Fungi and Their Role in Food Production

Food Products Requiring Fungi
- Those foods that require fungi in their recipes
- Some examples from Western and Eastern cultures.
  - Bread
  - Blue Cheeses
  - Shoyu (Soy Sauce)
  - Miso
  - Tempeh

Food Products Requiring Fungi
- Mushrooms, nutritional yeast, etc., not included in this category.
- Begin with bread.
  - Two categories:
    - Leavened Bread
    - Unleavened Bread (Flat Bread)

Unleavened Bread
- Tortillas
- Maztoh
- Altar Bread
- Pita Bread

Leavened Bread
- Sliced Roll
- Jewish Bread
- Sliced Loaf Bread

Bread
- In Western cultures bread was important food made from grain staple
- Originated during modern stone age, ~8000 BCE. May be world's oldest food.
  - Making of bread did not happen immediately.
  - Whole grain was eaten hard and raw, softened, later cracked.
  - Bulgur - Middle East
  - Groats - Europe
In Western cultures bread was important food made from grain staple (continued)
- Cracked grain used for porridge and unleavened bread.
- Problems with first unleavened bread.
- Origin of unleavened bread before 8000 BCE.
- Unleavened bread consumed for thousands of years before leavened bread was made.

Egyptians, around 3000 B.C., believed to be first to baked leavened bread.
- Wheat bread most desirable, but other grains also used, e.g., barley, sorghum, oat, etc.

Leavened bread was credited to Osiris, their god of grains.
- Rising bread due to wild yeast.
- Yeast required.
- Bread fluffy with “spongy” texture due to yeast.
- Chemical reaction same as in alcoholic beverages:
  Yeast + Glucose $\rightarrow$ Alcohol + CO2.

But unleavened bread still made, today:
- Matzoh
- Altar bread
- Pita bread
- Tortillas
In Rome, by 168 BCE, the first baker's guild, Collegium Pistorum was formed. Now called the Guild of Master Bakers still exist, today. Has its own coat of arms. For a time was separated into two guilds.

Bread was selected as a means of nutritional improvements for Americans during late 1930s and early 1940s. Only in leavened bread. B vitamins and iron added to bread. Program eliminated beriberi and pellagra in United States. Automation of bread making. Bread slicer invented in 1912.

Practice of taking piece of risen dough, leaven, continues to this day: Early settlers in North America passed on leaven to next generation. Distinctive leavens also developed, e.g., sourdough. Folklore of leaven also developed. In Palestine Origin of Fleischmann's Yeast

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Origin of cheese
Like many food products its discovery was accidental. Origin told myths and folklore. Process requires milk and enzyme rennet, which separates milk into whey and curd. Origin believed to be approximately 4000 years ago.

Origin of blue cheese
Believed to have occurred 2000 years after discovery of cheese. Blue cheeses referable to Roquefort. Requires Penicillium roqueforti. Discovery was accidental.

Roquefort Cheese believed to be first blue cheese. Origin of Roquefort is according to Roquefort publicist. Story is similar to origin of cheese. Roquefort cheese comes only from Roquefort. One reason why there are other names for blue cheeses Quality of Roquefort inconsistent until P. roquefort was discovered to be key.
Blue Cheeses

Roquefort Cheese: Note blue-green mycelium in cheese (right)

Blue Cheeses

- Making of Roquefort cheeses.
- Cheeses called "Roquefort" all contain same mold, but recipe is somewhat different
  - Town of Roquefort use sheep's milk to make cheese.
  - Canada and United States use either cow's or goat's milk.
  - Roquefort attempted to have a monopoly on their cheese, even into the 20th. Century.

Blue Cheeses

- Cheeses called "Roquefort" all contain same mold, but recipe is somewhat different (continued).
  - Italy developed Gorgonzola, which is made from cow's milk.
  - English developed Stilton.
  - Greeks developed Kopanisti, which has a woody, peppery taste.
  - Norwegians developed Gammelost, a low fat version.

Camembert Cheese

- Camembert Cheese
  - Origin is actually unknown, but has an often told story.
    - Discovered in Normandy, in town of Camembert.
    - Marie Fontaine credited with creation of cheese, in 1791.
    - Recipe given to her by Abbott, Charles-Jean Bonvoust.

Camembert Cheese

Camembert Cheese: Very different in appearance from Roquefort. Mycelium is on surface and is a soft, creamy cheese

Camembert Cheese

- Camembert Cheese
  - Although origin is not true, bicentennial of Camembert cheese was celebrated in 1991.
**Limburger Cheese**

- Main microorganism involved is a bacterium: *Brevibacterium linens*.
- Yeast are also involved, *Debaryomyces hansenii* and *Galactomyces geotrichum* has been isolated.
- Strong odor, of "dirty feet", related bacterium involved.

**Limburger Cheese**

- In North America, only one place in Wisconsin can manufacture this cheese.
- Cheese originated in Belgium.
- Cheese differs in different places manufactured.

**Asian Food Products**

- Currently there is a trend in adoption of more Asian food products.
- Several of these require the assistance of fungi to make.
  - *Shoyu* (Soy sauce)
  - *Miso*
  - *Tempeh*

**Shoyu**

- Probably most well known of all Asian food products.
- Requires a bacterium and fungus:
  - *Aspergillus oryzae* required to digest cooked soy bean and flour = *Koji*, fermentation product of fungus.
  - *Koji* mixed with salt and water = *moromi*, and inoculated with *Pediococcus soya*, a bacterium.
  - Allowed to ferment for 6 months.

**Shoyu**

- Probably most well known of all Asian food products (continued).
- Non-brewed method:
  - Soybeans are boiled with hydrochloric acid for 15 to 20 hours.
  - Amino acid liquid is neutralized and filtered.
  - Caramel color added for color, corn syrup for sweetness, and salt. The mixture is then refined and packaged.
Miso

- Japanese word for soy bean paste
  - Usually consumed by dissolving in water as a base for soup or flavoring agent.
    - Recipe is similar to shoyu.
    - Steamed rice is inoculated with *Aspergillus oryzae*, for about 2 days, at 40°C to produce a rice Koji.
    - Koji inoculated with yeast and bacteria and fermented for about 7 months, to give you the pasty miso product.

Tempe

- Various legumes and some grains have been used in making tempe.
  - Country of origin is Indonesia.
    - Soy bean, mung bean and peanuts normally used.
    - In United States has gained some popularity and additional legumes and grains used.
    - Beans or grains cooked and drained.
    - After cooling inoculated with *Rhizopus oligosporus*.

- Fungus digest complex carbohydrates and other compounds that may cause “gas”, when legumes are used.