

Microbiology of Meat, Poultry and Fish

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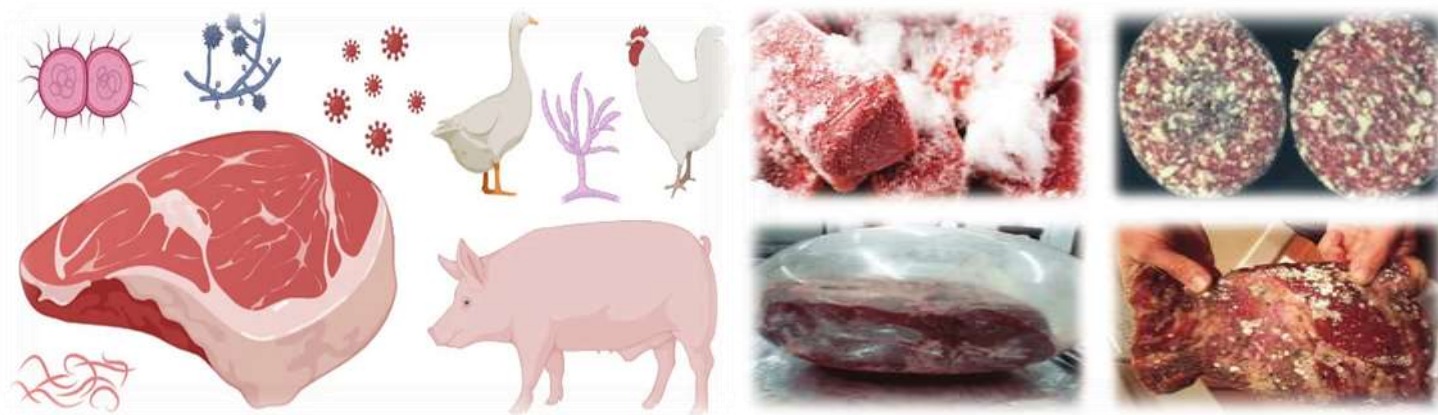
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SUMMARY

Meat is a highly perishable food, susceptible to microbial contamination and spoilage. Understanding the microbiology of meat is crucial for ensuring food safety and quality. Meat, a nutrient-rich environment, is an ideal breeding ground for microorganisms. It delves into the intricate relationship between microorganisms and meat, from the animal's living environment to the consumer's plate. When the conversion of muscle to meat begins, biological degradation of meat also done. In the absence of a living immune system, microorganisms are unchecked in their ability to grow and reproduce on meat surfaces. Generally, food-borne microorganisms can be classified as either food-spoilage or food-poisoning, with each presenting unique characteristics and challenges to meat product safety and quality.

INTRODUCTION

The microbiology of meat products presented to the consumers is the sum total of the slaughtered animal health, conditions under which it was grow, quality of slaughtering houses, processing, packaging and conditions under which the meat was stored. Meat pathogens can cause self-limiting human enteric diseases or systemic and fatal infections of the immunocompromised, the elderly and the young. Major meat associated pathogenic bacteria include *Clostridium perfringens*, *Staphylococcus aureus*, *Salmonella spp*, pathogenic strains of *E- coli*, *Campylobacter spp*, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Aeromonas hydrophila*.



Microbial Contamination Sources

Animal: The skin, gastrointestinal tract, and respiratory system of animals harbor various microorganisms.

Environment: Soil, water, air, and equipment used in handling meat can introduce contaminants.

Humans: Handlers can transfer microorganisms from their skin, hair, and respiratory tract.

Factors affecting microbial growth:

Intrinsic factors: pH, moisture content, redox potential, nutrients

Extrinsic factors: temperature, humidity, atmosphere

Microorganisms associated with Meat during Processing

Meat spoilages indicate color changes, textural changes and development of off-flavor or off-odour or slime as a result of microbial growth. Salmonella is the primary microbial challenge for poultry. The primary microbial to the beef industry is E-coli O157: H7. Listeria, which is an adulterant with zero tolerance, is the major problem for ready to eat meat products. Treatment with organic acids, hot water steam carcass pasteurization and steam carcass vacuuming, tri-sodium phosphate, acidified sodium chlorite, chlorine dioxide, sodium lactate, sodium acetate and diacetate, ozone and radiation have been used as microbial decontaminants during meat

processing operations. Carcass washing with hot water of 80°C for 10 seconds can reduce microbial loads by 2 logs. Current regulatory policies and inspection in the meat industry include the Hazard Analysis Critical Control Point (HACCP) food safety system with an objective to provide safe food for consumption and prevent chemical, physical and biological hazards.

Gram-negative bacteria (Aerobes)

Neisseriaceae: *Psychrobacter immobilis*, *P. phenylpyruvica*, *Acinetobacter* spp., *A. twoffii*, *A. Johnsonii*, Pseudomonadaceae: *Pseudomonas fluorescens*, *Pseudomonas lundensis*, *Pseudomonas. fragi*, *Pseudomonas putida*

Gram-positive bacteria:

Brochothrix thermosphacta, *Kurthia zophii*, *Staphylococcus* spp., *Clostridium estertheticum*, *C.frigidicarnis*, *C.casigenes*, *C. algidixylanolyticum* sp. nov.

Spoilage under aerobic condition

1.) **Surface slime**, caused by *P. acinetobacter*, *Moraxella alcaligenes* *Streptococcus*, *Leuconostuoc*, *Bacillus* and *Micrococcus*.

2.) **Change in colour of meat pigment.** The red color of meat may be changed to shades of green, brown or grey by *Lactobacillus* and *Leconostocs* spp.

3.) **Changes in fat.** The unsaturated fat in meat gets oxidized by lypolitic bacteria which produce off odors due to hydrolysis of fats and production of aldehydes and acids. This type of spoilage is caused by lypolitic *Pseudomonas*, *Achromobacter* and yeast.

4.) **Surface color change.** The red pigment producing bacteria, *Serratia marcescens*, caused red spots on meat. Blue color surface is caused by *Pseudomonas syncyanea* and yellow color is caused by *Micrococcus* species.

5.) **Off odor and off taste.** Volatile acid like formic, acetic, butyric and propionic acid produce sour odor and *Actinomycetes* produce musty or earthy flavor. Yeast also cause sliminess discoloration and off odor and taste defects.

6.) **Aerobic mold** also cause spoilage in meat. These are stickiness, whiskers, black-spot, white-spot, green patches off odor and off taste.

Spoilage under anaerobic condition.

i) **Souring** is caused by production of formic, acetic, butyric, lactic, succinic and propionic acid.

ii) **Putrefaction.** It is caused by decomposition of proteins under anaerobic condition by *Clostridium* species. The foul smell is due to production of hydrogen sulphide, mercaptans, indol, scatol, ammonia and amines.

CONCLUSION

Meat, a nutrient-rich food, is susceptible to microbial contamination throughout the production, processing, and distribution chain. This article has highlighted the critical role of microbiology in ensuring meat safety and quality. A comprehensive understanding of the microbial ecology of meat, including the identification of potential pathogens and spoilage organisms, is essential for implementing effective control measures. Advances in food science and technology have led to the development of various interventions to mitigate microbial risks. However, emerging challenges such as antimicrobial resistance and the increasing complexity of food supply chains necessitate continuous research and innovation. A multidisciplinary approach involving microbiologists, food scientists, veterinarians, and policymakers is crucial for safeguarding public health and ensuring the sustainability of the meat industry.

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