



COURSE TITLE: FOOD AND INDUSTRIAL MICROBIOLOGY
COURSE NO. - DTM-321: CREDIT HRS-3 (2+1)

OVERVIEW OF SPOILAGE

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OVERVIEW OF SPOILAGE

Food spoilage is defined as a microbiological, chemical, or physical changes in food items which renders a product undesirable or unacceptable to the consumer for consumption. In other words, food spoilage can be defined as any visible or invisible change which can makes food or product unacceptable for human consumption.

- Microbiological food spoilage is produced by the growth and action of microorganism in food. It is because of the production of objectionable end products of the biochemical activity of microbial chemical processes.
- Chemical spoilage may be caused by the non-microbial enzymic action, oxidation or because of some processing problem like non-enzymic browning. Spoilage may also be observed because of different components of food react with each other or with some component added or mixed during manufacturing process which alter the food's sensory characteristics.
- Physical food spoilage includes water loss or dehydration; increase in moisture or absorption of excessive moisture, freezing burn and recrystallisation of frozen foods.

About 25% of total food produced is spoilt due to microbial activities

Spoilage

- Original nutritional value, texture, flavor of the food are damaged &
- Food become harmful to people and unsuitable to eat

Major causes of spoilage

Biological factors	Non Biological factors
Insects	Purely chemical reactions
Enzyme action of food (plant/animal)	Physical changes
Activity of microorganisms	

Spoilage of food



Health hazard



Economic losses.

Spoilage → loss of nutrients → change in original flavour and texture.

Spoilage → Microbial and biochemical activities → metabolites are formed → type of spoilage

Perishable foods ---- Readily spoilt and require special preservation and storage conditions for use-milk, fruits, vegetables, fish etc.

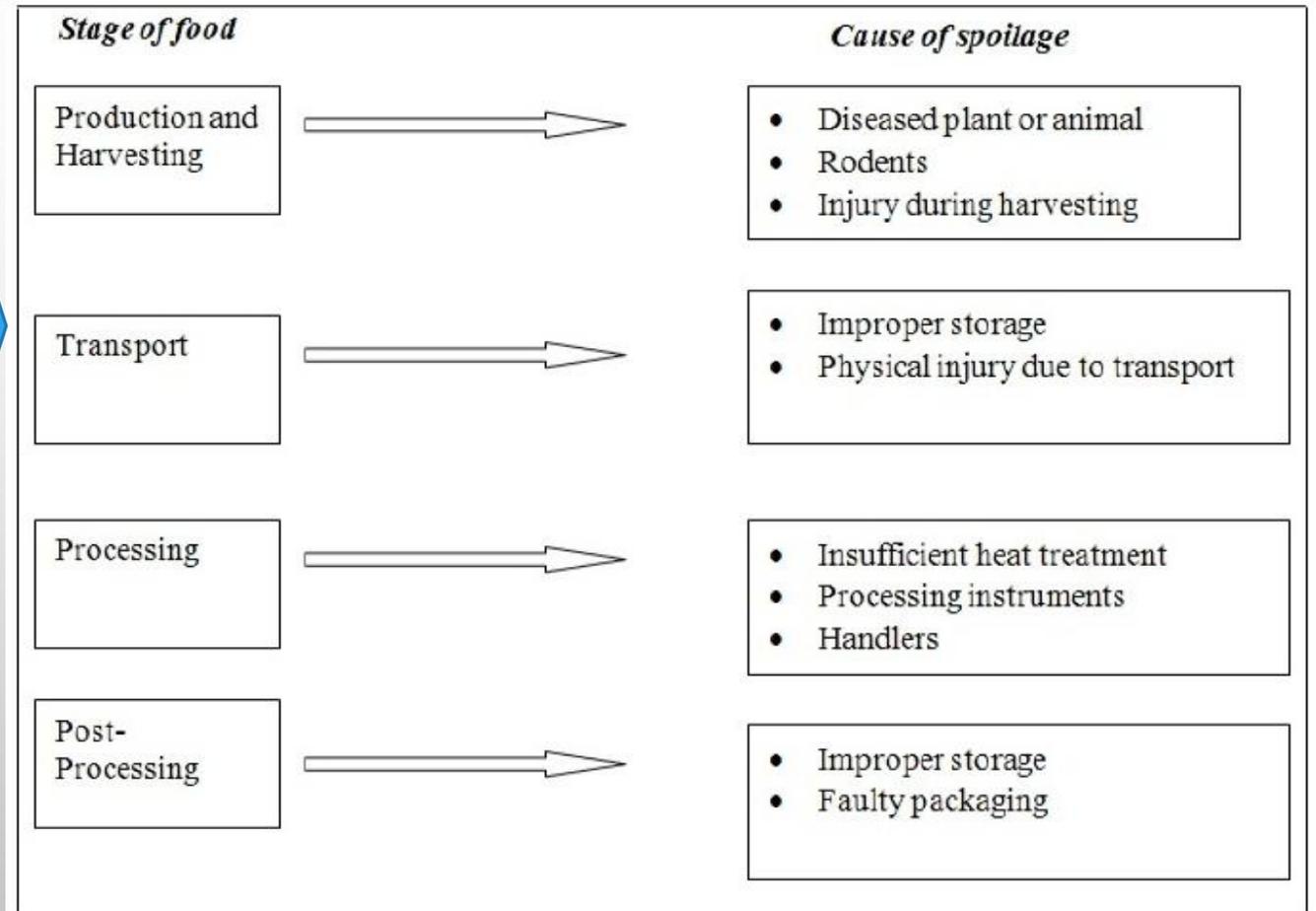
Semi perishable foods --- Require proper storage---for a long duration e.g. potatoes.

Non-perishable foods --- Remain in good form for long duration unless handled improperly-
----sugar, flour etc.

Factors Affecting Microbial Spoilage of Foods

Physical and chemical and the microbial spoilage has most significant role in food spoilage. Combination of all these factors is responsible for overall decay and spoilage of food. The spoilage of food can occur at different stages of harvesting & procurement of raw material, transportation, production, processing, Distribution.

Possible causes of spoilage and microbial contamination at different stages of food production



Spoilage of foods

Microbial activity (Contamination)

Undesirable microorganism colonizes in the food

Colonization and established in the food items

Microbial community grow on the food constituents

Utilizing them for their metabolism

Utilizing them for their metabolism

Intrinsic parameters

Water activity,

Acidity,

Oxidation-reduction potential,

Presence of antimicrobial

Compounds in food and food

structure.

Extrinsic parameters

Temperature,

Humidity and

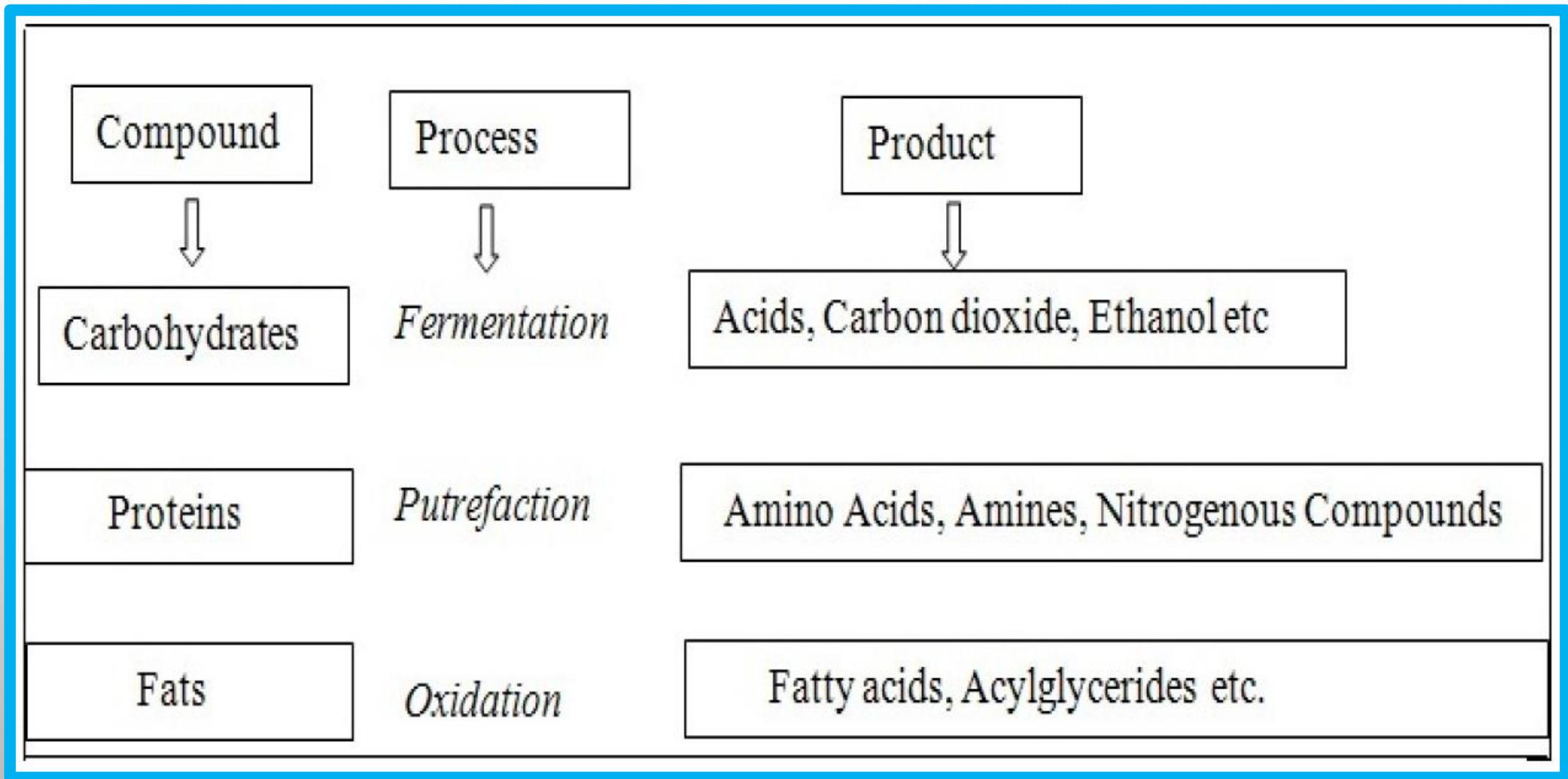
Other storage condition

Microorganisms in Food

Microorganisms because of its diversity in metabolism are the most significant cause of food spoilage. Uncontrolled growth of Bacteria, yeasts and moulds in foods are major cause of food spoilage. Bacteria can grow under a wide variety of conditions and a number of different types of bacteria can cause spoilage. Food spoiling bacteria are divided in two groups viz. *sporeforming* and *nonsporeforming*. Bacteria can grow in low acid foods like vegetables and meat while Yeasts brings fermentation by yeast metabolism. Two types of yeasts are found called *true yeast* and *false yeast*. *True yeast* utilises sugar and produce alcohol and carbon dioxide gas called fermentation while *False yeast* grows as a dry film on surface of food. False yeast growth take place having a high sugar or high acidic condition.

Molds grow and form filaments having a tough mass which is visible as mold growth. Molds form spores and float in the air and starts to grow whenever it gets suitable environment. Mold can cause illness in a person allergic to molds. The main symptoms of eating moldy food observed as nausea or vomition. Yeasts and molds can easily grow in high acid foods like fruit, tomatoes, jams, jellies and pickles and can be destroyed by heat. Thermal rocessing of high acid foods at 100°C (212°F) for the appropriate length of time or in boiling water can destroys yeasts and moulds.

Changes in major food components during spoilage



Changes in Foods Due to Microorganisms

Microorganisms grow in food \longrightarrow Mos diversity in metabolism \longrightarrow Utilizes components of foods \longrightarrow Convert them into variety of chemical compounds.

Change in Carbohydrates--- Carbohydrates are used to obtain energy. While monosaccharide are preferred over complex carbohydrates, microorganisms have ability to convert polysaccharides to simpler forms before obtaining energy. The utilization of simple sugar such as glucose vary under aerobic and anaerobic conditions. In aerobic conditions it is converted into carbon dioxide and water through glycolysis and other related pathways. In absence of oxygen, the process yields a number of compounds in different organisms. This process is known as fermentation. These compounds include:

Alcoholic fermentation-- Carbon dioxide and ethanol are the major end products by Yeast.

Lactic fermentation – In case of homolactic fermentation -- lactic acid is the end product and in hetero fermentation -- lactic acid, acetic acid, ethanol, glycerol, carbon dioxide is produced.

Coliform type fermentation-- lactic, acetic, formic. Ethanol, glycerol etc. are produced.

Propionic fermentation -- propionic acid, succinic acid and carbon dioxide are produced by propionic bacteria.

Change in Nitrogenous Compounds

Proteins are the major source of nitrogenous compounds in foods and its degradation through hydrolysis or enzymatic reactions by enzymes produce by microbes or enzymes naturally present. Proteins are converted into polypeptides, peptides, amino acids, amides amines etc. The enzymes proteinase involved in conversion of proteins into polypeptide while peptidases catalyze conversion of polypeptides to amino acids. This decomposition process are either aerobic or anaerobic. Anaerobic decomposition of proteins produces obnoxious odours known as Putrefaction. Nitrogenous compounds with some other compounds are responsible for such smells includes sulfure compounds. Amino acids cause either deamination (removal of amine group) or decarboxylation (removal of carboxyl group) by the action of microorganism. The other microorganism involved in conversion of nitrogenous compounds include *Pseudomonas*, *E. coli*, *Clostridium*, *Desulfotomaculum* etc.

Changes in Lipids

A number of microorganism produces lipase enzymes causes hydrolysis of lipids and the major end products are glycerol and fatty acids, which will be further utilised by those microorganisms for their metabolism. The oxidation of fats is done by inherent enzymes of food and mostly high fat containing foods have this type of defect.

Public Health Aspect

A number of foodborne pathogens cause numerous sufferings and deaths throughout in the whole world. There are about 1,000 million cases of gastroenteritis per year in children under the age of 5, which leads to 5 million deaths in different parts of Asia, Africa and Latin American countries. Half of the children aged 0–4 years suffer from the *Campylobacter* induced enteritis in Mexico and Thailand. In Europe, 50,000 cases / million population suffer from acute gastroenteritis. About 300,000 cases/million population occur yearly in the Netherlands.

The number of outbreaks continued to increase and place a huge economic burden on producers and processors. Mycotoxins are secondary fungal metabolites having low molecular weight formed in foods due to the overgrowth of some strains of *Pencillium*, *Aspergillus* and some other molds which are responsible for a number of outbreaks. They easily withstand the conventional processing temperatures and highly toxic to animals and human beings produces mycotoxicosis and affects kidney, liver, can cause skin irritation, birth defect and death.

Strains of *Aspergillus* viz. *Aspergillus flavus* and *A. parasiticus* produces aflatoxins like B1, B2, G1 and G2. Aflatoxin M1 and M2 are the hydroxylated derivatives of B1 and B2. Milch animals fed with aflatoxin B1 and B2 produces milk having aflatoxin M1 and M2 and also excrete in urine and faeces. Aflatoxin B1 is the most toxic among all aflatoxins. M1 and M2 are relatively less toxic compared to its parent compounds B1 and B2. Aflatoxins are found in nuts, spices and figs and produced under hot and humid storage condition. Viruses are host specific and obligate intracellular parasites. A number of viruses have been implicated in food borne outbreaks.

THANK YOU