Microorganisms Important in food microbiology: molds, yeast & bacteria

For

M.Sc IV sem

Paper – Food Microbiology

(401- B)

Unit I- Topic I

Introduction

- Food supply consists basically of plants and animals or product derived from them, it is understandable that our food supply can contain microorganism in interaction with food.

- These microorganisms use food supply as a source of nutrients for their own growth. These will cause 2 possibilities:

  Either – Result in deterioration of food ("spoil")

  OR

  These interactions between microorganisms and food give beneficial to human

How microorganisms can cause deterioration of the food?

- When they utilize the nutrients of the food, it involved changes in the food compound like synthesis a new compound that cause spoiling of the food or produced enzymatic changes and contributing off-flavours by mean of breakdown of product.

How to prevent deterioration of the food by microorganisms?

- Minimize the contact between microorganisms and food
- Eliminate microorganisms from foods
- Understand about preservation of the food

What are the importance of microorganisms in food?

Good (desirable)	Bad (undesirable)
• Food bioprocessing	• Foodborne disease
• Food biopreservation	• Food spoilage
• Probiotics	

GOOD (DESIRABLE)

Food bioprocessing

- Foods produce by using biological process. In this process, food-grade microorganisms are used to produce different types of fermented food using raw materials from animal and plant sources (this process known as **"starter culture"**).
- Besides, microbial enzymes are also being used to produce food and food additives.

Food biopreservation

- Is a food biological preservative by using antimicrobial metabolites (taken from certain microorganisms in order to control pathogenic and spoilage microorganisms in foods).

Probiotics

- Is a concentrated supplement of beneficial live cells of bacteria (friendly bacteria) culture taken orally intended to improve our health by promoting our body's natural immunity and improving digestion system.

BAD (UNDESIRABLE)

Foodborne disease.

- Is a disease cause by consumption of contaminate during various stage of handling between production and consumption by many pathogenic microorganisms (bacteria, molds and viruses).

Food spoilage.

- Is a condition of contaminate food due to:

Growth of microorganisms in food

OR

The action of microbial heat stable enzymes

- Microorganisms used food supply as a source of nutrients by their own growth.

CHARACTERISTICS OF PREDOMINANT MICROORGANISM IN FOOD

Mophology and structure of microorganisms

a) Moulds

- Eucaryotics cells*
- Multicellular
- Non motile, filamentous and branched
- Compose of large numbers of filaments called hyphae which are aggregated and called mycelium
- Reproduction occurs from spore formation
- Eg: *penicllium spp*

b) Yeasts

- Eukaryotic cells*
- Unicellular
- Oval, spherical or elongated
- Non motile, can see budding formation
- Eg: *Sacchromyces cerevisiae*

Eukaryotic cells* - generally are:

- Larger cells (20 to 100μm)
- Cells have rigid cell walls and thin plasma membrane

- Cytoplasm contains organelles such as mitochondria and vacuoles

c) Bacteria

- Prokaryotic cells
- Unicellular
- Three morphology forms:
  - Spherical (cocci) – eg: *streptococcus spp*
  - Bacilli (rod) - eg: *bacillus spp*
  - Curved (coma) – eg:
- Can be motile or non motile
- The cytoplasmic materials are enclosed in a rigid wall on the surface and a membrane beneath the wall
- The organelle does not enclosed in a separate membrane
- Bacterial are grouped as:

Gram negative = contain outer membrane which is compose of lipopolysaccharides (due to many enzymes, antibiotics, salts, etc)

Gram positive = have thick wall composed of several layers of mucopeptide and teicnoic acids

d) Viruses

- Non cellular entities
- Most important: bacteriphages (bacterial viruses)
- Virus contain nucleic acid (DNA and RNA) and protein

IMPORTANT MICROORGANISMS IN FOOD

A. IMPORTANT MOLD GENERA

1. Genus *Aspergillus*

   - Widely distributed and contain many species important in food.
   - Septate hyphae and produce asexual spores on conidia.
   - Xerophilic; causing spoilage in grains, jams, nuts and vegetable.
   - Example: *Aspergillus flavus* produce alfatoxin (a kind of mycotoxin)
   - Strains used in food processing:
     i. *A.oryzae* : hydrolyze starch in sake production.
     ii. *A.niger* : citric acid production.

2. Genus *Geotrichum*

   - Septate hyphae and produce arthrospore.

- Grow and forming a yeastlike cottony, creamy colony.
- Often grow on dairy products. Example: *Geotrichum candidum*

3. Genus *Mucor*
   - Widely distributed
   - Nonseptate hyphae and produce sporangiophores
   - Some species are used in food fermentation and others can cause spoilage of vegetables e.g: *Mucor rouxii*

4. Genus *Rhizophus*
   - Hyphae are aseptate and form sporangiophores
   - Common in spoilage of foods and vegetables
   - *Rhizophus stolonifer* : common black bread mould

5. Genus *penicillium*
   - Widely distributed and contain many species

- Septate hyphae and form conidiophores on a brushlike conidia head. *penicillium roquerfortii* and *Penicillium camembertii* are used in cheese production.
- Some species can cause spoilage in fruits, vegetables, grains, bread etc.
- The can also produce mycotoxin

B. IMPORTANT YEAST GENERA

1. Genus *saccharomyces*

- Cells may be round, ovate, and elongated.
- Reproduction is by budding or by acospore formation.
- *S.cerevisiae* is employed in many food industries e.g bread manufacturing, wines, alcohol etc.
- *S.fragilis* and *s.lactis* is important in milk and milk products because they are common spoilage microorganism.

2. Genus *Torulopsis*

- General spoilage yeast.

- Spoils a variety of food products e.g.: beer, milk products, fruit juices and some refrigerated foods.

3. Genus *Candida*

- Many spoil foods with high acid, salt and sugar form pellicle on the surface of liquids.
- Some can cause rancidity in butter and dairy products e.g: *Candida lipolytica*.
- Can form pseudohyphae or true hyphae with many budding cells.

4. Genus *Rhodotorula*

- Red, pink or yellow yeasts may caused discolourations on food such as in meat, fish and sauerkraut.

5. Genus *Pichia*

- Oval or cylindrical yeasts may form pseudomycelia.
- Ascospores are round or hat shaped.
- Form pellicle in beer, wine and brine.

. IMPORTANT BACTERIA GENERA

1. Genus *Bacillus*

- Different species may be mesophilic or thermophilic, lipolytic or proteolytic.
- Spores produce by this bacteria are generally heat-resistant.
- Some species may cause foodborne diseases (*Bacillus cereus*) and food spoilage in canned products (*Bacillus coagulans* and *Bacillus stearothermophillus*)
- The soil is an important source of this species.

2. Genus *Clostridium*

- Rod shaped cells, anaerobic and form endospores.

- Found in soil, marine sediments, animal and plant products.
- Some are pathogens e.g.: *Clostridium botulinum* and *Clostridium perfingens* while others are important in food spoilage.
- *C.perfingens* cause stormy fermentation in foods (disruption of curd in milk)

3. Genus *Escherichia*

- Found in faeces, gram negative rod isolated from the intestinal tract of warm blooded animals.
- E.g. *Escherichia coli* used as an indicator of sanitation in the coliform and fecal coliform group.
- Many strains are non-pathogenic but some can be pathogenic to humans and animals (foodborne disease).

4. Genus *Lactobacillus*

- Rod shaped facultative anaerobic, non-motile, mesophilic.
- Can be homo or heterolactic fermentors.

- Found in plant sources, milk, meat and feces.
- Usage:
  i. Food bioprocessing: *L. bulgaricus, L. lactis.*
  ii. Probiotics: *L. acidophilus*
- Spoilage:
  i. Wine or beer production.
  ii. Cheese making.
  iii. Can survive pasteurization.

5. Genus *Pseudomonas*

- Gram negative, aerobic, rod shaped, motile.
- Important in fish and meat spoilage.
- E.g: *P.aeruginosa* and *P.fluorescens*.

6. Genus *Staphylococcus*

- *S. aureus* are frequently involved in foodborne diseases.
- It usually gives yellow to orange growth.
- Many beta haemolytic, coagulase positive strains are pathogenic and produce enterotoxin which causes food poisoning.

7. Genus *Streptococcus*

   - *Streptococcus pyogenes* - important in foodborne diseases. A cause of human septic sore throat, scarlet fever. Can be found in raw milk.

   - *Strep. Thermophillus* is important in cheese making and yogurt.

D. GRUOPS OF BACTERIA IMPORTANT IN FOOD BACTERIOLOGY

1. Lactic Acid Bacteria
2. Acetic Acid Bacteria
3. Butyric Acid Bacteria
4. Propionic Acid Bacteria
5. Proteolytic Acid Bacteria
6. Lipolytic Acid Bacteria
7. Saccharolytic Bacteria
8. Thermophilic and Thermoduric Bacteria

9. Halophilic and Osmophilic Bacteria
10. Pigmented Bacteria
11. Slime or Rope Forming Bacteria
12. Gas Forming Bacteria
13. Fecal and Non-fecal Coliform group

1. Lactic Acid Bacteria

   - Ability to ferment sugars to lactic acid e.g: important in cheese making but undesirable in term of spoilage of wines.
   - Major genera: *Leuconostoc, Lactobacillus, Streptococcus, Pediococcus.*

2. Proteolytic Bacteria

   - Produce extracellular proteiases (enzymes which diffuse outside of the cells) and catalyzes the breakdown of protein.
   - Important genera : *Bacillus, Pseudomonas, Clostridium, Proteus*

3. Fecal coliform and coliform group

- Definition: Short rods, aerobic or facultative anaerobes, gram negative, non-spore forming bacteria which ferment lactose with gas forming.
- Major genera: *Escherichia, Enterobacter*
- The fecal coliform groups includes coliforms capable of growth at an elevated temperature (44.5°C)

Thanks