

Paper No.: 03

Paper Title: FOOD MICROBIOLOGY

Module -23 : Meat and Seafood Spoilage



INTRODUCTION

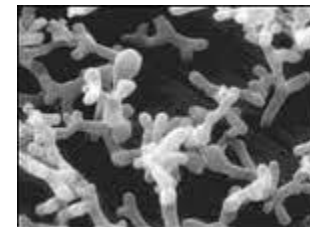
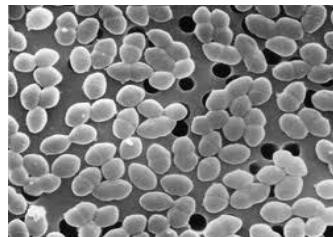
- ❑ Spoilage in different food stuffs have been showed by numerous microorganisms.
- ❑ Spoilage of milk, fruits and meat occurs quickly as compared to other food products.
- ❑ Approximately, 25% of the world's food produced post-harvest or post slaughter is lost to microbial degradation of food alone.
- ❑ Meat is an ideal culture medium for many organisms because it is high in moisture, rich in nitrogenous content and various degrees of complexity and plentiful of minerals and accessory growth factors.
- ❑ The breakdown of fat, protein and carbohydrates of meat impart off odors, off flavor and slime formation.



- Majority of the spoilage microorganisms are contaminants comes from external sources
- Molds (*Cladosporium*, *Thamnidium*, *Mucor*, *Penicilium*, *Alternaria*, and *Monilia*) can come in contact with the surface of meats and grow in this environment.
- Yeasts present on meat are mostly asporogenous.
- Major bacteria associated meat spoilage are *Pseudomonas*, *Acinetobacter*, *Alcaligenes*, *Micrococcus*, *Sarcina*, *Leuconostoc*, *Lactobacillus*, *Proteus*, etc.
- Spoilage of sea foods (fish and shellfish) caused by various microbes e.g. *Pseudomonas*, *Moraxella*, *Shewanella*, *Flavobacterium*, *Bacillus*, *Micrococcus*, *Clostridium*, etc.

Microbes Present in Meat and Meat products

- ▣ ***Brochothrix thermosphacta***: is able to grow under both aerobic and anaerobic conditions for which meat is an ecological niche. The presence of this microbe often seen in irradiated meat and poultry. These compounds, or their derivatives, are responsible for the foul odor of meat.
- ▣ ***Carnobacterium***: is gram-positive genus and *C. divergens* and *C. maltaromaticum* are commonly associated with meat products and seafood. These microbes are anaerobic and can even grow at high CO₂ concentration and high pressure. Due to production of H₂O₂, *C. divergens* has been shown to result green discoloration of ham.



Microbes Present in Meat and Meat products

- ***Clostridium tetani***: is a rod-shaped, gram positive, anaerobes, which are recognized as toxin-producing pathogens. *Clostridium* produces large amounts of gas in packaged meat, which usually coupled up with foul odors and causes the package to appear in a blown pack.
- ***Enterobacteriaceae***: gram-negative, straight rods, and sometimes motile species. This family composed of more than 150 bacterial strains that consist mostly of *E. coli*, *Klebsiella pneumonia*, *Klebsiella oxytoca*, and *Enterobacter cloacae*. *Serratia*, *Enterobacter*, *Proteus* and *Hafnia* often contribute to meat spoilage.



Microbes Present in Meat and Meat products

- ▣ ***Leuconostoc*** : is the member of lactic acid producing bacteria which produces D-lactate and ethanol. These microbes are responsible for the discoloration, gas production, and buttery smell of spoiled meat.
- ▣ ***Pseudomonas***: predominant bacteria associated with spoiled meat. The most common *Pseudomonas* species found in beef, pork, lamb and poultry meat is *Pseudomonas fragi*.



General types of Spoilage of meats and meat Products

Spoilage under Aerobic condition

- ❑ **Surface slime:** Spoilage of meat due surface slime is produced by species of *Pseudomonas*, *Acinetobacter*, *Moraxella*, *Alcaligenes*, *Micrococcus*, *Streptococcus*, *Leuconostoc*, and *Bacillus*.
- ❑ **Changes in colour of meat pigments:** The red colour of meat, changed to green, brown, or grey. Species of *Lactobacillus* (mostly heterofermentative) and *Leuconostoc* are reported to cause the greening of sausage.



Spoilage under Aerobic condition

- ❑ **Changes in fats:** The oxidation of unsaturated fats in meat takes place chemically. Lipolytic bacteria may cause some lipolysis & caused by lipolytic species of *Pseudomonas* and *Achromobacter* or by yeasts.
- ❑ **Phosphorescence:** *Photobacterium* spp., growing on the surface of the meat. Discolorations are caused by bacteria with yellow pigments, usually species of *Micrococcus* or *Flavobacterium*. *Chromobacterium lividum*.
- ❑ **Off odours and off tastes:** Taints, or undesirable odours and tastes, which appear in meat as a result of acid producing microbes. *Actinomycetes* may be responsible for a musty or earthy flavour.

Spoilage due to molds in aerobic condition

- ❑ **Stickiness:** Budding growth of molds causes the surface of the meat sticky to the touch known as stickiness.
- ❑ **Whiskers:** White, fuzzy growth in freezing caused by a number of molds, including *T. chaetocladioides*, or *T. elegans*, *Mucor mucedo*, *Rhizopus*, etc.
- ❑ **Black spot:** commonly caused by *Cladosporium herbarum*.
- ❑ **White spot:** *Sporotrichum carnis* is the most common cause of white spot.
- ❑ **Green patches:** *Penicillium* are responsible for the green patches on meat.
- ❑ **Decomposition of fats.** Hydrolysis of fats due lipase produce by molds causes the oxidation of fats.
- ❑ **Off odours and off tastes.** Musty flavor to meat caused by mold
- ❑ **Spots of surface.** Spoilage caused by yeasts and molds

Spoilage under Anaerobic Conditions

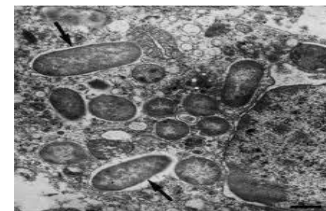
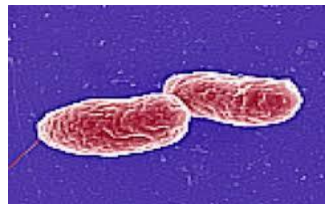
- **Souring:** Souring of meat caused by lactic or succinic produced by microbes. Souring can result from either from action of the meat's own enzymes during aging or ripening, anaerobic production of fatty acids or lactic acid by bacterial action.
- **Putrefaction.** Decomposition of protein is known as putrefaction, which produced by anaerobic microbes with foul-smelling compounds. Generally, *Clostridium* spp., *Pseudomonas*, *Proteus*, *Clostridium* and *Alcaligenes* cause putrefaction in meat and meat products

Preservation and storage of meat

- ❑ **Cold storage:** Refrigerated and Freezer storage is another superior method of meat preservation.
- ❑ **Vacuum packaging:** vacuum-packaging extends the storage life under refrigerated conditions to approximately 100 days.
- ❑ **Canning:** meat is sealed in a container and then heated to destroy all microorganisms capable of food spoilage.
- ❑ **Drying:** process removes moisture from meat products so that microorganisms cannot grow.
- ❑ **Fermentation:** process involves the addition of harmless bacteria to meat to inhibit the growth of many pathogenic microorganisms
- ❑ **Irradiation:** effective approach to killing meat spoilage microorganisms.
- ❑ **Curing and Smoking:** improves the safety and shelf life of meat products as well as color and flavor quality. Smoking & curing decreases moisture on the surface of meat products and hence prevents the microbial growth

Microorganisms responsible for seafood spoilage

- ***Clostridium botulinum***: *C. botulinum* is widely distributed in soil, aquatic sediments and fish.
- ***Vibrio spp.***: Most vibrios are facultative anaerobe and are of marine origin and needs sodium for growth.
- ***Aeromonas spp.***: *Aeromonas* is ubiquitous in freshwater environments and this organism also found in meat, fish and seafood and other foods.
- ***Plesiomonas spp.***: *Plesiomonas* commonly occurs in water, both fresh water and seawater.
- ***Listeria spp.***: Most of these environmental strains are probably non-pathogenic.



Microorganisms responsible for seafood spoilage

- ❑ ***Salmonella spp.***: *Salmonella* are members of the family *Enterobacteriaceae* and most common in the gut of man and animals.
- ❑ ***Shigella spp.***: *Shigella* is also a member of the *Enterobacteriaceae* and its presence in the environment is associated with fecal contamination
- ❑ ***Staphylococcus aureus***: This pathogen can easily transmit from air, water and dust to sea food.
- ❑ **Viruses**: Viral disease transmission to human via consumption of seafood Hepatitis, Norwalk virus, Snow Mountain Agent Calicivirus and Astrovirus common in seafood.

Microbial spoilage of processed fish

- ❑ **Spoilage of CO₂ and vacuum packing:** *Photobacterium phosphoreum* & Lactic acid bacteria are another group of bacteria that has the ability to adapt to the anaerobic packing environment.
- ❑ **Spoilage of salted foods:** Salt-loving bacteria called halophiles can survive in salt concentrations of up to 10-20% NaCl.
- ❑ **Spoilage of Heating/pasteurization food stuffs:** *Clostridium sp.* and *Bacillus anthracis* are able to spread in the face of pasteurization by producing spores.
- ❑ **Spoilage of food containing preservatives:** lactic acid bacteria and yeasts are able to remain active in this environment and become part of the surviving spoilage domain.

Preservation of Seafood

- ❑ **Salting:** Wet and dry salting is carried out in sea food to avoid the microbial growth.
- ❑ **Smoking:** hot and cold carried out to preserve the seafood. Hot smoking cooks the seafood but it preserves partially. Cold smoking is another preservation process; seafood is not cooked in process.
- ❑ **Marinating:** marinating liquid usually consists of an acidic base consisted of lime and mild vinegar. Herbs, spices, onions or soy sauce also be added to impart flavour.
- ❑ **Pickling:** immersion of sea food it into an acidic solution, which may also be salted or flavored.

Illness caused due to spoiled seafood and spoiled meat

- ❑ **Scombrototoxic fish poisoning:** caused by bacterial spoilage of finfish. The common symptoms include rash, sweating, diarrhea, flushing, headache, and vomiting
- ❑ **Botulism:** caused by *Clostridium botulinum*. Double vision, speech difficulty, inability to swallow are the major symptoms.
- ❑ **Campylobacteriosis:** caused by *Campylobacter jejuni*. The symptom includes abdominal cramping, diarrhea, fever, and sometimes bloody stools.
- ❑ **E. coli O157:H7:** rare illness. Seafood and meat become contaminated during slaughter or when it is ground. Symptoms include abdominal cramps, severe bloody diarrhea and; sometimes the infection causes non-bloody diarrhea or no symptoms.

Illness caused due to spoiled seafood and spoiled meat

- ❑ **Listeriosis:** caused by *Listeria monocytogenes*, Fever, headache, nausea, and vomiting are the sign of illness.
- ❑ **Perfringens food poisoning:** caused by *Clostridium perfringens* Abdominal pain and diarrhea, and sometimes nausea and vomiting are the common symptoms of this illness.
- ❑ **Salmonellosis:** Salmonella is most frequently involved in many foods including seafood. The illness caused by salmonella involves abdominal pain, nausea, vomiting and diarrhea.
- ❑ **Staphylococcal food poisoning:** Staphylococcal sea food poisoning caused by contaminated food. Abdominal pain, cramps, and prostration Diarrhea, vomiting and nausea are common symptoms.

Illness caused due to spoiled seafood and spoiled meat

- ❑ **Vibrio Infection:** found in coastal waters and cause chills and fever.
- ❑ **Amebiasis:** *Entamoeba histolytica* remain common. Polluted seafood spread the infection. Severe crampy pain, loss of weight, fatigue, and sometimes anemia are major symptoms.
- ❑ **Giardiasis:** Giardiasis in seafood is most frequently associated with contaminated water. Abdominal cramps, anorexia, nausea, and vomiting are the common symptoms.
- ❑ **Calicivirus:** Calicivirus cause of acute gastroenteritis. Nausea, vomiting, diarrhea, abdominal pain is symptoms such type of illness.
- ❑ **Hepatitis A virus:** Raw shellfish are especially potent carriers of Hepatitis A, as cooking does not always kill the virus.

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