Microbial Spoilage Of Fish

For

M.Sc IV sem

Paper – Food Microbiology

(401- B)

Unit II- Topic III

Introduction

- Fish is found abundantly in all natural waters.

- It is a valuable source of food, rich in high quality protein, minerals and vitamins. Oily fish are rich in omega-3 polyunsaturated fatty acids.

- Attack on fish by undesirable microorganism (bacteria, fungi, yeast , mold, virus or other toxins and by products) from external source is called microbial contamination of fish.

- Fish are mainly composed of 65-80% water, 1-20% fats, 14-20% protein and 0.8-2% Vitamins & minerals.

- Fish is highly perishable due to high moisture content, availability of the nutrients for the growth of microorganisms and ambient temperature.

CONTAMINATING MICROORGANISMS OF FISH:

Surface of fish contains Bacteria of the Genera:


Pseudomonas


Acinetobacter


Moraxella


Alcaligenes


Micrococcus


Flavobacterium


Corynebacterium


Sarcina

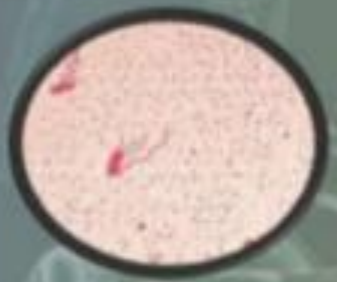

Vibrio


Bacillus

Fresh water Bacteria Genera of fish:


Aeromonas


Steptococucus


Alcaligenes


Lactobacillus


Brevibacterium

Intestinal Bacterial Genera of fish:


Alcaligenes


Pseudomonas


Flavobacterium


Bacillus

Sources Of Contamination

1. From water
2. From Intestine
3. At the time of catching
4. Density of microbes in surface slime
5. From equipment
6. From fish storage
7. During transport

1. From water-

- Fresh water fish carry fresh water bacteria.
- Northern waters carry mostly psychrophiles bacteria.
- Tropical waters carry more mesophiles bacteria

2. Density microbes in surface slime-

- The slime that covers the outer surface of fish has been found to contain bacteria.

3. From Intestine-

- Both salt water and fresh water fish contain bacteria in the intestine.
- The intestine fluid may contain 1000-100 million bacterial load/ml.

4. At the time of catching-

- The numbers of microorganisms on the skin of the fish can be influenced by the method of catching.
- If some injury have done at the time of catching fish , contamination may start.

5. From equipment-

- Boats, catching net, boxes, fish house and fisher may be contaminated with bacteria & may transport onto the fish during cleaning.

6. From Fish storage-

• Contamination in fish can be started from when it kept in ice due to low quality of ice or storage condition.

7. During transport-

•At the time of transporting fish from fishing place to selling market, if the temp. is not maintained, contamination may start.

8. Contamination may also occur from

•Fish processing instruments
•The polluted environment of that processing industry
•Fish processing table
•Microbial contamination may come from laborer, if they are not neat and clean.
•From auxillary gutting device (used to clean fish and their gut) and filleting machine etc

Spoilage of Fish

• Spoilage of fish can be considered as any change that render the product unacceptable for human consumption

•Fish and other sea food may start spoil upon death due to

1. Auto oxidation (oxidation of unsaturated lipids)
2. Reactions caused by the activities of the fish's own enzymes.
3. Metabolic activities of microorganisms

Causes of spoilage

The following factors contribute to spoilage of fish:

- High moisture content
- High fat content
- High protein content
- Weak muscle tissue
- Ambient temperature
- Unhygienic handling

Process of spoilage

- The process of spoilage starts immediately after the death of fish.
- The process involves:

a. Autolysis
b. Bacterial invasion &putrefaction
c. Rigor mortis

Factors influencing kind and rate of spoilage

1.The kind of fish-

- Flat fish spoil more readily than round fish because
  undergo rigor mortis more rapidly
  Deteriorate rapidly because of oxidation of unsaturated fats of their oils

2.The condition of the fish when caught

- Fish that are tired as a result of struggle, lack of oxygen and excessive handling spoil rapidly.
- Feedy fish that is full of food when caught are more perishable than those with an empty intestine tract

3. The kind and extent of contamination of the fish with bacteria

- Contamination may be from mud , water, handler and the exterior slime and intestinal content of the fish.
- Greater the load on fish , more rapid the spoilage

4.Temperature:

- Chilling the fish ,delay the bacterial growth
- Warmer the temperature, shorter the storage life of fish.

5. Use of an antibiotic ice or dip

ENZYMATIC SPOILAGE

- **Autolysis**

Careless handling of fish

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Fish cell broken

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Release of autolytic enzymes

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Production of spoilage substances

Spoilage substances are
1. **Cathepsin**
2. **Calpain**
3. **Trypsin**
4. **Chymotrypsin**

↓

These substance create the very good environment

↓

Favours growth of micro organisms

MECHANICAL SPOILAGE

CARELESS HANDLING CAN RESULT IN:

Bruised flesh→ The darkening is caused by burst blood vessels.

Broken skin → bacteria to enter the flesh

Burst guts →bacteria and enzymes to contaminate the flesh.

CHEMICAL SPOILAGE

- The chemicals present in living things are able to change due to them either splitting up or joining together.

- In both cases new chemicals are formed.

Depends upon
- Temperature:- high temperature – rapid spoilage
- Water availability
- Enzymes

It is more pronounced in fat fishes

e.g. oil sardine, mackerels, catla, trout, grass carp etc.

Rancidity

e.g. Herring & Mackerel

- Fat oxidation → occurs after autolysis & bacterial spoilage

- High Lipid concentration → contribute spoilage
- Fat→ mainly unsaturated fatty acid → easily oxidised by atm.O2

- Increase temperature & exposure to light→ increase oxidation rate→ bad & unpleasant odour & rancid taste. (sour or stale smell or taste)

BACTRIOLOGICAL SPOILAGE

Millions of bacterial present on outer surface and inside the fish

Healthy fish → natural protection against the harmful bacteria

Live fish→ bacteria present on skin & gills, intestine
→ but can not attack the fish muscle

Died fish → bacteria penetrate the fish muscle → more rapid for thin skin fish

When fish died →some of the bacteria enters in the flesh

Bacteria & enzymes → changes fish odour, flavour to sour, gassy, fruity & finally ammonia &faecal odour

Multiply quickly and produce its metabolites that are responsible for the causes of spoilage

• The guts contain huge numbers of bacteria which can easily contaminate the flesh inside the belly cavity. If acids break down the wall of the cavity , then they penetrate to all other parts of the flesh. This process is called "Autodigestion.

•Changes that carried out by microbes during spoilage

Proteins $\xrightarrow{\text{Proteolytic microorganisms}}$ Amino acids + Amines+ NH_3 +H_2S

Carbohydrates $\xrightarrow{\text{Fermentative microorganisms}}$ Acid + Alcohols + Gases

Fats $\xrightarrow{\text{Lipolytic microorganisms}}$ Fatty acids +Glycerol

Evidences of spoilage

- Colour of fish become fade, dirty and yellow or brown
- The slime of the skin increases, especially flaps and gills
- Eyes sink and shrink
- Pupil became cloudy
- Cornea opaque
- The softening of flesh
- Anus wet, swollen and red
- Meanwhile a sequence of odors is evolved

BACTERIA CAUSING SPOILAGE

- At chilling temperature – *Pseudomonas, Achromobacter, Flavobacterium*
- At ordinary atmospheric temp.- *Escherichia, Proteus, Serratia, Sarcina* & *Clostridium*
- At higher temperature- *Micrococcus* & *Bacillus*

Discolorations of fish

- Yellow to greenish- Pseudomonas fluorescence, micrococcus & others
- Red or pink- Sarcina, Micrococcus, or Bacillus species, or by molds & yeasts
- Chocolate-brown- Asporogenous yeast

The important changes brought out by the action of the bacteria in fish are as follows.

i) **Reduction of TMAO to TMA**

Marine fish contains a small percentage of odorless TMAO which is reduced to an offensive smelling TMA by the action of bacteria.

ii) **Breakdown of Amino Acids & formation of Primary Amines**

The bacterial action of amino acids present in the fish muscle leads to formation of primary amines.

e.g. Formation of Histamine from Histidine,
Arginine from Glutamic acid etc.

This bacterial action may cause food poisoning in extreme cases.

iii) **Breakdown in Urea**

The high concentration of urea →degraded to ammonia by the microorganisms--- offensive odour.

* TMA- Trimethyl amine

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