

3.1 FOOD MICROBIOLOGY

L T P
3 - 4

RATIONALE

This subject is aimed to develop an understanding among the students on various micro flora associated with food products and their beneficial role as well as deleterious effect on processed food products

DETAILED CONTENTS

1. Introduction – Definition, historical developments in the food microbiology and its significance (5 hrs)
2. Microbiology of milk and milk products like cheese, butter, Ice-cream, milk powder (6 hrs)
3. Microbiology of meat, fish, poultry and egg products (6 hrs)
4. Microbiology of fruits and vegetable products like jam, jelly, sauce, juice (6 hrs)
5. Microbiology of cereal and cereal products like bread, (6 hrs)
6. Microbial spoilage of foods – food borne pathogens, food poisoning, food infection and intoxication (14 hrs)
7. Concept, determination and importance of TDT, F, Z and D value; factors affecting the heat resistance of micro-organisms (09 hrs)
8. Anti-microbial agents – physical and chemical agents – their mechanism of action (6 hrs)

LIST OF PRACTICALS

1. Study of the microbiological quality of milk by MBR test
2. Estimation of total microbial bacterial plate count of food sample by direct microscopic and SPC method
3. Estimation of total microbial count of yeast and mould
4. Estimation of total microbial count of (a) milk products (b) fruits and vegetable products (c) meat, fish and poultry products (d) water (e) surface (f) air (g) workers (h) canned foods
5. Study of the growth curve of micro-organisms

6. Demonstration of effect of different anti-microbial agents i.e. (a) high and low temperature (b) UV radiation and (c) chemical preservatives on the growth of microbes

INSTRUCTIONAL STRATEGY

This being one of the most basic subjects for the students of food technology, the teachers should lay a lot of emphasis on explaining the facts, concepts, principles and procedures involved in various topics. The students should be given appropriate tutorial exercises. Teachers should made use of chart and other appropriate media to support classroom instruction. Emphasis during the practical session should be on performance by individual students and teacher should develop instructional manual for various exercises to facilitate the students. Visits to some of the local industries and quality control centers may be arranged to demonstrate various aspects of basic microbiology to the students. Experts may be invited to deliver lecturers on latest developments in the field.

RECOMMENDED BOOKS

1. Essentials of Microbiology by KS Bilgrami; CBS
2. Food Microbiology by WC Frazier; Tata McGraw Hill
3. Modern Food Microbiology by James M Jay; CBS
4. Bacteriology by Sale
5. Standard Methods for Waste Water Analysis by APHA
6. Basic Food Microbiology: Bannett , Chapman and Hall
7. Food Microbiology by M.R. Adams
8. Hand Book of Microbiology by Bisen
9. Text Book of Fungi by Sharma

3.2 FOOD CHEMISTRY AND NUTRITION

L T P
3 - 2

RATIONALE

Diploma holders in food technology are required to test the food products in the laboratories and should have theoretical as well as practical understanding of food chemistry and nutrition, which relates to different aspects of food chemistry and nutritive such as water, carbohydrates, fats, protein, minerals, vitamins, food pigments, enzymes etc. Hence the subject is included for developing these competencies.

DETAILED CONTENTS

1. Importance of food. Scope of food chemistry (1 hrs)
2. Introduction to different food groups: their classification and importance (3 hrs)
3. Water (5 hrs)
Structure of water molecule, types and properties of water, water activity and its importance
4. Carbohydrates (5 hrs)
Definition, classification, sources, chemical make-up, properties, nutritional and industrial importance
5. Proteins (5 hrs)
Sources, chemical make-up, properties, nutritional aspects– amino acids, amino essential acids, biological value, PER (Protein Efficiency Ratio), and industrial importance
6. Fats (5 hrs)
Sources, chemical make-up, properties, nutritional aspects – essential fatty acids, PUFA (Polyunsaturated Fatty Acids) hydrogenation, rancidity and industrial importance
7. Minerals and Vitamins (5 hrs)
Importance and sources of minerals and vitamins with special emphasis on calcium, iodine, zinc, iron, fluoride, fat, and minerals soluble and water-soluble vitamins, effect of processing and storage on vitamins
8. Deficiency disorders and requirement of different nutrients (8 hrs)

9. Food Pigments (3 hrs)
Importance, types and sources of pigments - their changes during processing and storage
6. Enzymes (8 hrs)
Definition, importance, sources, nomenclature, classification – discuss their application in food processing in brief

LIST OF PRACTICALS

1. Determination of moisture in a given food sample
2. Determination of protein in a given food sample
3. Determination of carbohydrates in a given food sample
4. Determination of ash in a given food sample
5. Determination of crude fat in a given food sample
6. Determination of pH of a given sample
7. Determination of acidity of given food sample/beverage
8. Determination of total non reducing and reducing sugars
9. Determination of vitamin C in given food sample
10. Determination of diastase enzyme activity
11. Determination of pigments in a given food sample

Note: Wherever necessary equipment are not available students may be demonstrated that topic in relevant industry or in any other institute.

INSTRUCTIONAL STRATEGY

This is one of the basic subjects for the diploma holders in food technology. Teacher should design appropriate tutorial exercises for the students. Students may be given sufficient practice on different experiments, individually, under the guidance of teacher. Teachers may also prepare charts and slides. Student may be taken to industry for showing different tests.

RECOMMENDED BOOKS

1. Essentials of Food and Nutrition by Swaminathan Vol. I and II
2. Food Chemistry by LH Meyer
3. Hand book of Analysis of Fruits and Vegetables by S. Ranganna
4. Biochemistry by Mohinder Singh
5. Introduction to Biochemistry by Braverman
6. Food Chemistry by Linhinger
7. Food Chemistry by FANNEMA
8. Hand Book of Food & Nutrition by Swaminathan
9. A Text Book of Biochemistry A.V.S.S. Rama Rao
10. A Text Book of Biochemistry A.K.Berry
11. Nutrition & Dietetics by Joshi
12. Clinical Dietetics and Nutrition by Antia & Abraham
13. Chemical Changes in Food During Processing by Richardson
14. Fundamentals of Food & Nutrition by Sumati R. Mudambi
15. Nutrition & Dietetics by Rose

3.3 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

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3 - 2

RATIONALE

Knowledge and skills related to food processing and preservation are essential for the diploma holder in food technology. In this subject, students are exposed to various techniques of food preservation such as high temperature, freezing and thawing of food, moisture removal, chemical and radiation preservation. Relevant skills will also be imparted through this subject

DETAILED CONTENTS

1. Scope and trends in food industry (8 hrs)
 Status of Indian food industry with emphasis on State of Haryana. Definition of food – food technology, food science, food preservation and food engineering – basic considerations. Importance of food processing and preservation. Classification of foods on the basis of shelf life, pH, origin; Different types of food spoilage viz. microbiological, bio-chemical, chemical, physical and their effects on food quality
2. Preservation by sugar and salt (5 hrs)
 Principles of Salt and sugar preservation, Intermediate Moisture Food (IMF) like jam, jelly, marmalade; Different techniques of pickling
3. Preservation by Low Temperature (6 hrs)
 Low temperature required for different foods – refrigeration – refrigeration load, refrigeration systems; slow and fast freezing, freezing process; types of freezer advantages and disadvantages of freezing; storage and thawing of frozen food
4. Preservation by High Temperature (6 hrs)
 Pasteurization, Sterilization, Canning: their Definition, Method, advantages and disadvantages,
5. Moisture Removal (10 hrs)
 Evaporation, concentration, drying and dehydration, types of dryers, advantages and disadvantages, selection of dryers,

6. Preservation by Chemical Preservatives (4 hrs)
Types of chemical preservatives used in different food products and their stability during processing
7. Preservation of foods by Radiation – Irradiation of foods, doses of irradiation – its effect on food quality (3 hrs)
8. Advanced method of food preservation (4 hrs)

Principles of:
 - a) High pressure technology of food preservation
 - b) Infra-Red (IR) technique
 - c) Microwave heating
9. Asepsis and removal of micro organism (2 hrs)

LIST OF PRACTICALS

1. Study of changes in fruits/vegetables during storage
2. Peeling of fruit and vegetable
3. Preparation of brine and syrup
4. Blanching of seasonal fruits and vegetables
5. Dehydration of fruits & vegetables
6. Preparation of fruit bars
7. Freezing of seasonal vegetables, meat and fish products
8. Preparation of Jam, Jelly & squash
9. Pickle preparation
10. Storage of frozen products
11. Preparation of sauerkraut
12. Visit to fruits and vegetable industry to see above operations

INSTRUCTIONAL STRATEGY

This being one of the most basic subjects for the students of food technology, the teachers should lay a lot of emphasis on explaining the facts, concepts, principles and procedures involved in various topics. The students should be given appropriate tutorial exercises. Teachers should made use of chart and other appropriate media to support classroom instruction. Emphasis during the practical session should be on performance by individual students and teacher should develop instructional manual for various exercises to facilitate the students. Visits to some of the local industries and quality control centers may be arranged to demonstrate various aspects of food technology and preservation and principles involved therein to the students. Experts may be invited to deliver lectures on latest developments in the field.

RECOMMENDED BOOKS

1. Food Science by Potter
2. Technology of Food Preservation by Desrosier
3. Principles of Food Science Vol. – I by Fennema, Karrel
4. Preservation of Fruit and Vegetables by Girdhari Lal, Sidhapa and Tandon
5. Hand book of Analysis of Fruits and Vegetables by S Ranganna
6. Fruits and Vegetable Processing by Cruss
7. The Technology of Food Preservation by Desrosier
8. Food Science by Mudambi
9. Basic Food Preparation(Manual)
10. Fruit & Vegetable Processing by Bhatt, Verma
11. Commercial Vegetable Processing by Woodroof
12. Preservation of Fruits & Vegetables by IRRI
13. Food Canning Technology by Larcousse & Brown
14. Food Composition & Preservation by Bhawna Sabarwal
15. Food Preservation by S.K. Kulshrestha
16. Processing Foods by Oliverra
17. Principles & Practices for the Safe Processing of Foods by Heinz

3.4 PRINCIPLES OF FOOD ENGINEERING

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4 - 2

RATIONALE

This subject is aimed to develop in the students the knowledge and skills related to various operations of process equipment used in food processing industry

DETAILED CONTENTS

1. Introduction (8 hrs)

Physical properties like colour, size, shape, density, specific gravity, thousand grain weight/bulk density, porosity, viscosity of food materials and their importance

Thermal, conductivity, specific heat and thermal diffusivity.
2. Materials and energy Balance (7 hrs)

Basic principles, total mass & component mass balance, system boundaries, material balance calculations, principle of energy balance, Heat, Enthalpy, calculations of specific neat.
3. Fluid Mechanics (5 hrs)

Manometers, fluid flow characteristics, Reynolds, number, pumps – principles, types, and working of most common pumps used in food industry
1. Heat and Mass Transfer during food processing – Modes of heat transfer (5 hrs)

i.e. conduction, convection and radiation. Principles of microwave heating, different heat exchangers. Principle of mass transfer, diffusion. Fick's law
5. Thermal Processing of Foods (7 hrs)

Specifications, selection, operation and periodical maintenance of equipment used in food industry viz pasteurizer, Auto clave, evaporators, heat exchangers, boilers, freezer
6. Preliminary Unit operation (2 hrs)

Clearing Aims & methods, sorting & Grading Aims & methods

7. Conversion Unit Operations: Size Reduction (8 hrs)
- Theory of comminution; Calculation of energy required during size reduction. Crushing efficiency; Size reduction equipment; Size reduction of fibrous, dry and liquid foods; effects of size reduction on sensory characteristics and nutritive value of food
- Mixing
- Mixing Agitating, kneading, blending, homogenization, mixing equipment, time calculation, mixing Index.
8. Separation Processes (18 hrs)
- d) Filtration
Theoretical aspects; fundamental equation for filtration, constant rate filtration, constant pressure filtration, filtration equipment, ultra filtration and reverse osmosis
- e) Sedimentation
Theory; Gravitational sedimentation of particles in liquids and gases, sedimentation equipment
- f) Separation
Theory, basic crystallization, liquid – liquid separation, particle gas separation, centrifuge equipment like cream separator, garber centrifuge and clarifies used in diary industry
- g) Sieving
Separation based on size; types of screens; effectiveness of screens, Fineness modulus of sample
- h) Distillation
Theory, Raoult's Law, Relative volatility, Types of distillation
9. Psychrometry (4 hrs)
- Principle of psychometry and its application

LIST OF PRACTICALS

1. Determination of physical properties like size, shape, roundness, sphericity of the food products
2. Determination of angle of repose of grains

3. Study of thermal processing equipment
 - a) Pasteurizer
 - b) Heat Exchanger
 - c) Evaporator
 - d) Spray drier
4. Constructional and working details of different types of
 - a) Pumps for liquid transportation
 - b) Blower and fan for transportation for gases/air
 - c) Size reduction equipment used in food industry
 - d) High speed mixer
5. Determination of critical speed of ball mill
6. Constructional details of continuous distillation system
7. Working of sedimentation equipment and determination of sedimentation rate
8. Construction of equilibrium and boiling point diagram
9. Calculation of number of stages in liquid – liquid extraction system
10. Reading and interpretation of psychro-metric charts
11. Determination of thermal conductivity of a given food sample

Note: Whenever the required equipment's are not available students may be demonstrated that topic in industry or other institution.

INSTRUCTIONAL STRATEGY

This being one of the most basic subjects for the students of food technology, the teachers should lay a lot of emphasis on explaining the facts, concepts, principles and procedures involved in various topics. The students should be given appropriate tutorial exercises. Teachers should made use of chart and other appropriate media to support classroom instruction. Emphasis during the practical session should be on performance by individual students and teacher should develop instructional manual for various exercises to facilitate the students. Visits to some of the local industries may be arranged to demonstrate various equipment used in food processing Industries and cold stores to the students. Experts may be invited to deliver lecturers on latest developments in the field.

RECOMMENDED BOOKS

1. Post Harvest Technology of Cereal, Pulse and Oil Seeds by Chakraborty, AC
2. Unit Operations in Agriculture Processing by Singh and Sahay
3. Fundamentals of Food Engineering by Brennen
4. Fundamentals of Food Processing Engineering by Romeo T Toledo
5. Agricultural Process Engineering by Henderson and Perry
6. Transfer Processes and Unit Operation by CJ Geankoplis
7. Physical Properties of Plants and Animal Materials by NK Mohsenin
8. Principles of Food Engineering by TE Charm
9. Introduction to Food Engineering by Singh RP and DR Heldmann
10. Unit Observation in Chemical Engineering by McCabe, Smith and others
11. Unit Operation in Food Processing by Earlle

3.5 HANDLING, TRANSPORTATION AND STORAGE OF FOODS

L T P
2 - 2

RATIONALE

This subject is aimed to develop an understanding among the students about various methods of handling, transportation and storage of food grains and perishables. It will also impart knowledge and skills as how to minimize post – harvest loss of food commodities

DETAILED CONTENTS

1. Introduction (2 hrs)
Scope and importance of handling, transportation and storage of food and food products, post harvest losses
2. Post Harvest Changes in Foods – Physiological, chemical, microbiological and biochemical (3 hrs)
3. Handling, Transportation and Storage (5 hrs)
Various unit operations of post-harvest handling, transportation, study of different conveying systems like belt conveyors, chain conveyors, screw conveyors, hydraulic conveyors, pneumatic conveyors, vibrating and oscillating conveyors, bucket elevators – their selection, operation and maintenance.
4. Grains (5 hrs)
Preparation of grains for storage, Storage requirements, infestation control, mycotoxin, handling practices, causes of spoilage and their prevention, factors affecting quality of grain during storage and types of storage structures and facilities
5. Fruits and Vegetables (3 hrs)
Handling and spoilage during transportation and storage – its prevention
6. Animal Foods (5 hrs)
Pre-slaughter handling and transportation system – their effects on quality of meat products, transportation and storage requirements, ante-mortem examination of animals

7. Milk (02 hrs)
Collection, pre-cooling, handling and transportation systems – their effects on quality of milk
8. Eggs (2 hrs)
Candling and grading, packaging, handling, pre-treatment, transportation and storage
9. Cold Storage (5 hrs)
Design parameters, selection of parameters for designing cold storage for food products, different types of refrigerants, refrigerator systems such as vapors compression refrigerators, vapors absorption refrigerators, air cycle refrigeration etc. Specific purposes, criteria for selection, operation and maintenance of refrigeration systems, Cooling load calculations

LIST OF PRACTICALS

1. Sampling of stored food grains in godown (Silo)
2. Analysis of sampled grain for foreign matter like straw parities, rodent excreta and rodents & insects infected grains
3. Demonstration of changes during storage of fresh fruits and vegetables in (a) traditional storage (b) modified storage system (c controlled atmosphere
4. Determination of changes in pH and acid values in storage of milk
5. Visit to a public distribution system (PDS) showing storage facilities, warehouse, cold storage, refrigeration system and slaughter house etc
6. Visit to demonstration of material handling systems in various food industries
7. Visits to cold storage

INSTRUCTIONAL STRATEGY

Teachers should prepare tutorial exercises for the students, involving visits to various food-processing units. These tutorials can be considered a mini projects. Students may be asked to bring specifications and catalogues from industries. Students may also be exposed to relevant National, BIS and international standards. An intensive exercise on actual workbench performance in the industries is recommended. Experts may be invited

to deliver lectures on various themes. Use of audio-visual aids will also be useful for better conceptualization of various operations.

RECOMMENDED BOOKS

1. Handling, Transportation and Storage of Fruits and Vegetables by A Lloyd, Ryall Penizer (AVI Publications)
2. Proceedings of Regional Workshop on Warehouse Management of Stored Food Grains by Girish and Ashok Kumar (UNDP)
3. Modern Potato and Vegetable Storage by Volkind and Roslov (Amerind)
4. Controlled Atmospheric Storage of Fruits by Mettel Skilv
5. Food Grains in Tropical and Sub Tropical Areas by Hall
6. Food Storage Part of a system by Sinha and Muir (AVI)
7. Post Harvest Technology of Fruits and Vegetables – Handling, Processing, Fermentation and Waste Management by LR Verma and VK Joshi; Indus Publishing com., New Delhi
8. Drying and Storage of Grains and Oilseeds by Brooker & Hall, CBS

3.6 TECHNOLOGY OF CEREAL AND PULSES

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3 - 4

RATIONALE

This subject is aimed at imparting knowledge and skills related to the processing techniques, value addition, and handling of processing equipment of cereal, pulses and oil seeds to the students, as the understanding of these aspects is essential for diploma holders in food technology to perform efficiently and effectively in the industry

DETAILED CONTENTS

1. Introduction (6 hrs)

Status, production and major growing areas of cereals, pulses and oil seeds in India and world
Structure and chemical composition of cereals, pulses and oil seeds, anti-nutritional factors wherever applicable
2. Cereals (20 hrs)
 - 2.1 Wheat: types of wheat, conditioning and tempering, types of wheat milling technology, pasta and extruded products
 - 2.2 Rice: Varieties of rice, classification of rice based on various physical parameters, parboiling, milling of rice, and factors affecting quality of rice products
 - 2.3 Maize: Classification of maize, dry and wet milling of corn, preparation of corn flakes
 - 2.4 Barley and sorghum: Grain characteristics, technology of malt production, milling, malting and popping of sorghum
3. Millets (6 hrs)

Different millets and their chemical composition, processing and utilization of millets
4. Pulses (6 hrs)

Pretreatment of pulses for milling, milling of major pulses

5. Snacks foods based on cereals, pulses and oil seeds – their production technology (4 hrs)
6. By-product utilization of different milling industries (6 hrs)

LIST OF PRACTICALS

1. Determination of physical characteristics of (a) rice (b) wheat (c) pulses (d) maize (e) barley and sorghum (f) oil seeds
2. Milling of wheat to study its effect on various physico-chemical properties
3. Estimation of flour quality: Gluten, Ash, Water Absorption Power (WAP) Sedimentation Test, Maltose Value, Pelshenke Value
4. Parboiling and milling of rice
5. Pre-treatment and milling of pulses
6. Demonstration of oil extraction and refining of oil, and visit to relevant industry
7. Preparation of Pasta products – Noodles, Macroni, Vermicelli (Sevian)
8. Preparation of ready-to-eat (RTE) food products by extrusion cooking technology
9. Visits to flour mill, Rice Mill/Rice Sheller, Dhal Mill, Oil expelling Unit, Refining Units, Milling and Brewing Units

INSTRUCTIONAL STRATEGY

This being one of the most important subjects, teacher should lay emphasis on developing basic understanding of various concepts and principles and procedures involved herein. Suitable tutorial exercises may be designed by the teachers, which require students visit to various industries. Students may also be exposed to various National, BIS and international standards. Visits to the relevant industry for demonstrating various operations involved in the cereal, pulses, and oilseed processing is a must. Experts from the industry may be invited to deliver lectures on the latest technology. Knowledge from pollution control and devices for the same may be provided to the students. Wherever relevant, students may be made aware about safety aspects.

RECOMMENDED BOOKS

1. Cereal Technology by Kent, CBS
2. Wheat Chemistry and Technology by Y Pomeranz, AACC

3. Post Harvest Technology of Cereals by Chakraborty AC, IBH
4. Rice Chemistry and Technology by Julian, AACC
5. Chemistry of Technology of Cereals as Food and Feed by Matz

Note: Wherever equipment's are not available students may be demonstrated that topic relevant industry or in any other institutions.