

DEPARTMENT OF POST HARVEST & FOOD BIOTECHNOLOGY

SYLLABUS

FB-121: HUMAN NUTRITION (1+1=2)

THEORY:

Nutritional science – historical perspective, Importance and functions of food, Food Constituents: carbohydrates, proteins, lipids, minerals and vitamins-their role and functions, Dietary requirements of food for infants, pre-school children, adults, Pregnant and nursing Mothers under nutrition and malnutrition. Nutrition and aging, Nutrition and human genetics – Genetic determinants of nutrient needs, genetic abnormalities, racial differences in nutrient Needs or nutritional processing, the frequency of genetic abnormalities, gene stability, genetic change and carcinogenesis, genetic basis of obesity, nutrition and immune system, nutritional disorders, Food in relation to health and diseases. Inborn errors of metabolism. Losses of vitamins and minerals due to food processing. Food pattern. Food policies – applied nutrition Programme

PRACTICAL:

1. Analysis of food for proximate composition
 - a. Determination of dry matter and moisture
 - b. Determination of ash
 - c. Determination of acid soluble and insoluble ash
 - d. Determination of crude fibre
 - e. Determination of crude fat
 - f. Determination of crude protein by micro-Kjeldhal method
 - g. Determination of nitrogen free extract
2. Estimation of calorific value of the food by bomb calorimeter
3. Estimation of the phosphorus by molybdo-vanadate method
4. Estimation of calcium
5. Estimation of water soluble vitamin ascorbic acid
6. Estimation of water soluble vitamin thiamine
7. Estimation of fat soluble vitamin A/D/E
8. *In vitro* protein digestibility of grain protein and starch.
9. Nutritional disorders

REFERENCE BOOKS:

1. Human Nutrition and Dietetics by Garrow, J.S., James, W.P. T. and Ralph, A. 2000 Churchill Livingstone, Edinburgh
2. Human Nutrition by Barasai
3. Food Science and Human Nutrition by Swaminathan Vol.1-2
4. Text Book of Human Nutrition by Bamji M. S., Oxford IBH

FB-232: INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY (2+2=4)

THEORY:

Histological land marks. Screening of microorganisms for new products. Improvements of strain, mutant selection. Fermentation process development. Shake flask, Scale up of process and bioreactors. Metabolite antibiotics enzymes, bio pesticides, growth regulators, steroids organic acids, bio ethanol and enzymes production. Genetically engineered microbes (GEMs). Metabolic engineering. Process and types of bioreactors, production of yeast and antibiotics, ethanol, lactic acids. Various methods of fermentation.

PRACTICAL:

1. Isolation and screening of microorganisms
2. Maintenance of isolates/strains
3. Development of inoculums
4. Improvement of strain.
5. Preparation of wine from fruits
6. Visit to beverages industries
7. GMOs and their industrial application
8. Production of bio pesticides, growth regulators, ethanol from grains
9. Study of fermentation technology of alcoholic beverages
10. Downstream processing of secondary metabolites
11. Technology of indigenous and oriental fermented food
12. Probiotics

REFERENCES BOOKS:

1. Industrial microbiology by Casida , Jr L.E 1966Wiley Eastern Ltd, New Delhi
2. Industrial microbiology and Biotechnology by Demain A.L and N.A Soloman 1986. American Socitiy for microbiology, Washington.
3. Biotechnology by Singh B.D 2000.Kalyani Publishers, Ludhiana.
4. Fermentation a Practical Approach by McNeil & Harvey, 2007, Panima N.Delhi.
5. Industrial Microbiology A Lab Manual, by MAthur & Singh, 2007, Avishkar, Jaipur

FB-243: ENZYME BIOTECHNOLOGY IN FOOD PROCESSING (2+1=3)

THEORY:

General Introduction – Introduction, historical developments, applications and business of enzymes, enzyme safety, enzyme therapy, enzyme specificity, measurement and expression of enzyme activity, enzyme stability and denaturation; Regeneration of cofactors for

biocatalysis- common cofactors required for biotransformation and their representative *in situ* regeneration methods : regeneration of NAD(P)(H), NAD(P)+, ATP/NTP, Sugar nucleotide, PAPS, Acetyl coenzyme A; Potential, selection and application of some of the important enzymes in food. Carbohydrases: amylases(s) glucoamylase(s), hemicellulase(s) and cellulase(s). Proteolytic enzymes: proteases; cathepsin(s), trypsin, papain, bromelain and ficin, , rennin, pepsin, lipase(s): lipoxygenase(s), lipoxidase, etc. Oxidoreductase(s) : glucose oxidase, catalase, peroxidase, polyphenol oxidase and ascorbic acid oxidase. Importance of enzymes in various food and agro process industry.

PRACTICAL:

1. High and efficient recovery of proteins from enzyme treated defatted oilseed flours.
2. Estimation of PPO activity, preparation of glucose syrup/ high fructose syrup
3. Immobilized cell for production of alcohol and high fructose syrup
4. Degradation of cellulose by cellulases
5. Use of pectinase in classification
6. use of papain in meat tenderization
7. Reduction of heavy flavor by inactivation of lipoxygenase

REFERENCE BOOKS

1. Advances in Enzymology, Vol. 1-10. Nord, F.F. (ed.). 1941-50. Interscience Publisher, New York.
2. Enzyme Technology by Pandey, A., Colin W., Carlos, R. S., Christian, L. 2005. Asiatech Publishers Inc., New Delhi.
3. Principles of Enzymology for the Food Sciences by Whitaker, J. R. 1972. Marcel Dekker, New York.
4. Enzymes in Food Processing by G. Reed 1975. Academic Press, London.
5. Industrial Enzymology by Godfry, T. and J. R. Relchelt, (2nd Edn.). 1997. Macmillan Publishing Co., London.

FB-244: POST HARVEST BIOTECHNOLOGY OF FOOD GRAINS (2+1)

THEORY:

Classification, chemical composition and nutritional values of food grains (cereals including millets, legumes and pulses). Anti-nutritional factors- chemistry and methods of their removal. Importance and scope of food preservation and storage. Food spoilages- causes and effects. Principles and methods of food preservation and processing of food crops. Starch- Role in cookery. Mechanism of starch isolation and applications. Molecular biology of starch, gluteins with their role in dough quality. Bakery and confectionary- types, ingredients used with their role. Other processing techniques- Fermentation, malting, brewing, puffing, flaking, pearling, sprouting, roasting. Enrichments- Methods, need and fortification. Genetic

engineering for value addition from economic point of view as well as nutritional composition- Transgenes for altered composition of oil/ starch/ amino acid/vitamins/antinutrients with their sources. Golden rice, high quality protein maize, hypoallergenic rice, wheat gluten modification. Biosol concept. Spheroplast fusion technology. Biocatalysts and worldwide food industry market

PRACTICAL:

1. Morphological, physical and chemical properties of various cereals, pulses and oilseeds
2. Estimation of protein, oil and starch contents in grain crops
3. Food preservation techniques osmotic (sugar/salt); physical (drying, freezing, radiation) and chemicals
4. Food processing techniques- baking, fermentation (curd/ sauerkraut) and malting
5. Determination of gluten content
6. Preparation of Idli and Dhokla
7. Reduction of antinutritional factor
8. Production of starch from grains

REFERENCE BOOKS:

1. Food processing: Biotechnological Applications by Marwaha & Arora, 2000, Asiatech Publishers N.D
2. Postharvest physiology and storage of tropical and subtropical Fruits, 2005, CABI Publishing
3. Postharvest by Wills, Mcglasson, 2007, CABI
4. Essentials of Food Science by Vaclavik, 2003, Plenum, NY
5. Fruit & Vegetable Biotechnology by Valpuestav

FB-355: TECHNOLOGICAL APPLICATIONS IN FOOD PROCESSING (1+1=2)

THEORY

Recent trends in food processing. Techniques and applications of immobilized enzymes in food industry. Applications of glucose oxidase, catalase and pectinase in food processing. Single cell proteins for human food consumption. Biotechnology for natural and artificial flavor and fragrance production. Microbial biotechnology for food flavour production, oils and fats, Molecular High Intensity Low Calorie sweeteners. Essential oils. Sources and production of vitamins under controlled conditions. Safety issues related processed foods, parealization, nanotechnology, hardle technology, bio-preservation/ Natural preservation. High electric light pulse technology. Aseptic packaging/ vacuum packaging, biodegradable plastics, extrusion cooking.

PRACTICALS:

1. Preparation of extruded products
2. preparation of pickles
3. preservation of food using organic acids
4. production of β -carotene/citric acid
5. SCP production
6. Bioflavours/ biocolor

REFERENCE BOOKS:

1. Food Biotechnology, by Roges, A. 1989. Elsevier Applied Sci. Pub., London, U.K.
2. Functional Foods by Goldberg, I. 1994. Chapman and Hall, New York.
3. Fundamentals of Food Biotechnology by Byong, H. L. 1996. VCH Publishers, New York.
4. Food Biotechnology by Shetty, 2006, CRC, NY
5. Comprehensive Biotechnology by Campbell, R.W. and J. A. Howell. 1995. Pergamon Press, Oxford.
6. Biotechnology by Singh, B. D. 2000. Kalyani Publishers, Ludhiana.

FB-366: POST HARVEST BIOTECHNOLOGY OF HORTICULTURAL CROPS (2+1=3)

THEORY:

Importance of post harvest loss management. Pre- and Post-harvest factors affecting shelf life of Horticultural crops. Post harvest molecular biology- ripening (role of ethylene, climacteric vs. non-climacteric fruits), fruit softening (Pectinase and polygalacturonases), flavor fragrance and senescence. Genetic engineering plants for delayed ripening and better shelf life. Packing techniques- grading, containers, cushioning, vacuum packing, canning, bottling, freezing, dehydration, drying, UV and Ionizing radiations. Principles of preservation by heat, low temperature, chemicals and fermentation. Preservatives and colours permitted and prohibited in India. Storage techniques- Zero Energy Cold Storage Chambers and On Farm Storage facilities. Microbial contaminants and post-harvest pathology. Export Quality Standards. Biotechnology for recycling Horticultural waste as manures and livestock feed. Phytosanitation, HACCP, GM fruits and vegetables.

PRACTICAL:

1. Maturity standards of some selected fruits and vegetables
2. Ethylene assay
3. Determination of Physiological loss of weight, TSS, total sugars, acidity, pigments and ascorbic acid contents in selected horticultural crops
4. Packing and storage techniques

5. Quality standards for exports
6. Visit to pre-cooling and packing unit
7. Grading for international market and national quality code standards
8. Role of UV in preservation of food.

REFERENCE BOOKS:

1. Food Biotechnology, by Roges, A. 1989. Elsevier Applied Sci. Pub., London, U.K.
2. Functional Foods by Goldberg, I. 1994. Chapman and Hall, New York.
3. Fundamentals of Food Biotechnology by Byong, H. L. 1996. VCH Publishers, New York.
4. Food Biotechnology by Shetty, 2006, CRC, NY
5. Comprehensive Biotechnology by Campbell, R.W. and J. A. Howell. 1995. Pergamon Press, Oxford.
6. Biotechnology by Singh, B. D. 2000. Kalyani Publishers, Ludhiana.
7. Hand book of horticulture – by ICAR, New Delhi

FB-367: FOOD AND NUTRITION SECURITY OF GM FOOD CROPS (1+1=2)

THEORY:

International aspects of the quality and safety of Foods derived from modern Biotechnology, Application of ELISA for detection of Toxins in food, Biosensors for food Quality Assessment, Malnutrition, consequences, causes, prevention and control. Applied Community nutrition. Food safety and food faddism. Safety testing for toxicity, allergenicity, anti nutritional effects Native toxins and toxins produce during storage, health hazards.

PRACTICAL:

1. Quantitation of toxins by various methods
2. Bio film production
3. Antimicrobial activity
4. ELISA for toxins and viruses

REFERENCE BOOKS:

1. Food Biotechnology, by Roges, A. 1989. Elsevier Applied Sci. Pub., London, U.K.
2. Functional Foods by Goldberg, I. 1994. Chapman and Hall, New York.
3. Fundamentals of Food Biotechnology by Byong, H. L. 1996. VCH Publishers, New York.
4. Food Biotechnology by Shetty, 2006, CRC, NY
5. Comprehensive Biotechnology by Campbell, R.W. and J. A. Howell. 1995. Pergamon Press, Oxford

CAFETERIA COURSES

FB-478: CEREAL BIOTECHNOLOGY (2+2=4)

THEORY:

Introduction, Genetic transformations of wheat, barley, rice and maize. Problems and future trends in genetic transformation, Commercial targets for cereal biotechnology, using biotechnology to add value to cereals: weed control, Disease resistance, improved nutritional properties, improved processing properties, improved cereal quality control, Deployment of molecular markers, current practice in milling, baking, malting, brewing and distilling. Risk assessment and legislative issues.

PRACTICAL:

1. Isolation of DNA from Wheat, Barley, Rice and Maize.
2. Isolation of Protoplast.
3. QTLs detection.
4. Preparation of gene cassette: Cloning vector, Gene of interest, Promoter, Terminator, Marker gene.
5. Gene transformation via *Agrobacterium*, *Biolistic*, *Electroporation* and *Micro-injection* method

REFERENCES BOOKS:

1. Cereal Biotechnology by Peter C. Morris and James H. Bryce, Wood head publishing Limited, publication 2000.
2. Food Biotechnology by Dietrich Knorr, Dekker publication 2005.
3. Biotechnology by B. D. Singh, Kalyani publication, 2000.

FB-479: FRUIT AND VEGETABLE BIOTECHNOLOGY (2+2=4)

THEORY:

Introduction, the nutritional importance of fruits and vegetables. Strategies for nutritional enhancement: The application of traditional breeding methods for selection of varieties, a reduction in the content of anti-nutritional factors, the use of genetic manipulation to introduce new traits. Nutritional health benefits through biotechnology. Relationship of structure to nutritional quality (Bioavailability). Nutritional enhancement versus food fortification. Constraints on innovation, further trends in food biotechnology. Food safety. Case studies to improve Nutritional quality and shelf life of fruits and vegetables- e.g. Potato, tomato, Grape etc. Case studies of grape, tomato, papaya and other fruits and vegetables

PRACTICAL:

1. Biochemical analysis of nutritionally important fruits and vegetables.
2. DNA isolation.
3. DNA fingerprinting of fruits and vegetables.
4. Identification of novel gene(s) related to nutritional character by using various markers.
5. MAS for the quality characters.

REFERENCES BOOKS:

1. Plant cell tissue and organ culture: fundamental methods by C. L. G. C. Philips and L.R. Wetter 1995. National Research council, Canada, PRL, Saskatoon.
2. In vitro embryogenesis in plants by Trevor Thorpe A.1995. Kluwer Academic press London.
3. Plant Tissue Culture Theory and Practices by Bhojwani & Razdan,2008, Elsevier, India.
4. Introduction to Plant Tissue Culture by Razdan, 2007, Oxford IBH.
5. Plant Cell Culture by Dixon, 2004, Panima New Delhi.
6. An introduction to Plant Tissue Culture by Kalyani Kumar De.
7. Fruit and Vegetable Preservation principals and practices 3rd revised and enlarged edition by R. P. Srivastava and Sanjeev Kumar.

FB-4710: BREWING TECHNOLOGY (1+3=4)

THEORY:

Introduction, History of brewing, Malts, Mash tun adjuncts and brewing liquor. Milling and mashing in, Mashing and wort separation systems. The hop-boil and copper adjuncts, wort clarification, cooling and aeration. Fermentation process development, scale of up process.

PRACTICAL:

1. Biochemical analysis of nutritionally important fruits and vegetables used in brewing.
2. Media preparation and instrument required for brewing.
3. Preparation of mother culture and starter culture for alcohol production.
4. Preparation of Beer / alcohol.
5. Contamination of beer during processing and effect of contaminants on quality of beer.
6. Sensory evaluation of Beer.
7. Removal of protein from beer by hydrolysis, precipitation and adsorption method.
8. Major problems in Beer production.
9. Defects in Beer
10. Studies on factors affecting quality of beer.

REFERENCES BOOKS:

1. Brewing Science and Practice by Briggs, Boulton, Brookes and Stevens 2004, Woodhead Publishing Limited, USA.
2. Food Biotechnology edited by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto and Robert E. Levin, Taylor & Francis Group 2006.
3. Biotechnology by B. D. Singh, Kalyani publication, 2000.

FB-4711: WINE TECHNOLOGY (1+3=4)

THEORY:

Introduction, Grape cultivars and wine types: *Vitis vinifera* cultivars, white cultivars, red cultivars, Advance techniques in production, Genetic engineering in wine grapes, clonal selection and somaclonal selection, Biotechnology in Viti culture, Genetic engineering for Yeast fermentations, Ideal Yeast; Yeast breeding and wine quality. Wine as a functional food, Factors affecting during storage or aging of wine.

PRACTICAL:

1. White wine production and recommended varieties.
2. Red wine production and recommended varieties.
3. Production of wines other than grapes.
4. Techniques of testing wine:- Selection of glass, serving temperature, Design of room for wine testing
5. Timing of testing wine, test the wine on the basis of senses (Vision, smell / aroma and palate structure).
6. Sensory evaluation and score card:- Rose worthy score card, Devis score card and sparkling wine score card.
7. Visit to the winery
8. Production of wines on lab scale / industrial scale.
9. Tartarate and bitartarate stability test / cold stability test
10. Determination of acetaldehyde / phenol content of wine.
11. Spoilage and Adulteration of wine.
12. Studies on factors affecting quality of wine.

REFERENCES BOOKS:

1. Fermentation a practical approach by McNeil and L M Harvey, published in the Practical Approach Series, Indian publication, 2007.
2. Food Biotechnology edited by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto and Robert E. Levin, Taylor & Francis Group 2006.
3. Biotechnology by B. D. Singh, Kalyani publication, 2000.

FB-4712: PATENTING INVENTIONS IN FOOD BIOTECHNOLOGY (2+2=4)

THEORY:

Nature of patent, patent application, patent ability, official examination, Re-examination, Features of US patent application, Conflicting patent application, Duration of patent, Enforcing patent, Licensing patent, Types of biotechnology patents: Food products and biological products (naturally occurring substances, micro-organisms, plants, animal breeds, DNA and RNA sequences), Patenting in biotechnology: Microbiological inventions, Descriptions of micro-organisms, Availability of the deposit, Patent for GM foods.

PRACTICAL:

1. Application formats for patenting.
2. Patenting of various strains.
3. Patenting of various proteins.
4. Patenting of extracted proteins.
5. Patenting of sweeteners.
6. Patenting of various genetically modified cultivars.
7. Enforcing patent.
8. Licensing and duration of patent.

REFERENCES BOOKS:

1. Food Biotechnology edited by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto and Robert E. Levin, Taylor & Francis Group 2006.
2. Biotechnology by B. D. Singh, Kalyani publication, 2000.
3. Food Biotechnology edited by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto and Robert E. Levin, Taylor & Francis Group 2006.