Oyster Mushroom Cultivation

Part III. Mushrooms Worldwide

Chapter 10

Regional Research

MUSHROOM CULTIVATION IN UGANDA

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Introduction

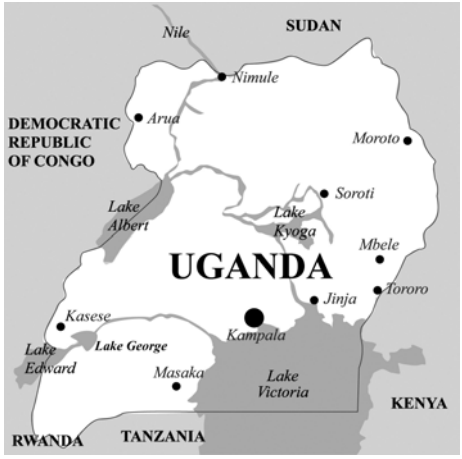

Figure 1. Map of Uganda

The climate of Uganda is mildly tropical. The temperatures range from 17 to 30℃ depending on the region, the northern part generally being warmer and drier than the southern region. There are two rainy seasons (March to June and August to October) in most parts of the country, the exception being the northeastern arid area that gets very little rain and is inhabited by nomadic pastoralists. Uganda is bisected by the equator, but despite this, the average room temperatures are around 25℃ because of the high altitude. There are highlands in the East, West and Southwest, which possess most of the wild mushroom species and are the areas most suitable for mushroom cultivation. In the highlands temperatures are as low as 11℃ and as high as 25℃. All types of tropical crops can be grown most of the year, and some temperate crops can be grown. Potential mushroom growing substrates include all crop residues of cereals and legumes, corncobs, tree leaves, sawdust, coffee hulls, banana leaves, bagasse, cotton waste, cotton seed hulls, brewers waste, papyrus reeds and elephant grass. Uganda has also the largest fresh water lake in the world, Lake Victoria, as well as four other large freshwater lakes. The climate around the shores of these lakes is warm and humid, suitable for cultivation of tropical mushroom species.

The major types of wild mushroom species are the *Termitomyces* species, with the most popular for consumption being the *Termitomyces microcarpus*. Mushrooms are mainly consumed with vegetables, in soups, or mixed in peanut sauce.

Ugandan society is patrilineal, with men mostly dominating women. This results in women doing most of the work, both farming and house chores, but they cannot own the land on which they work. Indeed, land ownership and the heavy workload are currently hot gender issues.

All Ugandans, except the nomadic pastoralists, appreciate mushrooms as a food delicacy and some tribes even use them as medicine and as fertility enhancers. There is a thriving market for local edible wild mushrooms, especially along motorways. There would be no problem at all in introducing any additional useful mushrooms into the diets of people.

Current Situation of Mushroom Industry

Scale of production: It is not clear how many mushroom growers we have in Uganda, nor the total production amount as no census has been carried out. A national association has been formed to work on these problems. There are, however, about six spawn centers that can serve as mushroom training and collection centers. Ugandan traders are still importing mushrooms from Kenya and South Africa, but the quantities imported are not known.

It is assumed that there are over 400 mushroom growers in Uganda, mainly concentrated in the southern and central districts, where there is a problem of land shortage. Due to the small-scale nature of Ugandan agriculture, substrates are also available on small scale, so the mushroom growers are also doing it on small scale. Most farmers have 20-100 bags of fruiting bags at a time, yielding only an average of 1-2kg per day per farmer, sometimes less depending on the humidity and season.

Species: Only oyster mushrooms (*Pleurotus* spp.) of various strains are cultivated. Some people are now eager for domestication of local wild edible mushrooms as they believe these would be more appreciated by the market.

Substrates: Farmers in different districts use different substrates. In the southwestern areas, where sorghum is the main staple food crop, they use sorghum stover and inflorescence residues. They also use bean trash and sometimes wheat and barley straws. In the midwestern areas, they use mainly millet straws, bean trash and dry banana leaves. In the central areas, they use mainly cottonseed hulls.

Surprisingly, there are plenty of bagasse and brewery residues polluting the environment around the sugar factories and breweries but nobody is using them due to the long travel distance to these factories, and also due to the bureaucratic difficulties associated with entering and leaving factory premises.

Post harvest and marketing: The marketing of mushrooms is mostly informal, by the roadside, or in individual arrangements with those growing the mushrooms. Due to the small-scale nature of Uganda's agriculture and industry, there is an inadequate supply of substrates for mushroom cultivation. The mushroom growers, therefore, operate on a small scale. This can be a hindrance to marketing, as buyers would like reliable, constant supplies of set amounts. This problem can be solved by the formation of co-operatives for the collection of substrates, accessing spawn, and collective marketing. The recent National Seminar on Mushrooms in Uganda has encouraged such activity. Mushrooms are marketed fresh in areas near the capital, Kampala, but mainly in dried form in outlying areas. The mushrooms are air-dried indoors. There has been an attempt to develop inexpensive solar dryers, but still many farmers cannot afford them at their scale of production. Moreover, the mushrooms dried in solar dryers become brittle and easily break into powder during packing.

Fresh mushrooms are sold at UGX*5,000/kg (USD2.5/kg). Dried mushrooms are sold at UGX25,000-30,000/kg (USD12.5-15.0).

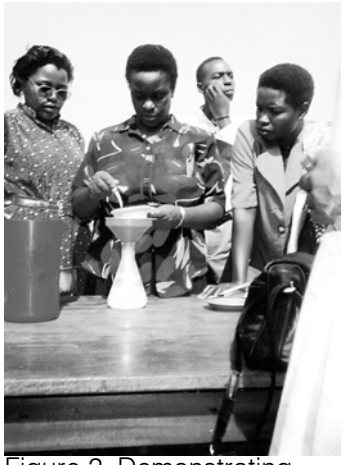

Figure 2. Demonstrating how to make PDA medium for mushroom culture

Cultivation

Species: Cultures of different strains of Pleurotus have been multiplied and preserved on Potato Dextrose Agar media.

Cultures: Fruiting cultures are made on PDA in small gin bottles that are re-usable (Fig. 2). PDA is made locally by using potatoes boiled in water that is then extracted and dextrose and agar are added to it, boiled then sterilized.

Spawn: Trials on different spawn substrates have been done. Trials included wheat grain, finger millet, sorghum and corn. We eventually settled for sorghum (Fig. 3).

We tried adding calcium sulfate and lime to the spawn grain substrate, but this was expensive and yet did not significantly affect the yields.

Figure 3. Mature spawn in the laboratory at Kawanda Resaearch Institute, Uganda

Figure 4. Inside the growing house, mushrooms growing out of black plastic bags on bamboo shelves

Figure 5. Oyster mushrooms growing out of a transparent plastic bag on sorghum stover as substrate

Substrates: Trial results with various substrates showed that cottonseed hulls were the best, followed by cereal straws (wheat straw, rice straw, millet straw, sorghum stover), then legume crop residues (beans and soy bean). Maize cobs, grass and banana leaves had the lowest yields. We tried mixing wheat and maize bran into the poorer substrates but this caused a lot of contamination and was discarded.

Plastic bags: We have tried using black and transparent plastic bags and these gave no significant differences in yields (Fig. 4, 5). We settled for the black bags because when black bags are used, there is no need for a dark incubation room.

Humidity: We tried different ways of keeping high humidity in the cropping rooms, including water filled clay pots, wet sacks and clothes around the walls, wet sand on the floor and direct watering of bags (Fig. 6). We settled for clay pots as these were easily available unlike sand that is available only in certain places. The hanging wet clothes and sacks proved catastrophic as farmers started using all types of unsightly old clothes that grew molds and became even more unsightly.

Figure 6. A farmer using clay pots filled with water to maintain high humidity in her mushroom

Figure 7. A growing house. In the foreground, a wooden rack for draining the substrate (rice straws) after pasteurization

Mushroom houses: We tried different housing units and settled for mud and wattle walls with grass or papyrus roof (Fig. 7). Where there are plenty of termites we recommend brick walls. All-straw structures are too temporary and have to be reconstructed after every rainy season.

Post harvest and marketing: We tried direct sun drying, but the mushrooms changed color drastically and also attracted flies. We tried a solar dryer but the mushrooms became brittle and were not easy to pack. We also tried indoor air-drying, and this is the method that we are currently using (Fig. 8). Marketing is a bit difficult because of inadequate infrastructure. We are now organizing the mushroom growers into associations for collective marketing and accessing spawn and training. We have also set up 5 spawn centres in up-country districts, but these need strengthening. They will in future also act as marketing centres.

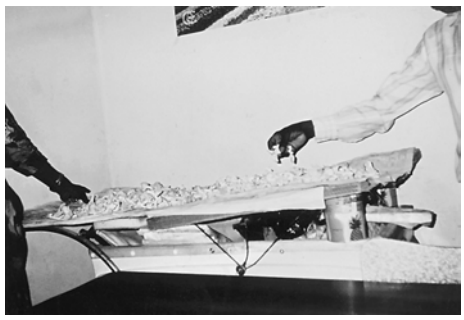

Figure 8. Drying oyster mushrooms indoors

The Next Step for Mushroom Industry in Uganda

This author thinks the next step is to develop, through adoptive research, cultivation techniques for other species of mushrooms, especially medicinal mushrooms (shiitake, *Ganoderma*, *Agaricus blazei*, and *Auricularia*). This is in order to diversify and give people a choice, and also for future development of the nutriceutical industry in Uganda. The diversity of species will also provide a broader base for income generation by farmers as it will widen the market. There is also a need to actively promote the consumption of mushrooms through Television, radio talks, print media and posters, calendars T-shirts and seminars. This will help create and expand the market for the growers. If the University gets involved in Mushroom Science, there is also a possibility of domesticating the saprophytic wild edible mushrooms.

Figure 9. Training the Poor Claires nuns and novices. Background, right, cottonseed hulls on a straining wire mesh draining into a sink. The black plastic bags have been filled with the cottonseed hulls and inoculated with spawn.

Advice to Prospective Growers

Advice is to join the newly formed association in order to access training, spawn supply and collective marketing (Fig. 9). This will also enable them to diversify the cultivated species and increase production. Then the possibility of exporting within the region can become a reality.