Claviceps purpurea - Ergot

- Calvicipitaceae - Temperate zones worldwide

One of the most amazing stories about naturally-occurring alkaloids in fungi concerns ergot (Claviceps purpurea); a fungus that infects grains of rye and related grasses. One of the psychoactive components of ergot fungus is the alkaloid ergine (d-lysergic acid amide), better known as natural LSD. The more potent synthetic LSD, (d-lysergic acid diethylamide), also known as LSD 25, is one of the most powerful psychoactive drugs known. LSD 25 was originally synthesized from natural psychoactive alkaloids in ergot. According to Lewis and Lewis (1977), it is 4,000 times more powerful than mescaline. Natural LSD (ergine) is also found in the seeds of two species of Mexican morning glory vines which are still ingested by native Indians in an important medicinal and religious ritual.

Ergot forms a dark, compact, fungal mass called a sclerotium where the grain would normally develop. One or several of these pelletlike sclerotia can be seen in an infected grain spike, typically extending out from the bracts (glumes). When separated from the grain spike, the sclerotia superficially resemble rat droppings (rat pellets). The sclerotia are the source of the potent alkaloids in Claviceps purpurea. In late spring, when rye plants are in bloom, the overwintering sclerotia from the previous year's crop produce stalked ascocarps resembling microscopic fungal fruiting bodies. The head of each ascocarp contains many embedded perithecia. The perithecia contain numerous saclike asci, each with eight ascospores. The ascospores infect the young, developing grains (ovaries) of rye plants, eventually replacing them with purplish-black sclerotia. Because it produces ascospores within saclike asci, Claviceps is placed in the fungal Class Ascomycetes.

During the Middle Ages, tens of thousands of people in Europe were afflicted with ergotism, a malady characterized by gangrenous extremities, convulsions, madness and death. They ate rye bread infested with ergot fungus containing several peptide alkaloids of the ergotamine group (including ergotamine, ergosine and ergocristine) that affect blood vessels. Since they are potent vasoconstrictors, these alkaloids can cause gangrene if ingested in sufficient dosages. Known as "St. Anthony's Fire," ergotism was a dreaded disease in Europe. Between 990 and 1129, more than 50,000 people died of this disease in France. The disease became so devastating that in 1093 in southern France the people formed an order to take care of the afflicted, and they chose St. Anthony as their patron saint. One of the symptons of the disease was an intense burning sensation, hence the name St. Anthony's Fire. It wasn't until 1597 (500 years after the first epidemic of ergotism) that physicians finally associated this horrendous disease with the ergot on rye. Another form of ergot poisoning involves severe hallucinations and madness, caused by pschoactive alkaloids in the sclerotia.

A number of important medical discoveries have come from the study of ergot fungus and ergotism. In 1935 the alkaloid ergonovine was isolated from ergot. Since it causes strong muscular contractions, it has been used to induce labor and to control hemmorrhaging. The alkaloid ergotamine has been used extensively to relieve migraine headaches through the constriction of blood vessels. Thousands of pounds of ergot sclerotia are harvested each year from midwestern rye farms, and are used for various prescription drugs. In 1943 chemist Albert Hofmann was studying ergot fungus, whose nuclei contain lysergic acid. When he added diethylamide he produced lysergic acid diethylamide, better known as LSD. While working on this new compound, Hoffman discovered that its strong hallucinogenic effects were similar to that of natural lysergic acid alkaloids in the seeds of "ololiuqui," morning glories used by the Aztecs in their religious ceremonies.