

Microbial spoilage of eggs

Food Spoilage:

- Food spoilage refers to the damage or destruction of food so as to make it undesirable for human consumption.
- Such spoilage may be due to:
 - Physical damage caused by cutting, bursting, freezing etc.
 - Mechanical damage caused by insect, bird, animal etc.
 - Activity of food enzyme itself
 - Growth of spoilage micro-organisms in food.
 - Improper environmental condition during harvesting transport, storage and marketing.
- The spoiled food may transfer the spoilage organism to the fresh food and result in spread of spoilage.
- Spoilage increase the amount of wastages.

Spoilage of eggs:

1. Contamination of eggs:

- Freshly laid egg is sterile but the egg shell soon becomes contaminated by fecal matter of hen by nest, by washing water, by handling and by other material in which it is stored.
- If a total number of micro-organisms per shell of hen's egg has been reported to range from 10^2 - 10^7 with average of 10^5 .
- *Salmonella* spp. may be found on shell or inside egg.

2. Non-microbial spoilage of eggs:

- These include loss of moisture and hence loss of weight during long term storage.
- Change in physical state of egg contents also occur during long term storage.
- They include thinning of egg white and breaking of yolk membrane.
- As the yolk membrane weaken and break, yolk becomes flat and homogenously mixed in egg white.

3. Microbial spoilage of eggs:

- In order to cause spoilage of shell of egg, microorganisms must contaminate the shell, penetrate through the pores in shell and inner membrane, reach the eggwhite and yolk and grow there.
- Some microorganisms cannot grow in egg white but can grow rapidly in egg yolk.
- Change in storage temperature facilitates penetration of organism through shell and hence facilitates microbial spoilage.

1. Bacterial spoilage of egg:

- Bacteria are more common spoilage organism than mold.
- Bacteria cause rots in egg.

- When bacteria grow within the egg, they decompose the content and form byproduct.
- This result in characteristic odor, appearance or color from which various microorganisms acquire their name:
- **Green rot:**
 - It is caused by *Pseudomonas fluorescense*.
 - Green egg white shows fluorescence when exposed to UV light.
 - In later stage of spoilage, egg yolk disintegrates and mask green color of egg white.
 - Odor is lacking or fruity or sweetish.
- **Colorless rot:**
 - It may be caused by *Pseudomonas*, *Acetobacter*, *Acinatobacter* and *coliform*.
 - In later stage of spoilage, egg yolk disintegrates or at least have incrustations.
- **Black rot:**
 - It is caused by *Proteus* and sometimes *Pseudomonas* and *aeromonas*.
 - Egg yolk blackens and then breakdown to give whole egg content muddy brown color.
 - Odor is putrified due to H₂S.
- **Pink rot:**
 - It is caused by *Pseudomonas* usually at the later stage of green rot.
 - They are similar to colorless rot except that pink coloration occurs in yolk and white.
- **Red rot:**
 - It is caused by *Serratia marcescens*.
 - These eggs are distinguished by a rod dissociation of egg white and the surface of the yolk in ammonical i.e. putrified odor.
- **Custard rot:**
 - In this rot, yolk is incrustated with custard like material and occasionally have green to olive pigment.
 - The albumin become thin with orange coloration.
 - This type of spoilage is caused by *Citrobacter* and *Proteus vulgaris*.

2. Fungal spoilage of egg:

- Fungal spoilage goes through following stages:
- **Pin spot molding:**
 - In this case, small compact colonies of mold appear on the shell and usually just inside the shell.
 - The color of pin spots varies with the type of mold. For example: *Cladosporium* give black spot and *Sporotrichum* give pink spot.
- **Superficial fungal spoilage:**
 - This occurs if eggs are stored in atmosphere of high humidity.
 - In this case, molds grow on shell in the form of whiskers.
- **Fungal rotting:**

- It is the final stage of spoilage by mold.
- In this case, mycelium of the mold grows through the pores and cracks in the shell.
- Jellying of egg white may occur and colored spots may be produced.
- Hypha of mold grows through the yolk membrane and rupture it, so that yolk mixes with the white.
- Molds causing spoilage of egg include *Penicillium*, *Sporotrichum*, *Mucor*, *Botrytis*, *Alternaria*, *Thamnidium* etc.

Preservation of eggs from spoilage:

- Eggs have several ways of protecting itself from microbial spoilage.
- Shell and underlying membrane serve as first line of defense to prevent entry of microorganisms.
- In addition to physical barrier, egg albumin is not suitable growth medium and discourage growth of many microorganisms.
- Characteristics of egg albumin that discourage microbial growth include pH of 9-10, low level of simple nitrogenous compound, apoprotein that binds riboflavin, avidin that binds biotin, ovotransferrin that chelate iron, and lysozyme that hydrolyze peptidoglycan of bacteria.
- Despite physical barrier and other anti-microbial factors, many microorganisms can invade and cause spoilage of egg.
- Therefore, following methods are employed for its preservation:

i. Asepsis:

- Great care should be taken to reduce contamination by fecal matter by dust and nest.
- When eggs are broken for freezing or drying, spoiled egg should be discarded and contamination from equipment can be reduced by sanitizing it.

ii. Removal of microorganism:

- Various methods can be employed to remove dirt and faecal matter from egg shell.
- Dry cleaning by sand blasting removes dirt and bloom.
- Washing with warm water removes dirt, bloom and apart of microorganisms but encourage penetration of bacteria into egg through pores in shell.
- Use of disinfectant in washing water reduce number of microorganisms.

iii. Use of heat:

- Heat treatment suggested include heating whole egg in oil for 10 minutes at 60°C or in water at 54.4°C for 80 min, Immersion of egg in boiling water for few second, immersion of egg in hot detergent, Sanitizer solution at 43.3°C to 54.4°C.
- Pasteurization is required for most egg product.
- Because of heat coagulability of egg, stabilization is required before pasteurization.
- This includes addition of aluminum salt and adjustment of pH.

iv. Preservation by low temperature:

- **Chilling:**
 - Eggs are commercially stored for six month or longer, at a temperature of -1.7°C to -0.55°C and relative humidity of 70-80%.
 - If temperature is greater than -1.67 , there is more rapid penetration of microorganisms and growth into egg and more physical and chemical changes.
 - Special treatment like impregnation of egg shell with colorless and odorless mineral oil keeps out moisture, slows dessication and air penetration during chilling.
- **Freezing:**
 - Eggs are first washed with 200-500ppm chloride solution and broken.
 - Egg yolk and egg white are separated and they are frozen separately at -17.8°C to -20.5°C .

v. Preservation by drying:

- Eggs are first washed with chloride solution, broken and then yolk and white are separated.
- Liquid egg is then dried by drum drying or spray drying method.
- Glucose should be removed from egg before drying because it causes browning of egg.

vi. Preservation by chemical preservative:

- Preservatives may be used on shells of egg in the atmosphere around them and on containers for egg.
- Some of them are:
 - Waxing and oiling of shell keep the shell dry, reduce penetration of oxygen into the egg and reduce passage of carbon dioxide and moisture out.
 - Immersion of whole egg in solution of sodium silicate is also a good preservative.
 - Use of CO_2 in ozone in storage atmosphere improves quality of egg.