Ergot of Rye

*Claviceps purpurea*

Ergot is a disease of Rye. The ergot is the dark purplish sclerotium of the fungus that replaces the grain.

Ergot of Rye

- Ergot was very common pathogen of rye.
- Also infect other grains.
- Ergot contains about forty alkaloids (mycotoxins), may be fatal when consumed.
- Some source of pharmacological medicine.
- Original source from which Lysergic Acid Diethylamide (LSD) isolated.

Ergot of Rye

- Appearance on rye has been documented in ancient Greece.
- Proportion of mycotoxins differ within species. Thus, symptoms may vary.
- “The Ergot” also over wintering stage in life cycle.
- In spring sclerotium produces stroma (pl. = stromata) containing asci & ascospores.

Ergot of Rye

- Stromata are mushroom-like (right) structures growing out of ergot.
- L-section (left) through stroma, with asci & ascospores.

Ergot of Rye

- Ascospores dispersed by wind, onto rye flowers.
- Infection initially produces asexual spores of *Spacelia* stage, in honey dew exudate.
- Fly dispersed.
- Can repeatedly infect rye flowers.
Ergot of Rye

- Ergot forms as winter approaches.
- Summary of life cycle:

  ![Ergot Cycle Diagram](image1)

Ergot of Rye

- Two types of ergot poisoning recognized:
  - **Convulsive ergotism**, a nervous dysfunction, fits, muscle spasms, hallucinations and delusions.
  - **Gangrenous ergotism**, constriction of blood vessels, especially to extremities, resulting in loss of extremities.
- Oversimplification of symptoms!

Ergot of Rye

- Loss of toes in foot due to gangrene.

Cow with gangrenous ergotism.

Ergot of Rye

- Gangrene of finger tips.

Gangrenous Ergotism

- Earliest observation of ergotism probably began with cultivation of Rye.
- Gangrenous ergotism was first documented during Middle Ages (around 5th Century).
  - First major outbreak in 875 A.D.
  - Named “Holy Fire” at this time.
- Major epidemics of ergotism occurred every few years.

http://dermatology.about.com/library/blgangrene1photo.htm
Blackened toes, fingers, arms and legs most common symptoms...Eventually dying of gangrene in infected limbs. Convulsive ergotism also could also occur resulting in victims becoming insane.

France was center of many severe epidemics. Rye was staple of poor. Climate was cool and wet, favorable for ergot growth. When wet and humid, flowers stay open longer and more prone to contamination.

Relief and hope: Outbreak of ergotism in 1039, in France. Gaston de la Valloire built hospital to care for afflicted. Hospital dedicated to St. Anthony. Led monks to start order of St. Anthony, leading to 370 hospitals. Eventually "Holy Fire" became "St. Anthony's Fire".

Thuillier, French Physician, 1670 believed Ergot was source of "disease". Formulated generalities of Ergotism. Only the poor seem to be afflicted. Entire families may be inflicted, but not neighbors. Thus, not contagious. Victims of St. Anthony's Fire all consumed rye bread. Believed that bread made from rye infected with ergot was responsible.

Thuillier, French Physician, 1670 believed Ergot was source of "disease" (continued). Correlated high ergot infection with high occurrence of "Fire". Was unable to convince anyone of his theory. Louis Tulasne (1853) would verify that Ergot was a fungus and cause of ergotism.
Historical Impact

- Has impacted geographical boundaries:
  - Between 800-900 A.D. Northmen (Vikings) invaded Holy Roman Empire.
  - Thousands of Franks died as a result of gangrenous ergotism.
  - Numerous raids caused Charles III to abdicate throne and Franks' land was split into two kingdoms.
  - Kingdom of West Frank became France.
  - Kingdom of East Frank became Germany.

Historical Impact

- Present day France and Germany:

Ergotism in the Past

- Period of the Bubonic Plague 1348-1350.
- One third of Europe's population died.
- An alternative cause Matossian (1989):
  - Some symptoms often not associated with Bubonic Plague, i.e., symptoms associated with Trichotheccenes.
  - Also, included rainfall and temperature data that would favor Trichotheccene formation in grain and not favor the occurrence of Bubonic Plague.
**Historical Impact**

- Matossian found certain category of people more infected:
  - Age, 5-14 and 15-24
  - Poor, substandard food more likely to eat rye
  - Lived near grain storage (attracted rats)
  - Rainfall, humidity and flooding.

- Depression of European population following plague:
  - Population depression lasted for over 100 years.
  - After plague, winters were cooler.
  - Evidence of ergotism.
  - Combination of trichothecene and ergot poisoning contributed to spontaneous abortions and low fertility.

**Convulsive Ergotism**

- Symptoms for convulsive ergotism more familiar and recently associated with witchcraft:
  - Mary Matossian also includes a chapter on ergotism and witchcraft.
  - Correlation between the occurrences of witchcraft reported and consumption of infected grain.
  - Not difficult to imagine if victims claim to be hearing voices and speaking to unseen spirits.

- Witchcraft and ergotism:
  - What did people think occurred when symptoms of convulsive ergotism observed?
  - Matossian correlated diet, locality, climatic condition with incidents of witchcraft trials.

- Witchcraft and ergotism (continued):
  - How did witch hunt begin?.
  - In Salem, Massachusetts, January 20, 1692.
  - Three pre-teen girls exhibited convulsive ergotism(?).
  - Thought to be bewitched by doctor.
  - Who were the witches? Consumption of witch cake would tell.

**Ergotism in the Past**

- Witchcraft and ergotism (continued):
  - Who were the witches?
    - Doctors.
    - Herbalists.
    - Why them?
An example of a modern day outbreak (1951, in Pont-St. Esprit, France):
- First noticed by Dr. Jean Vieu, on August 12, 1951.
- Combination of strange symptoms.
- By August 14th, Hospital filled with patients with same symptoms.
- However, it was not known immediately what cause was.

Found common food item.
- Took four weeks to trace source.
- Presently, quality control prevents such incidents from occurring.

Pharmaceutical usages of Ergot
- During 17th Century, mid-wives used extracts of ergot during child birth:
  - Inducing contraction of uterus.
  - Controlling postpartum hemorrhage.
  - Albert Hofman, 1935, synthesized ergonovine, in lab, Sandoz Laboratories.
- Ergotamine: Migraine headaches
- And of course, LSD, Thursday's topic.