurvy.

Later vitamin C was found to be ascorbic acid, which had already been identified.

Properties

Ascorbic acid is a white crystalline substance that is highly soluble in water. It tends to be easily oxidized. It is not affected by light, but it is destroyed by excessive heat, especially when in an alkaline solution. It is a powerful reducing agent and antioxidant and can therefore reduce the harmful action of free radicals. It is also important in enhancing the absorption of the non-haem iron in foods of vegetable origin.

Ascorbic acid is necessary for the proper formation and maintenance of intercellular material, particularly collagen. In simple terms, it is essential for producing part of the substance that binds cells together, as cement binds bricks together.

In a person suffering from ascorbic acid deficiency, the endothelial cells of the capillaries lack normal solidification. They are therefore fragile, and haemorrhages take place. Similarly, the dentine of the teeth and the osteoid tissue of the bone are improperly formed. This cell-binding property also explains the poor scar formation and slow healing of wounds manifest in persons deficient in ascorbic acid.

It is a common belief, claimed also by some scientists, that very large doses of vitamin C both prevent and reduce symptoms of the common cold (coryza). This claim has not been verified. One large study did suggest a modest reduction in the severity of cold symptoms in those taking vitamin C medicinally, but the vitamin Did not prevent colds from occurring. It is not advisable to take very large doses of medicinal vitamin C for long periods of time.

Dietary Sources

The main sources of vitamin C in most diets are fruits, vegetables and various leaves. In pastoral tribes milk is often the main source. Plantains and bananas are the only common staple foods containing fair quantities of vitamin C. Dark green leaves such as amaranth and spinach contain far more than pale leaves such as cabbage and lettuce. Root vegetables and potatoes contain small but useful quantities. Young maize provides some ascorbic acid, as do sprouted cereals and pulses. Animal products such as meat, fish, milk and eggs contain small quantities.

As vitamin C is easily destroyed by heat, prolonged cooking of any food may destroy much of the vitamin C present.

Ascorbic acid is measured in milligrams of the pure vitamin.

Human Requirements

Opinions regarding human requirements differ widely. It seems clear that as much as 75 mg per day is necessary if the body is to remain fully saturated with vitamin C. However, individuals appear to remain healthy on intakes as low as 10 mg per day. A recommendation of 25 mg for an adult, 30 mg for adolescents, 35 mg during pregnancy and 45 mg during lactation seems to be a reasonable compromise.

Deficiency

Scurvy and the other clinical manifestations of vitamin C deficiency are described in Chapter 19. Scurvy is not now a prevalent disease. Outbreaks have occurred in famine areas and recently in several refugee camps in Africa. In its early stages vitamin C deficiency may lead to bleeding gums and slow healing of wounds.

Vitamin D

Vitamin D is associated with prevention of the disease rickets and its adult counterpart osteomalacia (softening of the bones). Rickets was for many years suspected to be a nutritional deficiency disease, and in certain parts of the world cod-liver oil was used in its treatment. However, it was not until 1919 that Sir Edward Mellanby, using puppies, demonstrated conclusively that the disease was indeed of nutritional origin and that it responded to vitamin D in cod-liver oil. Later it was proved that action of sunlight on the skin leads to the production of the vitamin D used by humans.

Properties

A number of compounds, all sterols closely related to cholesterol,

possess antirachitic properties. It was found that certain sterols that did not have these properties became antirachitic when acted upon by ultraviolet light. The two important activated sterols are vitamin D_2 (ergocalciferol) and vitamin D_3 (cholecalciferol).

In human beings, when the skin is exposed to the ultraviolet rays of sunlight, a sterol compound is activated to form vitamin D, which is then available to the body and which has exactly the same function as vitamin D taken in the diet. Dietary vitamin D is only absorbed from the gut in the presence of bile.

The function of vitamin D in the body is to allow the proper absorption of calcium. Vitamin D formed in the skin or absorbed from food acts like a hormone in influencing calcium metabolism. Rickets and osteomalacia, though diseases in which calcium is deficient in certain tissues, are caused not by calcium deficiency in the diet but by a lack of vitamin D which would allow proper utilization of the calcium in the diet.

Vitamin D is often expressed in international units; 1 IU is equivalent to 0.025 μg of vitamin D3.

Dietary Sources

Vitamin D occurs naturally only in the fat in certain animal products. Eggs, cheese, milk and butter are good sources in normal diets. Meat and fish contribute small quantities. Fish-liver oils are very rich. Cereals, vegetables and fruit contain no vitamin D.

Storage in the Body

The body has a considerable capacity to store vitamin D in fatty tissue and in the liver. An adequate store is important in a pregnant woman, to avoid predisposition to rickets in the child.

Human Requirements

It is not possible to define human dietary requirements, because the vitamin is obtained both by eating foods containing vitamin D and by the action of sunlight on the skin. There is no need for adults to have any vitamin D in their diets, provided they are adequately exposed to sunlight, and many children in Asia, Latin America and Africa survive in good health on a diet almost completely devoid of vitamin D. It has been shown that fish-liver oil containing 400 IU (10 μg) of vitamin D will prevent the occurrence of rickets in infants or children not exposed to sunlight. This amount seems to be a safe allowance.

Deficiency

Rickets and osteomalacia, two diseases resulting from a deficiency

of vitamin D, are described in Chapter 18. As vitamin D is produced in humans by the action of the sun on the skin, deficiency is not common in tropical countries, although synthesis of vitamin D may possibly be reduced in darkly pigmented skin. Rickets and osteomalacia are seen sporadically but are more common in areas where tradition or religion keeps women and children indoors. Many cases have been reported from Yemen and Ethiopia. The conditions are manifested mainly by skeletal changes.

Toxicity

Like other fat-soluble vitamins, vitamin D taken in excess in the diet is not well excreted. Consumption of large doses, which has most commonly resulted from overdosing of children with fish-liver oil preparations, can lead to toxicity. Overdosing may lead to hypercalcaemia, diagnosed from high levels of calcium in the blood. Toxicity usually begins with loss of appetite and weight, which may be followed by mental disorientation and finally by kidney failure. Fatalities have been recorded.

Other Vitamins

The two fat-soluble vitamins (A and D) and the six water-soluble vitamins (thiamine, riboflavin, niacin, vitamin B_{12} folates and vitamin C) have been described in some detail because these are the vitamins most likely to be deficient and to be of public health importance in non-industrialized countries. Five other vitamins, although vital to human health, are not very commonly deficient in human diets and so are of less public health importance. These are vitamin B_6, biotin, pantothenic acid, vitamin E and vitamin K.

Vitamin B_6 (Pyridoxine)

Vitamin B_6 is a water-soluble vitamin widely present in foods of both animal and vegetable origin. It is important as a coenzyme in many metabolic processes. Primary dietary deficiency is extremely rare, but vitamin B_6 deficiency became common in tuberculosis patients treated with the drug isoniazid. The patients developed neurological signs and some times also anaemia and dermatosis. Now it is common to provide 10 mg of vitamin B_6 by mouth daily to those receiving large doses of isoniazid. Vitamin B_6 is relatively expensive, however, and the routine administration of vitamin B_6 to patients receiving isoniazid increases the cost of treatment of tuberculosis.

Biotin

Biotin is another water-soluble vitamin of the B complex group. It is

found widely in food, and deficiency in humans is extremely rare. The vitamin is very important, however, in physiological and biochemical metabolic processes. Avidin in uncooked egg white prevents absorption of biotin in animals and humans. Rats fed egg white as their only source of protein become thin and wasted and develop neuropathies and dermatitis. Biotin deficiency has been reported in a very few cases, in people consuming mainly egg white and in a few intravenously-fed patients with some special forms of malabsorption.

Pantothenic Acid

Pantothenic acid, a water-soluble vitamin, is present in adequate amounts in almost all human diets. It has important biochemical functions in various enzyme reactions, but deficiency in humans is very rare. A neurological condition described as burning feet syndrome, reported in prisoners of war held by the Japanese between 1942 and 1945, was ascribed to a deficiency of this vitamin.

Vitamin E (Tocopherol)

Vitamin E, a fat-soluble vitamin, is obtained by humans mainly from vegetable oils and whole-grain cereals. It has been termed the "anti-sterility vitamin" or even the "sex vitamin" because rats fed on tocopherol-deficient diets cannot reproduce: males develop abnormalities in the testicles and females abort spontaneously.

Because of its relationship to fertility and to many conditions in animals, vitamin E is widely self-prescribed and is not uncommonly recommended by physicians for a variety of human ills. However, true deficiency is probably rare; it occurs mainly in association with severe malabsorption states (when fat is poorly absorbed), in genetic anaemias [including glucose-6-phosphatase dehydrogenase (G-6PD) deficiency] and occasionally in very low-weight babies.

Vitamin E (like vitamin C) is an antioxidant, and because of its ability to limit oxidation and to deal with damaging free radicals it is sometimes recommended as a possible preventive for both arteriosclerosis and cancer. Its presence in oils helps prevent the oxidation of unsaturated fatty acids.

Vitamin K

Vitamin K has been termed the "coagulation vitamin" because of its relationship to prothrombin and blood coagulation, and because it is successfully used to treat a bleeding condition of newborn infants (haemorrhagic disease of the newborn). Humans obtain some vitamin K from food, and some is also made by bacteria in the intestines. Newborn infants have a gut free of organisms, so they do not get vitamin K from

bacterial synthesis. It is now believed that intravenously-fed or starved patients receiving broad-spectrum antibiotics that kill gut bacteria may bleed because of vitamin K deficiency. In many hospitals vitamin K is given routinely to newborn infants to prevent haemorrhagic disease.

FOOD GROUP

Milk and Dairy Products

This group contains milk, yoghurt, fromage frais, milkshakes, cheese – both hard cheese and soft cheese including soft cheese triangles. These foods contain protein and calcium and some vitamins like vitamin B12, vitamin A and vitamin D. Dairy products keep your bones and teeth healthy. The body absorbs the calcium in dairy foods easily. We should try and eat three servings of these a day.

One portion of milk and dairy products.

- One glass of milk.
- One pot of yoghurt or fromage frais.
- One matchbox size piece of cheese or two triangles. Half a tin of low-fat custard.

Fig. Milk and Dairy Products

Fruit and Vegetables

This group includes fresh as well as frozen, tinned, dried and juices of fruits and vegetables. Fruit and vegetables give you lots of vitamins and chemicals called antioxidants which keep you healthy. These can even stop you getting some cancers. They also contain fibre to keep your digestive system healthy. Because fruit and veg are low in calories and high in fibre (which keep kids feeling full) eating plenty will help control your weight It is important to eat a wide variety of fruit and vegetables. This way you get the whole range of all the important nutrients these foods give. You should eat at least five portions of fruit and vegetables a day.

One portion of fruit and vegetables.

- One apple, orange, pear or banana or similar sized fruit.
- Two smaller fruits such as plums, satsumas, kiwi fruit.
- A handful of very small fruits such as grapes, cherries or berries.
- Half to one tablespoon of dried fruits such as raisins, prunes or apricots.
- A slice of large fruit such as a piece of melon or a slice of pineapple.
- Three heaped tablespoons of raw, cooked, frozen or canned vegetables.
- A dessert bowl of salad.

Carbohydrates

This group contains starchy foods such as pasta, rice, oats, potatoes, noodles, yam, green bananas, sweet potato, millet, couscous, breads, breakfasts cereals, barley and rye. Carbohydrates give us energy, calcium and B vitamins. Wholegrain ones give us lots of fibre to help keep the digestive system healthy. Many breakfast cereals also have extra iron. A healthy diet would include 3-5 servings of carbohydrate a day. These portions should be spread throughout the day and eaten with every meal, including snacks.

One portion of carbohydrate is:

- One slice of bread, one roll or half a pizza.
- Six tablespoons of breakfast cereal or porridge.
- Four wholewheat crisp breads.
- Six tablespoons of pasta, rice, millet or couscous.
- Two small new potatoes.
- Two tablespoons mashed sweet potato.

Fats and Sugars

This group contains butter, margarine, cooking oils, cream, salad dressings, chocolate, crisps, sugary soft drinks, sweets, jam, cakes, pudding, biscuits and pastries. These foods give us a lot of energy (calories) but not many nutrients.

Junk foods are often high in fat, sugar and salt. It's important not to have too many foods from this group too often.

Meat and Vegetable Protein

This group contains meat, fish and eggs as well as vegetable protein, nuts, beans, peas, lentils, dahl, Quorn and soya. These foods give us protein, iron and some other minerals and vitamins. This helps the body to grow and repair itself. They are like building blocks for the body. Meat is a good source of iron. We should eat 2-3 servings of these every day.

One portion of meat or vegetable protein

- Two slices of cold ham, turkey and chicken.
- One medium chicken breast.
- Two sausages.
- Three bacon rashers.
- One beefburger.
- One fillet of fish or fish steak.
- One small can of tuna, salmon, mackerel, sardines.
- Four fish fingers.
- One cup of cooked lentils or beans.
- Half a large can of beans, chickpeas or lentils.
- A 100g portion of Tofu or Quorn.

Chapter 4

Digestion and Absorption

DIGESTION

Digestion is the breakdown of food into smaller particles or individual nutrients. It is accomplished through six basic processes, with the help of several body fluids—particularly digestive juices that are made up of compounds such as saliva, mucus, enzymes, hydrochloric acid, bicarbonate, and bile.

The six processes of digestion involve:

- The movement of food and liquids;
- The lubrication of food with bodily secretions;
- The mechanical breakdown of carbohydrates, fats, and proteins;
- The reabsorption of nutrients—especially water;
- The production of nutrients such as vitamin K and biotin by friendly bacteria; and
- The excretion of waste products.

Comprehension of the tasks or processes needed to break down food are essential to an understanding of how and when food really begins to function within the body. For example, not understanding that carbohydrates break down into glucose could lead one to believe that the best source of glucose is in liquid form such as a soft drink. This could cause one to miss out on the nutrients (and great taste) in fruits, vegetables, and grains. Likewise, not understanding the digestion process could lead a person to believe in the myth of "food combining," or perhaps to think it is normal to be hungry all the time. But, in fact, the digestive processes normal to human physiology can simultaneously handle carbohydrates, fats, and proteins—and allow people to go several hours between meals, especially if meals are balanced in fibre and the individual nutrients needed.

GI Tract Physiology

Digestion begins in the mouth with the action of salivary amylase. The food material then progresses past the esophagus and into the

stomach. A bolus (soft mass) of chewed food moves by muscular wave actions, called *peristalsis*, from the mouth to the pharynx, and then past the epiglottis that covers the larynx. The epiglottis closes off the air passage so that one doesn't choke. The cardiac sphincter prevents reflux of stomach contents into the esophagus.

From the Stomach to the Small Intestine

Food mixtures leaving the stomach are called *chyme*, and this empties into the small intestine after about two to four hours in the stomach. The small intestine is where most digestion takes place. A pyloric sphincter controls the rate of flow of chyme from the stomach into the small intestine.

Most digestion occurs in the upper portion of the small intestine, called the duodenum. Below the duodenum is the *jejunum*, and then there is the last segment, called the *ileum*. About 5 percent of undigested food products are broken down in the ileum. This is why some people can have a small part of their intestine removed and still seem to digest most foods with little problem.

Digestion of food that enters the small intestine is usually complete after three to ten hours. Once digestion is essentially finished, waste products leave the ileum with the help of fibre, and these solids then enter the large intestine (the colon). In the colon, water is reabsorbed; some nutrients are produced by friendly bacteria (vitamin K, biotin, vitamin B_{12}); fibers are digested to various acids and gases; and minerals, such as potassium and sodium, are reabsorbed (when needed). Any fibre that is not broken down—and small amounts of other undigested products—are excreted in the feces.

Protective Factors

During digestion in the stomach, large proteins break down into smaller protein forms, and harmful bacteria can become inactive. Hydrochloric acid is especially important for this because it lowers the pH of the stomach contents below 2. Along with the uncoiling of protein in the stomach, a little carbohydrate and lipid are broken down with the help of enzymes (called *amylase* and *lipase*, respectively).

In the stomach, carbohydrates in foods turn to starch, but it is not until the chyme reaches the small intestine and becomes more neutralized that starch turns to simple sugars that are then absorbed into the portal vein, which transports them to the liver. Also in the small intestine, lipids (mostly in the form of triglycerides) are emulsified and form monoglycerides and free fatty acids that can then go through the lymph system to the heart and bloodstream.

As previously mentioned, the mouth, stomach, small intestine, and

colon are the major organs of digestion. However, the liver, gallbladder, and pancreas are also important to the process. The liver detoxifies foreign compounds, such as natural toxicants in foods and drugs. The liver also makes bile, an emulsifier, which enters the small intestine and prepares fats and oils for digestion. This bile is stored in the gallbladder prior to delivery to the small intestine. A hormone called *cholecystokinin* helps control the release of bile.

The pancreas makes pancreatic juice consisting of enzymes (amylases, lipases, and proteases) and bicarbonate, which helps neutralize acidic secretions produced during digestion. The pancreas delivers the pancreatic juice to the small intestine, in response to a signal of food in the intestine and the release of the hormone *secretin*. The pancreas also has another function, the secretion of the hormones *insulin* and *glucagon*, which helps maintain a steady state of blood sugar in the body (insulin decreases blood glucose concentration, while glucagon increases it).

Food moves from the mouth to the epiglottis, bypassing the trachea, into the esophagus, past the cardiac sphincter into the stomach, past the pyloric valve into the small intestine (duodenum, jejunum, ileum), and then past the ileocecal valve into the colon. Waste then leaves the colon through the rectum and anus. When chyme reaches the small intestine, the pancreas and liver contribute to the digestion by providing products such as bicarbonate, enzymes, and bile.

Absorption

Absorption is the movement of molecules across the gastrointestinal (GI) tract into the circulatory system. Most of the end-products of digestion, along with vitamins, minerals, and water, are absorbed in the small intestinal lumen by four mechanisms for absorption:

- Active transport,
- Passive diffusion,
- Endocytosis, and
- Facilitative diffusion.

Active transport requires energy.

Nutrient absorption is efficient because the GI tract is folded with several surfaces for absorption and these surfaces are lined with villi (hairlike projections) and microvilli cells.. Efficient absorption can be compromised due to lactose intolerance. Lactose intolerance is not uncommon in the world, affecting about 25 percent of the U.S. population and 75 percent of the worldwide population. It is usually due to the lack or absence of the enzyme *lactase*, which breaks down milk sugar.

Lactose intolerance is not a food allergy. Food allergies are serious, even life threatening, but most people with lactose intolerance can digest

small amounts of milk, especially in yogurt and cheese. Protein, carbohydrate, lipid, and most vitamin absorption occur in the small intestine. Once proteins are broken down by proteases they are absorbed as dipeptides, tripeptides, and individual amino acids. Carbohydrates, including both sugar and starch molecules, are broken down by enzymes in the intestine to disaccharides called *sucrose, lactose,* and *maltose,* and then finally into the end-products known as *glucose, fructose,* and *galactose,* which are absorbed mostly by active transport. Lipase, an enzyme in the pancreas and the small intestine, and bile from the liver, break down lipids into fatty acids and monglycerides; these end-products then are absorbed through villi cells as triglycerides.

Alcohol is not a nutrient, but 80 percent of consumed alcohol is absorbed in the small intestine. The other 20 percent is absorbed into the stomach. Alcohol is absorbed by simple diffusion, which explains why gastric ulcers are not uncommon in people who drink excessively.

Coordination and Transport of Nutrients into the Blood or to the Heart

Hormones and the nervous system coordinate digestion and absorption. The presence of food, or the thought or smell of food, can cause a positive response from these systems. Factors that can inhibit digestion include stress, cold foods, and bacteria.

After foods are digested and nutrients are absorbed, they are transported to specific places throughout the body. Water-soluble nutrients leave the GI tract in the blood and travel via the portal vein, first to the liver and then to the heart. Unlike the vascular system for water-soluble nutrients, the lymphatic system has no pump for fat-soluble nutrients; instead, these nutrients eventually enter the vascular system, though they bypass the activity of the liver at first.

Chapter 5

Food Safety and Preparation

HEALTHY WAYS TO USE BREADS, CEREALS AND OTHER GRAIN PRODUCTS

Vary the taste and texture by choosing among whole-wheat, oatmeal, pumpernickel, rye, and cornmeal products. Try some of the flavored pastas available, spinach noodles or whole-wheat spaghetti. Brown rice gives added texture, fibre, and flavour to many dishes.

Home baking

Use two egg whites in place of each whole egg in quick breads, cookies, and cakes and use lowfat or skim milk. Add a small amount of vanilla, cinnamon, or nutmeg to sweet baked products to enhance flavour when you reduce sugars. Use 3 tablespoons cocoa in place of each ounce of baking chocolate. If fat is needed, to replace the fat in chocolate in baked goods, use 1 tablespoon or less of vegetable oil or margarine (in which the first ingredient on the ingredient label is a liquid as opposed to a hydrogenated solid fat). Some yeast breads, such as English muffins and French bread, can be made without any fat. Salt is a part of most baking products (baking powder and baking soda) so reduce the amount used or use only half the amount of salt called for in baked products.

INFORMATION ON DIFFERENT COOKING METHODS

Microwave

Microwaving cooks food faster than most other methods. You don't need to add fat to meat, poultry, or fish, and use little or no water with vegetables. Microwaving is an excellent way to retain vitamins and colour in vegetables. When foods are boiled in water and the water is subsequently discarded the water soluble vitamins and minerals are lost.

Steam

Steaming is a good way of cooking vegetables without using fat. Try

this method for frozen and fresh vegetables, such as asparagus, broccoli, carrots, spinach, and summer squash. Use a vegetable steamer or colander to hold vegetables, place in pot with a little boiling water and cover. Cook until the vegetables are just tender to preserve colour and vitamins.

Braise

Braising is used mainly for meats that need longer cooking times to become tender. Root vegetables are also good braised. Brown meat first in small amount of oil or in its own fat, then simmer in a covered pan with a little liquid, try using fruit juice, cider, wine, broth, or a combination of these for added flavour

Barbecue

Roasting foods on a rack or a spit over coals is fun, lower fat way to prepare meat, poultry, fish, and vegetables too. Barbecuing gives a distinctive smoked flavour to foods. Trim fat from meat to prevent flare-up of flames and to reduce calories. If seasoning with sauce, use a home-made one with less salt, sugar, and fat.

Broil

Broiling is a quick way of cooking foods under direct heat without added fat. It's great for poultry, fish, and tender cuts of meat. Use a broiling pan or rack set in a shallow pan to allow fat to drain away. If basting, use lemon juice, fruit juice, or both for flavour. Vegetables like onions, zucchini, and tomatoes can also be broiled.

Stirfry

Quick and easy, stirfrying requires relatively little fat and preserves the crispness and colour of vegetables. Heat wok or heavy skillet, add just enough oil to cover the base of the pan, add food, and stir constantly while cooking.

If using meat, start with thin strips or diced portions of meat, poultry, or fish. When meat is almost done, add small pieces of evenly cut vegetables such as onions, broccoli, cauliflower, zucchini, sprouts, carrots, green peppers, and mushrooms. Serve with a low-salt "sweat & sour" or soy sauce.

Roast or Bake

Roasting takes somewhat longer than other methods, but requires little work on your part. Poultry and tender cuts of meat may be roasted. Cook in oven, uncovered on a rack in a shallow roasting pan to drain fat and allow heat to circulate around meat. Potatoes, sweet potatoes, winter

squashes, and onions can also be baked. Simply wash, prick skins and place vegetables on a baking sheet in oven.

Broil or Stew

Foods are cooked in hot liquids in these low-fat, low-salt methods. The liquid left after cooking can become a tasty broth, base of a sauce or served together with dish. If keeping sauce separate for future use, chill liquid first and remove any fat that rises to the top. Starchy or root vegetables such as potatoes, corn-on-the-cob, lima beans, and turnips can also be broiled.

THE POSITIVE BENEFITS OF FOOD IRRADIATION

FDA issued a rule defining the use of irradiation as a safe and effective means to control a major source of food-borne illness, Salmonella and other food-borne bacteria in raw chicken, turkey, and other poultry.

People often become ill after eating contaminated poultry. Symptoms may range from a simple stomach-ache to incapacitating stomach and intestinal disorders, occasionally resulting in death.

Irradiating food to prevent illness from food-borne bacteria is not a new concept. Research on the technology began shortly after World War II, when the US Army began a series of experiments irradiating fresh foods for troops in the field. Since 1963, FDA has passed rules permitting irradiation to curb insects in foods and microorganisms in spices, control parasite contamination in pork, and retard spoilage in fruits and vegetables.

But to many people the word irradiation spells danger. It is associated with atomic bomb explosions and nuclear reactor accidents such as those at Chernobyl and Three Mile Island

Irradiation does not make food radioactive and, therefore, does not increase human exposure to radiation. The specified exposure times and energy levels of radiation sources approved for foods are inadequate to induce radioactivity in the products. The process involves exposing food to a source of radiation, such as to the gamma rays from radioactive cobalt or cesium or to x-rays. However, no radioactive material is ever added to the product. Manufacturers use the same technique to sterilize many disposable medical devices like syringes and needles.

The World Health Organization believes irradiation can substantially reduce food poisoning. According to a 35 year WHO study, there has been a constant increase in the incidence of food-borne diseases, as well as the emergence of "new" disease-causing organisms, such as Listeria.

Food irradiation would be another weapon in the arsenal against food-borne illness. FDA and WHO, however, emphasize that irradiation is not

a substitute for careful handling, storage and cooking of food. Irradiated poultry can become recontaminated if placed next to contaminated, nonirradiated poultry, or left unrefrigerated so that the remaining organisms can grow.

However, as Tanya Roberts of USDA's Economic Research Service stresses, the future of irradiation depends on consumer acceptance - based largely on proof that the process can produce safer foods at lower cost.

PREPARING FOODS TO EAT A HEALTHY DIET

By using a few simple techniques in your food preparation routine you can apply these guidelines, get a balanced diet, and follow the Dietary Guidelines developed by the US Department of Agriculture for developing and maintaining a healthier diet:-

- Decrease calories if you need to lose weight
- Avoid too much fat, saturated fat, and cholesterol
- Increase starch and dietary fibre
- Avoid too much sugar and other sweeteners
- Avoid too much salt and other sodium-containing ingredients

Its as simple as that. By keeping these five points high on your agenda (to-do-list) you will reduce your chances of becoming obese or developing any of the other adverse conditions covered in chapter on - Secondary diagnoses. It is not necessary to painstakingly follow an obscure diet that forbids you to eat your favourite foods, always weigh your foods, or meticulously count your calorie intake.

Use the recipes and menus that follow, until you are familiar with this healthy diet plan, and your lifestyle changes have developed to the stage where you are eating for nutrition and health (eating to live not living to eat). Only then be adventurous, plan your own menus, and live healthfully.

Variety and balance are the keys to planning menus. Each day's menus should include foods from the five major food group spreads, cereals and grain products; vegetables; fruits; meat, poultry, fish, and alternatives; milk, cheese and yogurt. Foods in these groups provide the protein, vitamins, minerals, and dietary fibre that you need. Go easy on foods in the sixth group - fats, sweets, and alcoholic beverages. Also vary your choices of foods within each group because specific foods differ in the kinds and amounts of nutrients they provide.

Keep in mind that no system is perfect! No one set of menus can satisfy everyone, nor can you always eat exactly as planned. It's what you do over the long run, day-to-day, week-to-week, that adds up to good nutritional health.

In spite of the trend to increased eating out, surveys show that people

get about 70 percent of their calories from foods eaten at home or packed in a bag lunches. Keeping nutritious, easy-to-prepare foods on hand for quick meals and snacks can assure your family a healthful diet.

IMPORTANT FOOD SAFETY INFORMATION

Food-borne microorganisms cause tens of millions cases of intestinal illness each year. For most healthy people, the distressful vomiting, abdominal cramps, and diarrhoea are short-lived. But in people with weakened immunity, such as those with AIDS, symptoms are often severe, and the infections are so difficult to treat they can be fatal.

Salmonella bacteria frequently contaminate unpasteurized milk and raw poultry, meat and eggs. Up to 40 percent of marketed raw chickens carry this bacteria. Cross-contamination from raw poultry to other foods during storage or food preparation is a major pathway for salmonella into the diet.

Listeria bacteria are found in unpasteurized milk, cold smoked fish, and certain cheeses, particularly soft-ripened varieties such as Brie and Camembert. Even vegetables can carry Listeria and, once cut, support its growth. A quarter of the estimated 1600 listeriosis cases each year end in death.

Hepatitis A can be transmitted by unsanitary food handling or by eating raw or undercooked shellfish harvested from contaminated waters.

Common-sense precautions in food selection and preparation can significantly lessen the hazard of infection from contaminated food. According to Hawley, M.D., medical director Whitman-Walker Clinic, Washington, D.C., a cardinal rule is:

"Any raw animal-derived food must be considered to be contaminated with harmful microorganisms. Under no circumstance should a high-risk person consume unpasteurized milk or raw or undercooked eggs, poultry, fish, shellfish or meat."

Look for cleanliness at meat and seafood counters and salad bars. For example, cooked shrimp lying on the same bed of ice as raw fish could be contaminated. Buy only Grade A or better eggs. Avoid eggs that are cracked or leaking. Don't buy any foods whose "sell by" or "best used by" date has passed. Read the label to see if the food contains raw or undercooked animal-derived ingredients. Caesar salad dressing, for instance, traditionally uses raw eggs. Buy only milk and cheeses labelled" pasteurized."

Put raw seafood, poultry and meat in plastic bags so drippings can't contaminate other foods in the shopping cart or bag. Take groceries directly home and refrigerate cold foods. Hot foods from the deli should be eaten, kept hotter than 60 degrees Celsius (140 degrees Fahrenheit), or

refrigerated right away. Leaving foods unrefrigerated for even a few hours fosters bacterial growth. Store eggs in their original carton in the main section of the refrigerator. Don't put them in the egg section of the door because the temperature there is higher.

Wash hands, utensils, counters, and cutting surfaces with hot soapy (preferably biodegradable) water between preparation of different foods, particularly after handling raw eggs, meat, poultry, or fish. In other words, wash repeatedly during mealpreparation to avoid cross-contamination. Use plastic or glass cutting boards rather than wooden ones, which are difficult or impossible to clean adequately. Be sure to disassemble and thoroughly wash the meat grinder and blender after grinding raw meat or poultry or blending eggs or vegetables.

Promptly refrigerate or cook foods, including vegetables, after you cut them up. Bacteria can grow at temperatures above 4°C (40°F) and below 60°C (140°F), so temperature is vital in keeping foods safe. Cook beef and lamb to at least 60°C (140°F), pork to 66°C (150°F), and poultry to 74°C (165°F). Follow the recipe for seafood, but don't undercook it. Avoid lightly steamed mussels and snails. Fish should be flaky, not rubbery, when cut. Never eat oysters on the half shell, raw clams, sushi, or sashimi. Cook eggs thoroughly until both the yolk and the white are firm, not runny.

Refrigerate leftovers in covered containers to avoid cross-contamination. Divide hot foods into small portions for quick cooling, and allow room for circulation around containers to prevent the refrigerator or freezer temperature from rising. If food looks or smells suspicious throw it out or put it in a compost heap to use as fertilizer in the garden.

At home don't eat uncooked animal-derived dishes such as steak tartar, sushi, raw oysters, Hollandaise sauce, and homemade mayonnaise, eggnog, or ice cream.

When dinning out, if you don't know what's in a particular dish, ask. Send back undercooked food - poultry that's even slightly pink. When ordering eggs, specify that scrambled eggs be "dry" and that fried eggs be well-cooked on both sides. The runnier the yolk, the higher the risk.

A consumer or physician who believes an episode of diarrhoea or other stomach disorder is related to a particular food or restaurant should tell the local health department or nearest FDA office. Such reporting can help others avoid the illness.

Chapter 6

Nutrition Disorder Related to Food

Acne

Acne is a disorder of the skin's oil glands (sebaceous glands) that results in plugged pores and outbreaks of lesions commonly called pimples or zits. Acne lesions usually occur on the face, neck, back, chest, and shoulders. Nearly 17 million people in the United States have acne, making it the most common skin disease. Although acne is not a serious health threat, severe acne can lead to disfiguring, permanent scarring, which can be upsetting for people who suffer from the disorder.

Acne vulgaris: A form of acne which results from the bacterial infection of cysts deep within the skin. Generally requires treatment with antibiotics and other agents (Isotretinoin). Without treatment cystic acne may result in scarring.

Acne rosacea: A facial skin disorder which results from chronic inflammation of the cheeks, nose, chin, forehead, and-or eyelids. This is often demonstrated by increased redness or acne-like eruptions in these locations on the face.

The exact cause of acne is unknown, but doctors believe it results from several related factors. One important factor is rising hormone levels. These hormones, called androgens (male sex hormones), increase in both boys and girls during puberty and can cause the sebaceous glands to enlarge and make more sebum. Another factor is heredity or genetics. Researchers believe that the tendency to develop acne can be inherited from parents. For example, studies have shown that many school-age boys with acne have a family history of the disorder.

There is no scientific evidence that chocolate, french fries or other greasy foods cause acne. Acne is a skin disorder that can affect people at all ages, from infancy to old age. The years from adolescence to middle age tend to be the most troublesome as far as acne is concerned. Acne treatment seeks to clear up existing acne and prevent more from

developing. Astringents, benzoyl peroxides, retinoic acids, and glycolic acids all work to prevent pores from clogging. Antibiotics, either taken orally or applied topically, can be used to control some types of acne. In order to decrease the inflammation associated with some cases of acne, topical corticosteroids are used to suppress immune cells in the acne-ridden areas.

Topical vitamin A acid preparations such as tretinoin, adapalene, and tazarotene normalize the shedding of skin at the follicular openings and serve to unplug pore openings. (Tretinoin is more commonly known by the brand name Retin-A.) The medication reduces the formation of new comedones, opens closed comedones, and prompts open comedones to expel their contents. While this process of "opening up" takes place, acne may temporarily appear to worsen. Existing lesions may need time to heal before improvement is noticed. Because of their preventative effect, patients should continue to use vitamin A acids even in the absence of active blemishes. The side effects for vitamin A acids include a mild irritation of the skin that can make a sunburn seem more severe.

Since the exact source of acne is not known, It is important to remember that there is no single medicine for acne treatment. Here are some guidelines to follow:

- Wash your skin twice a day with warm water and a gentle pH balanced soap that does not contain sulfur, chemicals, or perfume.
- Touch your face only when your hands are clean, wash them frequently and avoid touching your nasal area and then your skin.
- Steam your face a few times a week to open and cleanse your pores. Boil some water in a pot on the stove, turn off the heat, cover your head and face with a towel and hang your face over the pot. Take your face away from the heat whenever you need to, and when the steam is gone, rinse your face with cold water.
- Check out your diet. Try eating a diet high in fibre (salads, bran, complex carbohydrates), and lots of water. This will keep your digestive system working so that your skin is not burdened by wastes your system can't handle. Keep your diet low in fat and sugar. Eating healthier foods insures that your skin gets the nutrients it needs. Food allergies may also contribute to acne. You might try eliminating dairy products, wheat, and/or food preservatives.

For severe nodulocystic acne that does not respond to the above therapies, a doctor may prescribe a vitamin-A derivative taken orally, such as isotretinoin which is known by the brand name Accutane. Isotretinoin

has a very high success rate in improving severe acne. Such medication must be monitored very closely by a doctor because of its potentially severe side effects, the biggest of which is a likelihood for severe birth defects in an unborn child.

Vitamin A, vitamin B complex, vitamin E and zinc work together in helping overcome most skin disorders. Puberty increases the body's need for zinc thus a deficiency among adolescents is often the cause of acne. Iodine worsens acne, so eliminate all processed foods high in iodized salt from your diet.

Aging

Life expectancy at birth is now 75 years, compared with about 47 years at the beginning of the last century. Although it is not inevitable, health and mobility often change and decline with advancing age. The increasing life expectancy observed throughout this century suggests that diet, exercise, and other personal and socioeconomic factors can help prolong good health for most people.

Nevertheless, the chances are great that an individual in the eighth or ninth decade of life will be limited in activity and require health and social services. Many older people (the general term older will refer to people over age 65) suffer from arthritis, heart disease, hypertension, hearing loss, diabetes, obesity, gastrointestinal conditions, liver disease, cancer, and other chronic diseases. Heart disease, cancer, and stroke account for over three-quarters of the deaths among older persons and 50 percent of all days of bed confinement. Such chronic conditions as well as dementia prevent functional independence and increase the need for dietary and other long-term care services.

Until the early 1970's, nutrition services for the older population, with the exception of food stamps, were based almost exclusively in hospitals and long-term care facilities. In 1973, in response to the growing population of older people, to rising health care costs, and to greater interest in preventive health care, the Nutrition Programme for the Elderly was established under the Administration on Aging to expand food and nutrition services from the hospital to include communities and homes.

Aging is accompanied by a variety of physiologic, psychologic, economic, and social changes that may compromise nutritional status. Older persons have a prevalence of chronic disease, use medications heavily, and are relatively sedentary.

Many physiologic functions, including the senses of smell and possibly taste, decrease with age. These changes may result in decreased appetite as well as impaired utilization of nutrients and limitations of function.

Dental problems, common in old age, decrease the ability to chew certain foods. Physical disabilities such as diminution of vision may make eating less pleasant. The decreases in basal metabolic rate and physical activity noted with increasing age reduce nutrient needs, however, the intake of calories and essential nutrients may be even lower than these needs. Decreased physical activity also may predispose individuals to the development of osteoporosis.

Changes such as osteoarthritis can affect mobility and decrease an older person's ability to purchase and prepare food. Another possible hinderance to adequate nutrition in the aged is malabsorption, which can be caused by decrease or absence of gastric acid secretion and by interaction with medications commonly prescribed for older persons.

The most common psychologic factor affecting nutrition is depression. Of all psychiatric diagnoses, depression is most strongly correlated with increased mortality, regardless of the age of the subjects, and is most often related to chronic disease and to poverty, which are common among older persons. Neither institutionalization nor solitary living necessarily induces depression, but such life changes may be associated with poor self-esteem, which in turn, can lead to significant changes in eating patterns.

Older people as a group have a lower economic status than other adults. Although the percentage of older individuals living below the poverty level has decreased substantially over the past two decades and is now less than the percentage of those under 65 living in poverty, poverty continues to be too high. The decline in income most often results from retirement from the workforce, the effects of inflation on fixed incomes, death of wage-earning spouse, or failing health. Income and health status have been found to be important determinants of life satisfaction in the older population. Low income is also a major risk factor for inadequate nutrition in older individuals.

Most older people do not live in institutions, although institutional food is likely to meet minimal standards for nutrient content, factors such as lack of choice or limited day-to-day variety may increase the risk of inadequate consumption. Many residents of nursing homes consume a therapeutic diet that may further discourage adequate intake. An important issue for demented institutionalized individuals is that they may not consume the food, not that the menu is inadequate.

Clinical and dietary standards for younger adults may not be appropriate for older persons, yet few data are available on nutritional requirements or recommended intakes of older adults. The RDA's for example, were developed from research on the nutrient needs of younger healthy people. The present standards for adults over the age 50 are, for the most part, identical to those for people aged 23 to 50. Because these

standards fail to consider the great heterogeneity of adults whose ages may differ by as much as 50 years and because they were often not developed from actual measurements on older populations, their appropriateness for older persons is not known.

Energy and Nutrient Status of the Older Population

The national dietary and food consumption surveys conducted during the 1970's reported lower energy intakes among older persons than among younger adults. A study of male executives in the Baltimore Longitudinal Study of Aging found a steady decline in average energy expenditure from 2700 kcal per day at age 30 to 2100 kcal per day at 80 years of age. The decline in energy expenditure was attributed to reduced physical activity and to a decline in basal energy metabolism as a result of a reduction in lean body mass with age.

Although it is difficult to interpret dietary intake studies of older persons because of methodological problems, existingstudies almost always reveal decreases in energy intake with age that may also be influenced by income, race, food preference, and drug use. A low-calorie diet may not impair health as long as the nutrient density of the diet is high and can provide adequate amounts of essential nutrients. However, this issue has not been examined in great detail because nutrient requirements in older people remain largely unknown.

Consequently, the increasing level of obesity among older persons, as indicated by higher weight-for-height with age, requires explanation. Whether the inconsistency between reported low energy intake and increasing body weight is due to measurement errors, inappropriate standards, loss of height with age, or lack of physical activity has not been established.

A 30-day continuous metabolic balance study of seven men and eight women, over 70 years of age, who consumed the RDA levels of protein and energy found that about half were unable to maintain nitrogen balance on this level of protein (0.8 g of protein per kg per day). The results suggested that higher intakes were required to meet protein requirements. Because the RDA for protein includes a substantial safety margin and because clinical measurements have rarely found signs of protein deficiency among healthy older persons, it is not possible to conclude from these data that persons with intake below the RDA are protein deficient or that they would benefit from additional protein intake.

Older people, especially Caucasian women, lose bone mineral and have a higher incidence of fractures than younger persons. Metabolic and absorptive factors as well as low intake may contribute to chronic negative calcium balance. Reduced efficiency of calcium absorption may be due to

inadequate dietary intake, age related changes in gastric acidity, and/or interactions of intestinal constituents such as fibre, bacteria, and other nutrients. Perhaps in some individuals a negative effect on calcium nutriture may be caused by age-related changes in hormonal control, abberations in vitamin D metabolism, and imbalances of protein, phosphorus, alcohol, and electrolytes with calcium.

The RDA for calcium of 800 mg per day may not be sufficient to maintain calcium balance in populations consuming Western diets. Calcium intake by older people is often marginal, for example, 43 percent of women in nursing homes failed to get two-thirds of their calcium requirement. Women living at home consumed even less calcium than those in nursing homes. Older people may have reduced calcium intake because they avoid dairy products containing lactose, to which they are intolerant.

As with people of all ages, the frequency with which anaemia occurs in the older population and determination of its etiology depend on the criteria used for diagnosis.

Because iron reserves increase with age, studies that examine only dietary intake of iron in older people need to be interpreted cautiously. Low dietary iron intake at one point intime does not necessarily increase the risk for anaemia because iron may still be available from body stores and because iron absorption increases when intake and stores are low. In addition, the type of iron and other components of a meal such as ascorbic acid also influence the amount absorbed. Comparison of older subjects who took iron supplements with those who did not showed no clinically significant differences in the biochemical measures of iron status.

Vitamin deficiency may be a result of decreased dietary intake, absorption defects, decreased hepatic avidity for folate in Laennec's cirrhosis, decreased storage and conversion to active metabolic forms, or excessive utilization, destruction, or excretion.

No comprehensive study of all vitamins and their related enzyme systems has been conducted. Most studies have only examined the status of one or two vitamins. A number of studies have indicated a great risk for vitamin deficiencies in older persons on the basis of low dietary intakes, but such deficiencies are not always confirmed by biochemical or clinical results. In addition, interpretation of biochemical parameters is hampered by lack of data on normal standards for the older population. For example, a New Mexico study revealed that more than one-fourth of the older population consumed less than 75 percent of the RDA's for folate and vitamins B_6 and B_{12} from diet alone. However, biochemical studies failed to confirm that these individuals were at risk for developing clinical symptoms associated with low intakes of these vitamins. Intake of vitamin

supplements may explain part of this apparent discrepancy, although analysis showed little statistical difference in mean dietary intake for those individuals taking a specific supplement compared with those who did not take the supplement.

The body pool of ascorbic acid reaches a maximum of approximately 20 milligrams per kilogram. Women require an intake of 75 mg per day and men require an intake of 150 mg per day to achieve this ascorbic acid level in plasma. This finding was supported by a clinical trial that showed that a daily intake of 60 mg was insufficient to maintain this plasma concentration.

Vitamin A deficiency does not seem to be a particular problem in older persons, Although NHANES I and NHANES II (the National Health and Nutrition Examination Surveys) reported that half the study population over age 65 had vitamin A intakes at or less than two-thirds of the RDA, only 0.3 percent of the NHANES older population had low vitamin A blood levels. Whether vitamin A supplement use can account for the observed discrepancy is unknown, but similar data suggest that older individuals can maintain normal vitamin blood levels even with reportedly low dietary intakes.

Previous studies have revealed a generally lowered vitamin D status in older people, chronically ill individuals, and those living in institutions with little or no exposure to sunlight. Because the vitamin D endocrine system is the major regulator of intestinal calcium absorption, a reduced vitamin D status might promote a negative calcium balance in older people.

Two studies in the United States have found dietary intake of vitamin D to be approximately 50 percent of the RDA for older subjects. However, ultraviolet light induced endogenous production of vitamin D is the main external factor in maintaining adequate vitamin D status. Because sunlight exposure activates vitamin D precursors in the skin, it has been recommended that older people obtain at least minimal sunlight exposure (10 to 15 minutes) two or three times a week. Increased sun exposure may help compensate for aging skin's decreased capacity to produce these precursors. Supplements may be necessary to compensate for inadequate sunlight exposure due to seasonal variation in northern latitudes. Moderation of sun exposure should be recommended because overexposure to the sun is a strong risk factor for skin cancer.

There is no evidence that older individuals are deficient either in dietary intake or tissue levels of vitamin E. Despite statements that megadose vitamin E supplements retard the aging process and prevent atherosclerosis and cancer, its use to treat or prevent other conditions has not been established.

Nutritional Supplements

It has been estimated that 37 percent of American adults consume a daily multivitamin preparation, fuelling a $2 billion per year industry. NHANES II indicated that the persons most likely to take supplemental nutrients are less likely to need them, and those most in need of them are least likely to take them.

In older persons, vitamin use has increased dramatically in the past decade. Whether such supplements improve the health of these people cannot be determined from existing data, but it is clear that excessive supplementation may be harmful. High doses of the fat-soluble vitamins A and D are toxic.

Allergic Diseases

Allergic diseases are among the major causes of illness and disability. An allergy is a specific immunologic reaction to a normally harmless substance, one that does not bother most people.

People who have allergies often are sensitive to more than one substance.

Types of allergens that cause allergic reactions include pollens, dust particles, mold spores, food, latex rubber, insect venom, or medicines.

Scientists think that people inherit a tendency to be allergic, meaning an increased likelihood of being allergic to one or more allergens, although they probably do not have an inherited tendency to be allergic to any specific allergens.

Children are much more likely to develop allergies if their parents have allergies, even if only one parent is allergic. Exposure to allergens at certain times when the body's defenses are lowered or weakened, such as after a viral infection or during pregnancy, seems to contribute to the development of allergies.

Normally, the immune system functions as the body's defence against invading agents such as bacteria and viruses. In most allergic reactions, however, the immune system is responding to a false alarm. When an allergic person first comes into contact with an allergen, the immune system treats the allergen as an invader and mobilizes to attack. The immune system does this by generating large amounts of a type of antibody (a disease-fighting protein) called immunoglobin E, or IgE. Each IgE antibody is specific for one particular allergenic (allergy-producing) substance.

The signs and symptoms are familiar to many:

- Sneezing often accompanied by a runny or clogged nose.
- Coughing and postnasal drip.
- Itching eyes, nose, and throat.

- Allergic shiners (dark circles under the eyes caused by increased blood flow near the sinuses).
- The "allergic salute" (in a child, persistent upward rubbing of the nose that causes a crease mark on the nose).
- Watering eyes.
- Conjunctivitis (an inflammation of the membrane that lines the eyelids, causing red-rimmed, swollen eyes, and crusting of the eyelids).

In people who are not allergic, the mucus in the nasal passages simply moves foreign particles to the throat, where they are swallowed or coughed out. But something different happens to a person who is sensitive to airborne allergens.

As soon as the allergen lands on the mucous membranes lining the inside of the nose, a chain reaction occurs that leads the mast cells in these tissues to release histamine and other chemicals. These powerful chemicals contract certain cells that line some small blood vessels in the nose. This allows fluids to escape, which causes the nasal passages to swell, resulting in nasal congestion. Histamine also can cause sneezing, itching, irritation, and excess mucus production, which can result in allergic rhinitis (runny nose). Other chemicals made and released by mast cells, including cytokines and leukotrienes, also contribute to allergic symptoms.

Avoiding exposure to allergens prevents allergic rhinitis. This means avoiding animals if you are allergic to them, and staying in doors and using the air conditioner during times of high pollen counts.

In adults, the most common foods to cause allergic reactions include:

- Shellfish such as shrimp, crayfish, lobster, and crab;
- Peanuts, are one of the chief foods to cause severe anaphylaxis, a sudden drop in blood pressure that can be fatal if not treated quickly;
- Tree nuts such as walnuts;
- Fish;
- And eggs.

In children, the pattern is somewhat different. The most common food allergens that cause problems in children are eggs, milk, and peanuts. Adults usually do not lose their allergies, but children can sometimes outgrow them. Children are more likely to outgrow allergies to milk or soy than allergies to peanuts, fish, or shrimp.

The causes of nonimmunologic adverse reactions to foods include food toxicities, food poisonings, and pharmacologic or metabolic reactions. Such intolerances occur more frequently than true food allergies and are related to dose as well as to the concurrent presence of medications, other diseases, or genetic errors of metabolism.

Tartrazine is used in foods, beverages, drugs and cosmetics. It has been estimated that about 100 000 persons in the United States are sensitive to this substance. Symptoms of allergy include generalized urticaria, swelling, often of the face and lips, runny nose, and on occasion even life threatening asthma. Since tartrazine is found in a large number of products, tartrazine-sensitive individuals are advised to read labels and avoid food containing tartrazine.

The allergic-type reactions range from mild to severe, and in some cases can cause death. "Sulfites" or "sulfating agents" are general terms used to describe sulfur based substances that have been in widespread use for many years by the food and drug industries. They include sulfur dioxide, sodium sulfite, sodium and potassium bisulfite, and sodium and potassium metabisulfite. Although they have various permitted uses, their primary function is as a preservative or antioxidant to prevent or reduce spoilage and discolouration during the preparation, storage and distribution of many foods.

There is some evidence that some non-asthmatics also can suffer adverse reactions to sulfites. For example, out of more than 500 reports of sulfite reactions investigated by the FDA, about one-fourth involved people who had no known history of asthma.

Approximately 10 percent of people with asthma are sensitive to ingestion of sulphite, which induces asthma. Foods containing sulfur dioxide, as a preservative, should be used with caution.

Vitamin C may help alleviate some of the inflammation associated with chronic allergies and a daily dose of about 400 milligrams of magnesium should be taken to relieve respiratory problems.

Asthma

Asthma is a Greek word meaning panting. It is a chronic (condition that has a long duration) lung disease, characterized by recurrent episodes of breathlessness, wheezing, coughing, and chest tightness, termed exacerbations. The severity of exacerbations can range from mild to life threatening. Exacerbations can be triggered by exposures and conditions such as: respiratory infections, house dust mites, cockroaches, animal dander, mold, pollen, cold air, exercise, stress, tobacco smoke and indoor and outdoor air pollutants. Both the frequency and severity of asthma symptoms can be reduced by using medications and reducing exposure to environmental triggers.

It causes bronchoconstriction (narrowing of the airways) due to inflammation (swelling) and tightening of the muscles around the airways. The inflammation also causes an increase in mucus production, which causes coughing that may continue for extended periods.

Asthma currently affects more than 15 million Americans, approximately half of whom have mild, but persistent asthma (symptoms more than twice a week). It is currently estimated to cost the U.S. economy $11.3 billion in health costs and lost productivity. The additional cost of treating all patients with mild persistent asthma with daily medication is estimated at $2 billion.

For the past 15 years, an epidemic of asthma has been underway in the United States. The steady rise in the prevalence of asthma constitutes an epidemic, which by all indications is continuing. Even if rates were to stabilize, asthma would continue to be a profound public health problem. It is a potentially fatal, chronic disease responsible for over 1.8 million emergency room visits per year, over 460 thousand hospitalizations per year and over five thousand deaths per year. Although the burden asthma affects Americans of all ages, races and ethnic groups, recent data indicate that children, low-income and minority populations have been most severely affected.

It is only within the past 20 years that scientists have learned that asthma is due to an inflammatory process in the bronchial air passages of the lungs that causes chronic irritation and narrowing of the airways, resulting in loss of lung function. In 1991, the NHLBI's "Guidelines for the Diagnosis and Management of Asthma" emphasized for the first time the role of inflammation in asthma and called for the use of anti-inflammatory agents to reduce inflammation over the long term, in addition to medications to provide symptom relief.

In 1997, the updated Guidelines recommended that patients with mild persistent asthma take daily medication, such as inhaled corticosteroids or anti-leukotrienes, to prevent or reverse airway inflammation. Since anti-leukotrienes were a relatively new class of medication, the guidelines also called for additional research on them.

Asthma is difficult to diagnose because it has varying degrees of severity and its symptoms are similar to other lung conditions. Working closely with your physician to set up a comprehensive management plan can help reduce the risk of severe attacks and increase your quality of life. By identifying and eliminating triggers, routinely monitoring your breathing and properly using medications, you can help control symptoms and maintain your usual lifestyle. Patients must learn to identify these triggers and practice avoidance techniques. Patients should be aware of any circumstances or substances that worsen their asthma.

In most people younger than age 30, asthma is triggered by allergies. About 40 to 50 percent of adults with asthma are allergic to airborne particles. Skin testing is the best way to determine to what substances you may be allergic. Allergens include house dust mites, cockroaches,

tobacco smoke, pollen, molds and dander from animals, especially cats.

In some people, aspirin and other (Voltaren, Ibuprofen/Advil, Motrin/ Nuprin/Aleve, Ketoprofen / Orudis, Indomethacin, Indocin, Keterolac/ Toradal) nonsteroidal anti-inflammatory drugs (NSAIDs) can worsen symptoms, causing sudden, severe attacks. Sulfites are preservatives added to some perishable foods which can cause hives and shortness of breath in a few people with asthma. The Food and Drug Administration (FDA) now prohibits sulfites in fresh fruits and vegetables, except potatoes, and requires warning labels on foods containing the preservatives.

Nutritional supplements that may be helpful include Vitamin B6, of which a deficiency is common in asthmatics, Magnesium, Selenium, Vitamin C and Vitamin E.

Bacterial Infections

Bacterial infections are caused by the presence and growth of microorganisms that damage host tissue. The extent of infection is generally determined by how many organisms are present and how virulent (toxic) they are. Worldwide, bacterial infections are responsible for more deaths than any other cause. Symptoms can include inflammation and swelling, pain, heat, redness, and loss of function. The most important risk factors are burns, severe trauma, low white blood cell counts, very old or young patients, patients on immunotherapy treatment, and anyone suffering from malnutrition or vitamin deficiency.

Antibiotic is an agent that weakens or destroys bacteria; antibiotics are medicinally used to treat various types of bacterial infections. The various types of antibiotics work either by preventing an infection from growing or by destroying an existing infection. Antibiotics are produced either from a mold or a fungus or are produced synthetically. If bacteria become resistant to the antibiotics or together with the antibiotics these other remedies can be used:

Bromelain - a proteolytic digestive enzyme, can potentiate (augment or strengthen) the effects of conventional antibiotics, making them more effective in killing bacteria.

Arginine - a crystalline basic amino acid, can stimulate antibacterial components of the immune system when taken in doses ranging from 6 to 20 grams per day. Arginine promotes nitric oxide synthesis, which is believed to help protect against bacterial infections.

Burns

Burn is an area of tissue damage, caused by heat (including friction and electricity), by cold, by a caustic chemical, or by radiation. Burns are classified according to the depth of the tissue damage.

Each year in the United States, more than 2 million burn injuries demand medical attention. Ten thousand people die every year of burn-related infections. Tragically, many burn victims are children. The good news is that, in recent years, survival statistics for serious burns have improved dramatically. Twenty years ago, for instance, burns covering half the body were routinely fatal. Today, patients with burns encompassing 90 percent of their body surface can survive, albeit sometimes with permanent impairments.

Among the advances that have contributed directly to this public health benefit are discoveries of the importance of proper wound care, adequate nutrition, and infection control.

First-degree burns produce a redness of the skin, like a sunburn, and they heal without scarring.

Second-degree burns cause the destruction of deeper structures within the skin, resulting in blistering.

Third-degree burns destroy the full thickness of the skin, leaving an open area. The deeper tissues (fat or muscle) are also destroyed.

First and second-degree burns tend to be more painful than third-degree burns, because the nerve endings are damaged but not completely destroyed. Extensive third-degree burns are a life-threatening emergency. Large areas of burned skin cause the loss of the body fluid of the surrounding tissues, which can lead to dehydration and the rapid onset of shock, particularly in children. For this reason, intravenous rehydration may be necessary, as well as local treatment and painkilling drugs. Third-degree burns require a skin graft to prevent disfiguring scars. Recent developments in artificial skin hold great promise for burn victims.

Burn-induced skin loss affords bacteria and other microorganisms easy access to the warm, moist, nutrient-rich fluids that course through the body, while at the same time it provides a conduit for the rapid and dangerous loss of these fluids. Extensive blood loss can thrust a burn or trauma victim into shock, a life-threatening condition in which blood pressure plunges so low that vital organs—such as the brain, heart, and kidneys—simply cannot get enough blood (and thereby oxygen) to function. Hence, replenishing skin lost to severe burns is an urgent matter in the care of a burn patient. When a patient has lost 80 or 90 percent of the skin as a result of direct contact with scalding hot liquids, flames, harsh chemicals, electrical current, or nuclear radiation, two immediate tasks come to the fore. First, a burn surgeon must surgically remove the burned skin, then the unprotected underlying tissue must be quickly covered. Two classes of biomaterials useful in covering the wound are laboratory-grown skin cells and artificial skin; the two are sometimes used in combination.

Regardless of the type of burn, the result is fluid accumulation and

inflammation in and around the wound. Moreover, it should be noted that the skin is the body's first defence against infection by microorganisms. Damage to the skin can predispose the burn victim to both infection at the site of the wound as well as internally.

First degree thermal burns can be treated with local skin care such as Aloe Vera. Many topical antibiotics and antiseptics are available in the drug store for minor burns.

All second and third degree thermal burns and the complicated locations listed above need immediate physician evaluation. Special topical antiseptic creams are used for more serious burns, including silver sulfdiazine, silver nitrate, and mafenide acetate creams.

PABA (Para-aminobenzoic Acid) helps in the assimilation of protein and pantothenic acid. It is important for normal skin and hair growth. It can protect you against sunburn, prevent wrinkles, reduce the pain of burns and restore grey hair to its natural colour.

Proper nutrition may seem far from the minds of a critically injured burn patient or his or her doctor. But delivering the wrong mix of nutrients and minerals into the bloodstream can do more harm than good. NIGMS-funded research by Dr. David Herndon of the University of Texas Medical Branch at Galveston contributed to this conclusion by showing that making the intestinal tract "work" (by feeding the patient by mouth, instead of intravenously) keeps bacteria that normally live in the stomach from seeping into the bloodstream and causing body-wide infections that often lead to deadly septic shock.

The following nutrient combinations are those recommended for the treatment of burns:

Vitamins : A, C, E (internally & topically)
Minerals : Zinc, Postassium
Amino Acids : L-Arginine, L-Ornithine
Food Supplements : Protein, Chlorophyll
Herbs : Aloe Vera

Cholesterol

Cholesteryl esters are composed of a single fatty acid esterfied to cholesterol, in which the polar component is an alcohol.

Cholesterol is normally found in the body in cell walls and membranes, vitamin D, hormones, and fat-digesting enzyme. Excess cholesterol can get deposited in the walls of blood vessels, leading to atherosclerosis, or hardening of the arteries. Atherosclerosis leads to heart attack and stroke. Cholesterol is divided into LDL ("bad" cholesterol), which carries cholesterol in the blood and can get deposited onto the walls of blood vessels, causing atherosclerotic plaques. HDL ("good" cholesterol)

helps clear the blood of cholesterol, and may even remove cholesterol from atherosclerotic blood vessels.

Cholesterol is a major component of all cell membranes. It is required for synthesis of sex hormones, bile acids, and vitamin D. It is also a precursor of the steroid hormones produced by the adrenal cortex and gonads.

Dietary cholesterol is found only in foods derived from animals (meat, fish, poultry, eggs and dairy products); it is not present in plants. Saturated fats have a profound hypercholesterolemic (increase blood cholesterol levels) effect. They are found predominantly in animal products (butter, cheese and meat) but coconut oil and palm oil are common vegetable sources. Saturated fat raises blood cholesterol levels more than anything else in the diet, even more than dietary cholesterol.

Findings suggest that blood lipid cholesterol levels predict subsequent mortality in men, especially those with preexisting cardiovascular disease. Those with high blood cholesterol levels have a risk of death from cardiovascular disease, including coronary heart disease, that was 3.45 times higher than that for men with a "desirable" blood cholesterol level.

Lowering cholesterol levels decreases the incidence of heart disease. In fact, several studies have convincingly shown that adequate hypercholesterolemic treatment can not only prevent CHD, but can also reverse it.

Dietary therapy is the cornerstone of all hypercholesterolemic therapy, and it has been estimated that 65 million adult Americans may be candidates for dietary instruction.

The efficacy of hypercholesterolemic diets lowering cholesterol and in some cases, in preventing CHD, has been convincingly demonstrated. Such efficacy does depend, however, on the vigour which the physician and dietitian support dietary therapy. Many physicians have declared dietary therapy a failure without providing their patients with real dietary advice and support.

Two factors that probably contribute to physicians disinterest in dietary therapy are extensive advertising of hypercholesterolemic drugs compared with the little advertisingof dietary therapy and patient reluctance to alter diet and life-style. Getting patients to alter their life-style is often a challenging task.

To further facilitate dietary therapy, recent research suggests that certain forms of fat (eg. fish and monounsaturated fatty acids) may be hypocholesterolemic, especially if they replace saturated fatty acids in the diet. Food technology is improving daily in palatably, removing fat from items like cheese, chips, and crackers. Frozen yogurt has become a popular replacement for ice cream. Fat substitutes, as they become available, may

also facilitate compliance with a low-fat diet. Scientists first suspected a connection between soy and lower cholesterol levels after observing that people in Asian countries where diets contain much more soy than in the United States have significantly lower levels of heart disease than Americans. Experts believe natural soy compounds called isoflavones act like human hormones that regulate cholesterol levels. A 1998 study concluded that regular consumption of soy isoflavones may reduce total cholesterol levels by up to 10 percent.

A minimum of 25 grams of soy protein must be consumed daily in order to reap optimal cholesterol-lowering benefits. Good sources of soy protein include soy milk, tempeh, tofu, and textured soy protein, a main ingredient in many meat substitutes.

The amount of cholesterol synthesized and metabolized by the body is far greater than the amount usually consumed in the diet. It must also be noted that in healthy people little correlation has been found between the intake of cholesterol and blood cholesterol levels. Yet the level of cholesterol in the blood is increased with high intakes of dietary saturated fat and can be lowered by increasing the intake of linoleic acid and fibre, which leads to a reduction of cholesterol absorption from the intestine and an increased faecal excretion of dietary cholesterol.

There is some evidence indicating that other nutrients can lower blood cholesterol levels. Choline emulsifies cholesterol thus helps to control a build up. Inositol metabolizes fats and cholesterol. Vanadium inhibits the formation of cholesterol in the blood vessels and aids in preventing heart attacks. Zinc also helps to decrease cholesterol levels.

If you are on a cholesterol reducing drug, you will suffer a decrease in the absorption of Vitamin A, thus needing to increase the amount available in your diet.

Psyllium is an especially attractive hybrid intervention in that it is well tolerated, lowers LDL-cholesterol by 10% to 20%, has no adverse effects on triglycerides, high-density-lipoprotein (HDL) cholesterol, or serum glucose, and is readily available and fairly inexpensive. It has a long history of use without any evidence of long-term adverse effects. Onions, Garlic, and Ginger are also recommended for their ability to help lower cholesterol levels.

It is estimated that oat bran supplementation (90 gm per day) was a much more cost-effective method of lowering serum cholesterol than either cholestyramine or colestipol.

Coughing

Cough is an action that clears an irritated area of the lungs or throat. It is a common symptom of a number of disorders, such as the common

cold, influenza, or a minor respiratory illness. A cough may also accompany a serious lung disorder or heart disease. Any cough that lasts for more than a few days should be discussed with a physician.

Coughing is a useful and protective mechanism, and treatment that completely suppresses it could do more harm than good. When a person coughs, a deep breath is taken in, the vocal cords close, and pressure builds up within the lungs. When the cords open, a violent expulsion of air takes place as the body attempts to expel any foreign material in the throat or lower respiratory tract.

Cough syrups that help the person to bring up phlegm are called expectorants, and many kinds are available without prescription. Other preparations containing antihistamines may help to dry up secretions. A cough suppressant, sometimes prescribed by a physician, contains a drug such as codeine or dextromethorphan. Codeine is a narcotic cough suppressant that may be prescribed for a cough in severe cases. It works by "turning off" the part of the brain that controls the coughing response. Codeine is a powerful drug and can have side effects, including nausea, sleepiness, and constipation. It can also be highly addictive.

The following combinations of vitamins and herbs are those recommended for a cough:-

Vitamins :- A, C (chewable)

Minerals :- Potassium Chloride

Herbs :- Garlic, Horseradish , Fenugreek, Licorice (Licorice should not be given to a child with high blood pressure), Herbal Cough Mixture, Ginger, Slippery Elm.

Diabetes Mellitus

Diabetes mellitus (commonly called diabetes) is a condition found in 16 million Americans. About half of these people do not know they have diabetes and are not under care for the disorder. Diabetes is not a single disease but rather a syndrome of hyperglycaemia and glycosuria, accompanied by varying degrees of ketosis and acidosis, with or without weight loss. It has several causes and mechanisms of inheritance.

As diabetes is a condition characterized by metabolic abnormalities (the most evident is hyperglycaemia, an elevated concentration of glucose in the blood), the treatment of it must also prevent or reduce the risk and severity of other long term complications involving multiple organs, the eyes, kidneys, nerves and blood vessels. These complications result from a deficiency of the hormone insulin or a reduction in the effectiveness of insulin.

The longer the duration of diabetes, and the worse the long-term blood glucose control, the more likely are the complications to occur.

There are two major forms of diabetes: Type 1, insulin-dependent, and Type 2, noninsulin dependent.

Type 1 diabetes is characterized by an absolute deficiency of insulin caused by beta-cell destruction of the Islets of Langerhans in the pancreas. Type I diabetes usually appears before the age 40. Typical symptoms are thirst, fatigue, cramps, excessive urination, increased appetite, and weight loss.

Treatment requires administration of insulin, diet coordinated with insulin dosage schedule, and regular physical exercise. Dietary treatment is primary therapy in Type 2 diabetes and is vital treatment to Type I diabetes. Presently, there is no known method to prevent the development of this form of the disease.

Type 2 diabetes, usually appears in midlife, among people who are overweight or obese. Its onset is gradual, and many people have a long history of mild symptoms, or display no symptoms at all. In type 2 diabetes, the pancreas usually produces insulin, but for some reason, the body cannot use the insulin effectively. The end result is the same as for type 1 diabetes—an unhealthy buildup of glucose in the blood and an inability of the body to make efficient use of its main source of fuel.

Obesity is strongly associated with the onset and severity of Type 2 diabetes. New cases of this condition can be reduced by approximately half by preventing obesity in middle-aged adults. The risk of diabetes increases with the degree of obesity and its duration, as well as the distribution of body fat; upper body fat is more associated with Type 2 diabetes than is lower body fat.

Significant caloric reduction lowers blood glucose levels even before weight loss occurs. Once desirable weight is achieved, control of blood sugar levels can be accomplished by consuming just enough energy to maintain it. As weight falls to desirable levels, improvements in cardiovascular disease risk factors, hypertension and high blood lipid levels, also occur.

Diabetes is not contagious. People cannot "catch" it from each other. However, certain factors can increase one's risk of developing diabetes. People who have family members with diabetes (especially type 2 diabetes), who are overweight, or who are African American, Hispanic, or Native American are all at greater risk of developing diabetes.

Type 1 diabetes occurs equally among males and females, but is more common in whites than in nonwhites. Data from the World Health Organization's Multinational Project for Childhood Diabetes indicate that type 1 diabetes is rare in most Asian, African, and American Indian populations. On the other hand, some northern European countries, including Finland and Sweden, have high rates of type 1 diabetes. The

reasons for these differences are not known. People with diabetes must take responsibility for their day-to-day care. Much of the daily care involves trying to keep blood sugar levels from going too low or too high. When blood sugar levels drop too low—a condition known as hypoglycemia—a person can become nervous, shaky, and confused. Judgment can be impaired. Eventually, the person could pass out. The treatment for low blood sugar is to eat or drink something with sugar in it.

On the other hand, a person can become very ill if blood sugar levels rise too high, a condition known as hyperglycemia. Hypoglycemia and hyperglycemia, which can occur in people with type 1 diabetes or type 2 diabetes, are both potentially life-threatening emergencies.

The goal of diabetes management is to keep blood glucose levels as close to the normal (nondiabetic) range as safely possible. A recent Government study, sponsored by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), proved that keeping blood sugar levels as close to normal as safely possible reduces the risk of developing major complications of diabetes.

Generally diabetics should avoid foods containing sucrose and glucose. However, foods containing fructose (fruit sugar) and lactose are usually safe for diabetics. Very high carbohydrate, high-fibre diets, providing 70 percent of calories as carbohydrate consistently improve glucose tolerance. Fibre slows the rate of absorption of sugar into the bloodstream. The three principal approaches to diabetes management are diet, exercise, and treatment with oral antidiabetic agents. Overweight persons can be managed by diet and exercise alone.

Because of the secondary conditions (heart disease, hypertension and loss of sight) persons with diabetes need to be very selective with other nutrients besides sugars.

Dietary Recommendations for Persons with Diabetes

Calories	Should be prescribed to achieve and maintain a desirable body weight.
Carbohydrate	Should comprise 60% of calories. Unrefined should replace all refined carbohydrates.
Protein	should follow the RDA of 0.8 g per kg of body weight for adults. Some reduction in protein intake may prevent or delay the onset of the kidney complications of diabetes.
Fat	Should comprise less than 30% of total calories. Replacement of saturated fats for polyunsaturated fats to reduce the risk of CHD.
Cholesterol	Should be limited to 300mg or less per day to reduce cardiovascular risk.

Sweeteners	Both nutritive and non-nutritive sweeteners are acceptable in diabetes management.
Sodium (Salt)	Should not exceed 3g per day, to minimize symptoms of hypertension.
Alcohol	Should be moderate and may need to be restricted entirely by persons with diabetes and insulin-induced hypoglycaemia, neuropathy, poor control of blood sugar, blood lipids, or obesity.
Vitamin C	Often deficient in diabetics. May help to control blood cholesterol levels and reduce the chances of other complications.
Selenium	Selenium has been shown to reduce the risk of CHD and hypertension.
Selenium	Selenium has been shown to reduce the risk of CHD and hypertension.
Potassium	Potassium regularly produces a decline in blood pressure.
Chromium	Chromium is a constituent part of glucose tolerance factor in the prevention of diabetes.
Magnesium	Lost in urine due to the diuretic effect of high blood sugar. Studies suggest that a deficiency in magnesium may worsen the blood sugar control in Type 2 diabetes. Scientists believe that a deficiency of magnesium interrupts insulin secretion in the pancreas and increases insulin resistance in the body's tissues. Is also used extensively for the treatment of CHD.
Vanadium	A recent study found that when people with diabetes were given vanadium, they deveoped a modest increase in insulinsensitivity and were able to decrease their insulin requirements. Currently researchers want to understand how vanadium works in the body, discover potential side effects, and establish safe dosages.

In recent years, advances in diabetes research have led to better ways to manage diabetes and treat its complications. Major advances include:

- New forms of purified insulin, such as human insulin produced through genetic engineering.
- Better ways for doctors to monitor blood glucose levels and for people with diabetes to test their own blood glucose levels at home.
- Development of external and implantable insulin pumps that deliver appropriate amounts of insulin, replacing daily injections.
- Laser treatment for diabetic eye disease, reducing the risk of blindness.

- Successful transplantation of kidneys in people whose own kidneys fail because of diabetes.
- Better ways of managing diabetic pregnancies, improving chances of successful outcomes.
- New drugs to treat type 2 diabetes and better ways to manage this form of diabetes through weight control.
- Evidence that intensive management of blood glucose reduces and may prevent development of microvascular complications of diabetes.
- Demonstration that antihypertensive drugs called ACE-inhibitors prevent or delay kidney failure in people with diabetes.

In the future, it may be possible to administer insulin through nasal sprays or in the form of a pill or patch. Devices that can "read" blood glucose levels without having to prick a finger to get a blood sample are also being developed.

Researchers continue to search for the cause or causes of diabetes and ways to prevent and cure the disorder. Scientists are looking for genes that may be involved in type 2 diabetes and type 1 diabetes. Some genetic markers for type 1 diabetes have been identified, and it is now possible to screen relatives of people with type 1 diabetes to see if they are at risk for diabetes.

Chapter 7

Meal Planning

Balanced diet is defined as right kind of foods in the right amounts and proportions, to meet the nutrient needs of the persons.

- What to serve ?
- How much to serve ?
- How much to spend ?
- Where to shop ?
- How much to buy ?
- How to prepare food ?
- How to serve meals, at what time ?

MEAL PLANNING

It is a simple exercise which involves applying the knowledge of food, nutrient requirement, individual preferences to plan adequate and acceptable meals.

Meal planning for Adequate Nutrition

Meals must look good, smell good, taste good. Meal planning is a skill, which improves with practice.

Aims of Meal Planning

Fulfill the nutritional needs of the family members (Family size and composition) Plan meals within the family income. Maximum use of the money available, in the best possible way. Aid in the proper purchase, preparation and service of food. Economise on time, labour and fuel.

Provide variety in the diet, by making proper selection of foods from within each of the three food groups.

Make meals appealing and palatable by proper selection of food in terms of colour, texture and flavour.

Provide nutrition meals taking into account individual preferences.

Plan meals in advance, so that any pre-preparation required can be made and also the leftovers from the previous meals can be economically utilised.

MEAL PLANNING FOR VARIOUS AGE GROUPS IS GIVEN BELOW.

Meal Planning for Infants

Child below 1 year is reffered as infant.

Breast milk only is sufficient during the first 4 months.

A thich yellowish coloured liquid oozes out of the breast after 1 to 3 days of child birth. Colostrum is having life aving properties such as antibodies, and has high concentration of WBCs.

A child weighs 2.5 kg to 3.0 kgs at birth. The child will attain 3 times the birth weight by 1 year i.e 7.5 to 9 kgs. The height of the child at birth will be 50 cms. The child grows to a height of 75 cms by 1 year.

Infancy is the period of intense growth and development. Weight gain is the best indication of child's growth.

Muscles grow in size and strength.

Brain, kidneys, digestive system improves in their functional capacity.

RDI for energy, protein, iron and B Vitamins are given in terms of per kg body weight.

In case of adults, energy requirement is 40 Cal/Kg of body weight.

In case of infants it is 108 Cal/Kg of body weight.

In case of adults protein requirement is 1 gram per Kg of body weight.

In case of infants it is 2.05 gram/Kg of body weight.

Nutrients Required for Infants

- Energy giving
- Proteins
- Calcium
- Iron
- Vitamin A
- Vitamin C

Breast milk is available to the infant, after 3 to 4 days after birth.

Breast milk is most nutritious and balanced food for the baby.

Introduce supplementary foods after 4 months.

Comparison of Nutrients in Various Milk/100 ml

Milk	Energy (K Cals)	Protein (Grams)	Fats (Grams)	Carbohydrates (Grams)	Calcium (mg)
Human	65	1.1	3.4	7.4	28
Cow' Milk	67	3.2	4.1	4.4	120
Ass's Milk	48	2.1	1.5	6.5	80
Buffalo's Milk	117	4.3	6.5	5.0	210
Goat's Milk	72	3.3	4.5	4.6	170

Advantages of Breast Milk

- It protects the infant from infections and food allergies.
- It is free from contamination.
- It is safe and easily available.
- It is economical.
- It helps to develop strong bond between mother and child.

Supplementary Food

- Liquid suppliment: Juices, soups.
- Semi-solid supplement: Masted banana, carrot, porridge.
- Solid supplement: Buiscits, rusks, toasts.

Meal Planning for Pre School Child

Following points are important in case of Pre School Child.

- The child in the age group of 1 to 6 years is known as Pre School Child.
- The rate of growth is slow compared to infants.
- Average gain in weight is 2.0 to 2.5 Kgs per year.
- Height of the child increases.
- Increased physical ativity.
- The child becomes independan i.e. it gets control over the body.
- Regular weight gain is the most important sign of the child's overall health and nutritional status.
- Catch up growth is possible.

Nutrients

- Energy Giving
- Protein
- Calcium
- Iron
- Vitamin A

Points to keep in mind while feeding Pre School Child.

- It is a challenging task to feed the Pre School Child.
- Consider the child's likes and dislikes.
- Snacks should supplement the meal, not substitute the main meals.
- Allow the child to feed themselves. Child will enjoy eating.
- Introduce new foods one by one.
- Foods served to children must be warm, not cold or hot.
- Donot give spicy food, as it irritates the digestive tract.

Meal planning for School Child

- Child in the age group of 7 to 12 years is called as School child.
- Rate of growth of School Child is less than the rate of growth of Pre School Child.
- Rate of growth of Pre-school child is less than the rate of growth of infants.
- Growth continues at a steady pace.
- There will be an improvement in the functioning of body tissues and organs.
- Growth takes place in the form of development of muscles and bones.
- Preparation for adolescence.

Weight of boys/Girls (7-12 Years)

Age (Years)	Boys (10-22 Years)	Girls (10-12 years)
7+	24.46	24.45
8+	26.42	25.97
9+	30.00	29.82
10+	32.29	33.58
11+	35.26	37.17
12+	38.78	42.97

Nutrients

- Energy Giving
- Protein
- Iron
- Calcium

Points to be Kept in Mind while Feeding School Child

- Boys have more muscle tissue and less adipose tissue.
- Girls have more adipose tissue and less muscle tissue.
- Shedding of baby teeth takes place and permanant teeth will emerge.
- Boys and Girl are engaged in more vigourous activities may be in the form of sports. So, there is a need for more energy.
- More sweating will take place and hence loss of Water, Sodium and Potassium.
- Fluid intake should be increased.
- Blood volume increases and it pushes up the iron needs.
- Bones will grow due to mineralisation of bones.

- RDIs for energy, protein, calcium, Thiamine (B1), Riboflavin (B2) and Niacin increases as age increases.
- RDIs for Vitamin C, folic acid, Vitamin B12, Vitamin A remains unchanged.
- Iron absorption is more in case of girls.

Meal Planning for Adolescents

Persons in the age group of 13 to 18 years are called as adolescents. During this period, major physical, mental and emotional changes takes place. This is a period of rapid phytsical growth. Trere will be sharp increase in height and weight. Growth and development of skeletal system and muscular system.

Muscles and bones increase in size and strength. Heart, lungs, stomach and kidneys attain their final adult size and level of functioning. There will be an increase in blood volume. Functional capacity of respiratory, digestive and circulatory system increases. Sexual characters will appear.

Functioning of reproductive system starts. The changes in the body structure and functioning is guided by harmones, Androgens in males and Oestrogens in females.

It is a period of physiological stress for the body, because of the extremely rapid rate of growth. Diet plays a crucial role in promoting and sustaining growth. This is the last chance to chatch up growth. Pregnancy during adolescence increases the demand for nutrients.

Nutients

- Energy giving
- Protein
- Iron
- Calcium

Points to be considered while planning meals for Adolescents.

- Be careful about dieting, weight reducing technique.
- Avoid over-eating.
- Exercise is the remedy for over weight.

Meal Planning for Adults

Persons more than 20 years old are called as adults.

Growth in terms of body size is completed.

Nutritional needs is for maintainance of body functions. There will be a gradual and progressive change in body functioning. Breakdown of tissue increases, renewla of worn out tissue decreases.

In case of young adult, body has the capacity to replace the worn out tissues.

In case of older adult, the body has lost the capacity to replace the worn out tissues.

CHANGES DURING AGING

Kidney functions: Marked reduction in the number of functioning Kidney cells.

Digestive Tract Functioning

Number of taste buds in the mouth decreases. This reduces sensitivity to taste.

There will be a rduction in the amount of saliva secreted and hence the swallowing will become difficult.

Teeth will become loose and chewing will become difficult.

There will be a decrease in the secretion of digestive juices.

So, food is not digested and absorbed properly.

Food stays longer in the stomach.

Muscles of digestive tract becomes weak.

Movement of food in the tract slows down and constipation sets in.

Skeletal System

Skeletal bone losses occurs with aging.

Loss of Calcium and Phosphorus occurs and it results in thinning of bones.

Osteoporosis is a condition in which bones become weak and brittle (Mostly in women).

RDIs for adults

Sedentary work : Clerk, Teacher

Moderate work : House maid, Postman, Servants

Heavy work : Stone cutter, Richshaw puller

RDIs for energy and B Vitamins are based on activity level.

Basal Physical Total Energy

Requirement + Activity = Requirement

Muscle tissue requires more energy for its activities.

The RDIs for energy changes with age as given below.

Age (Years)	% of RDI for Energy
20 – 39	100
40 – 49	95
50 – 59	90
60 – 69	80
70 – 79	70

Nutrients

- Energy giving
- Body building
- Protective/Regulatory

MEAL PLANNING FOR PREGNANT WOMAN

Physiological Changes

Changes in Body Organs

Uterus and supporting muscles increase in size, to accomodate the growing foetus.

Breast grows in size and prepares to produce milk

Changes in Body Metabolism

Metabolic rate increases-rapid growth of foetus and mother's tissuses.

Changes in Body Fluids

Increase in blood volume by 50% to facilitate supply of nutrients to foetus and newly formed tissues.

Haemoglolbin levels falls to 10-11 mg/100 ml.

Changes in Digestive Functioning

Increased absorption of iron/calcium.

Less production/secretion of acid and digestive juices.

Food stays in the stomach for a long time.

Capacity of stomach/speed of digestion decrease because foetus exerts ph of the stomach.

Food is pushed up into food pipe. nousea, vomitting, heartburn.

The movement of food in digestive tract slows down.

Changes in Body Weight

Growing foetus Increase in size of the uterus dev of placenta increase in breast size increase in blood volume deposition of fat in the body	8–10 Kg incrase in weight as normal. Max wt gain occurs. only in 2/3rd trimester.
Nutrients Energy-giving (+300 cal) Protein (+15 g)	

Calcium
Iron
Provide Iron tablets in the 2nd trimester.
Provide small, but frequent meals.

MEAL PLANNING FOR LACTATING WOMAN

Lactating woman secrets about 500 ml of milk during the first month. Then the milk production increases to about 1000 ml per day by 4th to 5th month.

At an average a well nourished woman secrets about 850 ml of milk per day.

Nutritional component of human milk

Nutrient	Amount/100 ml
Energy (Cal)	65
Proteins(grams)	1.1
Carbohydrates(grams)	7.4
Fats(grams)	3.4
Calcium(mg)	28
Iron(mg)	-
Carotene(ug)	137
Thiamine	2
Riboflavin	2
Niacin	-
Vitamin C	3

Nutrients

Energy giving
Protein
Calcium
Vitamin A
Vitamin C

Along with increased food intake, the fluid intake should also increase during lactation. To maintain adequate supply of breast milk, coconut water, juice, coffee, tea, milk should be consumed.

Food with striong or specific flavour may alter the taste of breast milk.

Alcohol, drugs etc may enter the breast milk and interfere with infant development.

Chapter 8

Dietary Guidelines

Whether you need to lose or maintain weight, you should make healthy food choices. These guidelines will improve your health, help you meet your nutrient requirements, and reduce your risk of chronic disease.

The Dietary Guidelines recommend that you get the most nutrition out of the calories you eat. You need nutrients to perform well, maintain wellness, and fight disease. But it is important to get those nutrients without consuming more calories than you need. To do this, you can't eat too many high-calorie items (defined as foods with more than 400 calories per serving).

You should also eat a variety of nutrient-rich foods each day. The Dietary Guidelines recommend that you:

Use Plant Foods as the Foundation of Meals (Fruits, Vegetables, and Whole Grains)

Most of the calories in your diet should come from a variety of whole grain products, vegetables, and fruits. Plant foods provide a variety of vitamins and minerals essential for health and most are naturally low in fat.

You might want to pay particular attention to the antioxidant nutrients found in plant foods (e.g., vitamin C, carotenoids, vitamin E, and certain minerals) for their potentially beneficial role in reducing the risk for cancer and certain other chronic diseases.

Plant foods, such as whole-grain breads and cereals, vegetables, and fruits provide fibre, which is important for proper bowel function and may lower the risk for heart disease and some cancers. Because there are different types of fibre in foods, choose a variety of foods daily.

Get Enough Calcium-rich Foods

Consume three cups of low-fat or fat-free milk or an equivalent amount of calcium each day through other calcium rich foods or a dietary supplement.

Keep saturated and trans fats low (and keep total fat intake moderate)

Saturated fat and trans fatty acids raise blood cholesterol more than other forms of fat. Keep saturated fats to less than 10 percent of calories and keep trans fatty acids as low as possible.

The fats from meat, milk, and milk products are the main sources of saturated fats in most diets, so select lean meats, poultry, fish, and low-fat milk products. Many bakery products are also sources of saturated fats and trans fatty acids, such as palm oil and partially hydrogenated oils.

Fat, whether from plant or animal sources, contains more than twice the number of calories of an equal amount of carbohydrate or protein. Choose a diet that provides no more than 30 percent of total calories from fat.

Restrict Sugar and Salt

Some foods that contain a lot of sugars supply calories but few or no nutrients. Because maintaining a nutritious diet and a healthy weight is very important, sugars should be used in moderation by most healthy people and sparingly by people with low calorie needs.

Many studies in diverse populations have shown that a high sodium intake is associated with higher blood pressure. Most evidence suggests that many people at risk for high blood pressure reduce their chances of developing this condition by consuming less salt or sodium

Eat Moderate Portions

Pay particular attention to portion sizes—the portions in restaurants and on food labels are often far larger than recommended for weight management. Be especially careful to limit portion sizes of foods high in calories, such as baked goods, French fries, and fats and oils.

Use Alcohol in Moderation

Alcohol provides empty calories and is harmful when consumed in excess. Some people should not drink at all, such as children and adolescents, pregnant women, those with liver or other diseases, those taking certain medications that interact with alcohol, and those who can't restrict their drinking.

Moderation is defined as one drink per day for women and 2 drinks per day for men. (One drink is 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of hard liquor.)

Note that some individuals need to follow special diets to address particular health concerns, such as heart disease. They should follow the diet recommended by their physician.

Also, an individual's age and health must be factored into their

nutritional choices. Growing children, teenagers, women, pregnant women, and older adults have a higher need for some nutrients. For example adult women need almost a third more calcium intake than adult men of similar age.

Don't Forget to Drink Water

Although it is not formally part of the dietary guidelines, it is commonly realized that it is important to drink 8-10 glasses of water a day to help your body's biological processes, especially carrying nutrients to cells and eliminating wastes. It is best to drink purified water, so investigate getting a water purifier for your home if you don't already have one.

Chapter 9

Nutrition for Pregnant Women

A pregnant woman needs extra care and good nutrition for both herself and the foetus developing in her womb. As far as the nutrition for pregnant women is concerned, the would-be mother should develop healthy nutritional habits. Proper intake of nutrients is necessary for health pregnancy.

Pregnancy and Nutrition

The nutritional needs of a pregnant is always higher than that of a non-pregnant woman. As far as nutrition for healthy pregnancy is concerned, a women needs to include a variety of nutritional items in her diet. This is needed for getting the amount of calories, vitamins, carbohydrates and proteins recommended by the physician.

Protein

Both the mother and the baby in the womb requires good amount of protein. The doctors often advise the expectant mother to have 60 grams of protein per day. 10 grams of protein are approximately equivalent to 1½ ounces of meat.

Iron

The doctors generally doubles iron contents from 15 milligram per day to 30 milligram per day at the time of pregnancy. Other than this, food rich in iron are also recommended by the doctors.

Calories

An expectant mother requires more or less 300 calories per day. This is needed for the rapid growth of her baby.

Folic Acid

Folic acid plays a significant part in the development of cells. It also helps in developing the fetal structures. Thus, a pregnant woman must take food rich in folic acid. According to latest research, consumption of

folic acid during pregnancy can bring down the risk of Neural Tube Defects (NTDs) like spina bifida in babies.

Calcium

A pregnant woman is usually recommended 1000 milligram of calcium per day. Items like yogurt, butter, cheese and milk are full of calcium.

Nutritional Recommendations for Healthy Pregnancy

Here are few nutritional recommendations for the pregnant women of India:

- The pregnant women must drink a minimum of 8-10 cups to water daily. This is needed for clear urination.
- Intake caffeinated beverages should be limited during pregnancy.
- It is always better to avoid carbonated fluids a the time of pregnancy.
- Fibrous fruits, grains and leafy vegetables should be kept in a pregnant woman's diet. These are need to avoid constipation.
- Intake of Vitamin is must during pregnancy. However, excessive intake of Vitamin A has often led to defective births. So, consult your doctor, before you go in for a particular vitamin.
- The body also requires minerals a the time of pregnancy.
- Avoid tobacco during pregnancy.
- Wash the fruits and vegetables properly before eating.
- It is always better to stay away from the items with fermentative effects.

Food and Drinks to Avoid During Pregnancy

No level of alcohol consumption is considered safe during pregnancy. Also, check with your doctor before you take any vitamins or herbal products. Some of these can be harmful to the developing fetus.

And although many doctors feel that one or two 6- to 8-ounce cups per day of coffee, tea, or soda with caffeine won't harm your baby, it's probably wise to avoid caffeine altogether if you can. High caffeine consumption has been linked to an increased risk of miscarriage, so limit your intake or switch to decaffeinated products.

When you're pregnant, it's also important to avoid food-borne illnesses, such as listeriosis and toxoplasmosis, which can be life-threatening to an unborn baby and may cause birth defects or miscarriage. Foods you'll want to steer clear of include:

- Soft, unpasteurized cheeses (often advertised as "fresh") such as feta, goat, Brie, Camembert, and blue cheese

- Unpasteurized milk, juices, and apple cider
- Raw eggs or foods containing raw eggs, including mousse and tiramisu
- Raw or undercooked meats, fish, or shellfish
- Processed meats such as hot dogs and deli meats (these should be well-cooked)
- Fish that are high in mercury, including shark, swordfish, king mackeral, or tilefish

If you've eaten these foods at some point during your pregnancy, try not to worry too much about it now; just avoid them for the remainder of the pregnancy. If you're really concerned, talk to your doctor.

Managing Some Common Problems

Because the iron in prenatal vitamins and other factors may cause constipation during pregnancy, try to consume more fibre than you did before you became pregnant. Try to eat about 20 to 30 grams of fibre a day. Your best sources are fresh fruits and vegetables and whole-grain breads, cereals, or muffins. Some people also use fibre tablets or drinks or other high-fibre products available at pharmacies and grocery stores, but check with your doctor before trying them. (Don't use laxatives while you're pregnant unless your doctor advises you to do so. And avoid the old wives' remedy — castor oil — because it can actually interfere with your body's ability to absorb nutrients.)

If constipation is a problem for you, your doctor may prescribe a stool softener. Be sure to drink plenty of fluids, especially water, when increasing fibre intake, or you can make your constipation worse. One of the best ways to avoid constipation is to get more exercise. You should also drink plenty of water between meals each day to help soften your stools and move food through your digestive system. Sometimes hot tea, soups, or broth can help. Also, keep dried fruits handy for snacking.

Some pregnant women find that broccoli, spinach, cauliflower, and fried foods give them heartburn or gas. You can plan a balanced diet to avoid these foods. Carbonated drinks also cause gas or heartburn for some women, although others find they calm the digestive system. If you're frequently nauseated, eat small amounts of bland foods, like toast or crackers, throughout the day. If nothing else sounds good, try cereal with milk or a sweet piece of fruit. To help combat nausea, you can also:

- Take your prenatal vitamin before going to bed after you've eaten a snack — not on an empty stomach.
- Eat a small snack when you get up to go to the bathroom early in the morning.
- Suck on hard candy.

Chapter 10

Infant Nutrition

TWO MONTHS

Baby will get all of his nutrition from breast milk or an iron fortified infant formula until he is four to six months old. There is no need to supplement with water, juice or cereal at this time. He should now be on a more predictable schedule and will probably be nursing or drinking 5-6 ounces of formula every 3-4 hours.

Feeding practices to avoid are putting the bottle in bed or propping the bottle while feeding, putting cereal in the bottle, feeding honey, introducing solids before 4-6 months, or heating bottles in the microwave.

Also, avoid the use of low iron formulas, which are nutritionally inadequate to meet the needs of a growing infant. These types of infant formula do not contain enough iron and will put your child at risk for developing iron deficiency anemia (which has been strongly associated with poor growth and development and with learning disabilities). Iron fortified formulas do not cause colic, constipation or reflux and you should not switch to a low iron formula if your baby has one of these problems.

FOUR MONTHS

At this age, breast milk or formula is the only food that your baby needs and he should be taking 5-6 ounces 4-6 times each day (24-32 ounces), but you can start to familiarize your baby with the feel of a spoon and introduce solid baby foods. See the Guide to Starting Solids for more information, especially if your child is at risk for developing food allergies.

Cereal is the first solid you should give your baby and you can mix it with breast milk, formula or water and feed it to your baby with a spoon (not in a bottle). Start by feeding one tablespoon of an iron-fortified Rice cereal at one feeding and then slowly increase the amount to 3-4 tablespoons one or two times each day. This is a very important source of iron for your growing infant (especially if you are breastfeeding). You can then start with vegetables at about six months of age.

Your baby will probably have given up middle of the night feedings

by this age. If not, slowly reduce how much you are putting in the bottle each night and gradually stop this feeding all together.

Feeding practices to avoid are putting the bottle in bed or propping the bottle while feeding, putting cereal in the bottle, feeding honey, using a low-iron formula or heating bottles in the microwave.

SIX MONTHS

While continuing to give 4-5 feedings of breast milk or formula (24-32 ounces) and 4 or more tablespoons of iron fortified cereal each day, you can now start to give well-cooked, strained, or mashed vegetables or commercially prepared baby foods. Start with one tablespoon of a mild tasting vegetable, such as green beans, peas, squash or carrots and gradually increase to 4-5 tablespoons one or two times each day.

Start fruits about a month after starting vegetables and again, gradually increase to 4-5 tablespoons one or two times each day. You can use peeled, cooked, or canned fruits (but only those packed in light syrup or water) that have been blenderized or strained.

You can also begin to offer 4-6 ounces of 100% fruit juices. Start by mixing one part juice with two parts of water and offer it in a cup only. Delay giving finger foods or meat and other protein foods until infants are eight to nine months old.

To avoid having to supplement with fluoride, prepare powdered/concentrated formula with fluorinated tap water. If you are using ready-to-feed formula, or bottled or filtered water only, then your baby may need fluoride supplements.

Your baby will probably have given up middle of the night feedings by this age. If not, slowly reduce how much you are putting in the bottle each night and gradually stop this feeding all together.

Feeding practices to avoid are putting the bottle in bed or propping the bottle while feeding, putting cereal in the bottle, feeding honey, using a low-iron formula, offering juice in a bottle or heating bottles in the microwave.

NINE MONTHS

While continuing to give 3-4 feedings of breast milk or formula (24-32 ounces) and 4 or more tablespoons of cereal, vegetables and fruit one or two times each day, you can now start to give more protein containing foods. These include well-cooked, strained or ground plain meats (chicken, beef, turkey, veal, lamb, boneless fish, or liver), mild cheese, peanutbutter, or egg yolks (no egg whites as there is a high chance of allergic reactions in infants less than 12 months old).

If using commercially prepared jars of baby food, do not use

vegetables with meat as they have little meat and less protein and iron than jars with plain meat.

Start with 1-2 tablespoons and increase to 3-4 tablespoons once each day. If your baby doesn't seem to like to eat plain meat, then you can mix it with a vegetable that they already like as you offer it.

You should start to offer soft table foods and finger foods at this age. Give soft, bite-size pieces of food, such as soft fruit and vegetable pieces, pastas, graham or saltine crackers, and dry cheerios, but do not give these foods if the child is going to be unattended in case of choking.

Over the next three months your baby's diet will begin to resemble that of the rest of the families, with 3 meals and 2 snacks each day. You can also give4-6 ounces of 100% fruit juice in a cup.

To avoid having to supplement with fluoride, prepare powdered/ concentrated formula with fluorinated tap water. If you are using ready-to-feed formula, or bottled or filtered water only, then your baby may need fluoride supplements.

Your baby will probably have given up middle of the night feedings by this age. If not, slowly reduce how much you are putting in the bottle each night and gradually stop this feeding all together.

Feeding practices to avoid are changing to regular milk before your child is twelve months old, putting the bottle in bed or propping the bottle while feeding, feeding honey, using a low-iron formula, offering juice in a bottle or heating bottles in the microwave.

TWELVE MONTHS

You may now give your baby homogenized whole cow's milk. Do not use 2%, low fat, or skim milk until your child is 2-3 years old. Your baby's diet will begin to resemble that of the rest of the families, with 3 meals and 2 snacks each day.

You should limit milk and dairy products to about 16-24 oz each day (in a cup or bottle) and juice to 4-6 oz each day (offered in a cup only) and offer a variety of foods to encourage good eating habits later.

Your child should want to feed himself with his fingers and a spoon or fork and should be able to drink out of a cup.

The next few months will be time to stop using a bottle. Remember that your baby's appetite may decrease and become pickier over the next few years as his growth rate slows.

Your baby will probably have given up middle of the night feedings by this age.

If not, slowly reduce how much you are putting in the bottle each night and gradually stop this feeding all together.

To avoid having to supplement with fluoride, use fluorinated tap

water. If you are using bottled or filtered water only, then your child may need fluoride supplements (check with the manufacturer for your water's fluoride levels).

Feeding practices to avoid are giving large amounts of sweet desserts, soft drinks, fruit-flavored drinks, sugarcoated cereals, chips or candy, as they have little nutritional value. Also avoid giving foods that your child can choke on, such as raw carrots, peanuts, whole grapes, tough meats, popcorn, chewing gum or hard candy.

Chapter 11

Young Children and Toddlers

COMPLEMENTARY (WEANING FOODS)

In the first year of life, infants undergo periods of rapid growth when a good diet is crucial. In fact, nutrition in the early years of life is a major determinant of healthy growth and development throughout childhood and of good health in adulthood. Pediatricians and nutritionists have established nutritional guidelines to meet the specific needs of these early years. While there is great variety in the types of foods each infant and young child will gradually add to his or her diet, some generalizations may be helpful. If you are at all unsure about what or how to feed your infant during the first year of life, consult with your healthcare provider.

Breast milk is the ideal food for infants during the first six months of life. It contains still-undiscovered substances that cannot be reproduced artificially and its overall nutrient composition is superior to any alternative, including infant formula. In spite of its superiority, breast milk cannot provide all of the nutrients and calories that allow infants to thrive after the first six months of life. All infants should continue to receive breast milk for at least the first year and preferably for the second, but other, more nutritious foods should be added by the time an infant reaches six months of age. Formula-fed infants usually require only formula for their first year, but they should also be introduced to other kinds of foods once they reach six months of age.

From the age of six months until approximately two years, infants and young children should gradually be introduced to different types of semi-solid, solid or complementary foods as they gradually transition from a diet centered on breast milk or formula. This transition period helps the child to slowly become accustomed to eating adult-type foods and familiarizes them with a wide range of textures and tastes.

Most infants begin the transition from liquid to solid foods with the introduction of infant cereals. When mixed with breast milk or formula, cereal can be a good starting place. Eating cereals from a spoon takes practice, but most 6-month olds are able to adapt quickly. After

introducing cereal, many mothers next begin offering pureed or mashed vegetables and fruits. Whether prepared industrially or at home, these foods are a pleasant introduction to new tastes and textures. Gradually, the smooth, pureed foods can be replaced with foods of more solid texture, such as meat or fish based meals, until the infant begins to eat table food.

Introducing your infant to complementary foods is a gradual and, at times, trying process. The key to success is to gradually move from fairly bland and smooth foods to foods that are more robust in texture, taste, and smell. Be patient and have fun—this exciting and challenging stage will surely produce many funny memories.

Different Types of Industrially Prepared Complementary Foods

Many industrially prepared complementary foods are available to help your infant make the transition from breast milk or formula to solid food. While some parents choose to prepare their own foods, others find that industrially prepared foods are convenient, safe, and nutritious alternatives.

Complementary foods are formulated to satisfy the nutritional needs of infants and young children. Some types are sold dried and need reconstituting (such as infant cereals) while others are sold ready to eat (such as jars of baby food.) Meat, vegetables and fruit are major ingredients. Some are based on cereals, some on pasta. They run the whole gamut from biscuits, rusks, and "main meals" to desserts and drinks.

MAIN CATEGORIES OF INDUSTRIALLY PREPARED FOODS:

- Ready to eat baby foods
  These consist of prepared recipes that are cooked and sterilized and are normally sold in cans and jars. This broad category includes baby meals, fruit or vegetable based foods, and meat and fish based foods.
- Dried baby foods
  The range of dried foods available is similar to ready-to-eat and they are prepared according to recipes, but they are dried after cooking. Dried foods must be mixed with water or milk before feeding.
- Cereal-based foods
  Cereal foods are usually sold dried and ready for reconstitution. They are based on pre-cooked cereals with additions of meat, vegetables or fruit. Some are reconstituted with milk, but others are already mixed with high protein foods and should be reconstituted with a non-protein containing liquid such as water.
- Pasta

These foods are available with different pasta shapes and are used after cooking in boiling water or other appropriate liquid. Pasta is often used as a main ingredient in "main meal" products.

- Biscuits and rusks
  Biscuits and rusks can be offered in dried form or can be soaked in water or milk. These products can be particularly useful for teething infants.
- Milk based desserts
  Special deserts with controlled sugar content typically contain yogurt or other milk products as a main ingredient.
- Toddler drink
  Special formulations of cow's milk or soy extracts have been developed to match the specific nutritional needs of young children over one year of age.
- Other drinks

Industrially prepared complementary foods can be a convenient way to feed infants and are specially formulated as an introduction to the texture of adult foods while meeting the strict dietary requirements of infants and young children. Their manufacturers ensure they are processed according to the strictest hygiene and safety requirements as well as formulated to meet nutritional standards established by health authorities throughout the world.

Whether you are giving your child homemade complementary foods or industrially prepared foods, remember to keep your child's diet varied and appropriate to his or her stage of development. The inappropriate use of adult foods may result in insufficient intake of some nutrients, such as iron and fat, or an excess of others, such as salt and fibre. Stay with foods meant for infants at first and then gradually introduce "adult foods."

Fruit, vegetable and herbal drinks also contain controlled amounts of sugar.

Accurate Time of Offering Complementary or Solid Food to Infants

Although all infants require a liquid diet during the first months of life, solid foods eventually become the predominant source of nutrition. No infant should be introduced to solid or complementary foods before the age of four months and, in many cases, it may be better to wait until the infant is at least six months old.

By six months of age, your infant's nutritional needs are beginning to increase. Breast milk or infant formula, alone, may not provide all the nutrients your infant needs to continue growing and developing. The purpose of introducing complementary foods is to provide a more energy-dense diet with adequate protein for growth and a high proportion of

calories from fat. In addition, complementary foods are a good way to introduce new tastes and textures so your infant can eventually graduate to eating the same meals as the rest of your family.

In the past, many mothers started feeding solid foods too early, before their baby's digestive organs were sufficiently developed. In addition, semi-solid foods must be fed with a small spoon. Yet, before the age of four to six months, the infant's nervous system is not sufficiently developed to allow use of a spoon. Before starting to eat solid foods, your infant should be able to sit easily with support and coordinate chewing and swallowing. Solid foods such as cereal should never be placed in a bottle for feeding.

When starting the transition to complementary foods, milk or an appropriate formula should continue to be a major part of the infant's diet. Whole cow's milk or goat's milk, which are widely used by mothers throughout the world, are not appropriate as an exclusive source of food for infants. For this reason, and at the request of the medical profession, follow-on formulas were developed to meet the nutritional needs of older infants. They provide the liquid part of a weaning diet and, because they contain more iron, more vitamin D and less saturated fat, are nutritionally more appropriate than whole cow's milk or other animal milks.

Preventive Measures Taken by Baby Food Companies to Ensure the Safety of Baby Foods

Commercial baby foods are made according to the highest microbiological and nutritional specifications and all ingredients must meet strict safety and quality standards. Thorough heat treatment, combined with strict hygiene standards, ensures the sterility of the product throughout the manufacturing process.

In addition, companies operate controlled and dedicated supply chains so that the raw materials can be traced back to their sources.

Suppliers are thoroughly screened and audited using such qualified inspectors as veterinarians and quality control experts to ensure compliance with standards. All manufacturing processes are designed to ensure the microbiological safety of the product. Production and packaging processes are carefully chosen for maximum protection and to keep products in the best possible condition throughout their shelf life.

Amount of Meat Used in Commercial Baby Foods

The meat content of commercial baby foods varies. Generally, baby foods contain less meat than adult meat-based products do. Large amounts of meat can be overpowering for babies in terms of taste, smell and texture. Consequently, manufacturers try to balance the ingredients in meat-based

baby foods to ensure palatability and good nutrition. The protein content and protein quality of baby foods are far more important than actual meat content.

Accordingly, manufacturers control the total amount of protein (which may include meat) in their products to supply enough for optimal growth and development of infants without straining their kidneys. They also pay attention to the mixture of amino acids in baby foods by using a variety of protein sources including meat, fish, milk, eggs, vegetables and cereals. As a standard practice, manufacturers provide labels showing the percentage of meat contained in all packets and jars of commercial baby foods.

Genetically Modified Iingredients Used in Commercial Baby Foods

All baby food manufacturers are very sensitive to consumer concerns regarding genetic modification (GM) and consider their concerns when formulating products. In addition, GM ingredients offer no particular benefit over traditional foods at present.

Infant and Dietetic Foods Association (IDFA) member companies take all possible steps to ensure that ingredients used in baby foods are not derived from genetically modified crops. Where the potential exists for GM material to be present in ingredients, in soya or maize, for example, companies purchase non-GM, identity-preserved ingredients through carefully audited suppliers that have undergone rigorous independent testing.

Organic and Non-organic Baby Foods

Manufacturers cannot claim that individual foods are 'organic' unless an accredited body, such as the Soil Association in Europe, has certified that the ingredients comply with specific standards. The most well known organic standard is the restriction on the use of artificial fertilisers and pesticides, which protects most organic foods from containing pesticide residues.

In fact, all baby foods are subject to very strict controls on pesticide residues as current legislation bans the use of some pesticides and requires the level of any other to be below 10 parts per billion. Levels of pesticide residues in commercial baby foods are consistently very low or not detectable, whether the foods are labeled organic or not.

Additives Used in Commercial Weaning Foods

Infant food manufacturers take a precautionary approach to using additives in baby foods. Only those additives that have been shown to be both safe and required for technological processes are permitted by law.

For example, artificial preservatives, colourings, sweeteners and artificial flavourings cannot be used in baby foods.

Benefits of Commercial Baby Foods

Sometime around baby's sixth month, when he is just starting to lift his head and smile, he may be ready to try some solid foods, usually cereals.

Most mothers understand that commercially prepared baby cereals are fortified with the correct amounts of iron and other nutrients to help him grow best while he continues to breastfeed. As baby graduates from cereals to the first vegetables and fruits, many mothers request information about commercially prepared baby foods.

Commercial baby foods offer many valuable features for growing babies and their mothers.

- Nutrient content: similar to the best homemade foods.
- Appropriate texture: foods are formulated to contain recommended textures based on age or stage of development.
- Variety of tastes and ingredients: foods are available in many flavors and with a large variety of fruits, vegetables and other foods.
- Food combinations in recommended proportions: foods are carefully combined and formulated to be acceptable to infants and provide the right proportion of ingredients.
- Less pesticide contamination: baby foods are made from produce that is lower in pesticide residues and other chemicals than are fruits and vegetables purchased at markets for adult use.
- Convenience for home use: commercial baby foods are ready to use right out of the containers.
- Convenience for travel: containers of baby foods are safe, easy to store and convenient for travel.
- Stability of ingredients: commercial baby foods are guaranteed to contain what is listed on the label and will remain unspoiled for the stated time.
- Exact knowledge of ingredients: every ingredient included must be listed on the label.
- Hygiene: manufacturers follow strict quality control standards and monitor the cleanliness of preparation and cooking areas, the storage conditions of the suppliers and ingredients, and the clean-up procedures after cooking.

Mothers can feel confident that commercial baby foods provide high quality, convenient meals for their babies.

Chapter 12

School Age Children

Child's nutrition is important to her overall health. Proper nutrition can also prevent many medical problems, including becoming overweight, developing weak bones, and developing diabetes. It will also ensure that your child physically grows to her full potential.

The best nutrition advise to keep your adolescent healthy includes encouraging her to:

- Eat a variety of foods
- Balance the food you eat with physical activity
- Choose a diet with plenty of grain products, vegetables and fruits
- Choose a diet low in fat, saturated fat, and cholesterol
- Choose a diet moderate in sugars and salt
- Choose a diet that provides enough calcium and iron to meet their growing body's requirements.

You can also help promote good nutrition by setting a good example. Healthy eating habits and regular exercise should be a regular part of your family's life. It is much easier if everyone in the house follows these guidelines, than if your child has to do it alone. You should also buy low-calorie and lowfat meals, snacks and desserts, low fat or skim milk and diet drinks. Avoid buying high calorie desserts or snacks, such as snack chips, regular soft drinks or regular ice cream.

The Food Pyramid was designed by the US Dept. of Agriculture to promote healthy nutrition in children over two years of age. It is meant to be a general guide to daily food choices. The main emphasis of the Food Guide Pyramid is on the five major food groups, all of which are required for good health. It also emphasizes that foods that include a lot of fats, oils and sweets should be used very sparingly.

The Food Guide Pyramid shows a range of servings for each food group. How much you actually eat depends on your age and activity level. Schoolage boys and girls require about 1600 to 2400 calories each day, depending on their age and activity level. Once they hit their growth spurt, girls require an additional 200 calories and boys 500 calories. School age children will therefore require between the low and middle range of

servings. Children who are overweight and dieting should at least eat the lowest range of servings.

When determining how many servings to eat, it is important to look at the serving size. Larger portions should count as more than one serving, and smaller portions will count as only a part of a serving.

Fats, Oils and Sweets

No more than 30% of your diet should come from fats. For a 1600 calorie diet, that would equal 53g of fat each day and for a 2200 calorie diet, 73g of fat each day.

The type of fat that you eat is also important. Saturated fats in foods such as meats, dairy products, coconut, palm and palm kernal oil, raise cholesterol more than unsaturated fats, which are found in olive, peanut, and canola oils, or polyunsaturated fats in safflower, sunflower, corn, soybean and cottonseed oils. Limit saturated fats to no more than 10% of daily calories.

Sugars supply a large amount of calories, with little nutritional value. They include white sugar, brown sugar, corn syrup, honey and molasses and foods like candy, soft drinks, jams, and jellies.

Selection tips:

- Use lean meats and skim or lowfat dairy products
- Use unsaturated vegetable oils and margarines that list a liquid vegetable oil as the first ingredient on the label
- Read the nutrition label on foods to check for the amount and type of fat it includes
- Limit foods that contain a large amount of saturated fats
- Limit foods high in sugar and avoid adding extra sugar to your foods

Food	Servings	Grams of Fat
Butter, margarine, 1 tsp.		4
Mayonnaise, 1 tbs.		11
Salad dressing, 1 tbs.		7
Sour cream, 2 tbs.		6
Cream cheese, 1 oz.		10
Chocolate bar, 1 oz.		9

Milk, Yogurt and Cheese

Dairy products provide protein, vitamins and minerals and are an excellent source of calcium. Your schoolage child should have 2 to 3 servings of milk, yogurt and cheese each day.

Selection tips:

- Choose skim milk and nonfat yogurt
- Avoid high fat cheese and ice cream

Food	Servings	Grams of Fat
Skim milk, 1 cup	1	Trace
Nonfat yogurt, 8 oz	1	Trace
Lowfat milk, 1 cup	1	5
Whole milk, 1 cup	1	8
Chocolate milk. 2%, 1 cup	1	5
Lowfat yougurt, 1 cup	1	4
Process cheese, 2 oz.	1	18
Mozzarella, part skin 1 - 1/2 oz	1	7
Cottage cheese, 1/2 cup	1/4	5
Ice cream, 1/2 cup	1/3	7
Ice milk, 1/2 cup	1/3	3
Frozen yogurt, 1/2 cup	1/2	2

Meat, Poultry, Fish, Dry Beans, Eggs and Nuts

Foods in this group provide protein, and vitamins and minerals, including B vitamins, iron and zinc. You should have 2 to 3 servings of foods from this group each day, including the equivalent of 5 to 7 ounces of lean meat. Selection tips:

- A serving from this food group can include 2-3 ounces of lean meat, poultry or fish, which may be an average hamburger or medium chicken breast half.
- Choices with the least fat include lean meat, poultry without skin, fish, and dry beans and peas.
- Prepare meats in lowfat ways, by trimming away fat, and broiling, roasting, or boiling rather than frying.
- Remember that nuts and seed are high in fat, and egg yolks are high in cholesterol, so you should eat them in moderation.

Food	Servings	Grams of Fat
Lean meat, poultry, fish	3 oz	6
Ground beef, lean	3 oz	16
Chicken, with skin, fried	3 oz	13
Bologna, 2 slices	1 oz	16
Egg, 1	1 oz	5
Dry beans and peas, 1/2 cup	1 oz	Trace
Peanut butter, 2 tbs.	1 oz	16
Nuts, 1/3 cup	1 oz	22
Servings = ounces of meat these items count as.		

Vegetables

Vegetables supply you with vitamins, including vitamin A and C, and folate, minerals, such as iron and magnesium, and fibre. Plus they are low in fat. You should have 2 to 4 servings of vegetables each day.

Selection tips:

- You should eat a variety of vegetables to provide you with all of the different nutrients that they supply, including dark green leafy vegetables, deep yellow vegetables, starchy vegetables (potatoes, corn peas), legumes (navy, pinto and kidney beans), and other vegetables (lettuce, tomatoes, onions, green beans).
- Do not add a lot of fat to the vegetables you eat, by avoiding added toppings, such as butter, mayonnaise, and salad dressings.

Food	Servings	Grams of Fat
Vegs, cooked, 1/2 cup	1	Trace
Vegs, leafy, raw 1 cup	1	Trace
Vegs, nonleafy, raw, 1/2 cup	1	Trace
Potatoes, scalloped, 1/2 cup	1	4
Potato salad, 1/2 cup	1	8
French fries, 10	1	8

Fruits

Fruits and 100% fruit juices provide Vitamin A and C and potassium. They are also low in fat and sodium. You should have 2-4 servings of fruit each day.

Selection tips:

- Eat fresh fruits and 100 % fruit juices and avoid canned fruit in heavy syrups and sweetened fruit juices. According to the American Academy of Pediatrics, 100% fruit juice may substitute for half of your child's recommended servings of fruit each day.
- Eat whole fruits.
- Eat citrus fruits, melons, and berries, which are high in Vitamin C.

Food	Servings	Grams of Fat
Whole fruit	1	Trace
Fruit, raw or canned, 1/2 cup	1	Trace
Fruit juice, unsweetened, 3/4 cup	1	Trace
Avocado, 1/4 whole	1	9

Bread, Cereal, Rice and Pasta

Foods from this group provide complex carbohydrates (starches) and

provide vitamins, minerals, and fibre. You need at least 6 to 11 servings of foods from this food group each day.

Selection tips:

- Choose whole grain breads and cereals for added fibre.
- Choose foods that are low in fat and sugars.
- Avoid adding calories and fat to foods in this group by not adding spreads or toppings high in fat.

Food	Servings	Grams of Fat
Bread, 1 slice	1	1
Hamburger roll	2	2
Tortilla	1	3
Rice, pasta, 1/2 cup	1	Trace
Breakfast cereals, 1 oz	1	?
Pancakes, 2	2	3
Croissant, 1 large	2	12
Doughnut, 1 medium	2	11
Danish, 1 medium	2	13
Cake, frosted, 1 slice	1	13
Cookies, 2 medium	1	4

Calcium Requirements

Calcium is a mineral that is mostly present in your child's bones. Having a diet with foods that are high in calcium to meet daily requirements is necessary for the development of strong bones. It is also an important way to prevent the development of osteoporosis in adults.

School age children require about 800 mg of calcium each day. Once they begin puberty, their calcium requirements will increase to about 1200 mg each day. See the table for the calcium content of common foods and check the nutrition label to choose foods high in calcium when you prepare your families diet. Also choose foods that are fortified with calcium

Food	Servings	Calcium Content
Milk, whole or lowfat	1 cup	300 mg
White beans	1/2 cup	113 mg
Broccoli, cooked	1/2 cup	35 mg
Broccoli, raw	1 cup	35 mg
Cheddar cheese	1.5 oz	300 mg
Yogurt, lowfat	8 oz	300 mg
Orange juice, calcium fortified	1 cup	300 mg
Orange, medium	1	40-50 mg
Sweet potatoes, mashed	1/2 cup	mg

Iron Requirements

Iron is another mineral that is important for your child's growth. Having a diet with foods that are high in iron to meet daily requirements is necessary for the development of strong muscles and production of blood.

Adolescents require about 10 to 12 mg of iron each day. See the table for the iron content of common foods and check the nutrition label to choose foods high in iron when you prepare your families diet. Also choose foods that are fortified with iron (cereals, bread, rice, and pasta).

Food	Servings	Iron content
Beef, chicken, fish		
Liver		
Peanut butter		
Nuts and seeds		
Green peas, lima beans		
Pinto beans		
Spinach		
Greens, tumip/collard		
Strawberries		
Tomato juice		
Squash		
Whole grain bread		
Raisins		
Watermelon		

Chapter 13

Adolescent Nutrition

To develop to their optimal potential, it is vital that children are provided with nutritionally sound diets. Diet and exercise patterns during childhood and adolescence may spell the difference between health and risk of disease in later years. Different stages of the life cycle dictate differing nutrient needs.

The nutritional requirements of young people are influenced primarily by the spurt of growth that occurs at puberty. The peak of growth is generally between 11 and 15 years for girls and 13 and 16 years for boys. The nutrient needs of individual teenagers differ greatly, and food intake can vary enormously from day to day, so that those with deficient or excessive intakes on one day may well compensate on the next. In this period of life, several nutrients are at greater deficiency risk including iron and calcium

Iron

Among adolescents, iron-deficiency anaemia is one of the most common diet-related deficiency diseases.

Adolescents are particularly susceptible to iron deficiency anaemia in view of their increased blood volume and muscle mass during growth and development. This raises the need of iron for building up haemoglobin, the red pigment in blood that carries oxygen, and for the related protein myoglobin, in muscle. The increase in lean body mass (LBM), composed mainly of muscle, is more important in adolescent boys than in girls. In preadolescent years, LBM is about the same for both sexes. Once adolescence starts, however, the boy undergoes a more rapid accumulation of LBM for each additional kilogram of body weight gained during growth, ending up with a final LBM maximum value double that of the girl. Other factors contributing to elevated iron needs are increased body weight and the beginning of menstruation for girls. All these factors should be taken into account when assessing iron needs in this group of age.

One of the most important diet considerations during adolescence is

an increase in the intake of iron-rich foods such as lean meats and fish as well as beans, dark green vegetables, nuts and iron-fortified cereals and other grains. Iron from animal foods (known as haem iron) is much better absorbed than iron from non-animal sources (non-haem iron). Adolescents following vegetarian diets are therefore at an increased risk of iron-deficiency. However, vitamin C (e.g. from citrus fruits) and animal proteins (meat & fish) assist in the absorption of non-haem iron.

Calcium

The skeleton accounts for at least 99% of the body stores of calcium and the gain in skeletal weight is most rapid during the adolescent growth spurt. About 45% of the adult skeletal mass is formed during adolescence, although its growth continues well beyond the adolescent period and into the third decade. All the calcium for the growth of the skeleton must be derived from the diet. The largest gains are made in early adolescence, between about 10-14 years in girls and 12-16 years in boys.

During peak adolescent growth, calcium retention is, on average, about 200mg/day in girls and 300 mg/day in boys. The efficiency of calcium absorption is only around 30% so it is important that the diet supplies an adequate calcium intake to help build the densest bones possible. The achievement of peak bone mass during childhood and adolescence is crucial to reduce the risk of osteoporosis in later years. By eating several servings of dairy products, such as milk, yoghurt and cheese, the recommended calcium intake can be achieved.

As well as a good dietary supply of calcium, other vitamins or minerals, like vitamin D and phosphorous, are needed for building up bones. Physical activity is also essential, particularly weight-bearing exercise, which provides the stimulus to build and retain bone in the body. Activities such as cycling, gymnastics, skating, ball games, dancing and supervised weight training for at least 30-60 minutes a day, three to five times a week can help build bone mass and density. Making the right dietary and lifestyle choices early in life will help young people develop health-promoting behaviours that they can follow throughout life.

Food habits:

Dietary habits, which affect food preferences, energy consumption and nutrient intakes, are generally developed in early childhood and particularly during adolescence. The home and school environments play a major role in determining a child's attitude to, and consumption of individual foods.

Teenagers, as well as being exposed to periodic food fads and slimming trends, tend to skip meals and develop irregular eating habits.

One of the most frequently missed meals is breakfast. Studies show that breakfast plays an important role in providing needed energy and nutrients after an overnight fast and can aid in concentration and performance at school.

Snacks generally form an integral part of meal patterns for both children and teenagers. Younger children cannot eat large quantities at one sitting and often get hungry long before the next regular mealtime. Mid-morning and mid-afternoon snacks can help to meet energy needs throughout the day. Fast-growing and active teenagers often have substantial energy and nutrition needs and the teaching of food and nutrition in the school curricula will enable children to have the knowledge to make informed choices about the foods in their regular meals and snacks.

Energy needs

Lack of activity plays an important role in the development, progression and perpetuation of obesity in adolescence. Surveys of young people have found that the majority is largely inactive and health professionals and governments are now encouraging higher levels of physical activity among children and adolescents. Physical inactivity does not only have a prime role in the development of overweight and obesity, but also on the development of chronic diseases such as heart disease, certain cancers, diabetes, hypertension, bowel problems and osteoporosis in later life. In addition, physical activity is related to improvements in body flexibility, balance, agility and co-ordination and strengthening of bones. The current recommendation is for children to try to be physically active for at least 60 minutes daily.

Chapter 14

Adult Nutrition

Healthy eating and a healthful way of life are important to how we look, feel and how much we enjoy life. The right lifestyle decisions, with a routine of good food and regular exercise, can help us make the most of what life has to offer. Making smart food choices early in life and through adulthood can also help reduce the risk of certain conditions such as obesity, heart disease, hypertension, diabetes, certain cancers and osteoporosis.

Consume Wide Variety of Foods

We need more than 40 different nutrients for good health and no single food can supply them all. That's why consumption of a wide variety of foods (including fruits, vegetables, cereals and grains, meats, fish and poultry, dairy products and fats and oils), is necessary for good health and any food can be enjoyed as part of a healthy diet. Some studies have linked dietary variety with longevity. In any event, choosing a variety of foods adds to the enjoyment of meals and snacks.

Eating is one of the life's great pleasures and its important to take time to stop, relax and enjoy mealtimes and snacks. Scheduling eating times also ensures that meals are not missed, resulting in missed nutrients that are often not compensated for by subsequent meals. This is especially important for school children, adolescents and the elderly.

Breakfast is particularly important as it helps kick-start the body by supplying energy after the all-night fast.

Balance and Moderation

Balancing your food intake means getting enough, but not too much, of each type of nutrient. If portion sizes are kept reasonable, there is no need to eliminate favourite foods. There are no "good" or "bad" foods, only good or bad diets. Any food can fit into a healthy lifestyle by remembering moderation and balance.

Moderate amounts of all foods can help ensure that energy (calories) intake is controlled and that excessive amounts of any one food or food

component are not eaten. If you choose a high fat snack, choose a lower fat option at the next meal.

Maintain a Healthy Body Weight and Feel Good

A healthy weight varies between individuals and depends on many factors including gender, height, age and hereditary.

Excess body fat results when more calories are eaten than are needed. Those extra calories can come from any source - protein, fat, carbohydrate or alcohol - but fat is the most concentrated source of calories.

Physical activity is a good way of increasing the energy (calories) expended and it can also lead to feelings of well-being. The message is simple: if you are gaining weight eat less and be more active.

Fruits and Vegetables

Numerous studies have shown an association between the intake of these foods and a decreased risk of cardiovascular disease and certain cancers. An increased intake of fruits and vegetables has also been associated with decreased blood pressure. People can fill up on fresh fruit and vegetables because they are good sources of nutrients and the majority are naturally low in fat and calories.

Nutritionists are paying much more attention to fruits and vegetables as "packages" of nutrients and other constituents that are healthful for humans. The "antioxidant hypothesis" has drawn attention to the role of micronutrients found in fruits and vegetables like vitamins C and E , as well as a number of other natural protective substances.

The carotenes (beta-carotene, lutein and lycopene), the flavonoids (phenolic compounds that are widespread in commonly consumed fruits and vegetables such as apples and onions and beverages derived from plants like tea, cocoa and red wine) and the phytoestrogens (principally isoflavones and lignans), are being demonstrated to have beneficial roles in human health.

Base the Diet on Foods Rich in Carbohydrates

Most dietary guidelines recommend a daily diet in which at least 55 of the total calories come from carbohydrates. This means making more than half of our daily food intake should consist of carbohydrate-containing foods such as grains, pulses, beans, fruits, vegetables and sugars.

Although the body treats all carbohydrates in the same way regardless of their source, carbohydrates are often split into "complex" and "simple" carbohydrates. Complex carbohydrates that come from plants are called starch and fibres, and these are found for example in cereal grains,

vegetables, breads, seeds, legumes and beans. These carbohydrates consist of long strands of many simple carbohydrates linked together. Simple carbohydrates (sometimes called simple sugars) are found for example in table sugar, fruits, sweets, jams, soft drinks, fruit juices, honey, jellies and syrups. Both complex and simple carbohydrates provide the same amount of energy (4 calories per gram) and both can contribute to tooth decay, especially when oral hygiene is poor.

Drink Plenty of Fluids

Adults need to drink at least 1.5 litres of fluid daily, even more if its hot or they are physically active. Plain water is a good source of liquid but variety can be both pleasant and healthy. Choose alternative fluids from juices, soft drinks, tea, coffee and milk.

Fats in Moderation

Fat is a nutrient in food that is essential for good health. Fats provide a ready source of energy and enable the body to absorb, circulate and store the fat-soluble vitamins A, D, E and K. Fat-containing foods are needed to supply "essential fatty acids" that the body cannot make.

Too much fat however, especially saturated fats, can lead to adverse health effects such as overweight and high cholesterol and increase the risk of heart disease and some cancers.

Limiting the amount of fat, especially saturated fat in the diet -but not cutting it out entirely- is the best advice for a healthy diet. Most dietary recommendations are that less than 30% of the day's total calories should come from fat and less than 10% of the day's total calories should come from saturated fat.

Balance the Salt Intake

Salt (NaCl) is made up of sodium and chloride. Sodium is a nutrient and is present naturally in many foods. Sodium and chloride are important in helping the body to maintain fluid balance and to regulate blood pressure.

For most people, any excess sodium passes straight through the body however in some people it can increase blood pressure. Reducing the amount of salt in the diet of those who are sensitive to salt may reduce the risk of high blood pressure. However, the relationship between salt intake and blood pressure is still not known well and individuals should consult their doctor for advice.

Chapter 15

People Living on Low Income

The gap between the diets of people on low incomes and those of the rest of the population is not as wide as some feared

The dietary pattern of people on low incomes is the same as that of the general population, although in some aspects it is slightly less healthy. Before this survey, there had been some concerns that the diets of this population group were extremely poor and that factors such as restricted access to choice and a lack of confidence in cooking skills were preventing people from eating healthily. However, the Food Standards Agency study did not identify any direct link between dietary patterns and income, food access or cooking skills. The diet-related problems found to affect people on low incomes are in general much the same as those facing the population as a whole, including:

- Not eating enough fruit and vegetables
- Not eating enough oily fish
- Consumption of too much saturated fat and sugar

Levels of obesity were also found to be very high – 62% of men, 63% of women, 35% of boys and 34% of girls were overweight or obese, which mirrors the high levels within the general UK population. The comprehensive survey, involving more than 3,500 people and carried out over 15 months, looked at the dietary habits and nutritional status of the low income population.

It was commissioned by the Food Standards Agency to further inform its and other Government departments' work in the area of diet and nutrition among low income groups.

Food Standards Agency Head of Nutrition Rosemary Hignett said: 'The encouraging news from this research is that the gap between the diets of people on low incomes and those of the rest of the population is not as big as some feared.

'It is also positive that most people in this group are confident about their cooking skills, have reasonable kitchen facilities and access to large supermarkets. 'However, the bad news is that this group – like the general population – are not eating as healthily as they could be. Poor diets can

lead to chronic disease, such as heart disease and cancer, and contribute to obesity, which is on the rise.

Small changes to diet can make a big difference to health so we urge everyone to think about the food that they and their family are eating.'

The research found:

- The low income population were less likely to eat wholemeal bread, but drank more sugary drinks and consumed more table sugar
- Less than 10% of respondents ate the recommended 5 portions of fruit and vegetables per day – with about 20% eating less than 1 portion
- Less than a quarter of people ate oily fish during the survey period
- Adults are getting 13.4% of their energy from saturated fat, which exceeds the 'no more than 11%' recommendation
- 51% of men and 69% of women fell short of the minimum recommended intake of dietary fibre (12g)
- 65% of children had a non-diet fizzy drink during the 4-day survey period
- About two-thirds of men and women had cholesterol levels at levels associated with higher risks of cardiovascular disease (above 5mmol/l)
- Average daily intakes of all vitamins (apart from A and D) were above or close to the Reference Nutrient Intake (RNI) for all sex and age groups; the RNI is the amount sufficient, or more than sufficient, for about 97% of people

The survey also looked at other lifestyle-related factors, including alcohol consumption, smoking and exercise. It found higher levels of smoking and alcohol consumption, together with lower levels of activity within this low income group.

Nutrient Intakes

Protein

In common with the general population, mean daily intake of protein exceeded recommended levels in all sex and age groups.

The protein providers in adults and children were: meat and meat products (37% and 34% respectively), followed by cereals and cereal products (23% and 25% respectively) and milk and milk products (17% and 19% respectively).

Fat

Total fat intakes as a proportion of food energy were broadly similar

to those in the general population dietary recommendation. However, intakes of saturated fatty acids were above recommended levels. Mean daily intake of total fat was 79.1g for men, 59.4g for women, 76.7g for boys and 67.0g for girls.

These correspond to percentages of food energy from total fat of 35.9%, 35.2%, 36.1% and 35.7%, respectively.

The main contributors to total fat intake in adults' diets were meat and meat products (24%), cereals and cereal products (18%), milk and milk products (15%), fat spreads (15%), potatoes & savoury snacks (9%). In contrast to adults, children obtained a higher proportion of fat intake from potatoes and savoury snacks (19% vs 9%) and confectionery (6% vs 3%) but a lower proportion from fat spreads (10% vs 15%).

Saturated Fat

As in the general population, mean intakes of saturated fat exceeded the recommendation of not more than 11% of food energy in all age groups. This was most noticeably in adults aged 65 and over and children aged 2–10 years.

Trans Fatty Acids

Intakes of trans fatty acids as a percentage of food energy were below the recommendation of not more than 2% in adults and children.

Fibre

Cereal and cereal products were the largest source of non-starch polysaccharides (NSP) for adults and children, providing 37% and 38% of intake respectively. Among adults, 51% of men and 69% of women fell short of the minimum recommended intake 18g per day.

Vitamins and Minerals

- Average daily intakes of all vitamins from food sources, with the exception of vitamins A and D, were above or close to the required recommended intake for men and women in all age groups.
- Intakes of many minerals also met recommendations. However, average intakes of total iron, magnesium, potassium and zinc fell below requirements for a large proportion of respondents (mostly women for iron).
- There was evidence of inadequate levels of iron, folate and vitamin D.

This pattern of intakes is broadly similar to the wider population.

Sodium/salt intake

Adults and children both got one-third of their sodium intake (excluding salt added at the table or in cooking) from cereals and cereal products, the largest single contributor to which was white bread (12%). The survey was only able to measure sodium/salt from food sources, so the figures below almost certainly underestimate total salt intake.

Mean daily consumption of salt from food sources only (because the methods used could not quantify salt added in cooking or at the table) was in men about 7g, and in women 5g.

It is likely that true salt intake (taking into account salt added to food) will be in excess of the target of no more than 6g per day for both men and women.

Health Effects of Poor Diet

Eating a lot without taking enough exercise can lead to weight gain and, ultimately, obesity.

With obesity comes a substantially increased risk of diabetes, cardiovascular disease, high blood pressure, some cancers and osteoarthritis. There is a lot of evidence to suggest that diets low in fruits, vegetables and pulses are associated with an increased risk of cancer and heart disease.

High salt consumption is linked to increased blood pressure and this is a risk factor for coronary heart disease. Saturated fats are the main dietary factor in increased blood cholesterol. 61% of men and 65% of women had raised cholesterol at levels linked with a higher risk of cardiovascular disease.

Frequent consumption of foods high in sugars increases the risk of tooth decay.

Chapter 16

Nutrition for Senior Citizens

The life span of humans increases dramatically. Unfortunately, knowledge of the nutritional needs changes. Most experts agree that nutrition is a factor in the aging process. Age-related changes in body composition and metabolism require seniors to keep a sharp eye on their food choices.

Too many seniors are undernourished as a result of:

- Aging,
- Eating processed and refined foods that often have lost their nutritional value,
- Reduced metabolism,
- Diminished appetite, and
- Effects of medication.

Metabolic changes, along with decreased physical activity, require obtaining the same amount of nutrients from a lower caloric level. As one gets older the chances of suffering a chronic illness are greater, and health experts believe that poor eating habits contribute to some of those ailments.

AGING CHANGES HAVE NUTRITIONAL SIGNIFICANCE

First, older people produce less saliva and often have poor dentures. This causes difficulty with very dry foods.

An estimated 30% of seniors lose their ability to make stomach acid, and this interferes with the absorption of some nutrients such as vitamin B12 and folic acid. Deficiencies in these nutrients, as well as vitamin B6, can cause neurological changes such as decline in alertness, loss of memory, and numbness of the extremities.

The reduction of the natural movement of food and enzyme activity in the gastrointestinal tract, known to be associated with aging, often results in digestive difficulties in dealing with certain foods. Also, this reduction in the natural movement of food through the intestines causes food to remain in the intestines for a longer period of time, producing harder stools and resulting in constipation.

Aging affects certain senses, such as taste, smell, vision, and in turn

affects the types of foods that will be chosen. Salty and sweet taste sensations can decline markedly with age, causing some to prefer foods that are richly seasoned. However, certain spicy foods produce gas. Many older persons complain of "heartburn," that often is not caused by increased acidity but by gas production. Others resort to extra salt in order to overcome their gradual loss of taste. Sodium and its role in water retention and high blood pressure may then become a problem.

Due to particular diseases, such as heart disease or osteoporosis, as we age we need less of some minerals (such as sodium to lower blood pressure) and more of others (such as calcium for bone mass). Bones tend to weaken with age; evidence suggests that seniors require at least 1500 milligrams of calcium a day.

Depression and loneliness can further contribute to a disinterest in eating. Many seniors do not have the economical means, knowledge, or willingness to ensure the most nutritious choices in food selection and meal preparation, the result being malnutrition and potential health problems.

Because of changes in the body and decreasing physical activity, older people usually need fewer calories as the rate at which the body uses energy tends to decrease. For some, food intake generally is lower, and the amount of lean body tissue decreases while the amount of body fat increases. Yet others maintain old eating habits not realizing that most people gain weight more easily as they age

There are Nutritional Guidelines for Seniors that can be Derived from Conventional Wisdom

They are as follows:

- Eat a variety of foods from five of the six major food groups (fruits; vegetables; breads and cereals; milk and cheeses; meat, poultry, fish, and dry beans) to obtain all the nutrients needed for good health.
- Avoid foods high in cholesterol.
- Limit total fat intake to less than 30% of your calories and keep intake of saturated fats to less than 10%.
- Increase your intake of dietary fibre.
- Be selective of foods that cause gas problems.
- Prepare moister or softer foods, or smaller portions, if you have difficulty with dry foods.
- Limit the use of salt and sodium compounds.
- Increase your calcium intake, especially women.
- Avoid too much sugar.
- Drink at least eight (8 ounce) glasses of water daily.

- If you drink alcoholic beverages, do so in moderation.
- Drugs interact adversely with certain nutrients. If in doubt, before you take them, find out.

The guidelines cannot guarantee health and well-being as health depends on many things, including heredity, lifestyle, personality traits, mental health and attitudes, and environment, in addition to one's meals.

Food alone cannot make you healthy, but good eating habits based on moderation and variety can keep you healthy and even improve your health. Experts from Health Agencies agree that following these guidelines and eating well-balanced meals support:

- Adequate energy to carry out daily tasks.
- Good mental health and mental abilities.
- Resistance to disease.
- Recovery from illness, accident, or surgery.
- Medication effectiveness.
- Better management of chronic health problems to improve quality of life, mobility, and independence.

Chapter 17

Vegetarian Diet

Vegetarian diets can meet all the recommendations for nutrients. The key is to consume a variety of foods and the right amount of foods to meet your calorie needs. Follow the food group recommendations for your age, sex, and activity level to get the right amount of food and the variety of foods needed for nutrient adequacy. Nutrients that vegetarians may need to focus on include protein, iron, calcium, zinc, and vitamin B_{12}.

Nutrients to Focus on for Vegetarians

Protein has many important functions in the body and is essential for growth and maintenance. Protein needs can easily be met by eating a variety of plant-based foods. Combining different protein sources in the same meal is not necessary. Sources of protein for vegetarians include beans, nuts, nut butters, peas, and soy products (tofu, tempeh, veggie burgers). Milk products and eggs are also good protein sources for lacto-ovo vegetarians. Iron functions primarily as a carrier of oxygen in the blood. Iron sources for vegetarians include iron-fortified breakfast cereals, spinach, kidney beans, black-eyed peas, lentils, turnip greens, molasses, whole wheat breads, peas, and some dried fruits (dried apricots, prunes, raisins). Calcium is used for building bones and teeth and in maintaining bone strength.

Sources of calcium for vegetarians include fortified breakfast cereals, soy products (tofu, soy-based beverages), calcium-fortified orange juice, and some dark green leafy vegetables (collard greens, turnip greens, bok choy, mustard greens). Milk products are excellent calcium sources for lacto vegetarians. Zinc is necessary for many biochemical reactions and also helps the immune system function properly. Sources of zinc for vegetarians include many types of beans (white beans, kidney beans, and chickpeas), zinc-fortified breakfast cereals, wheat germ, and pumpkin seeds. Milk products are a zinc source for lacto vegetarians. Vitamin B_{12} is found in animal products and some fortified foods. Sources of vitamin B_{12} for vegetarians include milk products, eggs, and foods that have been fortified with vitamin B_{12}. These include breakfast cereals, soy-based beverages, veggie burgers, and nutritional yeast.

Tips for Vegetarians

- Build meals around protein sources that are naturally low in fat, such as beans, lentils, and rice. Don't overload meals with high-fat cheeses to replace the meat.
- Calcium-fortified soy-based beverages can provide calcium in amounts similar to milk. They are usually low in fat and do not contain cholesterol.
- Many foods that typically contain meat or poultry can be made vegetarian. This can increase vegetable intake and cut saturated fat and cholesterol intake. Consider:
- Pasta primavera or pasta with marinara or pesto sauce
- Veggie pizza
- Vegetable lasagna
- Tofu-vegetable stir fry
- Vegetable lo mein
- Vegetable kabobs
- Bean burritos or tacos

A variety of vegetarian products look (and may taste) like their non-vegetarian counterparts, but are usually lower in saturated fat and contain no cholesterol.

- For breakfast, try soy-based sausage patties or links.
- Rather than hamburgers, try veggie burgers. A variety of kinds are available, made with soy beans, vegetables, and/or rice.
- Add vegetarian meat substitutes to soups and stews to boost protein without adding saturated fat or cholesterol. These include tempeh (cultured soybeans with a chewy texture), tofu, or wheat gluten (seitan).
- For barbecues, try veggie or garden burgers, soy hot dogs, marinated tofu or tempeh, and veggie kabobs.
- Make bean burgers, lentil burgers, or pita halves with falafel (spicy ground chick pea patties).
- Some restaurants offer soy options (texturized vegetable protein) as a substitute for meat, and soy cheese as a substitute for regular cheese.
- Most restaurants can accommodate vegetarian modifications to menu items by substituting meatless sauces, omitting meat from stir-fries, and adding vegetables or pasta in place of meat. These substitutions are more likely to be available at restaurants that make food to order.
- Many Asian and Indian restaurants offer a varied selection of vegetarian dishes.

Chapter 18

Food Production and Processing

Agriculture refers to the production of food and goods through farming and forestry. Agriculture was the key development that led to the rise of civilization, with the husbandry of domesticated animals and plants (i.e. crops) creating food surpluses that enabled the development of more densely populated and stratified societies. The study of agriculture is known as agricultural science (the related practice of gardening is studied in horticulture).

Agriculture encompasses a wide variety of specialties. Cultivation of crops on arable land and the pastoral herding of livestock on rangeland remain at the foundation of agriculture. In the past century a distinction has been made between sustainable agriculture and intensive farming. Modern agronomy, plant breeding, pesticides and fertilizers, and technological improvements have sharply increased yields from cultivation. Selective breeding and modern practices in animal husbandry such as intensive pig farming (and similar practices applied to the chicken) have similarly increased the output of meat. The more exotic varieties of agriculture include aquaculture and tree farming.

The major agricultural products can be broadly grouped into foods, fibers, fuels, raw materials, pharmaceuticals and illegal drugs, and an assortment of ornamental or exotic products. In the 2000s, plants have been used to grow biofuels, biopharmaceuticals, bioplastics, and pharmaceuticals. Specific foods include cereals, vegetables, fruits, and meat. Fibers include cotton, wool, hemp, silk and flax. Raw materials include lumber and bamboo. Drugs include tobacco, alcohol, opium, cocaine,and digitalis. Other useful materials are produced by plants, such as resins. Biofuels include methane from biomass, ethanol, and biodiesel. Cut flowers, nursery plants, tropical fish and birds for the pet trade are some of the ornamental products.

In 2007, about one third of the world's workers were employed in agriculture. However, the relative significance of farming has dropped steadily since the beginning of industrialization, and in 2003 – for the first time in history – the services sector overtook agriculture as the economic

sector employing the most people worldwide. Despite the fact that agriculture employs over one-third of the world's population, agricultural production accounts for less than five percent of the gross world product (an aggregate of all gross domestic products).

CROP PRODUCTION SYSTEMS

Cropping systems vary among farms depending on the available resources and constraints; geography and climate of the farm; government policy; economic, social and political pressures; and the philosophy and culture of the farmer. Shifting cultivation (or slash and burn) is a system in which forests are burnt, releasing nutrients to support cultivation of annual and then perennial crops for a period of several years.

Then the plot is left fallow to regrow forest, and the farmer moves to a new plot, returning after many more years (10-20). This fallow period is shortened if population density grows, requiring the input of nutrients (fertilizer or manure) and some manual pest control. Annual cultivation is the next phase of intensity in which there is no fallow period. This requires even greater nutrient and pest control inputs. Further industrialization lead to the use of monocultures, when one cultivar is planted on a large acreage. Due to the low biodiversity, nutrient use is uniform, and pests tend to build up, necessitating the greater use of pesticides and fertilizers. Multiple cropping, in which several crops are grown sequentially in one year, and intercropping, when several crops are grown at the same time are other kinds of annual cropping systems known as polycultures.

In tropical environments, all of these cropping systems are practiced. In subtropical and arid environments, the timing and extent of agriculture may be limited by rainfall, either not allowing multiple annual crops in a year, or requiring irrigation. In all of these environments perennial crops are grown (coffee, chocolate) and systems are practiced such as agroforestry. In temperate environments, where ecosystems were predominantly grassland or prairie, highly productive annual cropping is the dominant farming system.

The last century has seen the intensification, concentration and specialization of agriculture, relying upon new technologies of agricultural chemicals (fertilizers and pesticides), mechanization, and plant breeding (hybrids and GMO's). In the past few decades, a move towards sustainability in agriculture has also developed, integrating ideas of socio-economic justice and conservation of resources and the environment within a farming system. This has led to the development of many responses to the conventional agriculture approach, including organic agriculture, urban agriculture, community supported agriculture,

ecological or biological agriculture, integrated farming, and holistic management.

LIVESTOCK PRODUCTION SYSTEMS

Animals, including horses, mules, oxen, camels, llamas, alpacas, and dogs, are often used to help cultivate fields, harvest crops, wrangle other animals, and transport farm products to buyers. Animal husbandry not only refers to the breeding and raising of animals for meat or to harvest animal products (like milk, eggs, or wool) on a continual basis, but also to the breeding and care of species for work and companionship. Livestock production systems can be defined based on feed source, as grassland - based, mixed, and landless. Grassland based livestock production relies upon plant material such as shrubland, rangeland, and pastures for feeding ruminant animals. Outside nutrient inputs may be used, however manure is returned directly to the grassland as a major nutrient source. This system is particularly important in areas where crop production is not feasible due to climate or soil, representing 30-40 million pastoralists. Mixed production systems use grassland, fodder crops and grain feed crops as feed for ruminant and monogastic (one stomach; mainly chickens and pigs) livestock. Manure is typically recycled in mixed systems as a fertilizer for crops. Approximately 68% of all agricultural land is permanent pastures used in the production of livestock. Landless systems rely upon feed from outside the farm, representing the de-linking of crop and livestock production found more prevalently OECD member countries. In the U.S., 70% of the grain grown is fed to animals on feedlots. Synthetic fertilizers are more heavily relied upon for crop production and manure utilization becomes a challenge as well as a source for pollution.

PRODUCTION PRACTICES

Tillage is the practice of plowing soil to prepare for planting or for nutrient incorporation or for pest control. Tillage varies in intensity from conventional to no-till. It may improve productivity by warming the soil, incorporating fertilizer and controlling weeds, but also renders soil more prone to erosion, triggers the decomposition of organic matter releasing CO_2, and reduces the abundance and diversity of soil organisms.

Pest control includes the management of weeds, insects/mites, and diseases. Chemical (pesticides), biological (biocontrol), mechanical (tillage), and cultural practices are used. Cultural practices include crop rotation, culling, cover crops, intercropping, compost, avoidance, and resistance. Integrated pest management attempts to use all of these methods to keep pest populations below the number which would cause economic loss, and recommends pesticides as a last resort.

Nutrient management includes both the source of nutrient inputs for crop and livestock production, and the method of utilization of manure produced by livestock. Nutrient inputs can be chemical inorganic fertilizers, manure, green manure, compost and mined minerals. Crop nutrient use may also be managed using cultural techniques such as crop rotation or a fallow period. Manure is utilized either by holding livestock where the feed crop is growing such as in Managed intensive rotational grazing, or by spreading either dry or liquid formulations of manure on cropland or pastures.

Water management is where rainfall is insufficient or variable, which occurs to some degree in most regions of the world. Some farmers use irrigation to supplement rainfall. In other areas such as the Great Plains in the U.S., farmers use a fallow year to conserve soil moisture to use for growing a crop in the following year. Agriculture represents 70% of freshwater use worldwide

FOOD PROCESSING

Food processing is the set of methods and techniques used to transform raw ingredients into food or to transform food into other forms for consumption by humans or animals either in the home or by the food processing industry. Food processing typically takes clean, harvested crops or slaughtered and butchered animal products and uses these to produce attractive, marketable and often long-life food products. There are several different ways in which food can be produced.

One Off Production. This method is used when customers make an order for something to be made to their own specifications, for example a wedding cake. The making of One Off Products could take days depending on how intricate the design is and also the ability of the chef making the product.

Batch Production. This method is used when the size of the market for a product is not clear, and where there is a range within a product line. A certain number of the same goods will be produced to make up a batch or run, for example at Greg's Bakery they will bake 1 certain number of chicken bakes. This method involves estimating the amount of customers that will want to buy that product.

Mass production. This method is used when there is a mass market for a large number of identical products, for example, chocolate bars, ready meals and canned food. The product passes from one stage of production to another along a production line.

Just in Time. This method of production is mainly used in sandwich bars such as Subway, it is when all the components of the product are there and the customer chooses what they want in their product and it is

made for them fresh in front of them. Extreme examples of food processing include the delicate preparation of deadly fugu fish or preparing space food for consumption under zero gravity.

Food Processing Methods

Common food processing techniques include:

- Removal of unwanted outer layers, such as potato peeling or the skinning of peaches.
- Chopping or slicing e.g. diced carrots.
- Mincing and macerating
- Liquefaction, such as to produce fruit juice
- Fermentation e.g. in beer breweries
- Emulsification
- Cooking, such as boiling, broiling, frying, steaming or grilling
- Deep frying
- Baking
- Mixing
- Addition of gas such as air entrainment for bread or gasification of soft drinks
- Proofing
- Spray drying
- Pasteurization
- Packaging

HISTORY

Food processing dates back to the prehistoric ages when crude processing incorporated slaughtering, fermenting, sun drying, preserving with salt, and various types of cooking (such as roasting, smoking, steaming, and oven baking). Salt-preservation was especially common for foods that constituted warrior and sailors' diets, up until the introduction of canning methods. Evidence for the existence of these methods exists in the writings of the ancient Greek , Chaldean, Egyptian and Roman civilisations as well as archaeological evidence from Europe, North and South America and Asia. These tried and tested processing techniques remained essentially the same until the advent of the industrial revolution. Examples of ready-meals also exist from pre industrial revolution times such as the Cornish pasty and the Haggis

Modern food processing technology in the 19th and 20th century was largely developed to serve military needs. In 1809 Nicolas Appert invented a vacuum bottling technique that would supply food for French troops, and this contributed to the development of tinning and then canning by Peter Durand in 1810. Although initially expensive and somewhat

hazardous due to the lead used in cans, canned goods would later become a staple around the world. Pasteurization, discovered by Louis Pasteur in 1862, was a significant advance in ensuring the micro-biological safety of food.

In the 20th century, World War II, the space race and the rising consumer society in developed countries (including the United States) contributed to the growth of food processing with such advances as spray drying, juice concentrates, freeze drying and the introduction of artificial sweeteners, colouring agents, and preservatives such as sodium benzoate. In the late 20th century products such as dried instant soups, reconstituted fruits and juices, and self cooking meals such as MRE food ration were developed.

In western Europe and North America, the second half of the 20th century witnessed a rise in the pursuit of convenience, food processors especially marketed their products to middle-class working wives and mothers. Frozen foods (often credited to Clarence Birdseye) found their success in sales of juice concentrates and "TV dinners". Processors utilised the perceived value of time to appeal to the postwar population, and this same appeal contributes to the success of convenience foods today.

BENEFITS

More and more people live in the cities far away from where food is grown and produced. In many families the adults are working away from home and therefore there is little time for the preparation of food based on fresh ingredients. The food industry offers products that fulfil many different needs: From peeled potatoes that only have to be boiled at home to fully prepared ready meals that can be heated up in the microwave oven within a few minutes.

Benefits of food processing include toxin removal, preservation, easing marketing and distribution tasks, and increasing food consistency. In addition, it increases seasonal availability of many foods, enables transportation of delicate perishable foods across long distances, and makes many kinds of foods safe to eat by de-activating spoilage and pathogenic micro-organisms. Modern supermarkets would not be feasible without modern food processing techniques, long voyages would not be possible, and military campaigns would be significantly more difficult and costly to execute.

Modern food processing also improves the quality of life for allergists, diabetics, and other people who cannot consume some common food elements. Food processing can also add extra nutrients such as vitamins.

Processed foods are often less susceptible to early spoilage than fresh foods, and are better suited for long distance transportation from the

source to the consumer. Fresh materials, such as fresh produce and raw meats, are more likely to harbour pathogenic micro-organisms (e.g. Salmonella) capable of causing serious illnesses.

DRAWBACKS

In general, fresh food that has not been processed other than by washing and simple kitchen preparation, may be expected to contain a higher proportion of naturally occurring vitamins, fibre and minerals than the equivalent product processed by the food industry. Vitamin C for example is destroyed by heat and therefore canned fruits have a lower content of vitamin C than fresh ones.

Food processing can lower the nutritional value of foods. Processed foods tend to include food additives, such as flavourings and texture enhancing agents, which may have little or no nutritive value, or be unhealthy. Some preservatives added or created during processing such as nitrites or sulphites may cause adverse health effects.

Processed foods often have a higher ratio of calories to other essential nutrients than unprocessed foods, a phenomenon referred to as "empty calories". Most junk foods are processed, and fit this category.

High quality and hygiene standards must be maintained to ensure consumer safety and failures to maintain adequate standards can have serious health consequences.

PERFORMANCE PARAMETERS FOR FOOD PROCESSING

When designing processes for the food industry the following performance parameters may be taken into account:

- Hygiene, e.g. measured by number of micro-organisms per ml of finished product
- Energy consumption, measured e.g. by "ton of steam per ton of sugar produced"
- Minimization of waste, measured e.g. by "percentage of peeling loss during the peeling of potatoes'
- Labour used, measured e.g. by "number of working hours per ton of finished product"
- Minimization of cleaning stops measured e.g. by "number of hours between cleaning stops"

Trends in Modern Food Processing

Health

- Reduction of fat content in final product e.g. by using baking instead of deep-frying in the production of potato chips

- Maintaining the natural taste of the product e.g. by using less artificial sweetener.

Hygiene

The rigorous application of industry and government endorsed standards to minimise possible risk and hazards. In the USA the standard adopted is HACCP.

Efficiency

- Rising energy costs lead to increasing usage of energy-saving technologies[2], e.g. frequency converters on electrical drives, heat insulation of factory buildings and heated vessels, energy recovery systems
- Factory automation systems (often Distributed control systems) reduce personnel costs and may lead to more stable production results

WHOLESALE AND DISTRIBUTION

A vast global transportation network is required by the food industry in order to connect its numerous parts. These include suppliers, manufacturers, warehousing, retailers and the end consumers. There are also those companies that, during the food processing process, add vitamins, minerals, and other necessary requrements usually lost during preparation. Wholesale markets for fresh food products have tended to decline in importance in OECD countries as well as in Latin America and some Asian countries as a result of the growth of supermarkets, which procure directly from farmers or through preferred suppliers, rather than going through markets.

Retail

With populations around the world concentrating in urban areas, food buying is increasingly removed from all aspects food production. This is a relatively recent development, taking place mainly over the last 50 years. The supermarket is a defining retail element of the food industry, where tens of thousands of products are gathered in one location, in continuous, year-round supply.

Food preparation is another area where change in recent decades has been dramatic. Today, two food industry sectors are in apparent competition for the retail food dollar. The grocery industry sell fresh and largely raw products for consumers to use as ingredients in home cooking. The food service industry offers prepared food, either as finished products, or as partially prepared components for final "assembly".

Chapter 19

Wheat

Wheat (*Triticum* spp.), is a worldwide cultivated grass from the Levant region of the Middle East. Globally, after maize, wheat is the second most-produced food among the cereal crops just above rice. Wheat grain is a staple food used to make flour for leavened, flat and steamed breads; cookies, cakes, breakfast cereal, pasta, juice, noodles and couscous; and for fermentation to make beer alcohol, vodkaor biofuel. Wheat is planted to a limited extent as a forage crop for livestock, and the straw can be used as fodder for livestock or as a construction material for roofing thatch. Although wheat supplies much of the world's dietary protein and food supply, as many as one in every 100 to 200 people has Coeliac disease, a condition which results from an immune system response to a protein found in wheat: gluten

As a Food

Raw wheat can be powdered into flour; germinated and dried creating malt; crushed and into cracked wheat; parboiled (or steamed), dried, crushed and de-branned into bulgur; or processed into semolina, pasta, or roux. Wheat is a major ingredient in such foods as bread, porridge, crackers, biscuits, Muesli, pancakes, pies, pastries, cakes & cupcakes, cookies, muffins, rolls, doughnuts, gravy, boza (a fermented beverage), and breakfast cereals (e.g. Wheatena, Cream of Wheat, Shredded Wheat, and Wheaties)

Nutrition

00 grams of hard red winter wheat contain about 12.6 grams of protein, 1.5 grams of total fat, 71 grams of carbohydrate (by difference), 12.2 grams of dietary fibre, and 3.2 mg of iron (17% of the daily requirement); the same weight of hard red spring wheat contains about 15.4 grams of protein, 1.9 grams of total fat, 68 grams of carbohydrate (by difference), 12.2 grams of dietary fibre, and 3.6 mg of iron (20% of the daily requirement). Gluten, a protein found in wheat (and other Triticeae), cannot be tolerated by people with celiac disease (an autoimmune disorder

in ~1% of Indo-European populations). Much of the carbohydrate fraction of wheat is starch. Wheat starch is an important commercial product of wheat, but second in economic value to wheat gluten. The principal parts of wheat flour are gluten and starch. These can be separated in a kind of home experiment, by mixing flour and water to form a small ball of dough, and kneading it gently while rinsing it in a bowl of water. The starch falls out of the dough and sinks to the bottom of the bowl, leaving behind a ball of gluten

Health Concerns

Roughly 1% of the population has coeliac (also written as celiac) disease—a condition that is caused by an adverse immune system reaction to gliadin, a gluten protein found in wheat (and similar proteins of the tribe Triticeae which includes other cultivars such as barley and rye). Upon exposure to gliadin, the enzyme tissue transglutaminase modifies the protein, and the immune system cross-reacts with the bowel tissue, causing an inflammatory reaction. That leads to flattening of the lining of the small intestine, which interferes with the absorption of nutrients. The only effective treatment is a lifelong gluten-free diet. While the disease is caused by a reaction to wheat proteins, it is not the same as wheat allergy.

Production and Consumption Statistics

In 2003, global per capita wheat consumption was 67 kg, with the highest per capita consumption (239 kg) found.Unlike rice, wheat production is more widespread globally though China's share is almost one-sixth of the world.

While winter wheat lies dormant during a winter freeze, wheat normally requires between 110 and 130 days between planting and harvest, depending upon climate, seed type, and soil conditions. Crop management decisions require the knowledge of stage of development of the crop. In particular, spring fertilizer applications, herbicides, fungicides, growth regulators are typically applied at specific stages of plant development.

For example, current recommendations often indicate the second application of nitrogen be done when the ear (not visible at this stage) is about 1 cm in size (Z31 on Zadoks scale). Knowledge of stages is also interesting to identify periods of higher risk, in terms of climate. For example, the meiosis stage is extremely susceptible to low temperatures (under 4°C) or high temperatures (over 25°C). Farmers also benefit from knowing when the flag leaf (last leaf) appears as this leaf represents about 75% of photosynthesis reactions during the grain-filling period and as such should be preserved from disease or insect attacks to ensure a good yield.

Several systems exist to identify crop stages, with the Feekes and Zadoks scales being the most widely used. Each scale is a standard system which describes successive stages reached by the crop during the agricultural season.

Diseases

Estimates of the amount of wheat production lost owing to plant diseases vary between 10-25% in Missouri.[1] A wide range of organisms infect wheat, of which the most important are viruses and fungi.

Chapter 20

Fats and Oils

Vegetable fats and oils are lipid materials derived from plants. Physically, oils are liquid at room temperature, and fats are solid. Chemically, both fats and oils are composed of triglycerides, as contrasted with waxes which lack glycerin in their structure. Although many different parts of plants may yield oil, in commercial practice, oil is extracted primarily from seeds.

The melting temperature distinction between oils and fats is imprecise, since definitions of room temperature vary, and typically natural oils have a *melting range* instead of a single melting point.

Vegetable fats and oils may be edible or inedible. Examples of inedible vegetable fats and oils include processed linseed oil, tung oil, and castor oil used in lubricants, paints, cosmetics, pharmaceuticals, and other industrial purposes.

Although thought of as esters of glycerin and a varying blend of fatty acids, fats and oils also typically contain free fatty acids, monoglycerides, and diglycerides.

Uses of Triglyceride Vegetable Oil

Oils extracted from plants have been used in many cultures, since ancient time. As an example, in a 4,000 year old "kitchen" unearthed in Indiana's Charlestown State Park, archaeologist Bob McCullough of IPFW found evidence that natives used large slabs of rock to crush hickory nuts, then boiled them in water to extract the oil.

Culinary Uses

Many vegetable oils are consumed directly, or used directly as ingredients in food - a role that they share with some animal fats, including butter and ghee. The oils serve a number of purposes in this role:

- Shortening - to give pastry a crumbly texture.
- Texture - oils can serve to make other ingredients stick together less.
- Flavour - while less-flavorful oils command premium prices, oils

such as olive oil or almond oil may be chosen specifically for the flavour they impart.

Flavour base - oils can also "carry" flavors of other ingredients, since many flavors are present in chemicals that are soluble in oil.

Secondly, oils can be heated, and used to cook other foods. Oils that are suitable for this purpose must have a high flash point. Such oils include the major cooking oils - canola, sunflower, safflower, peanut etc. Some oils, including rice bran oil, are particularly valued in Asian cultures for high temperature cooking, because of their unusually high flash point.

Hydrogenated Oils

Unsaturated vegetable fats and oils can be transformed through partial or complete hydrogenation into fats and oils of higher melting point. The hydrogenation process involves *"sparging"* the oil at high temperature and pressure with hydrogen in the presence of a catalyst, typically a powdered nickel compound. As each double-bond is broken, two hydrogen atoms each form single bonds with the two carbon atoms. The elimination of double-bonds by adding hydrogen atoms is called *saturation;* as the degree of saturation increases, the oil progresses towards being fully hydrogenated. An oil may be hydrogenated to increase resistance to rancidity (oxidation) or to change its physical characteristics. As the degree of saturation increases, the oil's viscosity and melting point increase.

The use of hydrogenated oils in foods has never been completely satisfactory. Because the centre arm of the triglyceride is shielded somewhat by the end fatty acids, most of the hydrogenation occurs on the end fatty acids. This makes the resulting fat more brittle. A margarine made from naturally more saturated oils will be more plastic (more "spreadable") than a margarine made from, say, hydrogenated soy oil. In addition, partial hydrogenation results in the formation of large amounts trans fats in the oil mixture, which, since the 1970s, have increasingly been viewed as unhealthy.

Industrial Uses

Vegetable oils are used as an ingredient or component in many manufactured products.

- Many vegetable oils are used to make soaps, skin products, candles, perfumes and other personal care and cosmetic products.
- Some oils are particularly suitable as drying agents, and are used in making paints and other wood treatment products. Dammar

oil (a mixture of linseed oil and dammar resin), for example, is used almost exclusively in treating the hulls of wooden boats.

- Vegetable oils are increasingly being used in the electrical industry as insulators as vegetable oils are non-toxic to the environment, biodegradable if spilled and have high flash and fire points. However, vegetable oils are less chemically-stable, so they are generally used in systems where they are not exposed to oxygen, and they are more expensive than crude oil distillate. Two examples are FR3 by Cooper Power and Biotemp by ABB. Midel 7131 by M & I materials is a synthetic tetraester, like a vegetable oil but with four fatty acid chains compared to the normal three found in a natural ester, and is manufactured by an alcohol plus acid reaction. Tetraesters generally have high stability to oxidation and have found use as engine lubricants.
- Vegetable oil is being used to produce bio-degradable hydraulic fluid and lubricant. Common vegetable oil has also been used experimentally as a cooling agent in PCs.

One limiting factor in industrial uses of vegetable oils is that all such oils eventually chemically decompose turning rancid. Oils that are more stable, such as Ben oil or mineral oil, are preferred for some industrial uses. Vegetable-based oils, like castor oil, have been used as medicine and as lubricants for a long time. Castor oil has numerous industrial uses, primarily due to the presence of hydroxyl groups on the fatty acid chains. Castor oil, and other vegetable oils which have been chemically modified to contain hydroxyl groups, are becoming increasingly important in the production of polyurethane plastic for many applications. These modified vegetable oils are known as natural oil polyols.

Pet Food Additive

Vegetable oil is used in production of some pet foods. AAFCO defines vegetable oil, in this context, as the product of vegetable origin obtained by extracting the oil from seeds or fruits which are processed for edible purposes. In some poorer grade pet foods, the oil is listed only as "vegetable oil", without specifying the particular oil.

Fuel

Vegetable oils are also used to make biodiesel, which can be used like conventional diesel. Some vegetable oil blends are used in unmodified vehicles but straight vegetable oil, also known as pure plant oil, needs specially prepared vehicles which have a method of heating the oil to reduce its viscosity. The vegetable oil economy is growing and the availability of biodiesel around the world is increasing.

Extraction

The "modern" way of processing vegetable oil is by chemical extraction, using solvent extracts, which produces higher yields and is quicker and less expensive. The most common solvent is petroleum-derived hexane. This technique is used for most of the "newer" industrial oils such as soybean and corn oils.

Another way is physical extraction, which does not use solvent extracts. It is made the "traditional" way using several different types of mechanical extraction. This method is typically used to produce the more traditional oils (e.g., olive), and it is preferred by most "health-food" customers in the USA and in Europe. Expeller-pressed extraction is one type, and there are two other types that are both oil presses: the screw press and the ram press. Oil seed presses are commonly used in developing countries, among people for whom other extraction methods would be prohibitively expensive. The amount of oil extracted using these methods varies.

Production

Crude oil, straight from the crushing operation, is not considered edible in the case of most oilseeds. The same is true for the remaining meal. For instance, animals fed raw soy meal will waste away, even though soy meal is high in protein.

Researchers at Central Soya discovered that a trypsin inhibitor in soybeans could be deactivated by toasting the meal, and both licensed their invention, and sold soy meal augmented with vitamins and minerals as MasterMix, a product for farmers to mix with their own grain to produce a high quality feed.

The processing of soy oil is typical of that used with most vegetable oils. Crude soy oil is first mixed with caustic soda. Saponification turns triglycerides into soap. The soap is removed with a centrifuge. Neutralized dry soap stock (NDSS) is typically used in animal feed, more to get rid of it than because it is particularly nourishing. The remaining oil is deodorized by heating under a near-perfect vacuum and sparged with water. The condensate is further processed to become vitamin E food supplement, while the oil can be sold to manufacturers and consumers at this point.

Some of the oil is further processed. By carefully filtering the oil at near-freezing temperatures, "winter oil" is produced. This oil is sold to manufacturers of salad dressings, so that the dressings do not turn cloudy when refrigerated.

The oil may be partially hydrogenated to produce various ingredient

oils. Lightly hydrogenated oils have very similar physical characteristics to regular soy oil, but are more resistant to becoming rancid.

Margarine oils need to be mostly solid at 32 °C (90 °F) so that the margarine does not melt in warm rooms, yet it needs to be completely liquid at 37 °C (98 °F), so that it doesn't leave a "lardy" taste in the mouth.

Another major use of soy oil is for fry oils. These oils require substantial hydrogenation to keep the polyunsaturates of soy oil from becoming rancid.

Hardening vegetable oil is done by raising a blend of vegetable oil and a catalyst in near-vacuum to very high temperatures, and introducing hydrogen. This causes the carbon atoms of the oil to break double-bonds with other carbons, each carbon forming a new single-bond with a hydrogen atom. Adding these hydrogen atoms to the oil makes it more solid, raises the smoke point, and makes the oil more stable.

Hydrogenated vegetable oils differ in two major ways from other oils which are equally saturated. During hydrogenation, it is easier for hydrogen to come into contact with the fatty acids on the end of the triglyceride, and less easy for them to come into contact with the centre fatty acid. This makes the resulting fat more brittle than a tropical oil; soy margarines are less "spreadable". The other difference is that trans fatty acids (often called trans fat) are formed in the hydrogenation reactor, and may amount to as much as 40 percent by weight of a partially hydrogenated oil. Trans acids are increasingly thought to be unhealthy.

Sparging

In the processing of edible oils, the oil is heated under vacuum to near the smoke point, and water is introduced at the bottom of the oil. The water immediately is converted to steam, which bubbles through the oil, carrying with it any chemicals which are water-soluble. The steam sparging removes impurities that can impart unwanted flavors and odors to the oil.

Chapter 21

Sugar

Sugar is a class of edible crystalline substances, mainly sucrose, lactose, and fructose. Human taste buds interpret its flavour as sweet. Sugar as a basic food carbohydrate primarily comes from sugar cane and from sugar beet, but also appears in fruit, honey, sorghum, sugar maple (in maple syrup), and in many other sources. It forms the main ingredient in much candy. Excessive consumption of sugar has been associated with increased incidences of type 2 diabetes, obesity and tooth decay.

As a Food

Originally a luxury], sugar eventually became sufficiently cheap and common to influence standard cuisine. Britain and the Caribbean islands have cuisines where the use of sugar became particularly prominent.

Sugar forms a major element in confectionery and in desserts. Cooks use it as a food preservative as well as for sweetening.

Human Health

Studies have indicated potential links between processed sugar consumption and health hazards, including obesity and tooth decay. John Yudkin showed that the consumption of sugar and refined sweeteners is closely associated with coronary heart disease. It is also considered as a source of endogenous glycation processes.

Tooth Decay

Tooth decay has arguably become the most prominent health hazard associated with the consumption of sugar. Oral bacteria such as *Streptococcus mutans* live in dental plaque and metabolize sugars into lactic acid.

High concentrations of acid may result on the surface of a tooth, leading to tooth demineralization. The American Dental Association sees] tooth decay as caused "mostly" by starchy foods like breadsticks, cereals and potato chips that linger on teeth and prolong acid production, not by simple sugars that dissolve rapidly in the mouth.

Diabetes

Diabetes, a disease that causes the body to metabolize sugar poorly, occurs when either:

- The body attacks the cells producing insulin, the chemical that allows the metabolizing of sugar in the body's cells (Type 1 diabetes)
- The body's cells ignore insulin (Type 2 diabetes)

When glucose builds up in the bloodstream, it can cause two problems:

- In the short term, cells become starved for energy because they do not have access to the glucose
- In the long term, frequent glucose build-up increases the acidity of the blood, damaging many of the body's organs, including the eyes, kidneys, nerves and/or heart

Authorities advise diabetics to avoid sugar-rich foods to prevent adverse reactions.

Obesity

a scientific/health debate has started over the causes of a steep rise in obesity in the general population — and one view posits increased consumption of carbohydrates in recent[update] decades as a major factor. Obesity can result from a number of factors including:

- An increased intake of energy-dense foods — high in fat and sugars but low in vitamins, minerals and other micronutrients (see United Nations advice below); and
- Decreased physical activity. The National Health and Nutrition Examination Survey I and Continuous indicates that the population in the United States has increased its proportion of energy consumption from carbohydrates and decreased its proportion from total fat while obesity has increased. This implies, along with the United Nations report cited below, that obesity may correlate better with sugar consumption than with fat consumption, and that reducing fat consumption while increasing sugar consumption actually increases the level of obesity

Gout

Researchers have implicated sugary drinks high in fructose in a surge in cases of the painful joint disease gout

Cancer

A link between sugar and cancer has been conjectured for some time

but this remains a controversial topic. Some recent studies lend support to this theory. However no major medical or nutritional organization currently recommends reducing sugar consumption to prevent cancer.

Production

Table sugar (sucrose) comes from plant sources. Two important sugar crops predominate: sugarcane (*Saccharum spp.*) and sugar beets (*Beta vulgaris*), in which sugar can account for 12% to 20% of the plant's dry weight. Some minor commercial sugar crops include the date palm (*Phoenix dactylifera*), sorghum (*Sorghum vulgare*), and the sugar maple (*Acer saccharum*). In the financial year 2001/2002, worldwide production of sugar amounted to 134.1 million tonnes.

The first production of sugar from sugarcane took place in India. Alexander the Great's companions reported seeing "honey produced without the intervention of bees" and it remained exotic in Europe until the Arabs started cultivating it in Sicily and Spain. Only after the Crusades did it begin to rival honey as a sweetener in Europe. The Spanish began cultivating sugarcane in the West Indies in 1506 (and in Cuba in 1523). The Portuguese first cultivated sugarcane in Brazil in 1532.

Most cane sugar comes from countries with warm climates, such as Brazil, India, China, Thailand, Mexico and Australia, the top sugar-producing countries in the world. Brazil overshadows most countries, with roughly 30 million tonnes of cane sugar produced in 2006, while India produced 21 million, China 11 million, and Thailand and Mexico roughly 5 million each. Viewed by region, Asia predominates in cane sugar production, with large contributions from China, India and Thailand and other countries combining to account for 40% of global production in 2006. South America comes in second place with 32% of global production; Africa and Central America each produce 8% and Australia 5%. The United States, the Caribbean and Europe make up the remainder, with roughly 3% each.

Beet sugar comes from regions with cooler climates: northwest and eastern Europe, northern Japan, plus some areas in the United States (including California). In the northern hemisphere, the beet-growing season ends with the start of harvesting around September. Harvesting and processing continues until March in some cases. The availability of processing plant capacity, and the weather both influence the duration of harvesting and processing - the industry can lay up harvested beet until processed, but a frost-damaged beet becomes effectively unprocessable.

The European Union (EU) has become the world's second-largest sugar exporter. The Common Agricultural Policy of the EU sets maximum quotas for members' production to match supply and demand, and a price.

Europe exports excess production quota (approximately 5 million tonnes in 2003). Part of this, "quota" sugar, gets subsidised from industry levies, the remainder (approximately half) sells as "C quota" sugar at market prices without subsidy. These subsidies and a high import tariff make it difficult for other countries to export to the EU states, or to compete with the Europeans on world markets.

The United States sets high sugar prices to support its producers, with the effect that many former consumers of sugar have switched to corn syrup (beverage manufacturers) or moved out of the country (candymakers).

The cheap prices of glucose syrups produced from wheat and corn (maize) threaten the traditional sugar market. Used in combination with artificial sweeteners, they can allow drink manufacturers to produce very low-cost goods.

Culinary Sugars

So-called raw sugars comprise yellow to brown sugars made by clarifying the source syrup by boiling and drying with heat, until it becomes a crystalline solid, with minimal chemical processing raw beet sugars result from the processing of sugar beet juice, but only as intermediates *en route* to white sugar. Types of raw sugar include *demerara*, *muscovado*, and *turbinado*. Mauritius and Malawi export significant quantities of such specialty sugars. Manufacturers sometimes prepare raw sugar as loaves rather than as a crystalline powder, by pouring sugar and molasses together into molds and allowing the mixture to dry. This results in sugar-cakes or loaves, called *jaggery* or *gur* in India, *pingbian tang* in China, and *panela, panocha, pile, piloncillo* and *pão-de-açúcar* in various parts of Latin America. In South America, truly raw sugar, unheated and made from sugarcane grown on farms, does not have a large market-share.

Mill white sugar, also called plantation white, crystal sugar, or superior sugar, consists of raw sugar where the production process does not remove colored impurities, but rather bleaches them white by exposure to sulfur dioxide. Though the most common form of sugar in sugarcane-growing areas, this product does not store or ship well; after a few weeks, its impurities tend to promote discoloration and clumping.

Blanco directo, a white sugar common in India and other south Asian countries, comes from precipitating many impurities out of the cane juice by using *phosphatation* — a treatment with phosphoric acid and calcium hydroxide similar to the carbonatation technique used in beet sugar refining. In terms of sucrose purity, blanco directo is more pure than mill white, but less pure than white refined sugar.

White refined sugar has become the most common form of sugar in

North America as well as in Europe. Refined sugar can be made by dissolving raw sugar and purifying it with a phosphoric acid method similar to that used for blanco directo, a carbonatation process involving calcium hydroxide and carbon dioxide, or by various filtration strategies. It is then further purified by filtration through a bed of activated carbon or bone char depending on where the processing takes place. Beet sugar refineries produce refined white sugar directly without an intermediate raw stage. White refined sugar is typically sold as *granulated sugar*, which has been dried to prevent clumping.

Granulated sugar comes in various crystal sizes — for home and industrial use — depending on the application:

- Coarse-grained sugars, such as *sanding sugar* (also called "pearl sugar", "decorating sugar", *nibbed sugar* or *sugar nibs*) adds "sparkle" and flavour for decorating to baked goods, candies, cookies/biscuits and other desserts. The sparkling effect occurs because the sugar forms large crystals which reflect light. Sanding sugar, a large-crystal sugar, serves for making edible decorations. It has larger granules that sparkle when sprinkled on baked goods and candies and will not dissolve when subjected to heat.
- Normal granulated sugars for table use: typically they have a grain size about 0.5 mm across
- Finer grades result from selectively sieving the granulated sugar
  - *Caster* (or *castor*) (0.35 mm), commonly used in baking
  - *Superfine* sugar, also called *baker's sugar*, *berry sugar*, or *bar sugar* — favored for sweetening drinks or for preparing meringue
- Finest grades
  - *Powdered sugar*, *10X sugar*, *confectioner's sugar* (0.060 mm), or *icing sugar* (0.024 mm), produced by grinding sugar to a fine powder. The manufacturer may add a small amount of anticaking agent to prevent clumping — either cornstarch (1% to 3%) or tri-calcium phosphate.

Retailers also sell sugar cubes or lumps for convenient consumption of a standardized amount. Suppliers of sugarcubes make them by mixing sugar crystals with sugar syrup. Jakub Kryštof Rad invented sugarcubes in 1841 in the Austrian Empire.

Brown sugars come from the late stages of sugar refining, when sugar forms fine crystals with significant molasses content, or from coating white refined sugar with a cane molasses syrup. Their colour and taste become stronger with increasing molasses content, as do their moisture-retaining properties. Brown sugars also tend to harden if exposed to the atmosphere,

although proper handling can reverse this. The World Health Organisation and the Food and Agriculture Organization of the United Nations expert report (WHO Technical Report Series 916 Diet, Nutrition and the Prevention of Chronic Diseases) defines free sugars as all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and fruit juices. This includes all the sugars referred to above. The term distinguishes these forms from all other *culinary sugars* added in their natural form with no refining at all.

Natural sugars comprise all completely unrefined sugars: effectively all sugars not defined as *free sugars*. The WHO Technical Report Series 916 Diet, Nutrition and the Prevention of Chronic Diseases approves only natural sugars as carbohydrates for unrestricted consumption. Natural sugars come in fruit, grains and vegetables in their natural or cooked form.

Chapter 22

Milk

Milk is an opaque white liquid produced by the mammary glands of female mammals (including monotremes). It provides the primary source of nutrition for newborn mammals before they are able to digest other types of food.

The early lactation milk is known as colostrum, and carries the mother's antibodies to the baby.

It can reduce the risk of many diseases in the baby. The exact components of raw milk varies by species, but it contains significant amounts of saturated fat, protein and calcium as well as vitamin C. Cow's milk has a pH ranging from 6.4 to 6.8, making it slightly acidic.

MODERN PRODUCTION

In the Western world today, cow milk is produced on an industrial scale. It is by far the most commonly consumed form of milk in the western world.

Commercial dairy farming using automated milking equipment produces the vast majority of milk in developed countries. Types of cattle such as the Holstein have been specially bred for increased milk production. 90% of the dairy cows in the United States and 85% in Great Britain are Holsteins. Other milk cows in the United States include Ayrshire, Brown Swiss, Guernsey, Jersey, and Milking Shorthorn. The largest producers of dairy products and milk today are India followed by the United States and China. In India, Amul, a cooperative owned jointly by 2.6 million small farmers was the engine behind the success of Operation Flood.

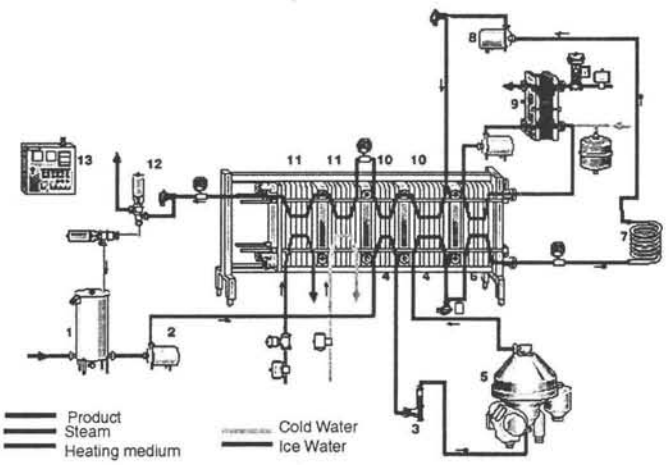
Processing

In most Western countries, a centralised dairy facility processes milk and products obtained from milk (dairy products), such as cream, butter, and cheese. In the United States, these dairies are usually local companies, while in the southern hemisphere facilities may be run by very large nationwide or trans-national corporations.

Pasteurization

Pasteurization is used to kill harmful microorganisms by heating the milk for a short time and then cooling it for storage and transportation. Pasteurized milk is still perishable and must be stored cold by both suppliers and consumers. Dairies print expiration dates on each container, after which stores will remove any unsold milk from their shelves. In many countries it is illegal to sell milk that is not pasteurized.[*citation needed*]

Milk may also be further heated to extend its shelf life through ultra-high temperature treatment (UHT), which allows it to be stored unrefrigerated, or an even longer lasting sterilization process.



Creaming and Homogenization

Upon standing for 12 to 24 hours, fresh milk has a tendency to separate into a high-fat cream layer on top of a larger, low-fat milk layer. The cream is often sold as a separate product with its own uses; today the separation of the cream from the milk is usually accomplished rapidly in centrifugal cream separators. The fat globules rise to the top of a container of milk because fat is less dense than water. The smaller the globules, the more other molecular-level forces prevent this from happening. In fact, the cream rises in cow milk much more quickly than a simple model would predict: rather than isolated globules, the fat in the milk tends to form into clusters containing about a million globules, held together by a number of minor whey proteins. These clusters rise faster than individual globules can. The fat globules in milk from goats, sheep, and water buffalo do not form clusters so readily and are smaller to begin with; cream is very slow to separate from these milks.

Milk is often homogenized, a treatment which prevents a cream layer

from separating out of the milk. The milk is pumped at high pressures through very narrow tubes, breaking up the fat globules through turbulence and cavitation. A greater number of smaller particles possess more total surface area than a smaller number of larger ones, and the original fat globule membranes cannot completely cover them.

Casein micelles are attracted to the newly-exposed fat surfaces; nearly one-third of the micelles in the milk end up participating in this new membrane structure.

The casein weighs down the globules and interferes with the clustering that accelerated separation. The exposed fat globules are briefly vulnerable to certain enzymes present in milk, which could break down the fats and produce rancid flavors. To prevent this, the enzymes are inactivated by pasteurizing the milk immediately before or during homogenization.

Homogenized milk tastes blander but feels creamier in the mouth than unhomogenized; it is whiter and more resistant to developing off flavors. Creamline, or cream-top, milk is unhomogenized; it may or may not have been pasteurized. Milk which has undergone high-pressure homogenization, sometimes labeled as "ultra-homogenized," has a longer shelf life than milk which has undergone ordinary homogenization at lower pressures. Homogenized milk may be more digestible than unhomogenized milk.

Concerns exist about the health effects of consuming homogenized milk. Work by Kurt A. Oster, M.D. in the 1960s through the 1980s suggested a link between homogenized milk and arteriosclerosis, due to the release of bovine xanthine oxidase (BXO) from the milk fat globular membrane (MFGM) during homogenization. While Oster's work has been widely criticized, it is apparent that homogenization introduces changes the MFGM and the exposure of its proteins, and the effects of these changes on food safety have not been thoroughly investigated.

Nutrition and Health

The composition of milk differs widely between species. Factors such as the type of protein; the proportion of protein, fat, and sugar; the levels of various vitamins and minerals; and the size of the butterfat globules and the strength of the curd are among those than can vary. For example:

- Human milk contains, on average, 1.1% protein, 4.2% fat, 7.0% lactose (a sugar), and supplies 72 kcal of energy per 100 grams.
- Cow milk contains, on average, 3.4% protein, 3.6% fat, and 4.6% lactose, 0.7% minerals and supplies 66 kcal of energy per 100 grams. See also Nutritional value further on.

Donkey and horse milk have the lowest fat content, while the milk of

seals and whales can contain more than 50% fat. High fat content is not unique to aquatic animals, as guinea pig milk has an average fat content of 46%

Nutritional Value

Processed milk began containing differing amounts of fat during the 1950s. A serving (1 cup or 250 ml) of 2%-fat milk contains 285 mg of calcium, which represents 22% to 29% of the daily recommended intake (DRI) of calcium for an adult. Depending on the age, 8 grams of protein, and a number of other nutrients (either naturally or through fortification)including:

Biotin
pantothenic acid
Iodine
Potassium
Magnesium
Selenium
Thiamine
Vitamin A
Vitamin B12
Riboflavin
Vitamins D
Vitamin K

The amount of calcium from milk that is absorbed by the human body is disputed. Calcium from dairy products has a greater bioavailability than calcium from certain vegetables, such as spinach, that contain high levels of calcium-chelating agents, but a similar or lesser bioavailability than calcium from low-oxalate vegetables such as kale, broccoli, or other vegetables in the Brassica genus.

Chapter 23

Cheese

Cheese is a food consisting of proteins and fat from milk, usually the milk of cows, buffalo, goats, or sheep. It is produced by coagulation of the milk protein casein. Typically, the milk is acidified and addition of the enzyme rennet causes coagulation. The solids are then separated and pressed into final form. Some cheeses also contain molds, either on the outer rind or throughout.

Hundreds of types of cheese are produced. Their different styles, textures and flavors depend on the origin of the milk (including the animal's diet), whether it has been pasteurized, butterfat content, the species of bacteria and mold, and the processing including the length of aging. Herbs, spices, or wood smoke may be used as flavoring agents. The yellow to red colour of many cheeses is a result of adding annatto. Cheeses are eaten both on their own and cooked in various dishes; most cheeses melt when heated.

For a few cheeses, the milk is curdled by adding acids such as vinegar or lemon juice. Most cheeses are acidified to a lesser degree by bacteria, which turn milk sugars into lactic acid, then the addition of rennet completes the curdling. Vegetarian alternatives to rennet are available; most are produced by fermentation of the fungus *Mucor miehei*, but others have been extracted from various species of the *Cynara* thistle family.

Cheese has served as a hedge against famine[*citation needed*] and is a good travel food. It is valuable for its portability, long life, and high content of fat, protein, calcium, and phosphorus. Cheese is more compact and has a longer shelf life than the milk from which it is made. Cheesemakers near a dairy region may benefit from fresher, lower-priced milk, and lower shipping costs. The long storage life of cheese allows selling it when markets are more favorable

Making Cheese

Curdling

The only strictly required step in making any sort of cheese is

separating the milk into solid curds and liquid whey. Usually this is done by acidifying (souring) the milk and adding rennet.

The acidification is accomplished directly by the addition of an acid like vinegar in a few cases (paneer, queso fresco), but usually starter bacteria are employed instead.

These starter bacteria convert milk sugars into lactic acid. The same bacteria (and the enzymes they produce) also play a large role in the eventual flavour of aged cheeses. Most cheeses are made with starter bacteria from the *Lactococci*, *Lactobacilli*, or *Streptococci* families. Swiss starter cultures also include *Propionibacter shermani*, which produces carbon dioxide gas bubbles during aging, giving Swiss cheese or Emmental its holes.

Some fresh cheeses are curdled only by acidity, but most cheeses also use rennet. Rennet sets the cheese into a strong and rubbery gel compared to the fragile curds produced by acidic coagulation alone. It also allows curdling at a lower acidity—important because flavour-making bacteria are inhibited in high-acidity environments. In general, softer, smaller, fresher cheeses are curdled with a greater proportion of acid to rennet than harder, larger, longer-aged varieties.

Curd Processing

At this point, the cheese has set into a very moist gel. Some soft cheeses are now essentially complete: they are drained, salted, and packaged. For most of the rest, the curd is cut into small cubes. This allows water to drain from the individual pieces of curd.

Some hard cheeses are then heated to temperatures in the range of 35 °C–55 °C (100 °F–130 °F). This forces more whey from the cut curd. It also changes the taste of the finished cheese, affecting both the bacterial culture and the milk chemistry. Cheeses that are heated to the higher temperatures are usually made with thermophilic starter bacteria which survive this step—either lactobacilli or streptococci.

Salt has a number of roles in cheese besides adding a salty flavour. It preserves cheese from spoiling, draws moisture from the curd, and firms up a cheese's texture in an interaction with its proteins. Some cheeses are salted from the outside with dry salt or brine washes. Most cheeses have the salt mixed directly into the curds.

A number of other techniques can be employed to influence the cheese's final texture and flavour. Some examples:

Stretching: (Mozzarella, Provolone) The curd is stretched and kneaded in hot water, developing a stringy, fibrous body.

Cheddaring: (Cheddar, other English cheeses) The cut curd is repeatedly piled up, pushing more moisture away. The curd is also mixed

(or *milled*) for a long period of time, taking the sharp edges off the cut curd pieces and influencing the final product's texture.

Washing: (Edam, Gouda, Colby) The curd is washed in warm water, lowering its acidity and making for a milder-tasting cheese.

Most cheeses achieve their final shape when the curds are pressed into a mold or form. The harder the cheese, the more pressure is applied. The pressure drives out moisture—the molds are designed to allow water to escape—and unifies the curds into a single solid body.

Aging

A newborn cheese is usually salty yet bland in flavour and, for harder varieties, rubbery in texture. These qualities are sometimes enjoyed—cheese curds are eaten on their own—but normally cheeses are left to rest under carefully controlled conditions. This aging period (also called ripening, or, from the French, *affinage*) can last from a few days to several years. As a cheese ages, microbes and enzymes transform its texture and intensify its flavour. This transformation is largely a result of the breakdown of casein proteins and milkfat into a complex mix of amino acids, amines, and fatty acids.

Some cheeses have additional bacteria or molds intentionally introduced to them before or during aging. In traditional cheesemaking, these microbes might be already present in the air of the aging room; they are simply allowed to settle and grow on the stored cheeses. More often today, prepared cultures are used, giving more consistent results and putting fewer constraints on the environment where the cheese ages. These cheeses include soft ripened cheeses such as Brie and Camembert, blue cheeses such as Roquefort, Stilton, Gorgonzola, and rind-washed cheeses such as Limburger.

Health and Nutrition

In general, cheese supplies a great deal of calcium, protein, and phosphorus. A 30-gram (1.1 oz) serving of Cheddar cheese contains about 7 grams (0.25 oz) of protein and 200 milligrams of calcium. Nutritionally, cheese is essentially concentrated milk: it takes about 200 grams (7.1 oz) of milk to provide that much protein, and 150 grams (5.3 oz) to equal the calcium.

Cheese potentially shares milk's nutritional disadvantages as well. The Centre for Science in the Public Interest describes cheese as America's number one source of saturated fat, adding that the average American ate 30 lb (14 kg) of cheese in the year 2000, up from 11 lb (5 kg) in 1970. Their recommendation is to limit full-fat cheese consumption to 2 oz (57 g) a week. Whether cheese's highly saturated fat actually leads to an

increased risk of heart disease is called into question when considering France and Greece, which lead the world in cheese eating (more than 14 oz/400 g a week per person, or over 45 lb/20 kg a year) yet have relatively low rates of heart disease. This seeming discrepancy is called the French Paradox; the higher rates of consumption of red wine in these countries is often invoked as at least a partial explanation.

Some studies claim to show that Cheddar, Mozzarella, Swiss and American cheeses can help to prevent tooth decay.[19][20] Several mechanisms for this protection have been proposed:

The calcium, protein, and phosphorus in cheese may act to protect tooth enamel.

Cheese increases saliva flow, washing away acids and sugars.

Cheese may have an antibacterial effect in the mouth.

World Production and Consumption

Worldwide, cheese is a major agricultural product. According to the Food and Agricultural Organization of the United Nations, over 18 million metric tons of cheese were produced worldwide in 2004. This is more than the yearly production of coffee beans, tea leaves, cocoa beans and tobacco combined. The largest producer of cheese is the United States, accounting for 30% of world production, followed by Germany and France.

The biggest exporter of cheese, by monetary value, is France; the second, Germany (although it is first by quantity). Among the top ten exporters, only Ireland, New Zealand, the Netherlands and Australia have a cheese production that is mainly export oriented: respectively 95%, 90%, 72%, and 65% of their cheese production is exported. Only 30% of French production, the world's largest exporter, is exported. The United States, the biggest world producer of cheese, is a marginal exporter, as most of its production is for the domestic market.

Germany is the largest importer of cheese. The UK and Italy are the second- and third-largest importers.Greece is the world's largest (per capita) consumer of cheese, with 27.3 kg eaten by the average Greek. (Feta accounts for three-quarters of this consumption.)

France is the second biggest consumer of cheese, with 24 kg by inhabitant. Emmental (used mainly as a cooking ingredient) and Camembert are the most common cheeses in France Italy is the third biggest consumer by person with 22.9 kg. In the U.S., the consumption of cheese is quickly increasing and has nearly tripled between 1970 and 2003. The consumption per person has reached, in 2003, 14.1 kg (31 pounds). Mozzarella is America's favourite cheese and accounts for nearly a third of its consumption, mainly because it is one of the main ingredients of pizza

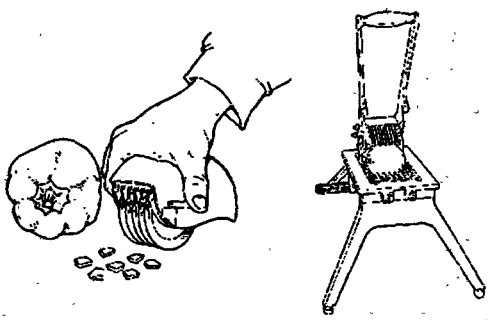
Chapter 24

Dried Fruits and Vegetables

Drying removes most of the water from fruits and vegetables to extend their shelf life and to increase their convenience and value. The reduction in weight and bulk also makes transport cheaper and easier although many dried foods are fragile and require packing in boxes to prevent them from being crushed. Different categories of dried foods can be described as *high-volume, lower-value* crops such as staple cereals and *low-volume, higher-value* foods such as dried fruits, vegetables herbs and spices. This second category offers better opportunities for profitable production by small scale processors.

Air dried products are the most common type of dried fruit and vegetables and other more expensive methods, such as freeze drying, are not considered in this book. Some products may be blanched or sulphured/ sulphited to protect their natural colour and help preserve them. Crystallized fruits, peels for marmalade and cake production and osmotically dried fruits (known as 'osmasol' products when dried in a solar dryer) are fruit pieces that are soaked in hot concentrated sugar syrups to extract some of the water before air drying.

Examples of fruit cutters suitable for small scale production



The preparation procedures needed for dried fruits and vegetables are summarized in Table 6 and production methods are shown in the Process Chart (Figure 10).

Some vegetables and a few fruits such as limes may also be salted

before drying. In this case the high salt concentration preserves the food by both drawing out water by osmosis and by the anti-microbial properties of the salt. Salt tolerant micro-organisms begin to grow while the product is sun dried and these produce acids and characteristic flavours, High salt concentrations also prevent the action of some enzymes, which would cause a loss in quality of the dried food during storage. Vegetables must be washed to lower the salt concentration before they are eaten

Fruits and vegetables must be carefully selected before drying. If fruits in particular are over-ripe they are easily damaged and may be difficult to dry. If they are under-ripe, they have a poorer flavour, colour and appearance. Care and attention to hygiene are essential because any bacteria or moulds that contaminate vegetables before drying are likely to survive on the dried food. The temperature of drying is not high enough to kill them and when the food is re-hydrated, they can grow again and cause food poisoning.

Blanching

Blanching destroys enzymes and prevents changes in colour, flavour and texture during storage. However, by itself, it does not preserve the food and vegetables must therefore be further processed by drying to achieve a long shelf life. Vegetables are blanched by heating in hot water or steam for a short time and then cooled on trays. For production at a small scale, vegetables can be placed in a wire basket and immersed in boiling water.

In steam blanching, vegetables are placed in a strainer and this is then fitted over a pan of boiling water and covered with a lid to prevent the steam escaping. Steaming takes a few minutes longer than water blanching, but has the advantage of retaining more nutrients as they are not lost into the water.

There are optional chemical treatments that help to retain the colour and texture of some dried fruits and vegetables. For example, the bright green colour of leafy vegetables, peas etc. can be retained by adding sodium bicarbonate to blancher water and the texture of some vegetables, such as okra and green beans, can be maintained by blanching in a calcium chloride solution. Both chemicals are usually available from pharmacies in major towns.

Sulphuring and Sulphiting

For most fruits, 350-400g sulphur are used per 100 kg fruit, burning for 1-3 hours. Sulphur dioxide prevents browning in foods such as apple, apricot and coconut, although it should not be used with red fruits as it bleaches the colour. Sulphuring (using sulphur dioxide gas) is achieved

by exposing pieces of cut or shredded fruits to burning sulphur in a sulphuring cabinet.

The amount of sulphur used and the time of exposure depend on the type of fruit, its moisture content and limits placed by law in some countries on the residual amounts of sulphur dioxide in the final product or by commercial limits set by importers. This should be checked with a local Bureau of Standards. There is an increasing consumer resistance to sulphited fruits in some industrialised countries and if the product is considered for export the local Export Development Board or import agents should be consulted.

In sulphiting, the sulphur dioxide is dissolved in water, rather than as the gas used in the sulphuring process. Sodium sulphite, sodium metabisulphite or potassium metabisulphite are made into solutions, either by adding one of them to the blanching water or more often, by soaking the food for 5-10 minutes in a sulphite dip.

About two thirds of the weight of sodium metabisulphite is formed as sulphur dioxide when it is dissolved in water. For example, to form a 0.001% solution which is equivalent to 1000 ppm, 1.5g is dissolved in a litre of water to form 1g of sulphur dioxide per litre. At this concentration, sulphiting can also be used as a method of intermediate storage of fruits to spread production over several months throughout the year.

Preparation Procedures for Fruits and Vegetables Before Drying

	Cleaning	Sorting/ Grading	Peeling	Size reduction	Blanching	Salting	Sulphur dioxide treatment
Fruits	Needed for all fruits	Important for all fruits	Required for most products	Cutting larger fruits for faster drying	Not usually done for fruits	Very few	For some fruits to prevent browning
Vege-tables	Needed for all vege-tables	Important for all vege-tables	Used for some vege-tables	Slicing for lar-ger vege-tables or shredding cabbage	Commonly used for softening and pre-venting browning	For some salted vege-table products (e.g.) cabbage)	Used with a few light col-oured vegetab -les to prevent browning

Syrup Pre-treatment

This method can be used to remove up to half of the water in fruit and is therefore a cheap way of increasing the production rate of a dryer or for part-processing fruits for intermediate storage so that production

can be extended throughout the year. In general the method gives good retention of colour in the dried food and produces a sweeter, blander tasting product. However, acids are also removed from fruits during the process and the lower acidity of the product may allow mould growth if the food is not properly dried and packaged.

In a more complex method to that described in Figure 10, fruit is first boiled in 20% syrup and then soaked overnight. The fruit is then strained from the syrup and transferred each day to 40% and 60% syrups in turn, with optional boiling for 10 minutes at each transfer.

After soaking, the syrup is diluted to approximately half of the original concentration. Each day the most dilute syrup (10%) is used for other products and a new 60% syrup is made up. The advantages of this method include reuse of sugar syrups and a softer texture in the final product. In Figure 11, the containers therefore circulate 'backwards' as they contain more dilute syrup. Some producers have even more stages in the process and may transfer fruit into increasing sugar concentrations each day for up to fourteen days. This results in a succulent, soft texture in the final product.

Types of Dryers

The higher value of dried fruit and vegetable products, compared for example to cereals crops, may justify the higher capital investment in a fuel-fired dryer or electric dryer and the extra operating costs for the fuel or electricity. These types of dryer allow higher drying rates and greater control over drying conditions than do solar or sun drying and they can therefore result in a higher product quality.

However it is necessary to make a careful assessment of the expected increase in income from better quality products compared to the additional expense, to make sure that this type of dryer is cost-effective. Sun drying is only possible in areas where, in an average year, the weather allows foods to be fully dried immediately after harvest. The main advantages of sun drying are the low capital and operating costs and the fact that little expertise is required.

Packaging

If the climate is dry, it may not be necessary to package dried foods as they will not pick up moisture from the air. However a humid climate is likely to result in dried foods gaining moisture and going mouldy. The stability of dried foods depends not only on the humidity of the air at which a food neither gains nor loses weight (the 'Equilibrium Relative Humidity'), but also on the type of food. Different foods can be grouped according to their ability to absorb moisture from the air. The two groups

are *hygroscopic*, which absorb moisture easily and *non-hygroscopic*, which do not absorb moisture. The classic example is salt and pepper, where salt is very hygroscopic and pepper is non-hygroscopic, but similar examples exist for fruit and vegetable products. This difference determines the packaging requirement for different fruit and vegetable products. The moisture content at which a food is stable is known as the *Equilibrium Moisture Content* and examples of this for different fruits and vegetables are shown in Table 8, together with the packaging requirement for different groups of foods.

Dried fruits and vegetables are usually packaged in one of the many different types of plastic film. The selection of the correct type of packaging material depends on a complex mix of considerations which include:

- The temperature and humidity of the air in which the product is stored
- The capacity of the product to pick up moisture from the air
- Reactions within the product caused by air or sunlight during storage
- The expected shelf life
- Marketing considerations
- Cost and availability of different packaging materials.

In general, although thin polythene film is usually the cheapest and most widely available material, it is only suitable for storing dried fruits and vegetables for a short time before they pick up moisture, soften and go mouldy.

Polypropylene has better barrier properties and therefore gives a longer shelf life, but it is usually more expensive and it may not be available in many countries. Other more complex films, such as laminated films made from polythene and aluminium foil, offer much better protection to dried foods, but are considerably more expensive and more difficult to find in developing countries.

Moisture Contents at which Selected Foods are Stable and Packaging Requirements

Food	Moisture content (%)	Degree of protection required
Fresh fruit and vegetables	78-85	Package to prevent moisture loss
	35	Non-hygroscopic:- Minimum protection or no packaging required
Marmalade	7	
Fruit sweets	3	Hygroscopic:- Package to prevent moisture uptake

Most dried foods also need a sturdy box or carton to both prevent crushing and to exclude light which causes loss of colour and development

of off-flavours during storage. The properties of different packaging materials for dried foods are shown in Table.

From the table, it can be seen that some types of packages provide good protection against air and moisture pickup for example, whereas other protect against light, crushing, etc. It is therefore common for dried foods to be packed in airtight and moisture-proof bags, which are then placed in an outer container to protect against light, crushing, etc.

Properties of Packaging Materials for Dried Fruits and Vegetables

Type of Packaging	Protection provided against:							
	Moisture	Light	Air & odours	Heat	Micro-organisms	Dust	Crushing	Animals & insects
Clear glass	3	1	3	2	3	3	3	3
Coloured glass	3	2	3	2	3	3	3	3
Ceramic pot	1	3	3	3	3	3	3	3
Metal tin	3	3	3	1	3	3	3	3
Metal foil	2	3	2	1	2	3	1	1
Plastic pot	3	3	3	2	3	3	2	2
Wooden chest	2	3	1	3	1	3	3	2
Paper board (cardboard) box	1	3	1	3	1	3	2	1
Fibreboard drum	1	3	1	3	2	3	3	2
Paper bag	1	2	1	1	1	2	1	1
Polythene film	2	1	1	1	2	3	1	1
Cellulose film	3	1	3	1	2	3	1	1
Polypropylene film	3	1	3	1	2	3	1	1
Cotton or Jute sack	1	2	1	1	1	2	1	1

Chapter 25

Chutneys, Pickles, Salted Vegetables and Sauces

CHUTNEYS

Chutneys are thick, jam-like mixtures made from a variety of fruits and vegetables, sugar, spices and sometimes vinegar. Any edible sour fruit can be used as a base for a chutney, to complement the sweet taste from the sugar.

The high sugar content has a preservative effect and vinegar addition is not always necessary, depending on the natural acidity and maturity of the fruits that are used.

Most products are boiled, which not only produces a caramelised syrup and alters the taste, colour and thickness, but also pasteurises the product and thus adds to the preservative action of the sugar and acids. Other products are allowed to ferment naturally and the acids produced by a mixture of bacteria preserve the product.

Depending on the types of spices that are added, these may also have a preservative effect, in addition to their contribution to flavour.

Fruits can also be sulphited as a method of intermediate storage to spread production over several months throughout the year. The process chart uses a formulation for mango chutney as a typical product of this type.

Natural acids from the fruit, from vinegar or those produced by fermentation, together with the high sugar content, are used to preserve the chutney after a jar has been opened.

A correct balance between the levels of sugar and acid is required to prevent mould growth and a *Preservation Index* can be used to calculate the amounts of ingredients to be added. Alternatively, when sugar is the main ingredient or the product is boiled, a refractometer can be used to check that the final sugar content of the syrup is 68-70%. Sugar is added before heating if a dark product is required or towards the end of boiling to produce a light coloured product.

The Preservation Index is a measure of the preserving power of combinations of acid and sugar (sugar is measured as 'total solids'). This is used to assess whether a chutney or pickle is safe from food spoilage and food poisoning micro-organisms. The value can be calculated as follows:

$$\frac{\text{Total acidity} \times 100}{(100 - \text{total solids})} = \text{not less than } 3.6\%$$

Details of how to measure acidity and total solids are given in Section 2.7.2. However, if a manufacturer has no access to basic laboratory equipment or is not sure how to carry out the calculation, it is best to take a sample of product to a Bureau of Standards, University Food Science Department or food testing laboratory which can analyse it and recommend adjustments to the recipe if necessary.

Pickles

Vegetables such as cucumber, cabbage, olive and onion are fermented by lactic acid bacteria which can grow in low concentrations of salt. The bacteria ferment sugars in the food to form lactic acid, which then prevents the growth of food poisoning bacteria and moulds or other spoilage micro-organisms.

The amount of added salt controls the type and rate of the fermentation. If for example 2-5% salt is used, a natural sequence of different types of bacteria produce the lactic acid.

If higher concentrations of salt (up to 16%) are used, a different product called 'salt stock' pickle is produced, which is preserved by the salt and not by fermentation.

Fruits and vegetables can be preserved in this way as a method of intermediate storage to spread production over several months throughout the year.

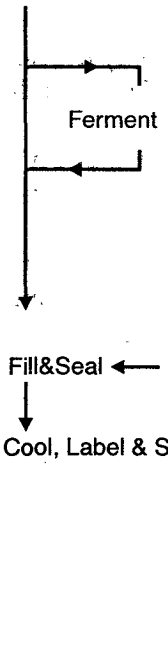
Sometimes, sugar is added to increase the rate of fermentation or to make the product sweeter.

Alternatively, vegetables may be packed in vinegar (acetic acid), salt and sometimes sugar to produce a variety of pickled products. Because these vegetables are not fermented they have a different flavour and texture. They are usually pasteurised. Sweet pickles are made from single fruits or mixtures of fruits and vegetables. They are preserved by the combined action of lactic or acetic acid, sugar and in some cases added spices.

Salted Vegetables

Salted vegetables are made by building up alternate layers of chopped

Stage in process Essential Optional	Quality Assurence	Equipment Required	Notes
Harvest fruit ↓	Check for full maturity but not over-ripe		Picked carefully to reduce bruising etc. Which would cause spoilage and loss of quality.
Wash ↓		Wash tank	Use clean water to remove stones, leaves or soil
Sort/ grade	Essential to produce uniform quality products		Sort by hand to get similar colour or maturity.
Peel	Check that all traces of peel are removed	Knives, peelers	Most fruits require peeling, but some chutneys include un-peeled fruits. By hand using sharp stainless steel knives or small peeling machines for some types of fruits
Cut/slice/core	Check for uniform sized pieces	Knoves, slicers, dicers	Most fruits are cut into small strips. It is important toreduce the size of pieces to obtain uniform mixtures of similar sized fruits and/or vegetables. Cutting also allows faster penetration of sugar. This may be done by hand, but small scale equipment is available to increase production rates.
Mix ← Spices, sugar vinegar		Mixing bowl, scales	For cach 500g of mango, spices such as ginger (0.5g), mustard (0.5g), chilli (1g), garlic (0.5g) and salt (1g) are washed, ground and mixed with vincgar (250ml) and sugar (300-500g). In some recipes, 7% oil is added.
Heat	Check time and temperature	Heat source, boiling pan,	Boil unit sufficiently thick and concentrated. Heat



		(refracto-meter-optional)	destroys enzymes and micro-organisms which together with high sugar level, spices & acid from the vinegar, helps to preserve product.
Ferment	Check temperature and absence of insects	Covered pans	Natural fermentation over 2-3 days peoduces acids to assist preservation. Traditionally such products were not pasteurised.
Jars/ lids	Check fill-weight and correctly sealed pack Check label & storage conditions	funncl or pasic filler, scales	Packaging contains the contents and prevents re-contamination. Hot fill into pre-sterilised jars and hand seal lids - see text for alternatives. In boxes, on racks, with a cool dry atmosphere.

or shredded vegetable such as cabbage, with layers of salt in a sealed drum. The salt has two preservative actions: it draws out water from the vegetables by osmosis to form a concentrated brine in the base of the drum; and salt also has a direct anti-microbial action.

The high levels of salt are reduced by washing the products before they are eaten.

Examples of Different Types of Fruit or Vegetable Pickles

Product	Salt	Sugar	Vinegar	Process
Fermented sweet pickle	5% then 3%	1-2% then 3%	0 then 5%	Fermented for 1-2 weeks then repack in vinegar + salt + sugar (optional pasteurization)
Fermented sour pickle	5% then 3%	0 then 0	0 then 5%	Ferment for 1-2 weeks then repack in vinegar + salt (optional pasteurization)
Salt-stock pickle	15%	0	0	Store until required. Then wash out salt and repack as unfermented pickle

Pickles which have an adequate Preservation Index do not need to be pasteurised.

However as an additional measure to prevent spoilage, they can be

pasteurised or the sugar/salt/vinegar mixture can be heated, added to the vegetables and the jars filled while product is still hot. In this way the hot product forms a partial vacuum in the jar when it cools and further aids preservation.

Glass jars are the most commonly used packaging material, but if a shorter shelf life is expected, pickles may also be packed in small quantities in polythene pouches and sealed with an electric heat sealer.

To avoid seepage of product, which can damage paper labels and make the package unattractive, a double pouch can be used comprising an inner pack that contains the product and an outer pouch with a label between the two.

Sauces

Sauces are thick viscous liquids, made from pulped fruit and/or vegetables with the addition of salt, sugar, spices and vinegar. They are pasteurised to give the required shelf life, but the basic principle of preservation is the use of vinegar, which inhibits the growth of spoilage and food poisoning micro-organisms.

Other ingredients such as salt and sugar contribute to the preservative effect and the correct Preservation Index (Section 2.2.4) ensures that the product does not spoil after opening and can be used a little at a time. Some may contain a preservative such as sodium benzoate, but this is not necessary if an adequate Preservation Index is achieved. Sauces can be made from almost any combination of fruit or vegetables, but in practice the market in many countries is dominated by tomato sauce, chilli sauce and to a lesser extent, mixed fruit sauces such as 'Worcester' sauce, which contains apples and dates in addition to tomatoes.

Depending on the scale of production, pulping and sieving out seeds and skins can be done by hand or using special pulper-finisher machines The process for making sauce is outlined in the process chart below, using tomato sauce as an example. Similarly, at a small scale, sauces can be made using simple open boiling pans, provided that care is taken to heat slowly with constant stirring to avoid localised burning of the product, especially at the end of heating. At a larger scale, processing is done using steam heated, stainless steel 'double jacketed' pans.

Pulper Finisher Used Extract Fruit Pulp Without Seeds or Skins

Bottled and Canned Products

Bottling and canning are essentially similar processes in that food is filled into a container and heated to destroy enzymes and micro-organisms. Fruits can be packed into jars with a hot, sugar syrup and

vegetables can be packed into a hot brine. The filled jars are sealed and pasteurized so that an internal vacuum forms when they are cool. The sealed container then preserves the food by preventing re-contamination and excluding air and sometimes light. Preservation depends on an adequate heat treatment and an air-tight (or 'hermetic') seal.

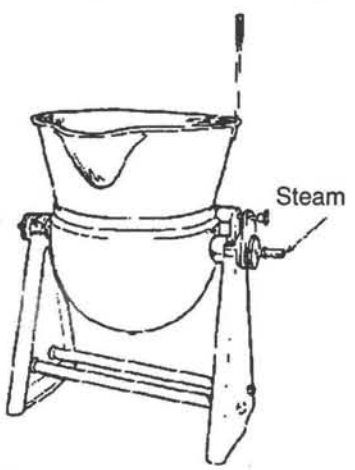
There are three grades of syrup: a light syrup contains 200g sugar per litre, a medium syrup 400-600 g/l and a heavy syrup 800g/l.

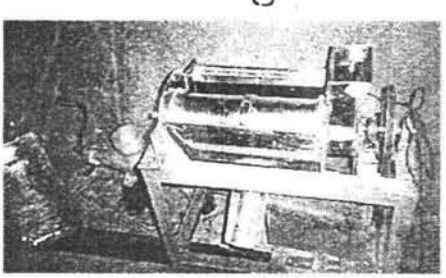
The concentration of salt in brine is usually 15 g/l. Acidic fruits require relatively mild heating conditions for pasteurization (e.g. 90-100°C for 10-20 minutes) to destroy yeasts and moulds, whereas less acidic vegetables require more severe heat sterilization to destroy food poisoning bacteria (e.g. 121°C for 15-40 minutes, depending on the size of the container).

Fruits can also be part-processed and stored until required in sugar syrup or sodium metabisulphite solution (equivalent to 1000 ppm.) to allow production to take place for a larger part of the year.

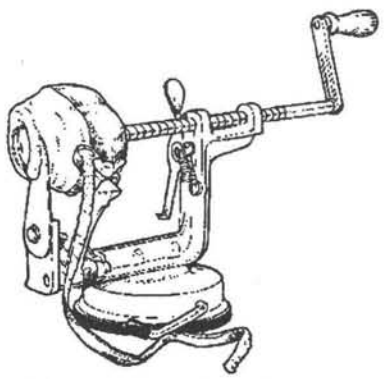
It is not advisable for inexperienced small scale processors to bottle vegetables unless they are acidified, because of the risk of poisoning from inadequately processed foods. Vegetables can however be processed by pasteurization if the acidity is first adjusted using citric acid or vinegar.

'Double Jacketed' Pan for Larger Scale Hoiling





Small Scale Peeler for Fruits



Canning is not suitable for small scale processing for the following reasons: the time and temperature of canning are critically important and must be carefully controlled. If the cans are under-processed, there is a risk of serious food poisoning and even death from a type of micro-organism named *Clostridium botulinum*. If cans are over-processed, the vegetables lose much of their texture, colour, vitamins and flavour and are not saleable. The establishment of correct heating conditions depends on the type of food, the size and shape of the can and the initial level of contamination of the vegetables. This requires the skills of a qualified food technologist or microbiologist.

When foods are heated in sealed cans during the canning process, the temperature of sterilization is above 100°C and the pressure outside the can must equal that inside, to prevent the cans from exploding. This is achieved using high pressure steam and a strong vessel named a 'retort'. Both steam boiler and retort are expensive and likely to be beyond the means of a small scale processor. Additionally, compressed air is needed to maintain the pressure while cans are being cooled, which together with the necessary controllers, adds to the capital cost of equipment.

Even if cans are available in a particular country, they are usually more expensive than other forms of packaging. Different types of product also require a particular internal lacquer to prevent the metal from corroding when it is in contact with the fruits or vegetables and such lacquers may not always be available. In addition a 'seamer' is needed to seal the lid onto the can and regular checks and maintenance are necessary to ensure that the seam is properly formed. Failures in seams are one of the main causes of spoiled or dangerous canned foods.

It is therefore necessary to ensure that seamer operators are fully trained and experienced in adjusting the machines and a 'seam micrometer' is another necessary capital expense to be able to do this. In

summary therefore, canning requires a considerable capital investment, trained and experienced staff, regular maintenance of relatively sophisticated equipment, a regular supply of the correct types of cans and a comparatively high operating expenditure.

Because of the more acidic nature of fruits, a lower processing temperature is adequate and this process is suitable for small scale operations. In all cases, a food technologist should be consulted to advise on process times and conditions for bottled products.

Chapter 26

Food Additive

Food additives play a vital role in today's bountiful and nutritious food supply. They allow our growing urban population to enjoy a variety of safe, wholesome and tasty foods year-round. And, they make possible an array of convenience foods without the inconvenience of daily shopping.

Although salt, baking soda, vanilla and yeast are commonly used in foods today, many people tend to think of any additive added to foods as complex chemical compounds. All food additives are carefully regulated by federal authorities and various international organizations to ensure that foods are safe to eat and are accurately labeled. The purpose of this brochure is to provide helpful background information about food additives, why they are used in foods and how regulations govern their safe use in the food supply.

Additives Used in Foods

Additives perform a variety of useful functions in foods that are often taken for granted. Since most people no longer live on farms, additives help keep food wholesome and appealing while en route to markets sometimes thousands of miles away from where it is grown or manufactured. Additives also improve the nutritional value of certain foods and can make them more appealing by improving their taste, texture, consistency or colour.

Some additives could be eliminated if we were willing to grow our own food, harvest and grind it, spend many hours cooking and canning, or accept increased risks of food spoilage. But most people today have come to rely on the many technological, aesthetic and convenience benefits that additives provide in food.

Additives are used in foods for five main reasons:

- To Maintain product consistency. Emulsifiers give products a consistent texture and prevent them from separating. Stabilizers and thickeners give smooth uniform texture. Anti-caking agents help substances such as salt to flow freely.

- To improve or maintain nutritional value. Vitamins and minerals are added to many common foods such as milk, flour, cereal and margarine to make up for those likely to be lacking in a person's diet or lost in processing. Such fortification and enrichment has helped reduce malnutrition among the U.S. population. All products containing added nutrients must be appropriately labeled.
- To maintain palatability and wholesomeness. Preservatives retard product spoilage caused by mold, air, bacteria, fungi or yeast. Bacterial contamination can cause foodborne illness, including life-threatening botulism. Antioxidants are preservatives that prevent fats and oils in baked goods and other foods from becoming rancid or developing an off-flavour. They also prevent cut fresh fruits such as apples from turning brown when exposed to air.
- To provide leavening or control acidity/alkalinity. Leavening agents that release acids when heated can react with baking soda to help cakes, biscuits and other baked goods to rise during baking. Other additives help modify the acidity and alkalinity of foods for proper flavour, taste and colour.
- To enhance flavour or impart desired colour. Many spices and natural and synthetic flavors enhance the taste of foods. Colors, likewise, enhance the appearance of certain foods to meet consumer expectations. Examples of substances that perform each of these functions are provided in the chart "Common Uses of Additives."

Many substances added to food may seem foreign when listed on the ingredient label, but are actually quite familiar. For example, ascorbic acid is another name for Vitamin C; alphatocopherol is another name for Vitamin E; and beta-carotene is a source of Vitamin A. Although there are no easy synonyms for all additives, it is helpful to remember that all food is made up of chemicals. Carbon, hydrogen and other chemical elements provide the basic building blocks for everything in life.

Food Additive

In its broadest sense, a food additive is any substance added to food. Legally, the term refers to "any substance the intended use which results or may reasonably be expected to result-directly or indirectly-in its becoming a component or otherwise affecting the characteristics of any food." This definition includes any substance used in the production, processing, treatment, packaging, transportation or storage of food.

If a substance is added to a food for a specific purpose in that food, it

is referred to as a direct additive. For example, the low-calorie sweetener aspartame, which is used in beverages, puddings, yogurt, chewing gum and other foods, is considered a direct additive. Many direct additives are identified on the ingredient label of foods.

Indirect food additives are those that become part of the food in trace amounts due to its packaging, storage or other handling. For instance, minute amounts of packaging substances may find their way into foods during storage. Food packaging manufacturers must prove to the U.S. Food and Drug Administration (FDA) that all materials coming in contact with food are safe, before they are permitted for use in such a manner.

Colour Additive

A colour additive is any dye, pigment or substance that can impart colour when added or applied to a food, drug, or cosmetic, or to the human body. Colour additives may be used in foods, drugs, cosmetics, and certain medical devices such as contact lenses. Colour additives are used in foods for many reasons, including to offset colour loss due to storage or processing of foods and to correct natural variations in food colour.

Colors permitted for use in foods are classified as certified or exempt from certification. Certified colors are man-made, with each batch being tested by the manufacturer and FDA to ensure that they meet strict specifications for purity. There are nine certified colors approved for use in the United States. One example is FD&C Yellow No.6, which is used in cereals, bakery goods, snack foods and other foods.

Colour additives that are exempt from certification include pigments derived from natural sources such as vegetables, minerals or animals. For example, caramel colour is produced commercially by heating sugar and other carbohydrates under strictly controlled conditions for use in sauces, gravies, soft drinks, baked goods and other foods. Most colors exempt from certification also must meet certain legal criteria for specifications and purity.

Regulation of Additives

Additives are not always byproducts of 20th century technology or modern know-how. Our ancestors used salt to preserve meats and fish; added herbs and spices to improve the flavour of foods; preserved fruit with sugar; and pickled cucumbers in a vinegar solution.

Over the years, however, improvements have been made in increasing the efficiency and ensuring the safety of all additives. Today food and colour additives are more strictly regulated that at any other time in history. The basis of modern food law is the Federal Food, Drug, and Cosmetic (FD&C) Act of 1938, which gives the Food and Drug

Administration (FDA) authority over food and food ingredients and defines requirements for truthful labeling of ingredients.

The Food Additives Amendment to the FD&C Act, passed in 1958, requires FDA approval for the use of an additive prior to its inclusion in food. It also requires the manufacturer to prove an additive's safety for the ways it will be used.

The Food Additives Amendment exempted two groups of substances from the food additive regulation process. All substances that FDA or the U.S. Department of Agriculture (USDA) had determined were safe for use in specific food prior to the 1958 amendment were designated as prior-sanctioned substances. Examples of prior-sanctioned substances are sodium nitrite and potassium nitrite used to preserve luncheon meats.

A second category of substances excluded from the food additive regulation process are generally recognized as safe or GRAS substances. GRAS substances are those whose use is generally recognized by experts as safe, based on their extensive history of use in food before 1958 or based on published scientific evidence. Salt, sugar, spices, vitamins and monosodium glutamate are classified as GRAS substances, along with several hundred other substances. Manufacturers may also request FDA to review the use of a substance to determine if it is GRAS.

Since 1958, FDA and USDA have continued to monitor all prior sanctioned and GRAS substances in light of new scientific information. If new evidence suggests that a GRAS or prior sanctioned substance may be unsafe, federal authorities can prohibit its use or require further studies to determine its safety.

In 1960, Congress passed similar legislation governing colour additives. The Colour Additives Amendments to the FD&C Act require dyes used in foods, drugs, cosmetics and certain medical devices to be approved by FDA prior to their marketing.

In contrast to food additives, colors in use before the legislation were allowed continues use only if they underwent further testing to confirm their safety. Of the original 200 provisionally listed colour additives, 90 have been listed as safe and the remainder have either been removed from use by FDA or withdrawn by industry.

Both the Food Additives and Colour Additives Amendments include a provision which prohibits the approval of an additive if it is found to cause cancer in humans or animals. This clause is often referred to as the Delaney Clause, named for its Congressional sponsor, Rep. James Delaney (D-N.Y.).

Regulations known as Good Manufacturing Practices (GMP) limit the amount of food and colour additives used in foods. Manufacturers use only the amount of an additive necessary to achieve the desired effect.

Additives Approved for Use in Foods

To market a new food or colour additive, a manufacturer must first petition FDA for its approval. Approximately 100 new food and colour additives petitions are submitted to FDA annually. Most of these petitions are for indirect additives such as packaging materials.

A food or colour additive petition must provide convincing evidence that the proposed additive performs as it is intended. Animal studies using large doses of the additive for long periods are often necessary to show that the substance would not cause harmful effects at expected levels of human consumption. Studies of the additive in humans also may be submitted to FDA.

In deciding whether an additive should be approved, the agency considers the composition and properties of the substance, the amount likely to be consumed, its probable long-term effects and various safety factors. Absolute safety of any substance can never be proven. Therefore, FDA must determine if the additive is safe under the proposed conditions of use, based on the best scientific knowledge available.

If an additive is approved, FDA issues regulations that may include the types of foods in which it can be used, the maximum amounts to be used, and how it should be identified on food labels. Additives proposed for use in meat and poultry products also must receive specific authorization by USDA. Federal officials then carefully monitor the extent of Americans' consumption of the new additive and results of any new research on its safety to assure its use continues to be within safe limits.

In addition, FDA operates an Adverse Reaction Monitoring System (ARMS) to help serve as an ongoing safety check of all additives. The system monitors and investigates all complaints by individuals or their physicians that are believed to be related to specific foods; food and colour additives; or vitamin and mineral supplements. The ARMS computerized database helps officials decide whether reported adverse reactions represent a real public health hazard associated with food, so that appropriate action can be taken.

Chapter 27

Food Packaging

Food packaging is packaging for food. It requires protection, tampering resistance, and special physical, chemical, or biological needs. It also shows the product that is labeled to show any nutrition information on the food being consumed.

Functions of Good Packaging

Packaging has several objectives

- Physical protection - The food enclosed in the package may require protection from, among other things, shock, vibration, compression, temperature, etc.
- Barrier protection - A barrier from oxygen, water vapour, dust, etc., is often required. Permeation is a critical factor in design. Some packages contain desiccants or Oxygen absorbers to help extend shelf life. Modified atmospheres or controlled atmospheres are also maintained in some food packages. Keeping the contents clean, fresh, and safe for the intended shelf life is a primary function.
- Containment or agglomeration - Small items are typically grouped together in one package for reasons of efficiency. powders, and granular materials need containment.
- Information transmission - Packages and labels communicate how to use, transport, recycle, or dispose of the package or product. Some types of information are required by governments.
- Marketing - The packaging and labels can be used by marketers to encourage potential buyers to purchase the product. Package design has been an important and constantly evolving phenomenon for several decades. Marketing communications and graphic design are applied to the surface of the package and (in many cases) the point of sale display.
- Security - Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved

tamper resistance to deter tampering and also can have tamper-evident features to help indicate tampering. Packages can be engineered to help reduce the risks of package pilferage: Some package constructions are more resistant to pilferage and some have pilfer indicating seals. Packages may include authentication seals to help indicate that the package and contents are not counterfeit. Packages also can include anti-theft devices, such as dye-packs, RFID tags, or electronic article surveillance tags, that can be activated or detected by devices at exit points and require specialized tools to deactivate. Using packaging in this way is a means of retail loss prevention.

- Convenience - Packages can have features which add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, and reuse.
- Portion control - Single serving packaging has a precise amount of contents to control usage. Bulk commodities (such as salt) can be divided into packages that are a more suitable size for individual households. It is also aids the control of inventory: selling sealed one-liter-bottles of milk, rather than having people bring their own bottles to fill themselves.

Food Packaging Types

Packaging type	Type of container	Food examples
Aseptic processings	Primary	Liquid whole eggs
Plastic trays	Primary	Portion of fish
Bags	Primary	Potato chips
Boxes	Secondary	Box of Coca-Cola
Cans	Primary	Can of Campbell's Tomato soup.
Cartons	Primary	Carton of eggs
Flexible packaging	Primary	Bagged salad
Pallets	Tertiary	A series of boxes on a single pallet used to transport from the manufacturing plant to a distribution centre
Wrappers	Tertiary	Used to wrap the boxes on the pallet for transport

Primary packaging is the main package that holds the food that is being processed. Secondary packaging combines the primary packages into one box being made. Tertiary packaging combines all of the secondary packages into one pallet.

There are also special containers that combine different technologies for maximum durability:

- Bags-In-Boxes (used for soft drink syrup, other liquid products, and meat products)
- Wine box (used for wine)

Packaging Machines

A choice of packaging machinery includes technical capabilities, labour requirements, worker safety, maintainability, serviceability, reliability, ability to integrate into the packaging line, capital cost, floorspace, flexibility (change-over, materials, etc.), energy usage, quality of outgoing packages, qualifications (for food, phamaceuticals, etc.), throughput, efficiency, productivity, ergonomics, etc.

Packaging machines may be of the following general types:

- Blister, Skin and Vacuum Packaging Machines
- Capping, Over-Capping, Lidding, Closing, Seaming and Sealing Machines
- Cartoning Machines
- Case and Tray Forming, Packing, Unpacking, Closing and Sealing Machines
- Check weighing machines
- Cleaning, Sterilizing, Cooling and Drying Machines
- Conveying, Accumulating and Related Machines
- Feeding, Orienting, Placing and Related Machines
- Filling Machines: handling liquid and powdered products
- Package Filling and Closing Machines
- Form, Fill and Seal Machines
- Inspecting, Detecting and Checkweighing Machines
- Palletizing, Depalletizing, Pallet Unitizing and Related Machines
- Product Identification: labelling, marking, etc.
- Wrapping Machines
- Converting Machines
- Other speciality machinery

Chapter 28

Principle of Cooking

To cook foods successfully, you must understand the science and principles of cooking.

Cooking is simply the transfer of energy from a heat source to a food. To cook foods successfully, you must understand the ways in which heat is transferred: conduction, convection and radiation.

Most important, specific to the principles of cooking, you must understand the methods used to transfer heat: broiling, grilling, roasting and baking, sauteing, pan-frying, deep-frying, poaching, simmering, boiling, steaming, braising and stewing.

Heat Transfer

According to the principles of cooking, heat is a type of energy. When a substance gets hot, the molecules have absorbed energy, which causes the molecules to vibrate rapidly. The molecules start to expand and bounce off one another. As the molecules move, they collide with nearby molecules, causing a transfer of heat energy.

Heat transfer can be transferred *to* foods through conduction, convection, or radiation. Heat travels *through* foods by conduction.

CONDUCTION

Conduction, one of the most basic principles of cooking, is the movement of heat from one item to another through direct contact. For example, when a flame touches the bottom of a pan, heat is conducted to the pan.

Generally, metals are good conductors. Copper and aluminum are the best conductors, while liquids and gases are poor conductors.

Conduction is a slow method of heat transfer because there must be physical contact from one molecule to another.

CONVECTION

Convection is the transfer of heat through a fluid. The fluid may be in a liquid or gas state. According to the principles of cooking, there are 2 types of convection: natural and mechanical.

Natural convection causes a natural circulation of heat because warm liquids and gases have a tendency to rise while cooler ones fall.

Mechanical convection causes heat to circulate more evenly and quickly through fans or stirring.

RADIATION

Radiation is energy transferred by waves of heat or light striking the food. Two types of radiant heat are infrared and microwave.

Infrared cooking is commonly used with toasters and broilers. These devices use an electric or ceramic element heated to such a high temperature that it gives off waves of radiant heat.

Microwave cooking relies on radiation generated by an oven to heat the food.

THE EFFECTS OF HEAT

Proteins Coagulate

Coagulation is when proteins transform from a liquid state to a solid state. Examples: the firming of meat fibers and egg whites changing from a clear liquid to a white solid when heated.

Starches Gelatinize

When a mixture of starch and liquid is heated, starch granules swell. The liquid thickens because the starch granules swell to occupy more space. Examples: The thickening of sauces when starch is added.

Sugars Caramelize

As sugars cook, they turn brown and change flavour. Caramelized sugar is used in many sugars, candies, and desserts. In fact, caramelization is used in most flavors we associate with cooking.

Water Evaporates

All foods contain some water. The evaporation of water drys foods during cooking.

Fats Melt

Fats are a greasy, smooth substance that do not dissolve in water. Oils are fats that remain liquid at room temperature. Fats melt when heated and then gradually liquefy. Fats will not evaporate.

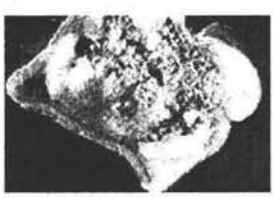
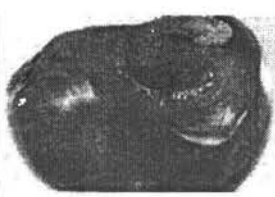
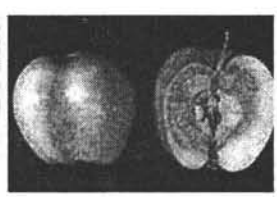
Chapter 29

Food Spoilage

Most natural foods have a limited life. Perishable foods such as fish, meat, milk, bread, tomatoes and potatoes have a short life span. Other foods keep for a considerably longer time but decompose eventually. Once food has been harvested, gathered or slaughtered it begins to deteriorate until eventually it becomes unfit for consumption. This deterioration is known as decay and leads to food spoilage.

Causes of the Spoilage of Food

Microbial Spoilage

There are three types of microorganisms that cause food spoilage — yeasts, moulds and bacteria.

- Yeasts growth causes fermentation which is the result of yeast metabolism. There are two types of yeasts *true* yeast and *false* yeast. *True yeast* metabolizes sugar producing alcohol and carbon dioxide gas. This is known as fermentation. *False yeast* grows as a dry film on a food surface, such as on pickle brine. False yeast occurs in foods that have a high sugar or high acid environment.
- Moulds grow in filaments forming a tough mass which is visible as 'mould growth'. Moulds form spores which, when dry, float through the air to find suitable conditions where they can start the growth cycle again.
- Mould can cause illness, especially if the person is allergic to molds. Usually though, the main symptoms from eating mouldy food will be nausea or vomiting from the bad taste and smell of the mouldy food.

- Both yeasts and moulds can thrive in high acid foods like fruit, tomatoes, jams, jellies and pickles. Both are easily destroyed by heat. Processing high acid foods at a temperature of 100°C (212°F) in a boiling water canner for the appropriate length of time destroys yeasts and moulds.

Fungal Spoilage

Fig. Storage Rot in Grapes Caused by *Botrytis cinerea.*

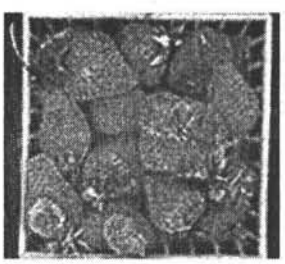


Fig. Storage Rot in Strawberry Caused by *Botrytis cinerea.*

Fig. Blue Mould Rot in Tomato Caused by *Penicilliumi* spp. (also by *Fusarium* spp.)

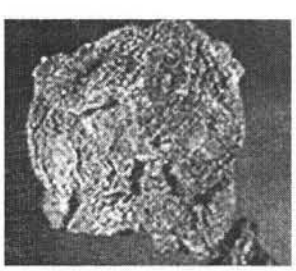


Fig. Black Mummy Rot of Grapes Caused by *Guignardia bidwellii*

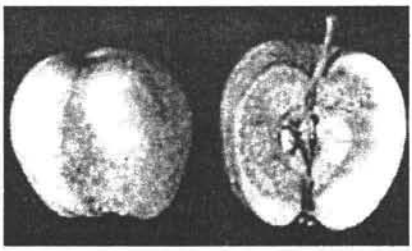


Fig. Watery Soft Rot in Apple Caused by *Sclerotinia sclerotiorum.*

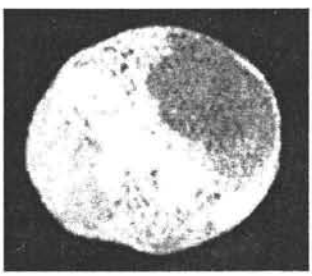


Fig. Blue Mould on Oranges Caused by *Penicillium digitatum.*

- Bacteria are round, rod or spiral shaped microorganisms. Bacteria may grow under a wide variety of conditions. There are many types of bacteria that cause spoilage. They can be divided into: *spore-forming* and *nonspore-forming*. Bacteria generally prefer low acid foods like vegetables and meat. In order to destroy bacteria spores in a relatively short period of time, low acid foods must be processed for the appropriate length of time at 116°C (240°F) in a pressure canner. (Temperatures higher than 100°C [212°F] can be obtained *only* by pressure canning.)
- Eating spoiled food caused by bacteria can cause food poisoning.

Bacterial Spoilage

Autolysis

- Enzymes

Enzymes are proteins found in all plants and animals. If uncooked foods are not used while fresh, enzymes cause undesirable changes in colour, texture and flavour. Enzymes are destroyed easily by heat processing.

- Oxidation by air

Atmospheric oxygen can react with some food components which may cause rancidity or colour changes.

Other Factors

- Infestations (invasions) by insects and rodents, which account for huge losses in food stocks.
- Low temperature injury - the internal structures of the food are damaged by very low temperature

Low Temperature Injury

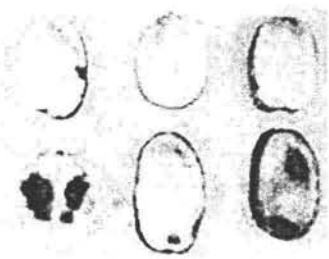
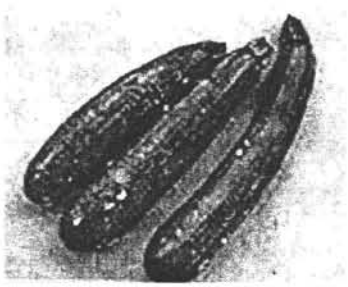


Fig. Internal Mahogany Browning of Potato Caused by Low Temperature Injury.



Chilling Injury in Cucumber Caused by Low Temperature. Note the Watery Surface

Types of Food Decay

Putrefaction.

Biological decomposition of organic matter, with the production of ill-smelling and tasting products, associated with anaerobic (no oxygen present) conditions.

Formula of putrefaction:

protein fds + protelytic microorganisms

↓

amino acids + ammonia + hydroge sulphide

Fermentation

Fermentation , chemical changes in organic substances produced by

the action of enzymes. This general definition includes virtually all chemical reactions of physiological importance, and scientists today often restrict the term to the action of specific enzymes, called ferments, produced by minute organisms such as molds, bacteria, and yeasts. For example, lactase, a ferment produced by bacteria usually found in milk, causes the milk to sour by changing lactose (milk sugar) into lactic acid.

Formula of fermentation:

carbohydrate foods + saccharolytic microorganisms

↓

acids + alcohol + gases(carbon dioxide)

Rancidity

Microbial Rancidity

Like all food components, fats undergo deteriorative changes with time, which result in undesirable flavors and odors. These changes in fats are given the term "rancidity".

Formula of microbial rancidity:

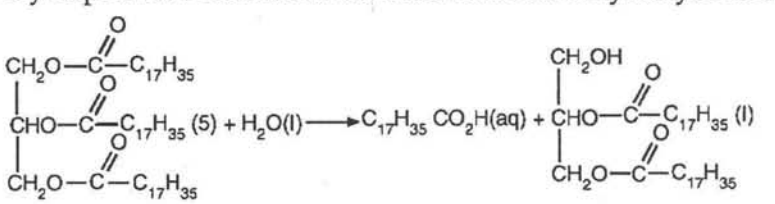
fatty foods + lipolytic microorganisms

↓

fatty acids + glycerol

Hydrolytic Rancidity

Fatty acids formed through hydrolysis of the lipid(fat) by the water which it contains. Some of the liberated fatty acids are volatile, and some have very unpleasant odours and flavours. Formula of hydrolytic rancidity



Trioctadecanoylglycerol + Water → Octandecanoic acid + Dioctadecanoylglycerol
(tristearin) (stearic acid) (disterin)

Oxidative Rancidity

The oxidation of acylglycerols which occurs in air, without the presence of enzymes, is called autoxidation. Among the products of autoxidation are hydroperoxides, ROOH. These have no taste, but they decompose easily to form aldehydes, ketones and acids, which give oxidised fats and oils their rancid flavours. It can be slow down by addition of antioxidants.

Chapter 30

Food Preservation

Food preservation is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility or nutritive value) caused or accelerated by micro-organisms. Some methods, however, use benign bacteria, yeasts or fungi to add specific qualities and to preserve food (e.g., cheese, wine). While maintaining or creating nutritional value, texture and flavour is important in preserving its value as food; this is a culturally dependent. What qualifies as food fit for humans in one culture may not qualify in another culture.

Preservation usually involves preventing the growth of bacteria, fungi, and other micro-organisms, as well as retarding the oxidation of fats which cause rancidity. It also includes processes to inhibit natural ageing and discolouration that can occur during food preparation such as the enzymatic browning reaction in apples which causes browning when apples are cut. Some preservation methods require the food to be sealed after treatment to prevent recontamination with microbes; others, such as drying, allow food to be stored without any special containment for long periods.

Common methods of applying these processes include drying, spray drying, freeze drying, freezing,vacuum-packing, canning, preserving in syrup, sugar crystallisation, food irradiation, and adding preservatives or inert gases such as carbon dioxide. Other methods that not only help to preserve food, but also add flavour, include pickling, salting, smoking, preserving in syrup or alcohol, sugar crystallisation and curing.

Preservation Processes

Preservation processes include:

- Heating to kill or denature organisms (e.g. boiling)
- Oxidation (e.g. use of sulphur dioxide)
- Toxic inhibition (e.g. smoking, use of carbon dioxide, vinegar, alcohol etc)
- Dehydration (drying)
- Osmotic inhibition (e.g. use of syrups)

- Low temperature inactivation (e.g. freezing)
- Ultra high water pressure (e.g. fresherized, a kind of "cold" pasteurization, the pressure kills naturally occurring pathogens, which cause food deterioration and affect food safety.)
- Many combinations of these methods
- Chelation

Drying

One of the oldest methods of food preservation is by drying, which reduces water activity sufficiently to prevent or delay bacterial growth.[*citation needed*] Drying also reduces weight, making food more portable. Most types of meat can be dried; a good example is beef jerky. Many fruits can also be dried; for example, the process is often applied to apples, pears, bananas, mangoes, papaya, apricot, and coconut. Zante currants, sultanas and raisins are all forms of dried grapes. Drying is also the normal means of preservation for cereal grains such as wheat, maize, oats, barley, rice, millet and rye

Freezing

Freezing is also one of the most commonly used processes commercially and domestically for preserving a very wide range of food including prepared food stuffs which would not have required freezing in their unprepared state. For example, potato waffles are stored in the freezer, but potatoes themselves require only a cool dark place to ensure many months' storage. Cold stores provide large volume, long-term storage for strategic food stocks held in case of national emergency in many countries..

Vacuum Packing

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival, slowing spoiling. Vacuum-packing is commonly used for storing nuts to reduce loss of flavour from oxidation.

Salt

Salting or curing draws moisture from the meat through a process of osmosis. Meat is cured with salt or sugar, or a combination of the two. Nitrates and nitrites are also often used to cure meat and contribute the characteristic pink colour, as well as inhibition of Clostridium botulinum.

Smoking

Meat, fish and some other foods may be both preserved and flavored

through the use of smoke, typically in a smokehouse. The combination of heat to dry the food without cooking it, and the addition of the aromatic (phenolic)hydrocarbons from the smoke preserves the food.

Sugar

Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallisation and the resultant product is then stored dry. This method is used for the skins of citrus fruit (candied peel), angelica and ginger. A modification of this process produces glacé fruit such as glacé cherries where the fruit is preserved in sugar but is then extracted from the syrup and sold, the preservation being maintained by the sugar content of the fruit and the superficial coating of syrup. The use of sugar is often combined with alcohol for preservation of luxury products such as fruit in brandy or other spirits. These should not be confused with fruit flavored spirits such as cherry brandy or Sloe gin.

Pickling

Pickling is a method of preserving food in an edible anti-microbial liquid. Pickling can be broadly categorized as chemical pickling (for example, brining) and fermentation pickling (for example, making sauerkraut).

In chemical pickling, the food is placed in an edible liquid that inhibits or kills bacteria and other micro-organisms. Typical pickling agents include brine (high in salt), vinegar, alcohol, and vegetable oil, especially olive oil but also many other oils. Many chemical pickling processes also involve heating or boiling so that the food being preserved becomes saturated with the pickling agent. Common chemically pickled foods include cucumbers, peppers, corned beef, herring, and eggs, as well mixed vegetables such as piccalilli, chow-chow, giardiniera, and achar.

In fermentation pickling, the food itself produces the preservation agent, typically by a process that produces lactic acid. Fermented pickles include sauerkraut, nukazuke, kimchi, surströmming, and curtido. Some chemically pickled cucumbers are also fermented.

In commercial pickles, a preservative like sodium benzoate or EDTA may also be added to enhance shelf life.

Lye

Sodium hydroxide (lye) makes food too alkaline for bacterial growth. Lye will saponify fats in the food, which will change its flavour and texture. Lutefisk uses lye in its preparation, as do some olive recipes. Modern

recipes for century eggs also call for lye. Masa harina and hominy use lye in their preparation, but not for preservation.

Canning and Bottling

Canning involves cooking food, sealing it in sterile cans or jars, and boiling the containers to kill or weaken any remaining bacteria as a form of sterilization. Various foods have varying degrees of natural protection against spoilage and may require that the final step occur in a pressure cooker. High-acid fruits like strawberries require no preservatives to can and only a short boiling cycle, whereas marginal fruits such as tomatoes require longer boiling and addition of other acidic elements. Low acid foods, such as vegetables and meats require pressure canning. Food preserved by canning or bottling is at immediate risk of spoilage once the can or bottle has been opened.

Lack of quality control in the canning process may allow ingress of water or micro-organisms. Most such failures are rapidly detected as decomposition within the can causes gas production and the can will swell or burst. However, there have been examples of poor manufacture (underprocessing)and poor hygiene allowing contamination of canned food by the obligate anaerobe, *Clostridium botulinum* which produces an acute toxin within the food, leading to severe illness or death. This organism produces no gas or obvious taste and remains undetected by taste or smell. Its toxin is denatured by cooking, though. Cooked mushrooms, handled poorly and then canned, can support the growth of Staphylococcus aureus, which produces a toxin that is not destroyed by canning or subsequent reheating.

Jellying

Food may be preserved by cooking in a material that solidifies to form

a gel. Such materials include gelatine, agar, maize flour and arrowroot flour. Some foods naturally form a protein gel when cooked such as eels and elvers, and sipunculid worms which are a delicacy in the town of Xiamen in Fujian province of the People's Republic of China. Jellied eels are a delicacy in the East End of London where they are eaten with mashed potatoes. Potted meats in aspic, (a gel made from gelatine and clarified meat broth) were a common way of serving meat off-cuts in the UK until the 1950s. Many jugged meats are also jellied.

Fruit preserved by jellying is known as jelly, marmalade, or fruit preserves. In this case, the jellying agent is usually pectin, either added during cooking or arising naturally from the fruit. Most preserved fruit is also sugared. Heating, packaging and acid and sugar provide the preservation.

Potting

A traditional British way of preserving meat (particularly shrimp) is by setting it in a pot and sealing it with a layer of fat. Also common is potted chicken liver; compare pâté.

Jugging

Meat can be preserved by jugging, the process of stewing the meat (commonly game or fish) in a covered earthenware jug or casserole. The animal to be jugged is usually cut into pieces, placed into a tightly-sealed jug with brine or gravy, and stewed. Red wine and/or the animal's own blood is sometimes added to the cooking liquid. Jugging was a popular method of preserving meat up until the middle of the 20th century.

Irradiation

Irradiation of food is the exposure of food to ionizing radiation; either high-energy electrons or X-rays from accelerators, or by gamma rays (emitted from radioactive sources as Cobalt-60 or Caesium-137). The treatment has a range of effects, including killing bacteria, molds and insect pests, reducing the ripening and spoiling of fruits, and at higher doses inducing sterility. The technology may be compared to pasteurization; it is sometimes called 'cold pasteurization', as the product is not heated. Irradiation is not effective against viruses or prions, it cannot eliminate toxins already formed by microorganisms, and is only useful for food of high initial quality.

The radiation process is unrelated to nuclear energy, but it may use the radiation emitted from radioactive nuclides produced in nuclear reactors. Ionizing radiation is hazardous to life; for this reason irradiation facilities have a heavily shielded irradiation room where the process takes

place. Radiation safety procedures ensure that neither the workers in such facility nor the environment receive any radiation dose from the facility. Irradiated food does not become radioactive, and national and international expert bodies have declared food irradiation as wholesome. However, the wholesomeness of consuming such food is disputed by opponents and consumer organizations. National and international expert bodies have declared food irradiation as 'wholesome'; UN-organizations as WHO and FAO are endorsing to use food irradiation. International legislation on whether food may be irradiated or not varies worldwide from no regulation to full banning.

It is estimated that about 500,000 tons of food items are irradiated per year worldwide in over 40 countries. These are mainly spices and condiments with an increasing segment of fresh fruit irradiated for fruit fly quarantine.

Modified Atmosphere

is a way to preserve food by operating on the atmosphere around it. Salad crops which are notoriously difficult to preserve are now being packaged in sealed bags with an atmosphere modified to reduce the oxygen (O_2) concentration and increase the carbon dioxide (CO_2) concentration. There is concern that although salad vegetables retain their appearance and texture in such conditions, this method of preservation may not retain nutrients, especially vitamins. - - Grains may be preserved using carbon dioxide. A block of dry ice is placed in the bottom and the can is filled with grain. The can is then "burped" of excess gas. The carbon dioxide from the sublimation of the dry ice prevents insects, mold, and oxidation from damaging the grain. Grain stored in this way can remain edible for five years. - Nitrogen gas (N_2) at concentrations of 98% or higher is also used effectively to kill insects in grain through hypoxia. However, carbon dioxide has an advantage in this respect as it kills organisms through both hypoxia and hypercarbia, requiring concentrations of only 80%, or so. This makes carbon dioxide preferable for fumigation in situations where an hermetic seal cannot be maintained.

Burial in the Ground

Burial of food can preserve it due to a variety of factors: lack of light, lack of oxygen, cool temperatures, pH level, or desiccants in the soil. Burial may be combined with other methods such as salting or fermentation.

Many root vegetables are very resistant to spoilage and require no other preservation other than storage in cool dark conditions, for example by burial in the ground, such as in a storage clamp.

Century eggs are created by placing eggs in alkaline mud (or other

alkaline substance) resulting in their "inorganic" fermentation through raised pH instead of spoiling. The fermentation preserves them and breaks down some of the complex, less flavorful proteins and fats into simpler more flavorful ones.

Most foods can be preserved in soil that is very dry and salty (thus a desiccant), or soil that is frozen.

Cabbage was traditionally buried in the fall in northern farms in the USA for preservation. Some methods keep it crispy while other methods produce sauerkraut. A similar process is used in the traditional production of kimchi.

Sometimes meat is buried under conditions which cause preservation. If buried on hot coals or ashes, the heat can kill pathogens, the dry ash can desiccate, and the earth can block oxygen and further contamination. If buried where the earth is very cold, the earth acts like a refrigerator.

Controlled Use of Micro-organism

Some foods, such as many cheeses, wines, and beers will keep for a long time because their production uses specific micro-organisms that combat spoilage from other less benign organisms. These micro-organisms keep pathogens in check by creating an environment toxic for themselves and other micro-organisms by producing acid or alcohol. Starter micro-organisms, salt, hops, controlled (usually cool) temperatures, controlled (usually low) levels of oxygen and/or other methods are used to create the specific controlled conditions that will support the desirable organisms that produce food fit for human consumption.

High Pressure Food Preservation

High pressure food preservation refers to high pressure used for food preservation. "Pressed inside a vessel exerting 70,000 pounds per square inch or more, food can be processed so that it retains its fresh appearance, flavour, texture and nutrients while disabling harmful microorganisms and slowing spoilage." By 2001, adequate commercial equipment was developed so that by 2005 the process was being used for products ranging from orange juice to guacamole to deli meats and widely sold.

Chapter 31

Cooking Methods

Food preparation is an important step in meeting the nutritional needs of the family. Food has to be pleasing in appearance and taste in order to be consumed.

Foods like fruits, vegetables and nuts can be eaten raw but most foods are cooked to bring about desirable changes. The process of subjecting food to the action of heat is termed as cooking.

Objectives of Cooking

- *Cooking sterilizes food:* Above 40°C the growth of bacteria decreases rapidly. Hence food is made safe for consumption.
- Cooking softens the connective tissues of meat and the coarse fibre of cereals, pulses and vegetables so that the digestive period is shortened and the gastro intestinal tract is less subjected to irritation.
- *Palatability and food quality is improved by cooking:* Appearance, flavour, texture and taste of food are enhanced while cooking.
- *Introduces variety:* Different dishes can be prepared with the same ingredients. (Eg.) Rice can be made into biriyani and kheer.
- *Increases food consumption:* Cooking brings about improvement in texture and flavour thereby increasing consumption of food.
- *Increases availability of nutrients:* Example in raw egg, avidin binds biotin making it unavailable to the body. By cooking, avidin gets denatured and biotin is made available.

COOKING METHODS

Moist Heat	Dry Heat	Combination
Boiling	Roasting	Braising
Stewing	Grilling	
Steaming	Toasting	
Pressure Cooking	Baking	
Poaching	Sauteeing	
Blanching	Frying	

MOIST HEAT METHODS

Boiling

Boiling is a method of cooking foods by just immersing them in water at 100°C and maintaining the water at that temperature till the food is tender. Rice, egg, dhal, meat, roots and tubers are cooked by boiling.

Merits

- *Simple method:* It does not require special skill and equipment.
- Uniform cooking can be achieved.

Demerits

- Continuous excessive boiling leads to damage in the structure and texture of food.
- Loss of heat labile nutrients such as B and C vitamins if the water is discarded.
- *Time consuming:* Boiling takes more time to cook food and fuel may be wasted.
- *Loss of colour:* Water soluble pigments may be lost.

Stewing

It refers to the simmering of food in a pan with a tight fitting lid using small quantities of liquid to cover only half the food. This is a slow method of cooking. The liquid is brought to boiling point and the heat is reduced to maintain simmering temperatures (82°C - 90°C). The food above the liquid is cooked by the steam generated within the pan. Apple, meat along with roots, vegetables and legumes are usually stewed.

Merits

- Loss of nutrients is avoided as water used for cooking is not discarded.
- Flavour is retained.

Demerits

- The process is time consuming and there is wastage of fuel.

Steaming

It is a method of cooking food in steam generated from vigorously boiling water in a pan. The food to be steamed is placed in a container and is not in direct contact with the water or liquid. Idli, custard are made by steaming. Vegetables can also be steamed.

Merits

- Less chance of burning and scorching.
- Texture of food is better as it becomes light and fluffy. Eg. Idli.
- Cooking time is less and fuel wastage is less.
- Steamed foods like idli and idiappam contain less fat and are easily digested and are good for children, aged and for therapeutic diets.
- Nutrient loss is minimised.

Demerits

- Steaming equipment is required.
- This method is limited to the preparation of selected foods.

Pressure Cooking

When steam under pressure is used the method is known as pressure cooking and the equipment used is the pressure cooker. In this method the temperature of boiling water can be raised above 100°C. Rice, dhal, meat, roots and tubers are usually pressure cooked.

Merits

- Cooking time is less compared to other methods.
- Nutrient and flavour loss is minimised.
- Conserves fuel and time as different items can be cooked at the same time.
- Less chance for burning and scorching.
- Constant attention is not necessary.

Demerits

- The initial investment may not be affordable to everybody.
- Knowledge of the usage, care and maintenance of cooker is required to prevent accidents.
- Careful watch on the cooking time is required to prevent over cooking.

Poaching

This involves cooking in the minimum amount of liquid at temperatures of 80°C - 85°C that is below the boiling point.

Egg and fish can be poached.

Merits

- No special equipment is needed.

- Quick method of cooking and therefore saves fuel.
- Poached foods are easily digested since no fat is added.

Demerits

- Poached foods may not appeal to everybody as they are bland in taste.
- Food can be scorched if water evaporates due to careless monitoring.
- Water soluble nutrients may be leached into the water.

Blanching

In meal preparation, it is often necessary only to peel off the skin of fruits and vegetables without making them tender.

This can be achieved by blanching. In this method, food is dipped in boiling water for 5 seconds to 2 minutes depending on the texture of the food. This helps to remove the skin or peel without softening food.

Blanching can also be done by pouring enough boiling water on the food to immerse it for some time or subjecting foods to boiling temperatures for short periods and then immediately immersing in cold water. The process causes the skin to become loose and can be peeled off easily.

Merits

- Peels can easily be removed to improve digestibility.
- Destroys enzymes that bring about spoilage.
- Texture can be maintained while improving the colour and flavour of food.

Demerits

- Loss of nutrients if cooking water is discarded.
- Dry heat methods.

Roasting

In this method food is cooked in a heated metal or frying pan without covering it. Eg. Groundnut.

Merits

- Quick method of cooking.
- It improves the appearance, flavour and texture of the food.
- Spices are easily powdered if they are first roasted.

Demerits

- Food can be scorched due to carelessness.
- Roasting denatures proteins reducing their availability.

Grilling

Grilling or broiling refers to the cooking of food by exposing it to direct heat. In this method food is placed above or in between a red hot surface. Papads, corn, phulkas, chicken can be prepared by this method.

Merits

- Enhances flavour, appearance and taste of the product.
- It requires less time to cook.
- Minimum fat is used.

Demerits

- Constant attention is required to prevent charring.

Toasting

This is a method where food is kept between two heated elements to facilitate browning on both sides. Bread slices are cooked by toasting.

Merits

- Easy and quick method.
- Flavour improved.

Demerits

- Special equipment required.
- Careful monitoring is needed to prevent charring.

Baking

In this method, the food gets cooked in an oven or ovenlike appliance by dry heat. The temperature range maintained in an oven is 120°C – 260°C. The food is usually kept uncovered in a container greased with a fat coated paper. Bread, cake, biscuits, pastries and meat are prepared by this method.

Merits

- Baking lends a unique baked flavour to foods.
- Foods become light and fluffy – cakes, custards, bread.
- Certain foods can be prepared only by this method – bread,cakes.
- Uniform and bulk cooking can be achieved. Eg. bun, bread.
- Flavour and texture are improved

- Variety of dishes can be made.

Demerits

- Special equipment like oven is required.
- Baking skills are necessary to obtain a product with ideal texture, flavour and colour characteristics.
- Careful monitoring needed to prevent scorching.

Sauteing

Sauteing is a method in which food is lightly tossed in little oil just enough to cover the base of the pan. The pan is covered with a lid and the flame or intensity of heat is reduced. The food is allowed to cook till tender in its own steam. The food is tossed occasionally, or turned with a spatula to enable all the pieces to come in contact with the oil and get cooked evenly.

The product obtained by this method is slightly moist and tender but without any liquid or gravy. Foods cooked by

sauteing are generally vegetables which are used as side dishes in a menu. Sauteing can be combined with other methods to produce variety in meals.

Merits

- Takes less time.
- Simple technique.
- Minimum oil is used.

Demerits

- Constant attention is needed as there is chance of scorching or burning.

Frying

In this method, the food to be cooked is brought into, contact with larger amount of hot fat. When food is totally immersed in hot oil, it is called deep fat frying. Samosa, chips, pakoda are examples of deep fat fried foods. In shallow fat frying, only a little fat is used and the food is turned in order that both sides are browned. Eg. Omlette, cutlets, parathas.

Merits

- Very quick method of cooking.
- The calorific values of food is increased since fat is used as the cooking media.

- Frying lends a delicious flavour and attractive appearance to foods.
- Taste and texture are improved.

Demerits

- Careful monitoring is required as food easily gets charred when the smoking temperature is not properly maintained.
- The food may become soggy due to too much oil absorption.
- Fried foods are not easily digested.
- Repeated use of heated oils will have ill effects on health.
- COMBINATION OF COOKING METHODS

Braising

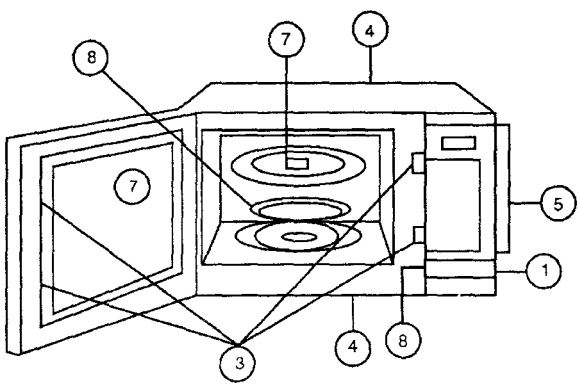
Braising is a combined method of roasting and stewing in a pan with a tight fitting lid. Flavourings and seasonings are added and food is allowed to cook gently. Food preparations prepared by combination methods are:

Uppuma - Roasting and boiling.
Cutlet - Boiling and deep frying.
Vermicilli payasam - Roasting and simmering.

MICROWAVE COOKING

Microwaves are electromagnetic waves of radiant energy with wave lengths in the range of 250 × 106 to 7.5 × 109 Angstroms.

The most commonly used type of microwave generator is an electronic device called a magnetron which generates radiant energy of high frequency. A simple microwave oven consists of a metal cabinet into which the magnetron is inserted. The cabinet is equipped with a metal fan that distributes the microwave throughout the cabinet. Food placed in the oven is heated by microwaves from all directions.



Microwave oven

- Door release button
- See –through window
- Door safety lock system
- External air vents
- Control panel
- Identification plate
- Glass tray 8.Roller ring

Moist foods and liquid foods can be rapidly heated in such ovens. Food should be kept in containers made of plastic, glass or china ware which do not contain metallic substances. These containers are used because they transmit the microwaves but do not absorb or reflect them.

Merits

- Quick method – 10 times faster than conventional method. So loss of nutrients can be minimised.
- Only the food gets heated and the oven does not get heated.
- Food gets cooked uniformly.
- Leftovers can be reheated without changing the flavour and texture of the product.
- Microwave cooking enhances the flavour of food because it cooks quickly with little or no water.

Demerits

- Baked products do not get a brown surface.
- Microwave cooking cannot be used for simmering, stewing or deep frying.
- Flavour of all ingredients do not blend well as the cooking time is too short.

SOLAR COOKING

Solar cooking is a very simple technique that makes use of sunlight or solar energy which is a non-conventional source of energy.

Solar cooker consists of a well insulated box which is painted black on the inside and covered with one or more transparent covers.

The purpose of these transparent covers is to trap heat inside the solar cooker. These covers allow the radiation from the sun to come inside the box but do not allow the heat from the hot black absorbing plate to come out of the box. Because of this, temperature upto 140°C can be obtained which is adequate for cooking.

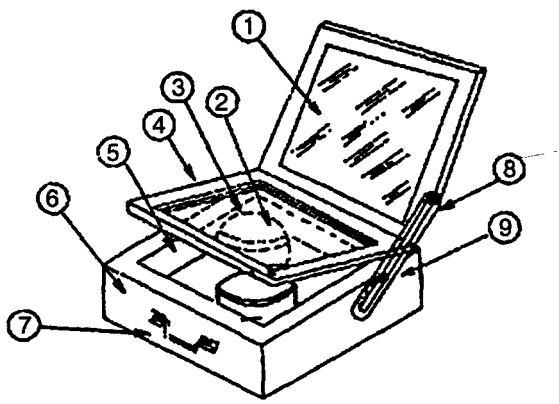
Merits

- Simple technique – requires no special skill.

- Cost effective as natural sunlight is the form of energy.
- Original flavour of food is retained.
- There is no danger of scorching or burning.
- Loss of nutrients is minimum as only little amounts of water is used in cooking.

Demerits

- Special equipment is needed.
- Slow cooking process.
- Cannot be used in the absence of sunlight – rainy season, late evening and night.



Solar cooker

- Solar plane mirror
- Cooking container
- Glass sheet
- Cover
- Insulation material glass
- Outer box
- Handle
- Mirror support
- Hinged adjuster and guide

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