Semester – III

16MBU302 FOOD AND DAIRY MICROBIOLOGY (4H – 4C)

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

SCOPE

This paper adds information about the role of microorganisms in many food, and beverage industries both in production and spoilage processes.

OBJECTIVES

To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.

Unit: 1 – Foods as a substrate for microorganisms

Natural flora and source of contamination of foods in general. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Microbial spoilage of various foods – Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Unit: 2 – Principles and methods of food preservation and sterilization

Principles of food preservation. Physical methods of food preservation: temperature (low, high, canning, and drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging. Chemical methods of food preservation: salt, sugar, organic acids, SO_2, nitrite and nitrates, antibiotics and bacteriocins, sterilization of dry heat, moist heat, chemical, physical and radition.

Unit: 3 – Fermented foods

Fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese. Other fermented foods: dosa, sauerkraut, soy sauce and tampeh. Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit: 4 – Food borne diseases

Causative agents, foods involved, symptoms and preventive measures of the following diseases

Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins. Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, Salmonellosis, Shigellosis, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni* , fungal diseases, toxins

Unit: 5 – Detection of food borne pathogens, food sanitation and control Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology. HACCP, FSSAI Indices of food sanitary quality and sanitizers.

Suggested readings

1. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
2. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
3. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
4. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
5. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
6. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
7. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

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DEPARTMENT OF MICROBIOLOGY

(Deemed University Established Under Section 3 of UGC Act, 1956)
Eachanari PO, Coimbatore -641 021, India.

II –B.Sc Microbiology (Batch 2016-2019)

Lecture Plan

Unit - I

S. No	Duration	Topic	Reference
1.	1	Natural flora and source of contamination of foods in general	
2.	1	Intrinsic and extrinsic factors that affects growth and survival of microbes in food	
3.	1	Microbial spoilage of vegetables and fruits	
4.	1	Spoilage of meat and eggs	
5.	1	Spoilage of milk and butter	
6.	1	Spoilage of bread	
7.	1	Spoilage of canned foods	
8.	1	Unit revision	
		Total Hours	**8**

R1: Frazier, W.C and D.C, Werthoff, 1995. Food Microbiology. Tata McCraw. Hill Publishing Company limited. New Delhi

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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FOOD AND AGRICULTURAL MICR

UNIT- I

OPTION 1

Most spoilage bacteria grow at	acidic pH
The microbiological examination of coliform bacteria in foods pref	MacConkey broth
Which of the following acid will have higher bacteriostatic effect at	Acetic acid
Water activity can act as	warm temperature
The different ACC's between food categories reflect the	expected level of contamination
Yeast and mould count determination requires	nutrient agar
A psychrophilic halophile would be a microbe that prefers	cold temperatures and increased
NaCl can act as	antagonist at optimal concentrat
Which of the bacteria can grow in alkaline pH?	*Lactobacilli*
The water activity range of fresh meat and fresh fish was _____	0.93-0.98
The O-R potential of a system is measured by	mV
When microbes can use fat as an energy source _____.	absence of sugar molecule
The approximate range of bacteria present in fresh vegetable is ___	10^9 -10^7/g
In fruit juices the growth of the fermentative yeast are favored by _	4.0-4.5
The water requirement of a microorganism is expressed in terms of	water action
The microorganism which apparently have no mechanism to tolerat	bacteria
---------- is the thermoduric bacteria	*Acenetobacteria*
To retard the contamination and other microbial growth in meat is c	10°C
The percentage of relative humidity is obtained by multiplying by_	aw*10
Which of the following can cause food to be contaminated because	Jewellery
Which of the following can cause food to be contaminated because	Hair
Cross-contamination of food occurs when	Cleaning and sanitising equipme
Which of the following are allergens?	Sources of gluten and Red meat
The undesirable change in a food that makes it or human consumpti	food decay
_____ microorganisms reqire positive Eh values or positive mV O-R potentials	Aerobic
_____ acid produced by the propionibacteria in swiss cheese is	sorbic
_____ bacteria oxidize ethylalcohol to acetic acid	Aeromonas
The endospores of _____ do not swell the foods in which they are formed	Streptococcus

_____ is associated with the market disease called bacterial soft rot	Erwinia
_____ is the causative organism for a bacterial pneumonia in human.	Flavobacterium
_____ bacteria grow and cause discoloration on foods high in salt	Halobacterium
Aeromonas grows at an optimum temperature of _____	27 to 37 °C
The culture of Brevibacterium produces _____ pigmentation and helps ripening	orange-red
_____ bacteria is found aseptically in drawn milk and cause bovine mastitis	Corynebacterium
Pectins are complex _____ that are responsible for cell wall rigidity in vegetables and fruits	Proteins
_____ bacteria are those which grow in high concentration of sugars	Halophilic
_____ bacteria are able to grow at commercial refrigeration temperatures	Pschrotropic
Truly halophilic bacteria require minimal concentration of dissolved _____ for growth	NaCl2
_____ causes ropiness in milk	Lactobacillus plantarum

_____ are short rods that are defined as aerobic and facultative anaerobic	Enterobacter
The use of indicator microorganisms began with use of E. coli testing in _____	soil
Many infectious disease agents of animals can be transmitted to people through _____	water
The _____ of many meat animals may contain micrococci, Staphylococci, and beta-hemolytic Streptococci	Hair
_____ used to fertilize plant crops will be contaminated with human pathogens	sewage
_____ contain the greatest variety of microorganisms of any source of contamination of food	plants
Contamination of foods from _____ may be important for sanitary as well as economic reasons	air
_____ does not contain a antural flora of microorganisms	soil
There are ___ aspects of water bacteriology that are interested by food microbiologist	2
The surface of a well washed tomato show _____ microorganisms per square centimeter	100-200
Pig and beef carcasses may be contaminated with _____	Salmonellae
Natural water contaminated with sewage contribute their microorganism to ____	meat
Chlorination of _____ water is practised when there is any doubt about the sanitory quality of the water	sewage
Cannery cooling water often contain _____	Coliforms
Many microorganisms cannot use the disaccharide lactose and therefore do not grow well in _____	milk
_____ yeast is grown with dairy starter cultures to maintain the activity and increase the longevity of the lactic acid bacteria	Candida sp.
Saccharomyces are reclassified by Lodder in the year ____	1985
_____ has been used as starter culture in fermented sausages	Photobacterium
_____ bacteria produce lipase enzyme that hydrolysis fat to fatty acids and glycerol	Saccharolytic

R EDUCATION

DAIRY MICROBIOLOGY **16MBU302**

OPTION 2	OPTION 3	OPTION 4
alkaline pH	neutral pH	any of the pH
violet Red Bile agar	Mac conkey agar	nutrient broth
Tartaric acid	Citric acid	Maleic acid
a processing factor	an extrinsic factor	both b and c
potential for microbial growth dur	potential shelf life	all of the above
acidified potato glucose agar	MacConkey agar	violet Red Bile agar
warm temperatures and increased	cold temperatures and the abs	warm temperatures and increased
synergistically if added in excess	Both (a) and (b)	None of the above
Vibrio cholera	*Salmonella*	*Staphylococcus*
0.98 and above	0.60-0.76	below 0.98
mM	aw	Eh
presence of glucose	presence of fructose	Presence of high sugar
10^3 -10^9/g	10^3 -10^7/g	10^1 -10^7/g
6.0-6.5	2.0-2.5	3.0-3.5
water adsorption	water affinity	water activity
fungi	viruses	both a and b
Morexella	*Bacillus*	*Flavobac*
0°C	100°C	-10°C
aw*1000	aw*100	aw*0.1
Dust	Rodent droppings	Incorrectly diluted chemicals
Dust	Live insects	Perfume
Keeping food stored in food-grade containers	Washing hands before handlin	Using food handling gloves for h
Fruits and vegetables	Fish and fish products	None of the above
food spoilage	food loss	all of the above
anaerobic	facultative	none of these
acetic	propionic	acetic
Acetobacter	Alcaligens	nas
Brochotrix	Brevibacterium	Bacillus

Enterobacter	Corynebacterium	Klebsiella
Escherichia	Klebsiella	Gluconobacter
Enterobacter	Erwinia	Corynebacterium
22 to 28 °C	35 to 37 °C	40 °C
yellow	black	red
Clostridium	Campylobacter	Enterobacter
lipids	carbohydrates	vitamins
thermophilic	osmophilic	none of these
halophilics	auttrophic	heterotrophic
Hcl	NaNo2	Cacl2
Klebsiella pneumonia	Klebsiella oxytoca	Flavobacterium

Coliforms	Proteus	Clostridium
plants	water	all of these
food	soil	juices
nail	skin	foot
distilled water	mineralized water	drinking water
sewage	water	soil
soil	water	sewage
air	water	sewage
5	6	4
400-700	100-300	200-400
Klebsiella	E. coli	Enterobacter
vegetables	fruits	seafoods
drinking	distilled water	surface water
Aeromonas	Klebsiella	Clostridium
water	food	sewage
Trichosporon	Rhodotorula	Torulopsis
1978	1982	1984
Pediococcus	Propionibacterium	Proteus
Pectinolytic	lipolytic	proteolytic

ANSWER KEY

neutral pH
MacConkey broth
Acetic acid
both b and c
all of the above
acidified potato glucose agar

l amounts c cold temperatures and increased amounts of salt

Both (a) and (b)
Vibrio cholera
0.93-0.98
mM
absence of sugar molecule
10^3 -10^4/g
4.0-4.5
water activity
fungi
Morexella
0°C
aw*100
Jewellery
Perfume

andling mc Using food handling gloves for handling money

Sources of gluten and Red meat

food spoilage

Aerobic
propionic

Acetobacter

Bacillus

Erwinia

Klebsiella

Halobacterium
22 to 28 °C

orange - red

Corynebacterium

Carbohydrate

osmophilic

Pschrotropic

Nacl2

Klebsiella oxytoca

Coliforms

water

food

skin

sewage

soil

air
air

2

400-700

Salmonellae

sea foods

drinking

Coliforms

milk

Candida sp.
1984
Pediococcus

lipolytic

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Lecture Plan

Unit - II

S. No	Duration	Topic	Reference
1.	1	Principles of food preservatives- physical methods temperature	
2.	1	Preservation by irradiation, hydrostatic pressure, high voltage	
3.	1	Preservation by microwave processing and aseptic package	
4.	1	Chemical methods salt, sugar and organic acids	
5.	1	So2, Nitrite and Nitrates	
6.	1	Preservation by antibiotic, bacteriocins	
7.	1	Sterilization by heat, moist heat, chemical, physical and radiation.	
8.	1	Unit Revision	
		Total Hours	**8**

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Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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FOOD AND AGRICULTURAL MICROBIOLOGY

16MBU302

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

UNIT-2

Introduction

Foods are mainly composed of biochemical compounds which are derived from plants and animals. Carbohydrates, proteins and fats are the major constituents of food. In addition, minor constituents such as minerals, vitamins, enzymes, acids, antioxidants, pigments, flavours are present. Foods are subject to physical, chemical, and biological deterioration. The major factors affecting food spoilage are

1) Growth and activities of microorganisms (bacteria, yeasts, and molds)
2) Activities of food enzymes and other chemical reactions within food itself
3) Infestation by insects, rodents
4) Inappropriate temperatures for a given food
5) Either the gain or loss of moisture
6) Reaction with oxygen
7) Light

The vast majority of instances of food spoilage can be attributed to one of two major causes: (1) the attack by microorganisms such as bacteria and molds, or (2) oxidation that causes the destruction of essential biochemical compounds and/or the destruction of plant and animalcells. Chemical and/or biochemical reactions results in decomposition of food due to microbial growth. There is an adverse effect on appearance, flavour, texture, colour, consistence and/or nutritional quality of food.

Food Preservation

Food preservation is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility or nutritive value) caused or accelerated by micro-organisms. Preservation usually involves preventing the growth of bacteria, fungi, and other micro-organisms, as well as retarding the oxidation of fats which cause rancidity. It also includes processes to inhibit natural ageing and discolouration that can occur during food preparation such as the enzymatic browning reaction in apples after they are cut. Preservative for food may be defined as any chemical compound and/or process, when applied to food, retard alterations caused by the growth of microorganisms or enable the physical properties, chemical composition and nutritive value to remain unaffected by microbial growth.

Principles of Food Preservation

The principles of various methods for food preservation are as

1) Prevention or delay of microbial decomposition

By keeping out microorganisms (asepsis),By removal of microorganisms, By hindering the growth and activity of microorganisms (e.g. by low temperatures, drying, anaerobicconditions,orchemicals), By killing the microorganisms (e.g. by heat or radiation)

2) Prevention or delay of self decomposition of the food

By destruction or inactivation of food enzymes (by blanching)
By prevention or delay of chemical reactions (By using antioxidant).

Methods of Food Preservation

Preservation of food is achieved by application of physical, chemical and/or biological methods are as follows:

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Physical methods

Thermal treatment

The term "thermal" refers to processes involving heat. Heating food is an effective way of preserving it because the great majority of harmful pathogens are killed at temperatures close to the boiling point of water. In this respect, heating foods is a form of food preservation comparable to that of freezing but much superior to it in its effectiveness. A preliminary step in many other forms of food preservation, especially forms that make use of packaging, is to heat the foods to temperatures sufficiently high to destroy pathogens.

In many cases, foods are actually cooked prior to their being packaged and stored. In other cases, cooking is neither appropriate nor necessary. The most familiar example of the latter situation is pasteurization. Conventional methods of pasteurization called for the heating of milk to a temperature between 145 and 149 °F (63 and 65 °C) for a period of about 30 minutes, and then cooling it to room temperature. In a more recent revision of that process, milk can also be "flash-pasteurized" by raising its temperature to about 160 °F (71 °C) for a minimum of 15 seconds, with equally successful results. A process known as ultra high pasteurization uses higher temperatures of the order of 194 to 266 °F (90 to 130°C) for periods of a second or more.

Low temperature

The lower the temperature, the slower will be chemical reactions, enzyme action, and microbial growth. Each microorganism present has an optimal temperature for growth and a minimal temperature below which it cannot multiply. As the temperature drops from this optimal temperature toward the minimal, the rate of growth of the organism decreases and is slowest at the minimal temperature. Cooler temperatures will prevent growth, but slow metabolic activity may continue. Most bacteria, yeasts, and molds grow best in the temperature range 16-38^{o}C (except psychrotrophs). At temperatures below 10^{o}C, growth is slow and becomes slower the colder it gets. The slowing of microbial activity with decreased temperatures is the principal behind refrigeration and freezing preservation.

Drying

One of the oldest methods of food preservation is by drying, which reduces water activity sufficiently to prevent or delay microbial growth. The term water activity is related to relative humidity. Relative humidity refers to the atmosphere surrounding a material or solution. Water activity is the ratio of vapour pressure of the solution to the vapour pressure of pure water at the same temperature. Under equilibrium conditions water activity equals RH/100. At the usual temperatures permitting microbial growth, most bacteria require a water activity as low as 0.90-1.00. Some yeasts and molds grow slowly at a water activity as low as 0.65. Food is dried either partially or completely to preserve it against microbial spoilage.

Chemical preservation

Chemical preservatives are added to kill or inhibit microorganisms in food. The may be incorporated into the foods or only their surface or the wrappers used for them may be treated, or they may be used as gas or vapors around the food. Some chemicals may be effective on selected group of microorganisms while others on a wide variety of them. Chemical preservatives may be harmless if they are added during the storage period and are removed before the food is

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

consumed. But if they are consumed as such, they may be poisonous to man or animal, as well as to microorganisms.

Organic acids and their salts:

Several organic acids and their salts are common preservatives as they have marked microbiostatic and microbicidal action.

Benzoic acid and benzoate are used for the preservation of vegetables. Sodium benzoate is used in the preservation of jellies, jams, fruit juice and other acid foods.

Salicylic acid and salicylates are used as preservatives of fruits and vegetables in place of benzoate. However, it is considered to be deleterious to health of consumer.

Sorbic acid is recommended for foods susceptible to spoilage fungi, e.g., it inhibits mold growth in bread. Wrapping material for cheese may be treated with it. It is also used in sweet pickles and for control of lactic fermentations of olives and cucumbers.

Foods prepared by fermentation processes, e.g. milk products etc. are preserved mainly by lactic, acetic and propionic acids.

Flavoring extracts of vanilla, lemons are preserved in 50-70% alcohol as it coagulates cell proteins.

Inorganic acids and their salts:

Most common among the inorganic acids and their salts are, sodium chloride, hypochlorites, sulphurous acids and sulphites, sulphurdioxide, nitrate and nitrite.

a. Sodium chloride

Sodium chloride produces high osmotic pressure and therefore causes destruction of many microorganisms by plasmolysis. It causes dehydration of food as well as microorganisms, releases disinfecting chlorine ion by ionization, reduces solubility of oxygen in the moisture, sensitizes microbial cells against carbon dioxide and interferes with the action of proteolytic enzymes. These are the reasons why this common salt is used widely for preservation either directly or curing solutions.

b. Hypochlorites

The hypochlorous acid liberated by these salts is an effective germicide. It is oxidative in its action. The commonly used forms are sodium and calcium hypochlorites. Drinking water or water used for washing foods may be dissolved with hypochlorites.

c. Sulphurous acids and Sulphites

Sulphurous acids and sulphites are added to wines as preservatives. Sulphurous acid is used especially in the preservation of dry fruits. It helps in retention of original colour of the preserve and inhibition of molds more than either yeasts or bacteria. Potassium metabisulphite is used in canning.

d. Sulphur dioxide

Sulphur dioxide has a bleaching effect desired in some fruits, and also suppresses the growth of yeast and molds. It is used as a gas to treat drying fruits and is also used in molasses.

e. Nitrates and Nitrites

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Nitrates and nitrites produce an inhibitory effect on bacterial growth and are used usually together in meat and fish preservation and for retention of red-colour of the meat. Nitrate is changed to nitrous acid which reacts with myoglobin to give nitric oxide myoglobin. It is the latter which gives a bright red colour to the meat making it more attractive in appearance. However, both nitrite and nitrate are poisonous, if present in potable water or food products in more than minimal amounts. It is why the generous use of these chemicals as preservative in meat and fish products has been questioned.

Antibiotics:

Aureomycin (chlorotetracycline) is the most commonly used antibiotic for the preservation of animal products under chilling conditions. It is extensively used for the preservation of poultry, meat and fish. The antibiotic is applied to the surface of the fresh meat by dipping it in a solution of the antibiotic or it may be fed to the animal, by mixing it with feed or water, for one to several days before slaughter. Fish are treated by adding the antibiotic in the ice or water in which they are to be transported.

The indiscriminate use of antibiotics as preservatives, however, should be prevented or the antibiotics used should be such that it is demobilized on cooking so that the internal flora of man using such food is not constantly exposed to the effect of the antibiotic. It is important for otherwise the use would lead to the development of the antibiotic resistant strains of microorganisms in the body. Aside from this, some individuals sensitive to antibiotics become exposed constantly to allergy.

Biological method

Souring (fermentation) lactic and acetic acid e.g. cheese and cultured milk.

Radiations

Low-frequency, long-wavelength, low energy radiation ranges from radio waves to infrared. Conversely, the high-frequency, shorter-wavelength radiations have high quantum energies and actually excite or destroy organic compounds and microorganisms without heating the product. Microbial destruction without the generation of high temperatures suggested the term "cold sterilization." Radiations of higher frequencies have high energy contents and are capable of actually breaking individual molecules into ions, hence the term ionizing irradiation.

Gamma rays and high-energy electron beams

Gamma rays and high-energy electron beams have been used for the preservation of fresh perishable canned and packaged foods. They have good penetration and are effective to a depth of about 15 cm in most foods. Food preservation by such radiation dosage is called "cold-sterilization" as it produces only a few degrees rise in temperature of the product.

Ultraviolet rays

Ultraviolet rays are short waves and are used to sterilize the surface of foods. These rays have been successfully used for the treatment of water for beverages, aging meat's packaging, and treatment of knives for slicing bread, for sterilizing utensils, for prevention of spoilage by organisms on the surface of preserved pickles, cheese and prevention of air contamination. Cold-storage rooms of meat-processing plants are sometimes equipped with germicidal lamps which reduce the surface contamination and permit longer periods of spoilage-free storage.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Radiation pasteurization or sterilization

It represents a term which describes the killing of over 98% but not 100% of the microorganisms by intermediate dosage of radiation. This method increases the storage life of some meats, sea-foods, certain fruits and vegetables when stored at low temperature. Radiation pasteurization provides the possibility of an entirely new approach to food preservation and could bring about a radical change in industrial methods of food processing.

However, the effect of radiation on colour, flavor nutritional quality of food, odorand texture needs to be more carefully understood. Similarly, chemical changes in food products brought about by radiations may cause bad effects on animal and human subjects and need to be more adequately investigated.

Other methods

There are many different methods for drying, each with their own advantages for particular applications. These include,

- Convection drying
- Bed dryers
- Drum drying
- Freeze Drying
- Microwave-vacuum drying
- Shelf dryers
- Spray drying
- Infrared radiation drying
- Sunlight
- Commercial food dehydrators and Household oven.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

UNIT -II

The time temperature combination for HTST paterurization of 71.1°C for 15 sec is selected on the basis of

The percentage fat constituent of double toned milk is

Which solvent is commonly used to determine fat content

Pasteurization is done to kill

Bacteria which is present in raw or undercooked meat, eggs, sea food and unpasteurized milk is

Milk and curry left over can be turned into sour and spoiled at

Preservation affects the growth of microorganism by

Souring of canned meat is caused by _____.

Sugars act as preservatives due to their ability to

The minimal pH for the growth of staphylococcus is about ----------

The concentration of salt used in high protein containing vegetables is _____

Fruit juice is sterilized by _____.

The reddish liquid comes out from meat on thawing process is called as

---------- is a storage method uses bins or boxes for equalization of moisture

---------- is mostly used preservative to prevent mold growth

The spoilage organism bring about the spoilage of meat by

Significant numbers of *S. aureus* in a food can be determined by examining the food

To retard the contamination and other microbial growth in meat is obtained by storing at _____ tempe

---------- is a storage method uses bins or boxes for equalization of moist
To retard the contamination and other microbial growth in meat is obtained by storing at _____ tempe
Increase in the concentration of dissolved substances like sugar and salt helps in _____ of the food mate
Sulfur stinker spoilage of canned food is caused by
The minimum growth temperature of Bifidobacteria range from
Food should be cooked to which temperature?

Sanitising is_____

Food preservation involves_____

Pasteurization is a _____

Which of the following statements are true about chemical preservatives _____

The sclerotia from a species of Penicillium can survive a heat treatment of ____
During _____ the internal temperature of bread, cake or other bakery products approaches but never reaches 100 °C

_____ in 1765 preserved food by heating it in a sealed containers

Combination of _____ irradiation with chilling storage helps preserve foods
_____ freezing usually refer to freezing in air with only natural air circulation
Christophersen classified microroganisms on the basis of sensitivity to freezing in the year_____

_____ temperature are more lethal

The simplest dryer is the _____
The sodium salt of _____ acid has been used extensively as an antimicrobial agent in foods

_____ is used most extensively in the prevention of mold growth and rope development in baked goods
_____organic acid is used in syrups, drinks, jam and jellies

_____ is used as treatment for wrappers used on butter
_____ alcohol is used as coagulant and enaturizer of cell proteins

The fumes of burning ____ are used to treat light colored dehydrated fruits
_____ solvent is poisonous and should not be added to foods

_____ can be used to control bacterial and fungal growth in tapholes of maple tree

_____ contains a large number of olatile compounds that may have bacteriostatic and bactericidal effect

_____ acid is used in soft drinks such as colas
_____ drying is limited to climates with a hot sun and dry atmosphere to fruits
_____ rays are streams of electrons emitted from radioactive materials
Gazing at ultraviolet lamps produces irritation of the ____ within few seconds

Radiation dose in kilograys of ____ inhibits sprouting in potatoes, onions and garlic

_____ can be dried by a process called explosive puffing

Jones and Loackhead found enterotoxin forming Staphylococci in _____food

_____ is a term used to label foods treated with low level ionizing radiation
97 to 99 % of E.coli in air were killed in ____ seconds with a 15 watts lamp
Flavoring etracts such as vanilla and lemon etracts are preserved by their content of ____
_____ from retail market contain from 0 to2 million bacteria per piece
About ____ percent of the suspected samples contained viable spores

OPTION 1	**OPTION 2**	**OPTION 3**	**OPTION 4**
Coxiella Burnetii	*E. coli*	*B. subtilis*	*C. botulinum*
0.5	1.5	3	4.5
Ethyl alcohol	Hexane	Acetone	Benzene
Selective microorganism	All the microorganism	Yeast	Yeast and its spores
E.coli	salmonella	staphylococcus	cyano bacteria
high temperature	very low temperature	room temperature	constant temperature
inhibition	retardation	arresting	degradation
thermoduric cells	thermostatic cells	thermo liable cells	thermostable
make water unavailable to o	interfere with the action of p	osmotic effect	chemical changes
2.5	4.8	2	3.5
4.3-10.3	17.5-20.0	18.6-26.5	19.2-22.2
filteration	freezing	cooling	heating
drying	wilting	bleeding	leakage
sweating	springer	cooling	freezing
sodium propionate	springer	sorbates	acetate
purification	oxidation	decomposition	hydrolysis
RNase	thermostable nuclease	protease	thermostable DNase
10°C	0°C	100°C	-10°C

Sweating	Springer	Cooling	Freezing
10 °C	0°C	100°C	-10°C
drying	freezing	moistening	thawing
E.coli	*D. nigrificans*	*Bacillus*	*Clostridium*
43 to 45	25 to 28	29 to 32	30 to 35
5°C	75°C	100°C	60°C

Applying detergent to a clea	Done before washing	Reducing bacteria by a	Wiping all surfaces v
increasing shelf life of food	ensuring safety for human consumption	both a and b	boiling
low temperature treatment	steaming treatment	high temperature treatment	low and high temperature treatment
microbicidal or microstatic	chemical preservatives often hazardous to humans	sodium benzoate is a widely used preservative	all these
70 °C	90 to100 °C	50-60 °C	37 °C
Heating	boiling	baking	all of these
Spallanzani	Ruiz-Argueso	Rodrigeuz-Navarro	Christophersen
Ultraviolet	infra red	gamma	none of the above
Sharp	slow	quick	speed
1984	1989	1973	1981
high freezing	frozen storage	freezing rate	thawing
sun	air	heat	evaporator
propionic	benzoic	sorbic	acetic
calcium propionate	calcium sorbate	monocholroacetic acid	nitrates
lactic	acetic	propionic	citric
sodium diacetate	calcium carbonate	sodium nitrate	potassium nitrite
methanol	ethanol	butanol	none of these

sulfur	ethylene	potassium	sodium
propylene	ethanol	methanol	glycerol
paraformaldehyde	benzaldehyde	formaldehyde	all of these
spices	woodsmoke	formaldehyde	alcohol
phosphoric	benzoic	acetic	sorbic
mechanical	solar	freeze	chemical
beta	cathode	gamma	X-rays
eye	ear	nose	throat
0.05-0.15	0.01-0.14	0.05-0.07	0.05-0.11
meat	vegetables	fruits	juices
frozen corn	cheese	bread	jam
Radicidation	radurization	picowaved	radappertization
40	10	50	30
sugar	salt	alcohol	ethylene
caramels	jellies	fudges	candies
20	10	30	50

ANSWER KEY

Coxiella Burnetii

1.5

Hexane

Selective microorganism

salmonella

room temperature

retardation

thermoduric cells

interfere with the action of proteolytic enzyme

4.8

18.6-26.5

filteration

bleeding

springer

sodium propionate

decomposition

protease

0°C

Springer
0°C
drying
D. nigrificans
43 to 45
75°C
Reducing bacteria by application of heat or chemical
*v*ith a clean cloth
both a and b
high temperature treatment

All of these
90 to100 °C

baking
spallanzani
ultraviolet
sharp
1973
high freezing
evaporator
benzoic
calcium propionate
citric
sodium diacetate
ethanol

sulfur
methanol
paraform
aldehyde
woodsmo
ke
phosphor
ic
solar
beta
Eye

0.05-0.15
vegetable
s
frozen
corn
Picowave
d
10
alcohol
candies
10

KARPAGAM ACADEMY OF HIGHER EDUCATION
DEPARTMENT OF MICROBIOLOGY

(Deemed University Established Under Section 3 of UGC Act, 1956)
Eachanari PO, Coimbatore -641 021, India.

II –B.Sc Microbiology (Batch 2016-2019)

Lecture Plan

Unit - III

S. No	Duration	Topic	Reference
1.	1	Fermented dairy products: yogurt, acidophilus milk	
2.	1	Fermented products kumis, kefir	
3.	1	Fermented products dhai, cheese	
4.	1	Fermented dosa, sauerkraut	
5.	1	Fermented soy sauce and tampeh	
6.	1	Probiotic health benefits and types of microorganisms used	
7.	1	Probiotics foods available in market	
8.	1	Unit revision	
		Total Hours	**8**

R1: Frazier, W.C and D.C, Werthoff, 1995. Food Microbiology. Tata McCraw. Hill Publishing Company limited. New Delhi

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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FOOD AND DAIRY MICROBIOLOGY

16MBU302

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Unit 3
Cultured/fermented dairy products
Yoghurt
Yoghurt is a fermented milk product that evolved by allowing naturally-contaminated milk to sour at a warm temperature. Yoghurt can be either unsweetened or sweetened, set, or stirred. Curd is the name given to a yoghurt-type product made from buffalo milk.

The principles of preservation for yoghurt are:
· Pasteurization of the raw milk to destroy contaminating microorganisms and enzymes.
· An increase in acidity due to the production of lactic acid from lactose. This inhibits the growth of food-poisoning bacteria.

· Storage at a low temperature to inhibit the growth of microorganisms.

Production stages for set yoghurt

Ingredients	***Process***	***Equipment***	***Section reference***
Milk and starter culture (2 per cent)	Preheat to 70°C for 15-20 minutes	Heat source	36.0
		Thermometer	63.0
		Boiling pan	48.0
	Cool to 30-40°C	Thermometer	63.0
	Addition of starter culture	Measuring and weighing equipment	64.1 and 64.2
	Pour into bottles/pots	Funnel or Liquid filler	28.1
		Sealing machine	47.1
		or Capping machine	47.2
	Incubate at 43-45°C	Commercial incubator	39.0
		Thermometer	63.0
	Store at 4°C	Refrigerated storage	

Heating

In the manufacture of yoghurt, milk is normally heated to 70°C for 15-20 minutes, using an open boiling pan, or alternatively a steam jacketed pan.

Addition of starter culture

The milk is cooled to between 30 40°C and inoculated with a mixed culture of Lactobacillus bulgaricus and Streptococcus thermophilus (usually in a ratio of 1:1). If a commercial starter-culture is used, the directions for use will be given. However, if a culture from a previous batch is used, then it is usual to add 2-3 tablespoons per litre of prepared milk.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Yoghurt of the stirred variety can be fermented in the mixing container. To make set yoghurt the inoculated milk should be poured into the individual pots before fermentation.

Incubation

The micro-organisms that produce yoghurt are most active within a temperature range of 32-47°C. Ambient temperatures are therefore not adequate and a heated incubator is needed. Small commercially-available yoghurt-makers consist of an electrically-heated base and a set of plastic or glass containers. Most yoghurt-makers make four or five individual half litre cups at a time. There are other simple and inexpensive ways of incubating yoghurt such as an insulated box, keeping the jars/pots surrounded by warm water, or by using thermos flasks (the latter is only suitable for stirred yoghurt). Incubation takes approximately five hours.

When fermentation is complete, stirred yoghurt is cooled and flavoured or sweetened prior to packaging. In set yoghurt all ingredients are added before fermentation.

Packaging and storage

Yoghurt or curd is commonly packaged in plastic pots fitted with a plastic lid, or heat-sealed with foil, although traditionally, curd is packaged in clay pots. Such pots are made from local materials and can be re-used or later used for cooking. The shelf-life of yoghurt is usually 3-8 days when stored at temperatures below 10°C.

Cheese

Cheese is made from milk by the combined action of lactic acid bacteria and the enzyme rennin (known as rennet). Just as cream is a concentrated form of milk fat, cheese is a concentrated form of milk-protein. The differences in cheeses that are produced in different regions result from variations in the composition and type of milk, variations in the process, and the bacteria used. The different cheese varieties can be classified as either hard or soft.

Collecting milk for cheese-making

Hard cheeses such as Cheddar and Edam have most of the whey drained out and are pressed. Soft cheeses such as paneer contain some of the whey and are not pressed. Many indigenous cheeses are soft types.

The hardness, flavour, and other qualities of a cheese can be varied by changes to the process conditions, to suit local tastes. However, the principal steps of a cheese-making process are basically the same.

The principles of preservation are:

· the raw milk is pasteurized to destroy most enzymes and contaminating bacteria
· fermentation by lactic-acid bacteria increases the acidity which inhibits the growth of food-poisoning and spoilage bacteria

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

· the moisture content is lowered and salt is added to inhibit bacterial and mould growth.

The table, right, outlines the stages of production and the equipment needed to produce Edam cheese.

Pre-heating

The pasteurized milk is heated to a temperature at which the starter-culture can work.

Addition of starter culture

Starter-culture is added to the milk at the rate of approximately 2 per cent of the weight of milk. The vessel used should be either aluminium or stainless steel.

Addition of rennet

The rennet should be 1 per cent of the weight of milk. The rennet alters the milk proteins and allows them to form the characteristic curd.

Incubation

The milk is allowed to stand until it sets to a firm curd.

Treatment of the curd

The curd is cut into cubes which facilitate the elimination of whey from the gel. The curd is then cooked at 40°C for a period of twenty minutes which has the action of firming the curd. After cooling, the whey is drained off. The curd is pressed to ensure that most of the whey has been removed, and is then cut to fit the cheese-moulds, and finally pressed with weights.

Ripening

This is the final stage in the cheese-making process. It is a process which allows the development of gas in some cheeses and the development of flavour. The longer the ripening process the stronger the flavour. Ripening usually takes place in ripening rooms, where the temperature and humidity must be controlled for the optimum development of the cheese.

Production stages for Edam-type cheese

Ingredients	*Process*	*Equipment*	*Section reference*
Pasteurized milk	Preheat to 35-40°C	Cheese vat	10.0
		or boiling pan	48 0
		Thermometer	63.0
		Heat source	36 0
Starter culture	Addition of starter culture	Measuring and weighing equipment	64.1 and 64.2
Rennet	Add rennet at 30°C	Measuring and weighing equipment	64.1 and 64.2
		Thermometer	63.0

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

	Incubate		
	Cut the curd	Curd cutters	16.1
	Heat to 40°C for 20 minutes	Heat source	36.0
		Thermometer	63.0
	Drain	Filter cloth	08.0
	Cut to fit a cheese-mould	Knife	17.1
	Put into a cheese-mould	Cheese-moulds	09.1
	Press with	Cheese-press weights	09.2
	Cool and dry at 10-12°C	Thermometer	63.0
Salt	Salting in 20 per cent salt solution at 12°C for 12-16 hours	Brine meter	64.6
		Thermometer	63.0
	Ripen for 6-8 weeks at 16°C	Thermometer (optional)	63.0.
	Washing		
	Drying for 30 minutes		
	Wax with paraffin wax store at 9°C	Refrigerated storage	15.0

Packaging and storage

The packaging requirements differ according to the type of cheese produced. Hard cheese, for example, has an outer protective rind which protects the cheese from air, microorganisms, light, moisture-loss or pick-up, and odour pickup. Cheese should be allowed to 'breathe', otherwise it will sweat. Suitable wrapping materials are therefore cheesecloth or grease-proof paper. Cheese should be stored at a relatively low temperature between 4 and 10°C to achieve a shelf-life of several weeks/months. Soft cheeses are often stored in pots or other containers, often in brine, to help increase their shelf-life of several days/weeks.

Butter

Butter is a semi-solid mass which contains approximately 80-85 per cent milk-fat and 15-20 per cent water. It is yellow/white in colour, with a bland flavour and a slightly salty taste. It is a valuable product that has a high demand for domestic use in some countries and as an ingredient in other food processing (e.g. for confectionery and bakery uses).

The principles of preservation are:

· to destroy enzymes and micro-organisms by pasteurizing the milk
· to prevent microbial growth during storage by reducing the water content, by storing the product at a low temperature, and optionally by adding a small amount of salt during processing.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Ingredients	*Process*	*Equipment*	*Section reference*
Cream or soured cream	Store at 4°C	Milk churns	62.0
		Refrigerated storage	15.0
		Thermometer	63.0
	Churning	Butter churns	13.0
	Draining (pour off buttermilk)		
	Washing		
	Draining (pour off washwater)		
Permitted colours and salt (optional)	Kneading/working	Butter pats	04.0
	Form into blocks	Butter pats	04.0
	Packaging	Paper/plastic/ foil wrapping Wrapping machines	47.3
	Storage at 4°C	Refrigerated storage	15.0

Churning

Churning disrupts the emulsion of fat and water and as a result the milk-fat separates out into granules. This process takes place in a butter churn.

Churning cream

Churning is continued until fat granules are present and at this stage the mixture is drained to remove liquid that has separated from the granules. This liquid is known as buttermilk and can be used as either a beverage or as an ingredient in animal feed.

Washing

Clean water equivalent in weight to the buttermilk is added to the churn in order to wash the butter granules. The wash water is drained away. Churning is continued for a short time to compact the butter, and once this has been achieved it is removed from the churn.

Forming and packaging

Butter is kneaded to achieve a smooth and pliable texture. This can be done using simple hand-tools such as butter pats. Alternatively for higher production rates a specially-designed kneader can be used. Once the butter has a uniform and smooth texture it is formed into blocks with butter pats and packed in either greaseproof paper or foil wrappers.

Working butter with butter pats

Storage

Due to its high fat composition, butter must be stored at temperatures below 10°C otherwise the fat becomes rancid and imparts undesirable 'off' flavours. The water droplets in butter (20 per cent) can also allow bacteria to grow if it is not kept under cool conditions.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Kumiss

Kumiss called fermented milk drink, traditionally made from mare's milk, by its fermentation. For him Mare's milk - a fermented milk drink made from mare's milk manufacture two kinds of fermentation: lactic acid and alcohol using yeast, Bulgarian and acidophilus lactic acid bacillus. The drink has a whitish, it is peculiar or foam. Kumys refreshing taste, sweet and sour. It is often used for medicinal purposes.

Manufacturing technology allows you to cook different mare fortress. In some types of beverage alcohol content is so high that it can cause intoxication, and lead the man to use it in the excitement-intoxicated state. For a small proportion of alcohol in a drink koumiss has a calming and relaxing effect, until sleepiness.

Kumiss prepared even the nomadic tribes of Mongolia and Central Asia. It is known that the drink existed in the Eneolithic, ie more than 5000 years ago. Proof of this are found in the valley Susamyr, where, besides the evidence of domestication of horses, the researchers found bags of goat skin with traces of horse milk. It is possible that it was fermented in the same way as the mare.

The first written mention of the drink was written by the ancient Greek historian Herodotus, who lived in the 5th century. BC. In describing the life of the Scythians, he tells about their favorite drink, which is made from fermented mare's milk by churning it in wooden tubs. Also, the historian noted that the Scythians so carefully guarded secret of the beverage that dazzled each slave, found out about the process of preparing a beverage.

Later mention of koumiss found in ancient chronicles (egHypatian) and in the notes of foreign missionaries and travelers. Thus, in the 13th century. French monk Guillaume de Rubruk, describing his journey to the "Tatars" describes in detail not only the effect of koumiss and taste, but also a way to cook it. Description somewhat distorted, but, in general, close to the truth.

Despite the fact that initially only used for kumys mare's milk, the Kalmyk nomads began to use the camel and cow's milk. Bashkirs still use a drink, traditional recipes, and the Turkmens and Kazakhs prefer to kumys camel milk.

Incidentally, the mare is the only intoxicating drinks authorized for Muslims.

The composition and caloric kumys

While the form of fermentation, which is used to prepare koumiss, milk protein becomes digestible and milk sugars are converted to ethanol, lactic acid, carbon dioxide and aromatics. With this composition mare gets high nutritional, easily digestible, has a pleasant taste and delicate flavor.

Traditionally, the alcohol content of koumiss is between 0 and 2% to 3% ethanol. Strong koumiss prepared from mare milk, and contains up to 4, 5% alcohol. Kazakh cooking method involves the creation of a drink, a fortress which reaches 40%.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

The drink contains a number of vitamins, including - thiamine, riboflavin, folic and pantothenic acid, biotin and vitamin B12, and C.

Calorie kumys the traditional manufacturing (from mare's milk) is 50 kcal per 100 g

Useful properties

Benefit Mare's milk in bottles
kumys marked by more than a thousand years ago, truly great. This drink is officially used, and later in the Soviet period, as a remedy in sanatoriums of the Volga region, Buryatia, Bashkortostan and Kyrgyzstan, and the treatment process called "kumysoterapiya." Now, unfortunately, the number of medical institutions, which is practiced kumysoterapiya greatly reduced. To date, only two are functioning actively resort located in Bashkiria.

The antibiotic substances contained in koumiss, do drink effective antimicrobial agent, increase the body's resistance to infectious diseases.

High nutritional value and ability to stimulate biological processes occurring in the body - the properties of koumiss, for which he also appreciated. Along with this, the drink is widely used to fill the shortage of vitamins and energy. It gives the body vitality, strength, stimulates the nervous system and helps to normalize metabolic processes in the body.

The content of the beverage alcohol, lactic acid and carbon dioxide stimulates the appetite and improves digestion.

Treatment kumis appointed in some forms of tuberculosis, anemia and to restore normal intestinal microflora.

Kumysfavor will surely appreciate those who suffer from the hangover. The drink is not only perfectly eliminates the causes of this condition, but also quenches thirst and gives strength.

Known benefits kumys and stomach: the regular use of a drink has a positive effect on the secretory activity of the digestive system, helps with gastric ulcer and dysentery.

According to some useful properties kumys allow you to use it as a means to help slow the progression of neoplastic processes in the body.

Raising the level of hemoglobin, leukocyte improvement, prevention of cardiovascular diseases - here's a small list of properties attributed to this drink.

It is also noteworthy that the application is not limited kumys age. It is equally useful for children and adults. It is not recommended to use it only for people with individual intolerance to the product, as well as those who suffer from diseases of the gastrointestinal tract in the acute form.

Health benefits of probiotics

Bacteria have a reputation for causing disease, so the idea of tossing down a few billion a day for your health might seem — literally and figuratively — hard to swallow. But a growing body of scientific evidence suggests that you can treat and even prevent some illnesses with

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

foods and supplements containing certain kinds of live bacteria. Northern Europeans consume a lot of these beneficial microorganisms, called probiotics (from pro and biota, meaning "for life"), because of their tradition of eating foods fermented with bacteria, such as yogurt. Probiotic-laced beverages are also big business in Japan.

Enthusiasm for such foods has lagged in the United States, but interest in probiotic supplements is on the rise. Some digestive disease specialists are recommending them for disorders that frustrate conventional medicine, such as irritable bowel syndrome. Since the mid-1990s, clinical studies suggest that probiotic therapy can help treat several gastrointestinal ills, delay the development of allergies in children, and treat and prevent vaginal and urinary infections in women.

Self-dosing with bacteria isn't as outlandish as it might seem. An estimated 100 trillion microorganisms representing more than 500 different species inhabit every normal, healthy bowel. These microorganisms (or microflora) generally don't make us sick; most are helpful. Gut-dwelling bacteria keep pathogens (harmful microorganisms) in check, aid digestion and nutrient absorption, and contribute to immune function.

Probiotics benefits

Not all probiotics are the same. Different strains of the bacteria have different effects. For example, one strain may fight against cavity-causing organisms in our mouths and don't need to survive a trip through our guts.

Research has been promising for these friendly critters. Potential benefits of probiotics have been seen in the treatment or prevention of

diarrhea
irritable bowel syndrome
ulcerative colitis
Crohn's disease
H. pylori (the cause of ulcers)
vaginal infections
urinary tract infections
recurrence of bladder cancer
infection of the digestive tract caused by Clostridium difficile
pouchitis (a possible side effect of surgery that removes the colon)
eczema in children.
Probiotics and gastroinstestional issues

The best case for probiotic therapy has been in the treatment of diarrhea. Controlled trials have shown that Lactobacillus GG can shorten the course of infectious diarrhea in infants and children (but not adults). Although studies are limited and data are inconsistent, two large reviews, taken together, suggest that probiotics reduce antibiotic-associated diarrhea by 60%, when compared with a placebo.

More common than diarrhea is the opposite problem — constipation. In a search for studies on the benefits of probiotocs in treating constipation, researchers found that probiotics slowed

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

"gut transit time" by 12.4 hours, increases the number of weekly bowel movements by 1.3, and helped to soften stools, making them easier to pass. But the jury is still out on specific recommendations when ot comes to the benefits of probiotics for constipation.

Probiotic therapy may also help people with Crohn's disease and irritable bowel syndrome. Clinical trial results are mixed, but several small studies suggest that certain probiotics may help maintain remission of ulcerative colitis and prevent relapse of Crohn's disease and the recurrence of pouchitis (a complication of surgery to treat ulcerative colitis). Because these disorders are so frustrating to treat, many people are giving probiotics a try before all the evidence is in for the particular strains they're using. More research is needed to find out which strains work best for what conditions.

Probiotics and vaginal health

Probiotics may also be of use in maintaining urogenital health. Like the intestinal tract, the vagina is a finely balanced ecosystem. The dominant Lactobacilli strains normally make it too acidic for harmful microorganisms to survive. But the system can be thrown out of balance by a number of factors, including antibiotics, spermicides, and birth control pills. Probiotic treatment that restores the balance of microflora may be helpful for such common female urogenital problems as bacterial vaginosis, yeast infection, and urinary tract infection.

Many women eat yogurt or insert it into the vagina to treat recurring yeast infections, a "folk" remedy for which medical science offers limited support. Oral and vaginal administration of Lactobacilli may help in the treatment of bacterial vaginosis, although there isn't enough evidence yet to recommend it over conventional approaches. (Vaginosis must be treated because it creates a risk for pregnancy-related complications and pelvic inflammatory disease.) Probiotic treatment of urinary tract infections is under study.

Probiotics are generally considered safe — they're already present in a normal digestive system — although there's a theoretical risk for people with impaired immune function. Be sure the ingredients are clearly marked on the label and familiar to you or your health provider. There's no way to judge the safety of unidentified mixtures**.**

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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FOOD AND AGRICULTURAL MICROBIOLOGY

UNIT -III **OPTION 1**

Which of the following toxin causing botulism is less toxic to human beings?	Type A
Which of the following is a food infection?	Salmonellois
The staphylococcal intoxication refers to pres	an enterotoxin
A bacterial food intoxication refers to	illness caused by presence of pathogens
The method of successful treatment of botulis	antibiotic
Botulism is caused by the presence of toxin de	*Clostridium tyrobutyricum*
Salmonellois is caused by the	enterotoxin of *Salmonella* spp
Group I *C. botulinum* strains generally includes in	all types of strains (proteolytic)A, B and F
The application of Gamma rays destroys botul	73 Gy
The *Bacillus* cereus causes gasteroenteritis by	cell growth
Staphylococcal intoxication is caused by the toxin in the food from	*Staphylococcus aureus*
What is the main type of micro-organism resp	Bacteria
Common food poisoning microbes are_____	Clostridium and Salmonella

Botulism prevention involves_____	Proper heat sterilization before food canning
Clostridium perfingens poisoning is associated with_____	meat products
Clostridium perfingens poison is an _____	exotoxin
Which of the following statements are true regarding Staphylococcus food poisoning_____	is an enterotoxin
Salmonellois involves _____	an enterotoxin and exotoxin
The major carrier of Salmonellosis are _____	meat and eggs
Aflatoxin is produced by _____	Aspergillus sp.
Botulism is caused by _____	Clostridium botulism

Which of the following statements are regarding botulinal toxin _____	is a neurotoxin
Human beings and animals are directly or indirectly the source of the contamination of food with _____	Salmonella
The disease gastroenterities caused by C. perfringens was first reported in the year___-	1952
The incubation period of Vibrio parahaemolyticus infection is _____	2-48 hrs
The etiologic agent of diarrheal syndrome is ____	Shigellosis
The sore and throat symptom caused by _____ etiologic agent	Streptococcus pyogenes
The control measure of foods that cause disease by Vibrio parahaemolyticus infection is to _____	reheat left over
The symptoms such as nausea and dehydration is caused by _____	Shigella sonnei
Entheropathogenic Escherischia coli infection is involved in ____ foods	vegetables
The etiological agent of Arizona infection is ____	Vibrio
The optimal temperature for growth of Shigellosis is _____	27 °C
Yersinia enterocolitica is a small _____ shaped bacteria	cocci
Nursery epidemics diarrheal disease in infants was implicated in the year _____	1950
The term heat tolerant is a misnomer and refers to growth at ___ temperature	37 °C
_____ is associated with warm blooded animals	C. jejuni
Miller and Kolurger examined forty environmental isolates of P. shigelloides in the year _____	1987
Aeroonas hydrophillia is a gram negative motile rods which are ubiquitous in ____	air

The toxin patulin is produced by _____fungi	Penicillium expansum
The mold Penicillium islandicum produces _____ toxin	Luteoskyrin
In the early _____ numerous surveys have been conducted on the detection aflatoxins in foods	1980s
The _____ virus enters a person through oral route in the fecal contamination of food	Poliomyelitis
The mode of transmission of poliomyelitis is _____	food
The pH near ____ favors C. botulinum	neutrality
The growth of Staphylococcus aureus on solid media is usually ____ in color	red
The term ___ is used to distinguish strains of different antigenetic complements	biovars
Depending on the food and the serotype the _____ values from 0.06 to 11.3 min	D50 C
_____ organism can be isolated from seafoods and sea water	Vibrio cholerae
Pathogenecity involves the release of a _____ endotoxin which affects the intestinal mucosa	lipopolysaccharides
The incubation period of Streptococcus faecalis is _____	5 to 10
The optimal pH for enteropathogenic E. coli is _____	4.0 to 5.0
A_____ refers to food borne illnesses caused by the entrance of bacteria into the body through ingestion of comtaminated food	Food infection
Typhoid fever is caused by _____	Salmonell enteritidis
_____ agencies aprove the Good house keeping institute	Commercial
The FDA and USDA cooperative is a _____ surveillance program for dry milk products	Pseudomonas
The food and Drug Administration act was amende in the year ____	1983

_____ involves the identification of ingredients and products that have effect on food safety Hazard analysis

DAIRY MICROBIOLOGY **16MBU302**

OPTION 2	**OPTION 3**
Type B	Type C
Botulism	Staphylococcal intoxication
neurotoxin	mycotoxin
food borne illness caused by the presence	both (a) and (b)
analgesic	antitoxin
Clostridium sporogenes	*Clostridium botulinum*
endotoxin of *Salmonella* spp	neurotoxin of *Salmonella* spp
all types of strains (non-proteolytic) E an	all types of strains (proteolytic)C, D and F
73 Rad	7.3 Mrad
cell autolysis	cell permeation
S. cerevisiae	*S. thermophillus*
Mould	Virus
Clostridium and E. coli	E. coli and Salmonella

addition of chemical preservatives	Proper low temperature treatment before food canning
vegetables	canned foods
enterotoxin produced during sporulation	endotoxin
causes gastroenteritis	is produced by Clostridium botulinum
an enterotoxin and cytotoxin	is produced by Staphylococcus aureus
meat and fish	eggs and fish
Salmonella sp.	Fusarium sp.
All Clostridium species	Clostridium tetanai

water soluble exotoxin	is produced by Clostridium botulinum
Staphylococcus	Bacillus
1961	1978
5-24 hrs	40 hrs
Yersiniosis	Bacillus cereus
Staphylococcus aureus	Bacillus anthrax
sanitize equipment	control files
Yersinia	Arizona
apple cider	ice creams
E. coli	Arizona
37 °C	40 °C
chain	rod
1940	1962
40 °C	42 °C
C. botulinum	C. perferigens
1982	1980
soil	water

Fusarium	Aspergillus flavus
aflatoxin	penicillic acid
1940s	1950s
Hepatitis	Adeno
air	contaminated water
alkalinity	acidic
brown	pink
serovar	herbivore
D40 c	D60 c
Vibrio vulnificus	Vibrio parahaemolyticus
monosaccharides	polysaccharides
2 to 10	2 to 18
7.0 to 7.5	3.0 to 4.0
food poisoning	food intoxication
Salmonella infantis	Salmonella typhi
State	Federal
E. coli	Salmonella

critical control points

fishery service

OPTION 4	**ANSWER KEY**
Type D	Type B
Tetanus	Salmonellois
exotoxin	an enterotoxin
food poisoning	food borne illness caused by the presence of a bacteri
antipyretic	antitoxin
Bacillus	*Clostridium botulinum*
exoenterotoxin of *Salmonella* spp	endotoxin of *Salmonella* spp
none of the above	all types of strains (proteolytic)A, B and F
173 Rad	7.3 Mrad
cell damage	cell autolysis
none of these	*Staphylococcus aureus*
Parasite	Bacteria
	Clostridi
	um and
Clostridium and	Salmonel
Streptococcus	la

freezing	Proper heat sterilization before food canning
fish products	meat products
enterotoxin produced during vegetative phase	enterotoxin produced during sporulation
Both a and b	Both a and b
endotoxin	an enterotoxin and cytotoxin
eggs and fruits	meat and egs
Streptococcal sp.	Aspergillus sp.
Clostridium subtilis	Clostridium botulinum

caused by Staphylococcus	is produced by Clostridium botulinum
E. coli	Salmonella
1945	1945
37 hrs	2-48 hrs
Vibrio	Bacillus cereus
E.coli	Streptococcus pyogenes
pastuerization	sanitize equipment
E.coli	Shigella sonnei
cheese	cheese
Streptococcus	Arizona
50 **°C**	37 °C
bacilli	rod
1980	1940
25 °C	42 °C
E. coli	C. jejuni
1986	1986
land	water

Mucor	Penicillium expansum
roquefortine	Luteoskyrin
1960s	1960s
Herpes	Hepatitis
all of these both b and c	contaminated water neutrality
yellow	yellow
none of these	serovar
D30 c	D60 c
All of these	vulnificus
peptidoglycon	lipopolysaccharides
8 to 12	2 to 18
8.0 to 9.0	7.0 to 7.5
contamination Salmonella typhimurium	food infection Salmonella typhi
Private	Private
Vibrio	Salmonella
1988	1980

research and development service	Hazard analysis

al toxin formed in food

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(Deemed University Established Under Section 3 of UGC Act, 1956)
Eachanari PO, Coimbatore -641 021, India.

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Lecture Plan

Unit - IV

S. No	Duration	Topic	Reference
1.	1	Causative agents foods involved symptoms of Staphylococcus aureus, C. botulinum	
2.	1	Mycotoxins	
3.	1	Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*	
4.	1	*E.coli*, Salmonellosis and Shigellosis	
5.	1	*Yersinia enterocolitica* and *Listeria monocytogenes*	
6.	1	Food infection *Campylobacterijejuni*	
7.	1	Fungal diseases- Toxin	
8.	1	Unit revision	
		Total Hours	**8**

R1: Frazier, W.C and D.C, Werthoff, 1995. Food Microbiology. Tata McCraw. Hill Publishing Company limited. New Delhi

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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Eachanari PO, Coimbatore -641 021, India.

FOOD AND AGRICULTURAL MICROBIOLOGY

16MBU302

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

UNIT – 4

Food poisoning is a term customarily applied to represent the illness caused both by the ingestion of toxins produced by the organisms in the food as well as resulting from the infection of the host by the organisms carried in by the food. But, more correctly, all food-borne diseases can be classified into two categories: 'food-poisoning' or 'food-intoxications' and 'food-infections'. Food-poisoning or food-intoxication diseases are those which are caused by the consumption of toxins produced by organisms in the food whereas food-infection diseases are those trial are caused by the organisms which enter into the body through ingestion of contaminated food.

Microbial 'Food-poisoning' or 'Food-intoxications'

Bacterial "Food-Poisoning" (Bacterial food-intoxications)

There are two major food-poisonings or food-intoxications caused by bacteria. These are: **Botulism** and **Staphylococoal poisoning**.

a. Botulism

Botulism is caused by the ingestion of food containing the neurotoxin (toxin that affects the nervous system) produced by Clostridium botulinum, an anaerobic spore forming bacterium. Sixty to seventy percent-cases of botulism die. There are 7 types (type A,B,C, D,E,F,G) of these neurotoxins recognized on the basis of serological specificity. The neurotoxin of C. botulinum is a protein. It has been purified and crystallized and is so powerful that only a does as low as 0.01 mg is said to be fatal to human being. The toxin is absorbed mostly in the small intestine and paralyzes the involuntary muscles of the body.

Source

The main sources of botulism are canned meat, fish, string beans, sweet corn, beets and other low medium acid foods. The foods implicated are generally those of a type that have undergone some treatment intended for the preservation of the product such as canning, pickling or smoking, but one which failed to destroy the spores of this bacterium. When the intended preservative treatment is inadequate and is followed by storage conditions which permit the germination and growth of the microorganisms, one of the most lethal toxins known to humanity is produced, The toxin has been known to persist in foods for long periods, especially when storage has been at low temperatures. It is unstable at pH value above 6.8.

Temperature is considered to be the most important factor in determining whether toxin production will take place and what the rate of production will be. Various strains of C. botulinum types A and B vary in their temperature requirements; a few strains grow at 10 to 11 °C. However, the lowest temperature for germination of spores of most of the strains is 15 °C and maximum of 48 °C.

Symptoms

Symptoms generally occur within 12 to 36 hours after consumption of the spoiled food. Early symptoms are digestive disturbances followed by nausea, vomiting, diarrhea together with dizziness and headache. Double vision may occur early and there may be difficulty in speaking. Mouth may become dry, throat constricted; tongue may get swollen, and coated. Involuntary Muscles become paralyzed and paralysis spreads to the respiratorysystem and to the heart. Death normally results from respiratory failure.

Prevention

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Canned food should be properly processed by using approved heat processes.
Avoiding food that has been cooked but not well heated.Raw foods, frozen foods thawed and held at room temperature should be avoided. Gassy and spoiled canned foods should be rejected.Boiling of suspected food for at least 15 minutes.

Treatment:

Successful treatment is by the administration of polyvalent antitoxin in the early stages of infection. Once the symptoms appear the fails to proveuseful.

b. Staphylococcal-poisoning:

This is the most common type of food-poisoning caused due to the food contaminated with a potent toxin namely, **enterotoxin.** This toxin is produced by certain strains of Staphylococcus aureus. A sudden onset of illness starts usually within 3to 6 hours after ingestion of the contaminated food.

Source

These bacteria are commonly present on the skin, nose and other parts of human body. People who handle foods carelessly usually transfer them to the food. Foods most commonly contaminated involve those which are eaten cold, e.g., cold meat, poultry, salads, bakery products etc.

Symptoms

As said earlier, the disease starts within 3 to 6 hours after ingestion of the contaminated food and is manifested by nausea, vomiting, abdominal pain and diarrhoea within 24 to 48 hours. If the case becomes severe, dehydration and collapse may follow. However, in usual conditions death is rare.

Control

The disease can be controlled by preventing the entry of the bacteria to food. It is important that all susceptible foods are kept under refrigeration to restrict the growth of the bacteria; and also by the destruction of the bacteria.

Bacterial Food Infections

a. Salmonellosis

This disease is caused through the ingestion of Salmonella bacteria present in food. A large number of species and serotypes are involved. An inoculum of about 600,500 cells is required to become established and cause illness in the host. These bacteria are gram-negative, non-spore forming rods and motile by means of peritrichous flagella. Various species of Salmonella get ingested with improperly cooked eggs, puddings and meat that have been contaminated by the carriers. The carriers may be cats, dogs, chickens and others.

The disease appears through gastrointestinal infections as a result of the growth of the bacteria in the intestine. Typical symptoms of salmonellosis are nausea, vomiting, abdominal pain and diarrhoea. Generally the symptoms persist for 2 to 4 days. The incubation period ranges between 4 to 36 hours.

Salmonellosis can be prevented by avoiding consumption of contaminated food, by heat destruction of the bacteria, or by refrigeration to check the growth of bacteria.

b. Perfringens poisoning

The disease caused by the strains of Clostridium perfringenes is called ‘perfringens poisoning’ or more technically, ‘Clostridium perfringens - gastroenteritis’. This bacterium is a

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

gram-positive, anaerobic non-motile, spore former with an optimum growth temperature of 37-43°C.

This disease has been caused by the ingestion of prepared meat, meat products and poultry. Generally, the meat that has been cooked and allowed to cool slowly before consumption allows the growth of these microorganisms. What happens is that the cooking destroys only the vegetative cells not the spores. The latter survive the heating applied during cooking and germinate into vegetative cells. It could be avoided by adequate refrigeration of the food.

Symptoms

Symptoms appear in the form of diarrhoea, acute abdominal pain and, rarely, vomiting when the, growth of microorganisms takes place in the human intestine. Disease manifestation occurs between 8 to 22 hours after the contaminated food has been taken.

Prevention

Prevention of the disease includes rapid cooling of cooked meats and other foods and reheating of the remaining food before further consumption.

Bacillus cereus gastroenteritis

Bacillus cereus is a gram-positive, aerobic, rod-shaped, spore forming bacterium that causes food infections called 'gastroenteritis'. Its spores are heat resistant and remain viable even after considerable degree of cooling; germinate and produce vegetative cells. It is believed that the bacterial cells undergo lysis in the intestinal tract and release enterotoxin.

Escherichia coli gastroenteritis

Escherichia coli bacterium is generally regarded as a part of the natural flora of the human and animal intestinal tract. In recent years, however, various serotypes of this bacterium have been thought responsible for human and animal diarrhoeal diseases. These bacteria can be classified into two groups: one group representing enteropathogenic E.coli and the other representing enterotoxin producing E. coli.

The enteropathogenic E. coli are pathogenic within the intestinal tract. They have ability to penetrate epithelial cells of the intestinal mucosa, cause spithelial necrosis and ulceration resulting in the presence of red blood cells and large number of neutrophils in the stool during dysentery. This acute gastroenteritis (dysentery-like syndrom) is generally reported in the new-born and in infant up to two years of age.

The enterotoxin-producing E. coli fails to invade the intestinal mucosa but release an enterotoxin which causes diarrhea like syndrome. The latter refers to a profuse watery discharge generally from the small intestine. Since these bacteria do not penetrate and cause epithelial necrosis, red blood cells and neutrophils are not present in the diarrheal stool.

Foods which are highly contaminated or inadequately preserved allow the growth of such E. coli serotypes. The latter are heat sensitive and can be destroyed by pasteurization or by proper cooking methods.

Cholera

This disease, generally called 'asiatic cholera', is caused by Vibrio cholerae and has been the cause of untold suffering and death. The symptoms include vomiting and profuse diarrhoeal (rice-water) stools which result in mineral deficiency, dehydration and increased blood acidity of the body tissues leading, finally, to the death.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Vibrio cholerae is a gram-negative, uniflagellate bacterium and is transmitted through contaminated flies, water, raw and exposed foods etc. They find their way through mouth into the intestines and produce endotoxins which disintegrate the epithelial cells of the intestines. Death rate is rather high and the course of the disease may be as short as 12 hours after the onset of the first symptoms. Individuals recovering from infection are said to be effective in controlling the disease. Cholera patients should be kept in quarantine and all materials contaminated by faeces burnt for checking infection spread.

Yersinia enterocolitica

This rare form of food poisoning occurs as a result of eating contaminated food, in particular undercooked pork. This results in those all too familiar symptoms of nausea, abdominal pain and diarrhoea which characterise most cases of food poisoning.

This type of illness affects both children and adults although children are affected more than adults. Anyone in a high risk group such as the elderly or those with a weakened immune system is also susceptible.Theyersinia enterocolitica bacteria

These bacteria form part of a larger group called the ‘enterobacteriaceae’. This group also includes the E coli and salmonella bacteria.

Other similar strains include ‘yersinia pestis’(responsible for plague) and ‘yersinia pseudotuberculosis’ (tuberculosis symptoms).

Not all strains of Y enterocolitica bacteria cause food poisoning in humans. The rod shaped bacterial strain which infects humans is found in pigs but other strains are found in cattle, horses, cats and dogs.

Causes of yersinia enterocolitica poisoning

This illness develops as a result of eating raw or undercooked pork, or pork based products. Other sources of contamination include unpasteurised milk or untreated water, or contact with an infected animal.

Another factor is person to person contact. If someone who has handled food or soil which has been contaminated by infected animal faeces, touches another person then this will transfer the infection to them. This tends to happen if the infected person fails to wash their hands properly or shows a lack of attention to basic hygiene. These bacteria can be transmitted to another person via a blood transfusion but this is very rare.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Symptoms of yersinia enterocolitica poisoning

These symptoms appear several days after initial contact with the bacteria, usually around 4 days to a week. They last from 1 to 3 weeks although they may persist even longer.

Symptoms include:

Abdominal pain
Fever
Diarrhoea (often bloody)

Many older children and adults experience abdominal pain on the right had side of their bodies which along with fever, is often mistaken for signs of appendicitis.

Complications of yersinia enterocolitica poisoning

These occur in only a small number of cases. They include a skin rash, pains in the joints or the bacteria spread into the bloodstream and cause diseases such as arthritis.

Diagnosing yersinia enterocolitica poisoning

This involves a physical examination and a stool sample. The stool sample is a very common test in which a small sample of faeces is obtained and sent for laboratory analysis.

The yersinia enterocolitica bacteria are not usually tested at laboratories so any laboratory that receives this type of sample will have to be notified beforehand.

There are other tests that can be done to confirm a diagnosis which include blood, urine and swabs taken from the throat.

Treatment for yersinia enterocolitica poisoning

Most cases resolve themselves without the need for treatment. But if they require some extra help then bed rest and consuming plenty of liquids will help.

This will also prevent against dehydration which is always a risk in food poisoning cases, usually due to the frequent bouts of vomiting and /or diarrhoea.

One way of dealing with this is to purchase re-hydration powders from a local pharmacy. These powders contain electrolytes which are a replacement for essential vitamins and minerals which have become depleted as a result of this illness.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Antibiotics are not usually prescribed unless symptoms are severe or complications have arisen.

Preventing yersinia enterocolitica poisoning

There are a few measures you can take to prevent this illness. These include:
Ensure that all pork is cooked at the correct temperature and cooking time. Do not eat undercooked pork.
Wash your hands with soap and water before and after handling food.
Use separate utensils, chopping boards and containers for raw and cooked foods.
Store raw food away from cooked food

Listeria Monocytogenes

This is the name given to the bacteria which causes listeria food poisoning. These bacteria are rod shaped in appearance and is one of the most dangerous forms of pathogenic bacteria known to humans.

These bacteria are found in poultry, sheep, cattle, dairy foods, fruit and vegetables. They enter the body via the gastrointestinal tract and release toxins which damage cells within the body. It also spreads through the bloodstream where it particularly targets the nervous system.

However it is considered a rare form of food poisoning and one that is treatable. But, it is nevertheless, a serious type of food poisoning which is particularly dangerous for pregnant women, the elderly and anyone with poor immunity.

Foods which contain the listeria bacteria

These bacteria are usually found in soft cheeses such as Brie or Camembert but it also appears in the following foods:

Pates
Butter
Ice cream
Sliced meats
Poultry, e.g. cooked chicken

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Smoked salmon (packaged)
Packaged sandwiches
Unpasteurised milk
Canned fish
Unwashed fruit and vegetables

Listeria is a tough, durable type of bacteria which can resist extremes of temperature much better than other bacteria. It even thrives at temperatures of minus 24 Fahrenheit which means that it is able to survive refrigeration.

Refrigeration usually kills off most strains of bacteria but listeria appears to have a stronger than normal survival instinct in this respect.

Causes of listeria food poisoning

Listeria is caused by consuming food which has been contaminated by the listeria monocytogenes bacteria. These bacteria invade cells within the lining of the intestinal walls and releases toxins which cause an infection.

These bacteria are able to travel throughout the body but are particularly attracted to the nervous system. This leads to a range of health problems such as meningitis and septicaemia.

These bacteria are found in a variety of foods which include processed ready meals, side salads such as coleslaw (mixed vegetables in mayonnaise), cooked poultry and canned fish.

But one of the biggest high risk foods is soft cheese. These include Brie, Camembert, Ricotta and Feta and have been highlighted as one of the main causes of listeria food poisoning.

Symptoms of listeria food poisoning

The time between the consumption of the contaminated food and the appearance of the first symptoms is known as the ‘incubation period’.With listeria, the symptoms take much longer to appear than with most other types of bacteria. In fact, it can be 8 weeks before the symptoms develop. Symptoms usually appear after a month which appears to be the average.

The symptoms start off as relatively mild but soon worsen once the immune system has been infected. They include:

Fever
Nausea
Vomiting

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Diarrhoea
Muscle aches and pains
Tiredness
Loss of appetite
These are the initial symptoms of listeriosis and in many ways will feel like a bad case of ‘the flu’.

But if the infection has affected the immune system it will cause the following symptoms:

Poor balance
Lack of co-ordination
Severe headaches
Stiff neck
Seizures\
Confusion

Meningitis or septicaemia is likely to develop if the infection has spread to the brain or throughout the bloodstream.

Listeria food poisoning and pregnancy

The group of people who are at a very high risk of listeriosis are pregnant women.

If a women contracts listeria food poisoning during her pregnancy then she will experience the symptoms mentioned above but these may be relatively mild

However, the risks to the unborn baby are anything but mild.

These bacteria are able to transfer from the mother to the baby via the placenta or at birth. If this happens they will enter the baby’s bloodstream and once there, will cause a serious infection.

This will result in either a stillborn baby or a miscarriage.

Pregnant women appear to be a greater risk of listeria food poisoning than other women which means that they need to take greater care about what they eat and food safety in general.

This is covered in more detail in our pregnancy and food poisoning section.

Other high risk groups and listeria food poisoning

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

These include people who have undergone a transplant; cancer treatment, e.g. chemotherapy; who suffer from HIV or AIDS or have kidney or liver disease. This is because their immune systems are less effective at fighting off bacteria which cause infections such as listeriosis.People in any of these groups are more likely to develop a serious form of this illness and/or complications.

Diagnosing listeria food poisoning

Contact your GP if you have developed symptoms of this illness within the last month or two. Do this if you are in a high risk group, for example, you suffer from diabetes.

A blood test can detect the symptoms of listeria food poisoning. Another equally useful test is a spinal fluid test.

Treatment for listeria food poisoning

Listeriosis can be treated with antibiotics. If this food poisoning has occurred during pregnancy then antibiotics will be given to the mother as soon as possible to prevent the risk of the infection spreading to the unborn baby.Antibiotics are also prescribed if a newborn baby exhibits these symptoms although it may be given a different type or combination compared to an adult.

Preventing listeria food poisoning

There are a few measures you can take to avoid the risk of you contracting this form of food poisoning. These are especially important if you are pregnant or have a poorly functioning immune system.

They include:

Avoid eating canned meats and meat based products such as ham, luncheon meat and hot dog sausages.
Avoid soft cheeses such as Brie unless you know that they have been produced from pasteurised milk.
Avoid canned fish or pates.
Wipe kitchen surfaces, utensils and containers after use.
Store raw and cooked food separately

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Campylobacter jejuni

This is the most common type of food poisoning which affects people in many countries around the world. The campylobacter bacteria cause a range of gastrointestinal illnesses but it is more commonly known for causing food poisoning.Campylobacter food poisoning affects anybody but there are certain groups of people who are particularly vulnerable to this illness. These include children, the elderly and anyone who has a weak immune system.

It occurs as a result of eating foods which have been contaminated by these bacteria. These bacteria do not grow within food but are transmitted to the human body via consumption of this food. Once there they cause an extremely unpleasant disease.This illness is also known as 'campylobacteriosis'.

The Campylobacter bacteria

These bacteria have a spiral shape and are classed as a pathogenic type of bacteria. This means that they act as a type of 'germ'which causes disease in its surrounding environment.In this case the surrounding environment is the human gastrointestinal tract.

Foods which contain the campylobacter bacteria

The worst offender is chicken but it also found in other type of poultry such as turkey, duck and goose. It also occurs in these types of foods:

Red meat
Pork
Lamb
Offal, e.g. liver
Shellfish
Eggs
Fresh fruit and vegetables (unwashed)
These bacteria are also found within unpasteurised milk or unchlorinated water.

Causes of campylobacter food poisoning

There are several ways in which this bacteria causes food poisoning. These ways or 'methods of transmission' refer to how the bacteria get into the human body and cause an infection.

The most obvious method is through eating contaminated food or drinking infected water.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Other methods include a failure to wash the hands after coming into contact with infected faeces and contact with infected birds and animals. This often occurs after touching or stroking an infected pet, e.g. a dog or contact with its infected faeces.

Another factor is person to person contact.

These bacteria are able to access the gastrointestinal tract where they invade the cells within the lining of the intestines. They are aided in this by the release of a toxin. This toxin prevents the cells from reacting to this attack by stopping them from dividing which would trigger a response from the immune system.This gives the bacteria a short amount of survival time within the cells which enables it to cause damage within that area.

Symptoms of campylobacter food poisoning

The 'onset'of these symptoms refers to the period of time between initial contact with the bacteria and the appearance of the symptoms.

This is also known as the 'incubation period'.

With campylobacter food poisoning the incubation period is usually around 2 to 5 days but there are exceptions to this. In some cases the symptoms appear after little more than 2 days or as long as 10 days.This illness usually lasts for a week but may persist for up to 3 weeks in severe cases.

Symptoms of this food poisoning include:

Diarrhoea (this may be bloody)
Fever
Abdominal pains
Muscle aches
Headache

Vomiting is another symptom although this tends to be rare. Some people do experience nausea and vomiting but the most frequent symptom is diarrhoea. This can be severe and often bloody.

Diagnosing campylobacter food poisoning

A stool sample (sample of faeces) will determine if you have campylobacter food poisoning. It is a simple test in which you provide a sample of your stool which is then sent away to a laboratory for analysis.The results of this analysis will confirm or reject this diagnosis.

Treatment for campylobacter food poisoning

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

This involves plenty of rest and fluids.

It is important that you consume plenty of fluids to replace those lost during this illness. But what is equally important is replacing those vitamins and minerals lost due to severe diarrhoea and/or vomiting.

These electrolytes as they are known can easily be replaced. There are 'oral rehydration therapy' sachets you can purchase –either at a local pharmacy or online which you add to water or some other fluid. These are a quick and easy way of topping up your electrolyte levels.

This works with mild cases but if you have a severe form of food poisoning then intravenous fluids will be required. These are administered in hospital.

Hospital treatment is only required for people who are considered a 'high risk'group, for example, the very young, the very old and those people who have a weakened immune system.

Antibiotics can also help although there is evidence to show that some strains of bacteria have developed a resistance to them. However they are useful, particularly in severe cases and significantly shorten the period of illness.

Complications of campylobacter food poisoning

Most cases clear up without any problems but there are a few situations in which people experience a relapse. This means a reoccurrence of the symptoms or long term complications such as 'Guillain-Barre Syndrome'.

Guillain-Barre Syndrome is a disease which affects the nervous system and may leave some people with permanent damage.

Another complication is 'Miller Fisher Syndrome'. This is another neurological disorder which affects the nerves within the head rather than the rest of the body (as in Guillain-Barre Syndrome).

Then there is a chronic condition called reactive arthritis or 'Reiter's Syndrome' which commonly affects the knee joints and the bottom of the spine. This occurs in people who have a marked genetic tendency, for example they have a particular antigen which predisposes them towards this disorder.

Prevention of campylobacter food poisoning

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Washing food and vegetables before use. This applies to foods which have been purchased at an outdoor market.

Ensure that meat and poultry have been properly defrosted before use. Also ensure that they are cooked through before consumption.

Avoid unpasteurised milk

Prevent cooked foods coming into contact with uncooked foods. This is known as ‘cross contamination.

Wash your hands before and after handling food; visiting the bathroom and after stroking or touching a pet or farm animal.

Consider buying irradiated foods. These are foods which undergo a form of heat treatment which kills off any bacteria without affecting the taste or texture of the food.

Differentiate between the major types of food borne diseases -- infection, intoxication, and toxin-mediated infection.

Microbiological hazards cause most foodborne diseases in the United States. The three microbiological hazards of concern are bacteria, viruses, and parasites. These microorganisms can cause one of three types of illness -- infection, intoxication, or toxin-mediated infection.

Infection

A foodborne disease is when a person eats food containing harmful microorganisms, which then grow in the intestinal tract and cause illness. Some bacteria, all viruses, and all parasites cause foodborne illness via infection. The foodborne bacteria that cause infection are: Salmonella spp., Listeria monocytogenes, Campylobacter jejuni, Vibrio parahaemolyticus, Vibrio vulnificus, and Yersinia enterocolitica. The most common viral agents that cause foodborne disease are: Hepatitis A, norovirus, and rotavirus. The most common foodborne parasites are: Trichinella spiralis, Anisakis simplex, Giariaduodenalis, Toxoplasma gondii, Cryptosporidium parvum, and Cyclosporacayetanensis.

Intoxication

An intoxication results when a person eats food containing toxins that cause illness. Toxins are produced by harmful microorganisms, the result of a chemical contamination, or are naturally part of a plant or seafood. Some bacteria cause intoxication. Viruses and parasites do not cause food borne intoxication. The foodborne bacteria that cause intoxication are: Clostridium botulinum, Staphylococcus aureus, Clostridium perfringens, and Bacillus cereus. Chemicals that can cause intoxication include cleaning products, sanitizers, pesticides and metals (lead, copper, brass, zinc, antimony, and cadmium). Seafood toxins include ciguatera toxin, scombroid toxin, shellfish toxins, and systemic fish toxins. Plants and mushrooms can also cause intoxication.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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II –B.Sc Microbiology (Batch 2016-2019)

Lecture Plan

Unit - V

S. No	Duration	Topic	Reference
1.	1	Culture and rapid detection methods of food pathogens	
2.	1	Introduction to predictive microbiology	
3.	1	HACCP and FSSAI	
4.	1	Indices of food sanitary	
5.	1	Quality of food products	
6.	1	Quality of sanitizers used and types	
7.	1	Unit revision	
8.	1	Old question paper discussion	
		Total Hours	**8**

R1: Frazier, W.C and D.C, Werthoff, 1995. Food Microbiology. Tata McCraw. Hill Publishing Company limited. New Delhi

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

UNIT IV

The concentration of salt used in high protein containing vegetables is _____

_____ is a term used to label foods treated with low level ionizing radiation

Flavoring etracts such as vanilla and lemon etracts are preserved by their content of ____

Which of the following statements are true about chemical preservatives _____

The time temperature combination for HTST paterurization of 71.1°C for 15 sec is selected on the basis of

_____ contains a large number of olatile compounds that may have bacteriostatic and bactericidal effect

_____ has been used as starter culture in fermented sausages

_____ is used most extensively in the prevention of mold growth and rope development in baked goods

_____ can be dried by a process called explosive puffing

_____ in 1765 preserved food by heating it in a sealed containers

Combination of _____ irradiation with chilling storage helps preserve foods

Which solvent is commonly used to determine fat content

During _____ the internal temperature of bread, cake or other bakery products approaches but neve reache

Pasteurization is done to kill

Sanitising is_____

The simplest dryer is the _____

Bacteria which is present in raw or undercooked meat, eggs, sea food and unpasteurized milk is

Milk and curry left over can be turned into sour and spoiled at

_____ rays are streams of electrons emitted from radioactive materials

Increase in the concentration of dissolved substances like sugar and salt helps in _____ of the food mate

Sulfur stinker spoilage of canned food is caused by

Radiation dose in kilograys of ____ inhibits sprouting in potatoes, onions and garlic

Preservation affects the growth of microorganism by

Souring of canned meat is caused by _____.

Significant numbers of S. aureus in a food can be determined by examining the food

To retard the contamination and other microbial growth in meat is obtained by storing at _____ tempe

Gazing at ultraviolet lamps produces irritation of the ____ within few seconds

Sugars act as preservatives due to their ability to

The minimal pH for the growth of staphylococcus is about ----------

_____ alcohol is used as coagulant and enaturizer of cell proteins

The fumes of burning ____ are used to treat light colored dehydrated fruits

_____ can be used to control bacterial and fungal growth in tapholes of maple tree

Christophersen classified microroganisms on the basis of sensitivity to freezing in the year_____

The percentage fat constituent of double toned milk is

---------- is mostly used preservative to prevent mold growth

_____ solvent is poisonous and should not be added to foods

_____ drying is limited to climates with a hot sun and dry atmosphere to fruits

Food should be cooked to which temperature?

The sclerotia from a species of Penicillium can survive a heat treatment of ____

The sodium salt of _____ acid has been used extensively as an antimicrobial agent in foods
Fruit juice is sterilized by _____.
Pasteurization is a _____
The reddish liquid comes out from meat on thawing process is called as
The spoilage organism bring about the spoilage of meat by
The minimum growth temperature of Bifidobacteria range from
_____ acid is used in soft drinks such as colas
_____ freezing usually refer to freezing in air with only natural air circulation
Jones and Loackhead found enterotoxin forming Staphylococci in _____food
_____ from retail market contain from 0 to2 million bacteria per piece
---------- is a storage method uses bins or boxes for equalization of moist
To retard the contamination and other microbial growth in meat is obtained by storing at _____ tempe
_____organic acid is used in syrups, drinks, jam and jellies
Food preservation involves_____
97 to 99 % of *E.coli* in air were killed in ____ seconds with a 15 watts lamp
_____ is used as treatment for wrappers use don butter
_____ temperature are more lethal
About ____ percent of the suspected samples contained viable spores
Sugars act as preservatives due to their ability to
_____organic acid is used in syrups, drinks, jam and jellies
Sanitising is_____
_____ is used most extensively in the prevention of mold growth and rope development in baked goods

OPTION 1	OPTION 2	OPTION 3
4.3-10.3	17.5-20.0	18.6-26.5
Radicidation	radurization	picowaved
sugar	salt	alcohol
microbicidal or micros	chemical preservatives often hazardous to humans	sodium benzoate is a
Coxiella Burnetii	*E. coli*	*B. subtilis*
spices	woodsmoke	formaldehyde
sweating	springer	cooling
calcium propionate	calcium sorbate	monocholroacetic ac
meat	vegetables	fruits
Spallanzani	Ruiz-Argueso	Rodrigeuz-Navarro
Ultraviolet	infra red	gamma
Ethyl alcohol	Hexane	Acetone
Heating	boiling	baking
Selective microorganis	All the microorganism	Yeast
Applying detergent to a	Done before washing	Reducing bacteria by
sun	air	heat
E.coli	*Salmonella*	*Staphylococcus*
high temperature	very low temperature	room temperature
beta	cathode	gamma
drying	freezing	moistening
E.coli	*D. nigrificans*	*Bacillus*
0.05-0.15	0.01-0.14	0.05-0.07
inhibition	retardation	arresting
thermoduric cells	thermostatic cells	thermo liable cells
RNase	thermostable nuclease	protease
10°C	0°C	100°C
eye	ear	nose
make water unavailabl	interfere with the action of proteolytic enzyme	osmotic effect
2.5	4.8	2
methanol	ethanol	butanol
sulfur	ethylene	potassium
paraformaldehyde	benzaldehyde	formaldehyde
1984	1989	1973
0.5	1.5	3
sodium propionate	springer	sorbates
propylene	ethanol	methanol
mechanical	solar	freeze
5°C	75°C	100°C
70 °C	90 to100 °C	50-60 °C

propionic	benzoic	sorbic
filteration	freezing	cooling
low temperature treatm	steaming treatment	high temperature tre
drying	wilting	bleeding
purification	oxidation	decomposition
43 to 45	25 to 28	29 to 32
phosphoric	benzoic	acetic
Sharp	slow	quick
frozen corn	cheese	bread
caramels	jellies	fudges
Sweating	Springer	Cooling
10 °C	0°C	100°C
lactic	acetic	propionic
increasing shelf life of	ensuring safety for human consumption	both a and b
40	10	50
sodium diacetate	calcium carbonate	sodium nitrate
high freezing	frozen storage	freezing rate
20	10	30
make water unavailabl	interfere with the action of proteolytic enzyme	osmotic effect
lactic	acetic	propionic
Applying detergent to a	Done before washing	Reducing bacteria by
calcium propionate	calcium sorbate	monocholroacetic ac

OPTION 4

19.2-22.2
radappertization
ethylene
all these
C. botulinum
alcohol
freezing
nitrates
juices
Christophersen
none of the above
Benzene
all of these
Yeast and its spores
Wiping all surfaces with a clean cloth
evaporator
cyano bacteria
constant temperature
X-rays
thawing
Clostridium
0.05-0.11
all the above
none of the above
thermostable DNase
-10°C
throat
both a and c
3.5
none of these
sodium
all of these
1981
4.5
acetate
glycerol
all of these
60°C
37 °C

ANSWER KEY

18.6-26.5
Picowaved
alcohol
All of these
Coxiella Burnetii
woodsmoke
springer
calcium propionate
vegetables
spallanzani
ultraviolet
Hexane
baking
Selective microorganism
Reducing bacteria by application of heat or chemical
evaporator
salmonella
room temperature
beta
drying
D. nigrificans
0.05-0.15
retardation
thermoduric cells
protease
0°C
eye
interfere with the action of proteolytic enzyme
4.8
ethanol
sulfur
paraformaldehyde
1973
1.5
sodium propionate
methanol
solar
75°C
90 to100 °C

acetic
heating
low and high temperature treatment
leakage
hydrolysis
30 to 35
sorbic
all of these
jam
candies
Freezing
-10°C
citric
none of these
30
potassium nitrite
thawing
50
both a and c
citric
Wiping all surfaces with a clean cloth
nitrates

benzoic
filteration
high temperature treatment
bleeding
decomposition
43 to 45
phosphoric
sharp
frozen corn
candies
Springer
0°C
citric
both a and b
10
sodium diacetate
high freezing
10
interfere with the action of proteolytic enzyme
citric
Reducing bacteria by application of heat or chemical
calcium propionate

KARPAGAM ACADEMY OF HIGHER EDUCATION
DEPARTMENT OF MICROBIOLOGY
(Deemed University Established Under Section 3 of UGC Act, 1956)
Eachanari PO, Coimbatore -641 021, India.

FOOD AND DAIRY MICROBIOLOGY

16MBU302

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Unit 5

Food laws and Regulations

- To meet a country's sanitary and phytosanitary requirements, food must comply with the local laws and regulations to gain market access.
- These laws ensure the safety and suitability of food for consumers.
- The requirement of food regulation may be based on several factors such as
- whether a country adopts international norms developed by the Codex Alimentarius Commission of the Food and Agriculture Organization of the United Nations and the World Health Organization or a country may also has its own suite of food regulations.
- Each country regulates food differently and has its own food regulatory framework.

Food laws in our country

The Indian Parliament has recently passed the *Food Safety and Standards Act, 200*6 that overrides all other food related laws.

Such as;

Prevention of Food Adulteration Act, 1954

Fruit Products Order,1955

Meat Food Products Order ,1973;

Vegetable Oil Products (Control) Order, 1947

Edible Oils Packaging (Regulation) Order 1988

Solvent Extracted Oil, De- Oiled Meal and Edible Flour (Control) Order, 1967,

Milk and Milk Products Order, 1992 etc are repealed after commencement of FSS Act, 2006.

Food Safety and Standards Authority of India (FSSAI)

The Food Safety and Standards Authority of India (FSSAI) has been established under Food Safety and Standards Act, 2006 which consolidates various acts & orders that have hitherto handled food related issues in various Ministries and Departments.

FSSAI has been created for laying down science based standards for articles of food andto regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.

Functions performed by FSSAI

- Framing of Regulations to lay down the Standards and guidelines in relation to articles of food and specifying appropriate system of enforcing various standards.
- Laying down mechanisms and guidelines for accreditation of certification bodies engaged in certification of food safety management system for food businesses.
- Laying down procedure and guidelines for accreditation of laboratories and notification of the accredited laboratories.
- To provide scientific advice and technical support to Central Government and State Governments in the matters of framing the policy and rules in areas which have a direct or indirect bearing of food safety and nutrition .
- Collect and collate data regarding food consumption, incidence and prevalence of biological risk, contaminants in food, residues of various, contaminants in foods products, identification of emerging risks and introduction of rapid alert system.
- Creating an information network across the country so that the public, consumers, Panchayats etc receive rapid, reliable and objective information about food safety and issues of concern.
- Provide training programmes for persons who are involved or intend to get involved in food businesses.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

- Contribute to the development of international technical standards for food, sanitary and phyto-sanitary standards.
- Promote general awareness about food safety and food standards

Bureau of Indian Standards (BIS)

- The Bureau of Indian Standards (BIS), the National Standards Body of India, resolves to be the leader in all matters concerning Standardization, Certification and Quality.

Main Activities

- Harmonious development of standardization, marking and quality certification
- To provide new thrust to standardization and quality control.
- To evolve a national strategy for according recognition to standards and integrating them with growth and development of production and exports.
- Certification of Product
- Hallmarking of Gold Jewellery.
- Quality Management System
- Environmental Management Systems
- Occupational Health and Safety Management System
- Food Safety Management System
- Hazard Analysis and Critical Control Points
- Imported Products
- Laboratory Management
- International Activities
- Training Services

AGMARK

- The Directorate of Marketing and Inspection enforces the Agricultural Produce (Grading and Marketing) Act, 1937. Under this Act Grade standards are prescribed for agricultural and allied.
- AGMARK is a Quality Certification Mark .
- It ensures quality and purity of a product.
- It acts as a Third Party Guarantee to Quality Certified.
- Quality standards for agricultural commodities are framed based on their intrinsic quality.
- Food safety factors are being incorporated in the standards to complete in World Trade.
- Standards are being harmonized with international standards keeping in view the WTO requirements. Certification of agricultural commodities is carried out for the benefit of producer/manufacturer and consumer.
- Products available under AGMARK are as follows:-

✓ Pulses
✓ Whole spices & ground spices
✓ Vegetable oils
✓ Wheat Products
✓ Milk products.
✓ Other products such as Honey, Compounded asafetida, Rice, Tapioca Sago, Seedless tamarind, Besan (Gram flour).

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

 HACCP Plan A document prepared in accordance with the principles of HACCP to ensure control of hazards which are significant for food safety in the segment of the food chain under consideration.

HACCP System: The hazard analysis critical control point system (HACCP) is a scientific and systematic way of enhancing the safety of foods from primary production to final consumption through the identification and evaluation of specific hazards and measures for their control to ensure the safety of food. HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end-product testing.

Some establishments may use **Good Manufacturing Practices (GMP)** to reduce the likelihood of certain hazards. GMPs are minimum sanitary and processing requirements. GMPs are fairly broad and general, for example, "*Training: All employees should receive training in personal hygiene."* GMPs are usually not designed to control specific hazards, but are intended to provide guidelines to help establishments produce safe and wholesome products.

- ✓ **Standard Operating Procedures (SOP)** are step-by-step directions for completing important procedures and are usually very specific. SOP may be used to address a specific hazard, for instance, an establishment may have specific preventive maintenance procedures for its processing equipment, which prevent the hazard of metal fragments.
- ✓ **Sanitation SOP (SSOP)** may be considered by establishments to reduce the likelihood of occurrence of some food safety hazards. For example, the SSOP may address washing and sanitizing of knife and hands between carcasses to reduce potential contamination with pathogens.

Product specific GMPs

- thermally processed low-acid canned foods
- acidified foods
- bottled drinking water

GMPs Regulations

21CFR Part 110

- *Subpart A - General Provisions*
- *Subpart B - Building and Facilities*
- *Subpart C - Equipment*
- *Subpart D - [Reserved]*
- *Subpart E - Production and Process Controls*
- *Subpart F - [Reserved]*
- *Subpart G - Defect Action Levels*

GMPs - General Provisions

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

- provides definitions necessary for *important in understanding implications and applications*

- ✓ Buildings and Facilities. Buildings must be designed and constructed to facilitate *effective maintenance and sanitation.The*results specified rather than method for achieving detailed expectations in sanitation of operations**.**
- ✓ The equipment and utensils are *designed and constructed to be easily and properly cleaned*, temperature is measured and recorded by refrigerators and freezers. Also the critical parameters are measured.
- ✓ Production and Process Controls-
  - The end results emphasizes *ensuring that no adulterated food enters marketplace.The terms used subject to variation in interpretation.*
  - *The* raw materials and ingredients properly *inspected, analyzed, segregated, stored and handled.*
  - manufacturing operations must be monitored
    - *pH, water activity, temperatures*
    - *elimination of metal from product*
  - personnel should be trained and aware of GMP requirements
- ✓ Defect Action Levels
  - natural or unavoidable defects may be in food
    - *not harmful at levels present*
    - *present even with GMPs*
  - FDA establishes DALs when necessary and possible
  - defect level may not be reduced by blending

Thus GMPs are Intended to prevent adulteration. Opportunity for considerable judgment in defining and interpreting regulations. *"spirit" of GMPs is to do what is reasonable and necessary to ensure safe and unadulterated food supply.*

Specific GMPs:

Low acid canned foods

- *Life threatening risk if improperly processed*
- Requires supervision of personnel who have been trained
- Regulations quite detailed for equipment design and operation
- Extensive record keeping requirements

Acidified foods:

- Defined as a low acid food with
  - A_w *greater than 0.85*
  - *acid added to lower pH to 4.6 or lower*
- Product examples
  - *includes beans, cucumbers, cabbage*
  - *excludes carbonated beverages*
- Personnel trained under approved program

Bottled Drinking Water:

- *All water sealed in bottles, packages for human consumption*
- Regulations are general and similar to umbrella GMPs
- Source of water must be approved
- Sanitation, equipment designed, personnel emphasized

Extensive record keeping

What is HACCP?

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

- The National Advisory Committee on Microbiological Criteria for Food (NACMCF) working group created guidelines and redefined the seven basic principles of HACCP as an effective and rational means of assuring food safety from harvest to consumption.
- The working group published the HACCP principles and application guideline document in August 1997.
- The hazard analysis critical control point system (HACCP) is a scientific and systematic way of enhancing the safety of foods from primary production to final consumption through the identification and evaluation of specific hazards and measures for their control to ensure the safety of food. HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end-product testing.
- Under the HACCP regulatory system, establishments assume full responsibility for producing products that are safe for consumers.

History of HACCP

- Developed by Pillsbury in 1959 as a nontesting approach to assure the safety level required by NASA for foods produced for the space program
- NASA's major concerns • Food crumbs • Foodborne illness
- NASA's Zero Defects program Testing materials
- National Research Council – 1985 • An Evaluation of the Role of Microbiological Criteria for Foods and Food Ingredients
- Microbiological hazards not controlled by testing
- Recommended using HACCP for food safety assurance
- **National Advisory Committee on Microbiological Criteria for Food (NACMCF) 1988**
- NACMCF proposed 7 principles of HACCP application, Published in 1989;
- 1st. Revision in 1992; 2nd. Revision (latest) in 1997

PRINCIPLES OF THE HACCP SYSTEM

The seven principles of HACCP, which encompass a systematic approach to the identification, prevention, and control of food safety hazards include:

PRINCIPLE 1 Conduct a hazard analysis.

PRINCIPLE 2 Determine the Critical Control Points (CCPs).

PRINCIPLE 3 Establish critical limit(s).

PRINCIPLE 4 Establish a system to monitor control of the CCP.

PRINCIPLE 5 Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.

PRINCIPLE 6 Establish procedures for verification to confirm that the HACCP system is working effectively.

PRINCIPLE 7 Establish documentation concerning all procedures and records appropriate to these principles and their application.

APPLICATION

The application of HACCP principles consists of the following tasks as identified in the Logic Sequence
for Application of HACCP (Diagram 1).

1. Assemble HACCP team

The food operation should assure that the appropriate product specific knowledge and expertise is

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

available for the development of an effective HACCP plan. Optimally, this may be accomplished by
assembling a multidisciplinary team. Where such expertise is not available on site, expert advice should
be obtained from other sources, such as, trade and industry associations, independent experts, regulatory
authorities, HACCP literature and HACCP guidance (including sector-specific HACCP guides). It may
be possible that a well-trained individual with access to such guidance is able to implement HACCP inhouse.

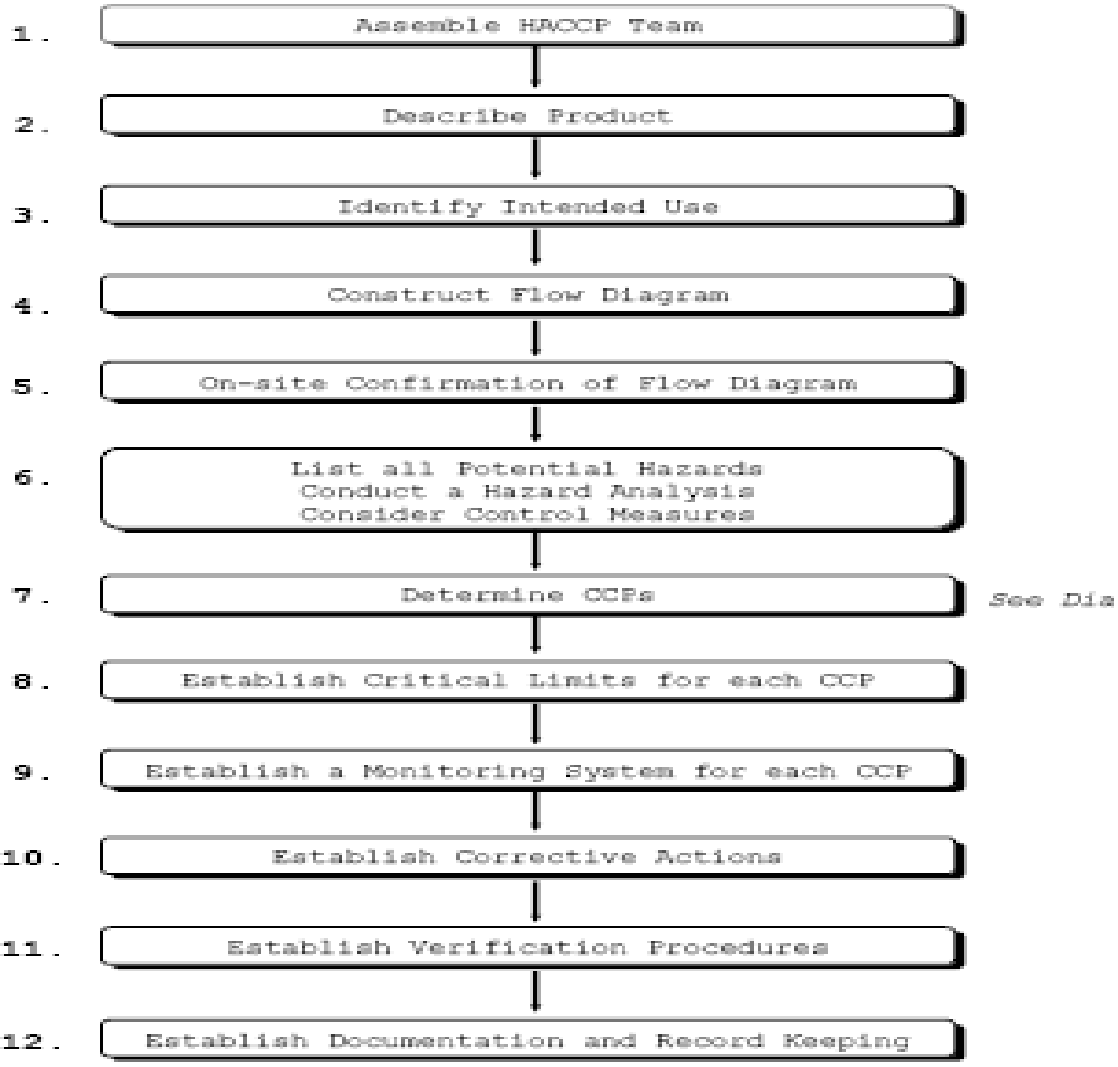
The scope of the HACCP plan should be identified. The scope should describe which segment
of the food chain is involved and the general classes of hazards to be addressed (e.g. does it cover all
classes of hazards or only selected classes).

2. Describe product

A full description of the product should be drawn up, including relevant safety information such as:
composition, physical/chemical structure (including Aw, pH, etc), microcidal/static treatments (heattreatment,
freezing, brining, smoking, etc), packaging, durability and storage conditions and method of
distribution. Within businesses with multiple products, for example, catering operations, it may be
effective to group products with similar characteristics or processing steps, for the purpose of development of the HACCP plan.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

LOGIC SEQUENCE FOR APPLICATION OF HACCP



3. Identify intended use

The intended use should be based on the expected uses of the product by the end user or consumer. In specific cases, vulnerable groups of the population, e.g. institutional feeding, may have to be considered.

4. Construct flow diagram

The flow diagram should be constructed by the HACCP team (see also paragraph 1 above). The flow diagram should cover all steps in the operation for a specific product. The same flow diagram may be used for a number of products that are manufactured using similar processing steps. When applying HACCP to a given operation, consideration should be given to steps preceding and following the specified operation.

5. On-site confirmation of flow diagram

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

Steps must be taken to confirm the processing operation against the flow diagram during all stages and
hours of operation and amend the flow diagram where appropriate. The confirmation of the flow
diagram should be performed by a person or persons with sufficient knowledge of the processing
operation.

6. List all potential hazards associated with each step, conduct a hazard analysis, and consider any measures to control identified hazards

The HACCP team should list all of the hazards that may be reasonably expected to occur at each step according to the scope from primary production, processing, manufacture, and distribution until the point of consumption.

The HACCP team should next conduct a hazard analysis to identify for the HACCP plan, which hazards are of such a nature that their elimination or reduction to acceptable levels is essential to the production of a safe food.

In conducting the hazard analysis, wherever possible the following should be included:

- the likely occurrence of hazards and severity of their adverse health effects;
- the qualitative and/or quantitative evaluation of the presence of hazards;
- survival or multiplication of micro-organisms of concern;
- production or persistence in foods of toxins, chemicals or physical agents; and,
- conditions leading to the above.

Consideration should be given to what control measures, if any exist, can be applied to each hazard.

More than one control measure may be required to control a specific hazard(s) and more than one
hazard may be controlled by a specified control measure.

- ✓ A hazard is defined by NACMCF as a biological, chemical or physical agent that is **reasonably likely to occur**, and will **cause illness or injury in the absence of its control**. Establishments must consider all **three types of hazards – biological, chemical, and physical** – at each step of the production process.

7. Determine Critical Control Points

- ✓ A ***critical control point*** is defined as a point, step, or procedure in a food process at which control can be applied, and, as a result, a food safety hazard can be prevented, eliminated, or reduced to acceptable levels. Critical control points are locations in a process at which some aspect of control can be applied to control food safety hazards that have been determined reasonably likely to occur.
- ✓ Examples of CCPs include product temperature, certification of incoming product, microbiological testing, testing for foreign objects such as metal contamination, the chemical concentration of a carcass rinse or spray, and other such parameters.

There may be more than one CCP at which control is applied to address the same hazard. The determination of a CCP in the HACCP system can be facilitated by the application of a decision tree, which indicates a logic reasoning approach. Application of a decision tree should be
flexible, given whether the operation is for production, slaughter, processing, storage, distribution or
other. It should be used for guidance when determining CCPs. This example of a decision tree may not

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

be applicable to all situations. Other approaches may be used. Training in the application of the
decision tree is recommended.
If a hazard has been identified at a step where control is necessary for safety, and no control measure
exists at that step, or any other, then the product or process should be modified at that step, or at any
earlier or later stage, to include a control measure.

8. Establish critical limits for each CCP

Critical limits (CL) are the parameters that indicate whether the control measure at the CCP is in or out of control. The National Advisory Committee on Microbiological Criteria for Foods (NACMCF) states that a CL is **a maximum or minimum value** to which a biological, chemical, or physical parameter must be controlled at a CCP to prevent, eliminate, or reduce to an acceptable level the occurrence of a food safety hazard.
Critical limits must be specified and validated for each Critical Control Point. In some cases more than
one critical limit will be elaborated at a particular step. Criteria often used include measurements of
temperature, time, moisture level, pH, Aw, available chlorine, and sensory parameters such as visual
appearance and texture.
Where HACCP guidance developed by experts has been used to establish the critical limits, care should
be taken to ensure that these limits fully apply to the specific operation, product or groups of products
under consideration. These critical limits should be measurable.

9. Establish a monitoring system for each CCP

Monitoring is the scheduled measurement or observation of a CCP relative to its critical limits. The
monitoring procedures must be able to detect loss of control at the CCP. Further, monitoring should
ideally provide this information in time to make adjustments to ensure control of the process to prevent
violating the critical limits. Where possible, process adjustments should be made when monitoring
results indicate a trend towards loss of control at a CCP. The adjustments should be taken before a
deviation occurs. Data derived from monitoring must be evaluated by a designated person with
knowledge and authority to carry out corrective actions when indicated. If monitoring is not
continuous, then the amount or frequency of monitoring must be sufficient to guarantee the CCP is in
control. Most monitoring procedures for CCPs will need to be done rapidly because they relate to online
processes and there will not be time for lengthy analytical testing. Physical and chemical
measurements are often preferred to microbiological testing because they may be done rapidly and can
often indicate the microbiological control of the product.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

All records and documents associated with monitoring CCPs must be signed by the person(s) doing the
monitoring and by a responsible reviewing official(s) of the company.

10. Establish corrective actions

Specific corrective actions must be developed for each CCP in the HACCP system in order to deal with
deviations when they occur.

The actions must ensure that the CCP has been brought under control. Actions taken must also include
proper disposition of the affected product. Deviation and product disposition procedures must be
documented in the HACCP record keeping.

The corrective actions consist of:

- ✓ Identifying and eliminating the cause of the deviation,
- ✓ Ensuring that the CCP is under control after the corrective action is taken,
- ✓ Ensuring that measures are established to prevent recurrence, and
- ✓ Ensuring that no product affected by the deviation is shipped.

11. Establish verification procedures

Establish procedures for verification. Verification and auditing methods, procedures and tests,
including random sampling and analysis, can be used to determine if the HACCP system is working
correctly. The frequency of verification should be sufficient to confirm that the HACCP system is
working effectively.

Verification should be carried out by someone other than the person who is responsible for performing
the monitoring and corrective actions. Where certain verification activities cannot be performed in
house, verification should be performed on behalf of the business by external experts or qualified third
parties.

Examples of verification activities include:

• Review of the HACCP system and plan and its records;
• Review of deviations and product dispositions;
• Confirmation that CCPs are kept under control.

Where possible, validation activities should include actions to confirm the efficacy of all elements of the
HACCP system.

12. Establish Documentation and Record Keeping

Efficient and accurate record keeping is essential to the application of a HACCP system. HACCP
procedures should be documented. Documentation and record keeping should be appropriate to the
nature and size of the operation and sufficient to assist the business to verify that the HACCP controls

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

are in place and being maintained. Expertly developed HACCP guidance materials (e.g. sector-specific
HACCP guides) may be utilised as part of the documentation, provided that those materials reflect the
specific food operations of the business.

Documentation examples are:

Hazard analysis;
CCP determination;
Critical limit determination.

Record examples are:

• CCP monitoring activities;
• Deviations and associated corrective actions;
• Verification procedures performed;
• Modifications to the HACCP plan;

An example of a HACCP worksheet for the development of a HACCP plan is attached as Diagram 3.

A simple record-keeping system can be effective and easily communicated to employees. It may be
integrated into existing operations and may use existing paperwork, such as delivery invoices and
checklists to record, for example, product temperatures.

Benefits of HACCP

Although the adoption of HACCP systems worldwide is due primarily to the added food safety protection provided to consumers, there are other benefits to the food industry that can be realized by implementing a successful HACCP system.

a. Formally incorporates food safety principles as integral steps of production processes

HACCP recognition status cannot be completed without a firm commitment by senior management to formally support food safety control measures throughout the production process. The implementation and maintenance of those control measures play a critical role in raising awareness of front line production management and staff of the presence and importance of specific food safety procedures within their process.

b. Increased employees' ownership of the production of safe food

As a sign of this commitment, it is the responsibility of senior management to foster the idea within the facility that food safety is the responsibility of everyone. Through the process of developing and implementing a HACCP system, employees become more aware of food safety and their role in contributing to food safety. This increased knowledge leads to ownership of and pride in the production of a safe food product.

c. Increased buyer and consumer confidence

Establishments that have implemented a HACCP system provide buyers and consumers with a greater degree of confidence that the facility is producing a safe food product. Establishments can demonstrate by showing documents and records that food safety is under control.

d. Maintaining or increasing market access

Market forces continue to drive HACCP implementation throughout the food industry. In many cases, buyer demands and foreign governments require HACCP implementation to maintain market share and/or gain access to previously inaccessible markets. As HACCP

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

systems are accepted worldwide, FSEP helps the Canadian industry to maintain and expand its international markets.

e. Reduced waste

The preventative nature of HACCP allows a company to control costs by minimizing the amount of product requiring rejection or recall, and by focusing resources on areas that have been identified as critical in the manufacture of a safe food product. With the regular monitoring inherent in a HACCP system, establishments become aware of problems earlier and the costs of waste are reduced.

Dr. V. USHA RANI
Assistant Professor
Department of Microbiology, KAHE

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Assistant Professor
Department of Microbiology, KAHE

KARPAGAM
DEPARTME
FOOD AND

UNIT V	OPTION
Which of the following toxin causing botulism is less toxic to human beings?	Type A
Which of the following statements are true regarding *Staphylococcus* food poisoning___	is an enter
Aflatoxin is produced by _____	*Aspergillu*
Which of the following statements are regarding botulinal toxin _____	is a neurot
The sore and throat symptom caused by _____ etiologic agent	*Streptococ*
Botulism is caused by the presence of toxin developed by	*Clostridiu*
The control measure of foods that cause disease by *Vibrio parahaemolyticus* infection is	reheat left
Salmonellois involves _____	an enterot
The term heat tolerant is a misnomer and refers to growth at ___ temperature	37 °C
The mold Penicillium islandicum produces _____ toxin	Luteoskyr
The major carrier of Salmonellosis are _____	meat and e
Yersinia enterocolitica is a small _____ shaped bacteria	cocci
The staphylococcal intoxication refers to presence of	an enterot
The FDA and USDA cooperative is a _____ surveillance program for dry milk products	*Pseudomo*
The application of Gamma rays destroys botulism toxin. The dose of gamma rays requir	73 Gy
The Bacillus cereus causes gasteroenteritis by the production of an exoenterotoxin whic	cell growt
Nursery epidemics diarrheal disease in infants was implicated in the year _____	1950
Botulism is caused by _____	*Clostridiu*
The toxin patulin is produced by _____fungi	*Penicilliu*
Miller and Kolurger examined forty environmental isolates of P. shigelloides in the year	1987
Which of the following is a food infection?	Salmonell
The symptoms such as nausea and dehydration is caused by _____	*Shigella s*
Staphylococcal intoxication is caused by the toxin in the food from	*Staphyloc*
The etiologic agent of diarrheal syndrome is ____	*Shigellosi*
_____ involves the identification of ingredients and products that have effect on food sa	Hazard an
The term ___ is used to distinguish strains of different antigenetic complements	biovars
A bacterial food intoxication refers to	illness cau
Salmonellois is caused by the	enterotoxi
Group I *C. botulinum* strains generally includes in	all types o
A_____ refers to food borne illnesses caused by the entrance of bacteria into the body th	Food infec
_____ organism can be isolated from seafoods and sea water	*Vibrio cho*
Botulism prevention involves_____	Proper hea
Entheropathogenic Escherischia coli infection is involved in ____ foods	vegetables
The etiological agent of Arizona infection is ____	*Vibrio*
Aeroonas hydrophillia is a gram negative motile rods which are ubiquitous in ____	air
The term ___ is used to distinguish strains of different antigenetic complements	biovars
The method of successful treatment of botulism prior to appearance of botulism symptor	antibiotic
_____ organism can be isolated from seafoods and sea water	*Vibrio cho*
The optimal temperature for growth of Shigellosis is _____	27 °C
The FDA and USDA cooperative is a _____ surveillance program for dry milk products	*Pseudomo*

_____ is associated with warm blooded animals	*C. jejuni*
Human beings and animals are directly or indirectly the source of the contamination of f	*Salmonell*
The food and Drug Administration act was amende in the year ____	1983
The _____ virus enters a person through oral route in the fecal contamination of food	Poliomyel
The mode of transmission of poliomyelitis is _____	food
Clostridium perfingens poisoning is associated with_____	meat prod
Clostridium perfingens poison is an _____	exotoxin
The pH near ____ favors *C. botulinum*	neutrality
In the early _____ numerous surveys have been conducted on the detection aflatoxins in	1980s
The optimal pH for enteropathogenic E. coli is _____	4.0 to 5.0
The disease gastroenterities caused by C. perfringens was first reported in the year___-	1952
Depending on the food and the serotype the _____ values from 0.06 to 11.3 min	D50 C
Pathogenecity involves the release of a _____ endotoxin which affects the intestinal mu	lipopolysa
Common food poisoning microbes are_____	*Clostridiu*
Typhoid fever is caused by _____	*Salmonell*
The incubation period of Vibrio parahaemolyticus infection is _____	2-48 hrs
The incubation period of Streptococcus faecalis is _____	5 to 10
The growth of Staphylococcus aureus on solid media is usually ____ in color	red
A_____ refers to food borne illnesses caused by the entrance of bacteria into the body th	Food infec
What is the main type of micro-organism responsible for food poisoning?	Bacteria
_____ agencies aprove the Good house keeping institute	Commerci

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OPTION	OPTION	OPTION 4	ANSWER KEY
Type B	Type C	None of these	Type B
causes gas	is produce	All of these	All of these
Salmonell	*Fusarium*	*Streptococcal sp.*	*Aspergillus sp.*
water solu	is produce	All of these	is produced by Clostridium botulinum
Staphyloc	*Bacillus a*	*E.coli*	*Streptococcus pyogenes*
Clostridiu	*Clostridiu*	*none of these*	*Clostridium botulinum*
sanitize ec	control fil	pastuerization	sanitize equipment
an enerot	is produce	All of these	an enterotoxin and cytotoxin
40 °C	42 °C	25 °C	42 °C
aflatoxin	penicillic a	roquefortine	Luteoskyrin
meat and f	eggs and f	eggs and fruits	meat and egs
chain	rod	bacilli	rod
neurotoxir	mycotoxir	All of these	an enterotoxin
E. coli	*Salmonell*	*Vibrio*	*Salmonella*
73 Rad	7.3 Mrad	173 Rad	7.3 Mrad
cell autoly	cell perme	cell damage	cell autolysis
1940	1962	1980	1940
All Clostri	*Clostridiu*	*Clostridium subtilis*	*Clostridium botulinum*
Fusarium	*Aspergillu*	*Mucor*	*Penicillium expansum*
1982	1980	1986	1986
Botulism	Staphyloc	None of these	Salmonellois
Yersinia	*Arizona*	*E.coli*	*Shigella sonnei*
S. cerevisi	*S. thermo*	none of these	*Staphylococcus aureus*
Yersiniosi	*Bacillus c*	*Vibrio*	*Bacillus cereus*
critical co	fishery ser	research and development servi	Hazard analysis
serovar	herbivore	none of these	serovar
food borne	both (a) ar	none of the above	food borne illness caused by the presence c
endotoxin	neurotoxir	exoenterotoxin of Salmonella sp	endotoxin of Salmonella spp
all types o	all types o	none of the above	all types of strains (proteolytic)A, B and F
food poisc	food intox	all of these	food infection
Vibrio vul	*Vibrio par*	All of these	*Vibrio vulnificus*
addition o	Proper lov	All of these	Proper heat sterilization before food cannir
apple cide	ice creams	cheese	cheese
E. coli	*Arizona*	*Streptococcus*	*Arizona*
soil	water	land	water
serovar	herbivore	none of these	serovar
analgesic	antitoxin	antipyretic	antitoxin
Vibrio vul	*Vibrio par*	All of these	*Vibrio vulnificus*
37 °C	40 °C	50 °C	37 °C
E. coli	*Salmonell*	*Vibrio*	*Salmonella*

C. botulin	*C. perferi*	*E. coli*	*C. jejuni*
Staphyloc	*Bacillus*	*E. coli*	*Salmonella*
1980	1989	1988	1980
Hepatitis	Adeno	Herpes	Hepatitis
air	contamina	all of these	contaminated water
vegetables	canned fo	fish products	meat products
enterotoxi	endotoxin	enterotoxin produced during ve	enterotoxin produced during sporulation
alkalinity	acidic	both b and c	neutrality
1940s	1950s	1960s	1960s
7.0 to 7.5	3.0 to 4.0	8.0 to 9.0	7.0 to 7.5
1961	1978	1945	1945
D40 c	D60 c	D30 c	D60 c
monosacc	polysaccha	peptidoglycon	lipopolysaccharides
Clostridiu	*E. coli an*	*Clostridium and Streptococcus*	*Clostridium and Salmonella*
Salmonell	*Salmonell*	*Salmonella typhimurium*	*Salmonella typhi*
5-24 hrs	40 hrs	37 hrs	2-48 hrs
2 to 10	2 to 18	8 to 12	2 to 18
brown	pink	yellow	yellow
food poisc	food intox	all of these	food infection
Mould	Virus	Parasite	Bacteria
State	Federal	Private	Private

ɔf a bacterial toxin formed in food

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Reg. No._____

[16MBU302]

KARPAGAM UNIVERSITY
(Under Section 3 of UGC Act 1956)
Coimbatore – 641 021
B.Sc., DEGREE EXAMINATION, July, 2017
THIRD SEMESTER

MICROBIOLOGY
FOOD AND DAIRY MICROBIOLOGY

TIME: HOURS **Max Marks: 60**

PART –A (Multiple choice questions) **20 x 1= 20 marks**

1. Most spoilage bacteria grow at _____
   a.Acidic pH b. alkaline pH
   c. neutral pH d. any of the pH
2. The water requirement of a microorganism is expressed in terms of _____
   a. water action b. water adsorption
   c. water affinity d. water activity
3. The undesirable change in a food that makes it or human consumption is referred as _____
   a. food decay b. food spoilage
   c. food loss d. food contamination
4. Souring of canned meat is caused by _____
   a.thermoduric cells b. thermostatic cells
   c. thermo liable cells d. thermo labile cells
5. Pasteurization is a _____
   a. low temperature treatment b. steaming treatment
   c. high temperature treatment d. low and high temperature treatment
6. Clostridium perfingens poisoning is associated with_____
   a.meat products b. vegetables
   c. canned foods d. fish products
7. ____organic acid is used in syrups, drinks, jam and jellies
   a.Lactic b. acetic
   c. propionic d. citric
8. Sulfur stinker spoilage of canned food is caused by _____
   a.E.coli b. D. nigrificans
   c. Bacillus d. Clostridium
9. Bacteria which is present in raw or undercooked meat, eggs, sea food and unpasteurized milk is_____
   a.E.coli b. salmonella
   c. staphylococcus d. cyanobacteria
10. Preservation affects the growth of microorganism by_____
   a. Inhibition b. retardation

c. arresting d. prevention

11. The concentration of salt used in high protein containing vegetables is _____
    a. 4.3-10.3 b. 17.5-20.0
    c. 18.6-26.5 d. 19.2-22.2
12. _____ is associated with the market disease called bacterial soft rot
    a.Erwinia b. Enterobacter
    c. Corynebacterium d. Klebsiella
13. _____ is used as treatment for wrappers used on butter
    a.sodium diacetate b. calcium carbonate
    c. sodium nitrate d. potassium nitrite
14. When microbes can use fat as an energy source _____
    a. absence of sugar molecule b. presence of glucose
    c. presence of fructose d. Presence of high sugar
15. The concentration of salt used in high protein containing vegetables is _____
    a. 4.3-10.3 b. 17.5-20.0
    c. 18.6-26.5 d. 19.2-22.2
16. pH of milk is _____
    a. 5 b. 6
    c.8 d. 4
17. Clostridium perfingens poisoning is associated with_____
    a. meat products b. vegetables
    c. canned foods d. fish products
18. The O-R potential of a system is measured by _____
    a. Mm b. mV c. aw d. Eh
19. Botulism is caused by _____
    a.Clostridium botulism b. All Clostridium species
    c. Clostridium tetanai d. Clostridium subtilis
20. Proteolytic
    a. Binding of proteins b. Lysis of protein
    c. Precipitating proteins d. Polymerizing proteins.

Part - B

19. Define water activity
20 what is pasterizastion
21. what are the factors involved in food spoilage?

Part - c

22. a. Explain in detail about the factors and its types in food spoilage

(or)

b. Writes in detail about spoilage of vegetables and fruits
23. a. Contamination of eggs and aseptic conditions for preservation
    b. Write in detail about spoilage of canned foods
24. a. Types of physical method of preservation explain about high and low temperature used
    b. Explain about canning and drying methods of preservation

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KARPAGAM UNIVERSITY
(Under Section 3 of UGC Act 1956)
Coimbatore – 641 021
B.Sc., DEGREE EXAMINATION, AUGUST, 2017
THIRD SEMESTER – II INTERNAL EXAM

MICROBIOLOGY
FOOD AND DAIRY MICROBIOLOGY

TIME: HOURS **Max Marks: 50**

PART –A (Multiple choice questions) **20 x 1= 20 marks**

1. Radiation dose in kilograys of ____ inhibits sprouting in potatoes, onions and garlic
   a. 0.05-0.15 b. 0.01-0.14 c. 0.05-0.07 d. 0.05-0.11
2. Gazing at ultraviolet lamps produces irritation of the ____ within few seconds
   a. Eye b. Ear c. Nose d. Throat
3. 97 to 99 % of *E. coli* in air were killed in ____ seconds with a 15 watts lamp
   a. 40 b. 10 c. 50 d. 30
4. The sodium salt of _____ acid has been used extensively as an antimicrobial agent in foods
   a. Propionic b. Benzoic c. Sorbic d. Acetic
5. Combination of _____ irradiation with chilling storage helps preserve foods
   a. Ultraviolet b. Infra red c. Gamma d. Cathode
6. _____organic acid is used in syrups, drinks, jam and jellies
   a. Lactic b. Acetic c. Citric d. Propionic
7. _____ solvent is poisonous and should not be added to foods
   a. Propylene b. Ethanol c. Methanol d. Glycerol
8. _____ acid is used in soft drinks such as colas
   a. Phosphoric b. Benzoic c. Acetic d. Sorbic
9. _____ is used as treatment for wrappers used on butter
   a. Sodium diacetate b. Calcium carbonate c. Sodium nitrate d. Potassium nitrite
10. _____ drying is limited to climates with a hot sun and dry atmosphere to fruits
    a. Mechanical b. Solar c. Freeze d. Chemical
11. _____ has been used as starter culture in fermented sausages
    a. Photobacterium b. Pediococcus c. Propionibacterium d. Proteus
12. During _____ the internal temperature of bread, cake or other bakery products approaches but never reaches 100 °C
    a. Heating b. Boiling c. Baking d. Thawing
13. The simplest dryer is the _____
    a. Sun b. Air c. Heat d. Evaporator
14. _____ is a term used to label foods treated with low level ionizing radiation
    a. Radicidation b. Radurization c. Picowavedd. Radappertization
15. The fumes of burning ____ are used to treat light colored dehydrated fruits

a. Sulfur b. Ethylene c. Potassium d. Sodium

16. In bread manufacturing, alcoholic fermentation is carried out by
    a. *S.thermophilus* b. *S. cerevisae*c. *S. carlsbergensis* d. *S. carlsbergensis*
17. Type of yeast used for alcoholic fermentation is
    a. *S. cerevisiae*b.*S. thermophilus* c. *A. acceti* d. *C.botulinum*
18. Two types of fermentations are carried out for the production of
    a. Pickle b. Yoghurt c.Vinegar d. Sausages
19. Special beer yeast is
    a. *S. cerevisiae* b. *S. carlsbergensis* c. *S.thermophilus* d. *L. bulgaris*
20. Milk fermentation to produce cheese is done initially by inoculating with
    a. *S. cerevisiae* b. S. lactis & Lactobacillus c. *S.thermophilus* r d. *L. bulgaris*

Part B (Answer all the questions) **3x2 = 6 Marks**

21. What is cold sterilization?
22. Define probiotics
23. Define fermentation

Part C (Answer all the questions) **3x 8 = 24 Marks**

24. a. Describe about the use of radiation as food preservative and its effectiveness on microorganisms **(or)**
    b. Antibiotics in food preservation explain
25. a. Explain in detail about chemical methods of sterilization? **(or)**
    b. describe about sterilization by dry heat and moist heat
26. a. Explain in detail about fermentation? **(or)**
    b. uses of probiotic organism

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Reg. No._____

[16MBU302]

KARPAGAM UNIVERSITY
(Under Section 3 of UGC Act 1956)
Coimbatore – 641 021
B.Sc., DEGREE EXAMINATION, SEPTEMBER, 2017
THIRD SEMESTER – III INTERNAL EXAM

MICROBIOLOGY
FOOD AND DAIRY MICROBIOLOGY

TIME: HOURS **Max Marks: 50**

PART –A (Multiple choice questions) **20 x 1= 20 marks**

1. Aflatoxin is produced by _____
   a. *Aspergillus* sp. b. *Salmonella* sp. c. *Fusarium* sp. d.*Streptococcal*sp.
2. Botulism is caused by the presence of toxin developed by
   a. *C. tyrobutyricum* b. *C. sporogenes* c. *C. botulinum* d. *C. perifringes*
3. The pH near ____ favors C. botulinum
   a. Neutrality b. Alkalinity c. Acidic d. Mild acidic
4. The spoilage organism bring about the spoilage of meat by
   a.Purification b.Oxidation c.Decomposition d. Hydrolysis
5. The major carrier of Salmonellosis are _____
   a. Meat and eggs b.Meat and fish c.Eggs and fish d.Eggs and fruits
6. The staphylococcal intoxication refers to presence of
   a.An enterotoxin b. Neurotoxin c. Mycotoxin d. Exotoxin
7. The symptoms such as nausea and dehydration is caused by _____
   a. *Shigella sonnei* b. *Yersinia* c. *Arizona* d. *E.coli*
8. The term ___ is used to distinguish strains of different antigenetic complements
   a. Biovars b. Serovar c. Herbivore d. none of these
9. EntheropathogenicEscherischia coli infection is involved in ____ foods
   a. Vegetables b.Apple cider c. Ice creams d. Cheese
10. The method of successful treatment of botulism prior to appearance of botulism symptoms involve administration of
   a. Antibiotic b. Analgesic c. Antitoxin d. Antipyretic
11. _____ is associated with warm blooded animals
   a. *C. jejuni* b. *C. botulinum* c.*C.perferigens* d. *E. coli*
12. The optimal pH for enteropathogenic E. coli is _____
   a. 4.0 to 5.0 b. 7.0 to 7.5 c. 3.0 to 4.0 d. 8.0 to 9.0
13. The incubation period of Vibrio parahaemolyticus infection is _____
   a. 2-48 hrs b. 5-24 hrs c. 40 hrs d. 37 hrs
14. The _____ virus enters a person through oral route in the fecal contamination of food
   a. *Poliomyelitis*b.*Hepatitis* c. *Adeno* d. *Herpes*
15. The optimal temperature for growth of Shigellosis is _____
   a. 27 °C b. 37 °C c. 40 °C d. 50 °C
16. Yersinia enterocolitica is a small _____ shaped bacteria
   a. Cocci b. Chain c. Rod d. Bacilli

17. The mold Penicillium islandicum produces _____ toxin

a. Luteoskyrin b.aflatoxin c. penicillic acid d. roquefortine

18. The minimum growth temperature of Bifidobacteria range from

a. 43 to 45 b. 25 to 28 c. 29 to 32 d. 30 to 35

19. The etiologic agent of diarrheal syndrome is ____

a. *Shigellosis* b. *Yersiniosis* c. *Bacillus cereus* d. *Vibrio*

20. The incubation period of Streptococcus faecalis is _____

a. 5 to 10 b. 2 to 10 c. 2 to 18 d. 8 to 12

Part B (Answer all the questions) **3x2 = 6 Marks**

21.Write two disease conditions caused by Salmonellosis ?

22.What is Ergotism?

23. What are the symptoms caused by Aflatoxins?

Part C (Answer all the questions) **3x 8 = 24 Marks**

24. a) Describe in detail about *Clostridium botulinium* as food toxicant **(or)**
b) Elaborate about Salmonellosis

25. a)Write a detailed note on food borne infection caused by Staphylococcus aureus. (or)
b) Mycotoxins in food poisoning

26. a) Role of Listeria monocytogens in causing food borne disease (or)
b)HACCP and FSSAI as food quality and sanitizers(or)