Lec (5) Intrinsic & Extrinsic Factors Affecting Microbial Spoilage of Food

There are many factors related to the food itself (**Intrinsic**) and factors surrounding the food (**Extrinsic**) strongly affect the type and time of food spoilage, some of these factors are:

### **I-** The number and kind m-ms in food

Generally when the number of m-ms on food surface is high; the spoilage will be occurred faster and vice versa, for example slime appeared on the meat surface with high load faster than on the meat with low number of bacteria. This is not always true, because in spite of a high number of m-ms there is no microbial group or type which can act on a food with a special chemical composition as in the proteolytic group in protein food and the lipolytic group in fatty food.

## II- Chemical composition of food

M-ms need simple sources of carbon, nitrogen and energy for growth and activity, so food with simple chemical composition and simple sources of carbon such as glucose and nitrogen as amino acids spoiled faster than complex food. According to the main chemical constituent, the foods are divided into three big groups:

1-Protein Foods: The main spoilage in this food is: Putrefaction which occurred as follows:

Protein food True proteolytic mo Polypeptides Proteolytic m.o Amino acids amino acid break down Organic acid, Amines, Gases, Putrid compounds

The main pathways of amino acid break down which lead to putrid compounds production:

A-Deamination CH3CHNH2COOH <u>Alanine deaminase</u> CH3COCOOH + NH3 B- Decarboxylation CH3CHNH2COOH <u>Alanine decarboxylase</u> CH3CH2NH2 + CO2

C- Tryptophan Escherichia coli Skatole + Indole

#### 2- Sugar Foods :

The common spoilage is fermentation. The type of fermentation is determined according to the sugar content:

A-Low sugar food (Meat) Bacterial oxidation Organic acid + Gases

**B-** Medium sugar food (Milk) **Organic acid fermentation** LacticA + Org. A.+Gases

C- High sugar food (Juice) Alcoholic fermentation by yeast Alcohols

D- Very high sugar food (Honey) very slow <u>alcoholic fermentation amount</u> by (osmophilic yeast) Little of Alcohol (yeasty honey)

**3-Fatty Foods:** The main spoilage is: Rancidity: there are two main types of rancidity:

**1) Oxidative Chemical Rancidity:** All fats are exposed this non - microbial rancidity during the storage particularly in the light and sun. This rancidity occurred as a result of autochemical reaction in the fat and produce rancid fatty acids, ketones and aldehydes.

2) Microbial Hydrolytic Rancidity: Occurred by the Activity of Lipolytic m - ms.,

Lipid lipase by lipolytic m.o Fatty acides + glycerol Rancid aldehydes & Ketones

# **III-** Food pH:

Most foods are with neutral pH suitable to activity of most bacteria and spoiled faster than some foods with low or high pH. Food PH strongly affects the type of m - ms growing in that food and consequently the type of spoilage as shown in the following table:

Food type	Food pH	Main spoilage m-ms
Alkaline food Egg white (pH 9.6)	8-10	Alkaliphilic m - ms, some strains of Pseudomonas and Proteus
Neutral foods	6-7	Most of Bacteria
Low acid Foods Fruits & Vegetables	5-6	Acidophilic bacteria 5-6 Lactobacillus
Medium acid Foods Juices & Fermented milk	4-5	Most yeasts, Lactobacillus
Acids Foods Juices and pickeles	3-4	Acetobacter, Lactobacillus
High acid Foods Lemon Juice (pH 2)	2-3	Rarely spoiled by m - ms * If occurred by fungi

# Table: The relationship between food pH and food spoilage

# **IV-** Food Moisture:

Water is necessary to the growth of bacteria and to the enzymatic activity in the food, particularly the food free water which could be expressed as Water activity

 $a_w (a_w = P_1/P_2)$   $P_1$ : vapor pressure of solution,  $P_2$ : vapor pressure of solvent (usually in food is water).

Food with aw more than 0.90 is spoiled by bacteria while less than 0.90 spoiled by mold and yeasts, except some rare cases:

M-ms causing spoilage	Lowest aw Value	Examples
Bacteria	0.91	Fresh meat, Fresh cheese
Yeasts	0.88	Salted meat, Salted cheese
Molds	0.80	Dry fruits, Grains
Halophilic Bacteria	0.75	Salted foods
Xerophilic Molds	0.65	Dry fruits, Grains
Osmophilic Yeasts	0.60	Sugar Foods (Jams, Honey)
No Microbial Spoilage	< 0.50	Corn flaks, Milk powder

## V- Other factors less important such as:

- **1-** Aerobic & anaerobic conditions.
- **2-** Biological structure of food particularly the surface of food which protects the entrance of m-ms inside the food.
- **3-** The presence of antimicrobial substances in the food.
- 4- Some food treatments that stimulate the microbial growth, for example:
  - A- Washing with raw water without drying or disinfectants.
  - B- Non-efficient heating that promotes the spore germination, not killing them.
  - C- Mincing or slicing the food: such treatment lead to promote the microbial growth in the minced food because:
  - 1) Increasing the food surfaces for microbial growth.
  - 2) Increasing the oxygen content inside of food.
  - **3)** Outflow the food juices rich in nutrient from the inner tissues to form optimal medium for microbial growth.
  - **4)** Increasing the sources of contamination from mincing and slicing machines; rest food in these machines forms permanent sources of contamination, knife working surfaces, etc..

## Investigation and inspection of food disease outbreaks

Gastro-intestinal disturbance resulting from the ingestion of food (Food illness) have a variety of causes:

1- Overeating 2- Allergies 3- Nutritional Deficiencies 4-Toxic Plants

5- Toxic Animals 6- Toxic Chemicals 7- Bacterial Intoxication

8- Bacterial Infection 9- Food Mycotoxins 10- Fungal Infections

11- Food Viruses 12- Food Parasites 13- Unknown Causes.

However for long time, thousands researches proved that m-ms are the main cause of food illness.

For example the following table has been issued by U.S. disease center:

Disease agent	Percentage %
A- Microbial agents	65
1- <u>Staphylococcusaureus</u>	25
2- Clostridium perfringens	15
3- <u>Clostridium</u> botulinum	6
4- <u>Salmonella</u>	10
5- Other Bacteria	3
6- Viruses& Parasites	6
B- Chemicals & Unknown	35

The most important food microbial diseases are:

food microbial disease	Causative agent	
Staphylococcal Food Poisoning (SFP)	Staphylococcus aureus	
Botulism	Clostridium botulinum	
Clostridium perfringens F. P.	Clostridium perfringens	
Salmonellosis	<u>Salmonella</u> sp.	
A- Typhoid fever(human)		
B- Paratyphoid fever(zoonotic)		
Shigellosis, Bacillary dysenteriae	Shigella sp.	
Food poisoning	Enterotoxigenic <u>E</u> . <u>coli</u>	
Enterocolitis	Yersinia enterocolitica	
Food poisoning	Vibrio parahaemolyticus	
Food poisoning	Bacillus cereus	
Food poisoning	Entamoeba histolytica,	
	<u>Cryptosporidium, Giardia</u>	
Chemicals, toxic plants, toxic	Arsenic, <u>Vicia</u> <u>faba</u> , Shark	
animals		

The main purposes of the investigation of an outbreak of food born disease are to determine:

1- How the foodstuff became contaminated?

**2-** How the growth of toxigenic or infectious m-ms could take place. 3- How

can we prevent the repetition of this case?

This requires:

- 1) Location of the outbreak
- 2) Identification of the causative agents
- **3)** Route of transmission
- 4) Demonstration of the opportunity for growth of pathogen
- 5) Proof that pathogen has infected the publicity given an outbreak.

The investigation team includes:

- 1- <u>Field group</u>:
- A- Persons consumed suspected food, physicians and nurses who are treating the victims.
- B- Collecting samples of suspected food, specimens from food handlers and patients and transmitting them to lab.
- C- Inspects the site where the food was stored, prepared, served and sold.
- 2- <u>Lab. group</u>: Microbiological and chemical tests.
- **3-** <u>The person in charge</u> who can explain the data from all sources to determine the cause and the source of disease outbreak.

# **Collection the Food Inspection**

- **1-** Collection of food samples
- 2- Collection of specimens from human sources a-

Fecal samples b- Blood samples c- Vomit

**3-** Laboratory testing:

A- Test for botulism
B- Test for Staphylococcal food poisoning CTest for <u>Salmonella</u> and <u>Shigella</u>
D- Test for <u>C</u>. <u>perfringens</u> & <u>B</u>.cereus ETest for Mycotoxins
F- Test for Parasites: <u>Entamoeba histolytica</u>, <u>Cryptosporidium</u>, <u>Giardia lamblia</u>
G- Test for viruses
H-Test for toxic plants & animals

I- Test for pesticides and heavy metals.

### The practices employed to protect food from dangerous m-ms:

- 1- Keep food free from contamination with pathogens and food handlers and other sources.
- **2-** Prevention the microbial growth in food
- **3-** Rejection suspected food
- **4-** Educate the public about the prevention of food borne illness.

