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Lecture title: **Meat Hygiene: Meat Spoilage**

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Summary:

Meat is a foodstuff that can be spoiled quickly. Certain species of bacteria multiply easily on fresh meat due to its chemical composition, favorable water activity (aw) value and pH value. The first microbial population on meat depends on:

1. the physiological state of the animal at the moment it is slaughtered
2. the level of environmental contamination in the slaughterhouse
3. areas in which subsequent handling of the meat is performed, including the level of hygiene of employees and the tools and equipment used.

All bacteria that cause meat spoilage use soluble compounds contained in muscle tissue for their growth, particularly glucose and amino acids. The preferred substrate is glucose. When glucose ceases to be available, the bacteria begin to attack amino acids and a large quantity ammonia and a lesser number of organic sulphides and amines causing an unpleasant smell are released. Offensive putrefaction is associated with the growth of bacteria growing in the absence of oxygen and producing indole methylamine , hydrogen sulphide from decomposition of proteins and amino acids, Sour odors are produced by the decomposition of sugars.

Factors influence the growth of microorganisms to cause spoilage are:

1. The type and degree of contamination with microorganisms
2. Physical properties of meat
3. Chemical properties of meat
4. Availability of oxygen
5. Temperature of meat storage

components of microflora compete with another for the available nutrients and the organisms that grow fastest under a particular set of circumstances will become dominant and give rise to spoilage. Which part of the microflora becomes dominant is determined by:

1- Extrinsic factors

2- Intrinsic factor

The intrinsic factors are:

-The nutrient content of meat

-Any natural antimicrobial substances that may be present.

-PH of the meat

-Eh the oxidation reduction potential of meat and it is ability to resist redox changes

- Water activity : bacteria : 1-0.75

Fungi : grow slowly at 0.62

Extrinsic factor is:

-The temperature at which the meat is stored

-The gaseous atmosphere surrounding the meat

-The relative humidity of the atmosphere surrounding the meat

-Time

Microbes that cause spoilage can be bacteria, yeasts, and fungi. in the presence of oxygen or where oxygen is absent

Examples of **Gram-negative spoilage bacteria** often found on carcasses are:

- Pseudomonas
- Acinetobacter
- Psychrobacter,
- Salmonella
- Campylobacter.

Examples of **Gram-positive spoilage bacteria** are:

- micrococcus
- Bacillus
- Brochothrix

Spoilage under aerobic condition

Surface slime which may caused by pseudomonas, leuconostic, micrococcus. Temperature and availability of moisture influence the kind of organisms causing surface slime

Changes in meat pigments

The production of oxidizing agents causes change in red color of meat to green, brown, and grey by lactobacillus species. Leuconostoc causes greening of sausages, red spot caused by serratia marcescens ,Yellow pigments produced by micrococcus or flavobacterium , Greenish to brownish black spots on stored beef caused by chromobacterium lividum , purple discoloration of surface fat caused by cocci and rods.

Changes in fats

1-Oxidation of unsaturated fatty acids in meat and may be catalyze by light

2- lipolysis caused by lipolytic bacteria

3- off flavor due to aldehydes and acids. e.g., Achromobacter

Off odors and off tastes

Souring due to volatile acid

Stale flavor

Earthy flavor caused by actinomycetes

Pseudomonas is one of the commonest and most important spoilage bacteria found on both red meat and poultry. Pseudomonas may form up to 90% of the flora on the surface of carcasses stored in chill rooms because many species will still grow at refrigerated temperatures.





A population of pseudomonades of $10^7 – 10^8$ cfu/g causes slime to form on meat and a bad smell to appear. when pseudomonades exhaust the glucose and lactic acid in the meat and begin to metabolize nitrogenous compounds, particularly amino acids, Pseudomonas can metabolize glucose to gluconate and 2-oxo-gluconate.

When the pH of the meat is high, as in DFD (dark, firm, dry) meat, Brochothrix thermosphacter, which grows best at pH values above 6.5, may be important, especially at temperatures above 5°C.

Aerobic growth of molds in meat

Stickiness

Whiskers: white growth caused by mucor. Rhizopus

Black spot: cladosporium herbarum

White spot: sporotrichum carnis, geotrichum

Green patches: penicillium expansum, p. Asperulum

Decomposition of fat: many molds have lipases and hence hydrolysis of fats ،off odor and off taste molds give musty flavor to meat called thamnidium taint.

Anaerobic spoilage condition

Under anaerobic conditions, and where the carbon dioxide concentration increases to 20%, for example in vacuum packages, the normal aerobic flora is suppressed and lactic acid-producing bacteria, such as Lactobacillus, are favored. These tolerate high carbon dioxide levels. Fungi (moulds) are less important than bacteria as spoilage organisms. They can cause surface stickiness, or ‘whiskers the hyphae that form the threadlike vegetative parts of the fungus. Bacon can be prone to spoilage by moulds because of its low water activity and high fat content.

The list of microorganisms found on meat and poultry is extensive. Frequently encountered genera include Pseudomonas, Bacillus, Brochothrix, Campylobacter, Clostridium, Escherichia, Enterobacter, Enterococcus, Streptococcus, Lactococcus, Lactobacillus, Listeria, Micrococcus, Staphylococcus, Pediococcus, Salmonella, Serratia, Yersinia, and other members of the family Enterobacteriaceae.

Yeasts and molds found in meat products include Candida, Torulopsis, Saccharomyces, Rhodotorula, Mucor, Rhizopus, Penicillium, Geotrichum, and Aspergillus.

The number of microorganisms on the surface of meat also varies greatly. A bacterial count on meat of

• 0 log to 2 log cfu/g is considered low.

• 3 logs to 4 log cfu/g, it is considered intermediate.

• 5 logs to 6 log cfu/g are considered high.

• 7 log cfu/g is considered the "Index of Spoilage," because when the number reaches higher than 8 log cfu/g, the meat will have an odor, and at 9 log cfu/g, slime will appear.

Aerobic or Anaerobic spoilage	Defect	Microorganisms involved
Aerobic (Bacterial)	Surface Slimes	*Alcaligenes,Pseudomonas,Lactobacillus, Leuconostoc, Micrococcus, Bacillus*
	Bloom of Discolorations	*Lactobacillus, Leuconostoc*
	Rancidity	*Pseudomonas, Achromobacter*
	Phosphorescence	*Photobacterium spp*
	Red spot	*Serratia marcescens*
	Yellow discolorations	*Micrococcus, Flavobacterium*
	Off-odors off-tastes (Taints)	Lactic acid bacteria, Actinomycetes.
Aerobic (Yeasts)	Discolorations/Taints/ sliminess/ lipolysis	*Rhodotorula*
Aerobic (Molds)	Stickiness	*Rhizopus, Aspergillus, Penicillium*
	Whiskers	*Rhizopus, Thamnidium, Mucor*
	Black spot	*Cladosporium herbarium*
	White spot	*Sporotrichum carnis*
	Green Patches	*Penicillium expansum, P. oxalicum*
	Decomposition of fats	Lipolytic molds
	Taints	*Penicillium, Thamnidium*
Anaerobic (Bacterial)	Souring	*Clostridium spp*
	Putrefaction	*Alcaligenes, Pseudomonas, Clostridium spp*
	Taints	*Alcaligenes, Pseudomonas*