

FISH PROCESSING TECHNOLOGY

CODE	COURSE TITLE	CREDITS
FPT 501*	TECHNOLOGY OF FREEZING AND STORAGE	2+1
FPT 502*	THERMAL PROCESSING OF FISHERY PRODUCTS	2+1
FPT 503*	QUALITY ASSURANCE, MANAGEMENT AND CERTIFICATION	2+1
FPT 504*	APPLIED FISH BIOCHEMISTRY	2+1
FPT 505	TECHNIQUES IN MICROBIOLOGY	1+1
FPT 506	CURED, DEHYDRATED AND SMOKED FISHERY PRODUCTS	1+1
FPT 507	HANDLING, STORAGE AND TRANSPORT OF FRESH FISH	1+1
FPT 508	TECHNOLOGY OF MINCE-BASED FISH PRODUCTS	1+1
FPT 509	ADDITIVES IN FISH PROCESSING	1+1
FPT 510	FISH BY-PRODUCTS AND UTILIZATION OF FISHERY WASTE	1+1
FPT 511	MICROORGANISMS OF PUBLIC HEALTH SIGNIFICANCE	1+1
FPT 512	DESIGN, MAINTENANCE OF FISH PROCESSING PLANTS AND INSTRUMENTATION	1+1
FPT 513	PACKAGING OF FISH AND FISHERY PRODUCTS	1+1
FPT 591	MASTER'S SEMINAR	1+0
FPT 599	MASTER'S RESEARCH	20
FPT 601**	BIOCHEMICAL TECHNIQUES IN FISH ANALYSIS	2+1
FPT 602**	FUNCTIONAL PROPERTIES OF PROTEINS FROM FISH AND SHELLFISH	2+1
FPT 603**	QUALITY MANAGEMENT SYSTEMS	2+1
FPT 604	LIPIDS OF AQUATIC ORIGIN	2+1
FPT 605	MICROBIAL HAZARDS IN FISH PROCESSING	2+1
FPT 606	VITAMINS, MINERALS AND FLAVOUR BEARING COMPONENTS IN AQUATIC ORGANISMS	2+1
FPT 607	TOXINS AND CONTAMINANTS	2+1
FPT 608	NUTRITIONAL ASPECTS AND NUTRITION LABELING	2+1
FPT 609	ENVIRONMENTAL IMPACT OF FISHERY INDUSTRIES	2+1
FPT 610	BY-PRODUCTS, SPECIALTY PRODUCTS AND VALUE ADDED PRODUCTS	2+1
FPT 691	DOCTORAL SEMINAR I	1+0
FPT 692	DOCTORAL SEMINAR II	1+0
FPT 699	DOCTORAL RESEARCH	45

* Compulsory for Master's programme; ** Compulsory for Doctoral programme

Course Contents

FPT 501 **TECHNOLOGY OF FREEZING AND STORAGE** **2+1**

Objective

To give detailed insight into various aspects of freezing of fish.

To provide understanding on chemical, bacterial and sensory changes during freezing.

Theory

UNIT I

Freezing: Structure of water and ice, Influence of solutes on the structure of water and ice, phase equilibria and freezing curves of pure water and binary solutions, freezing curve for fish. Determination of freezing points from time- temperature plots, calculation of freezing time.

UNIT II

Crystallization, homogeneous and heterogeneous nucleation, super cooling, crystal growth, eutectic point, location of ice crystals in tissue, physical changes during freezing.

UNIT III

Technological aspects of freezing: Slow and rapid freezing, Methods of freezing, comparison of various freezing methods, selection of a freezing method, product processing, packaging and different types of freezers.

UNIT IV

Chemical treatment prior to freezing: antioxidants, cryoprotectants and other additives, theories of cryopreservation, glazing.

UNIT V

Frozen storage: Physical and chemical changes - freezer burn and recrystallisation, different types of recrystallisation.

UNIT VI

Chemical changes in lipids, proteins and nucleotides, freeze denaturation and theories on denaturation, changes in pH, bacterial changes, sensory changes, texture, taste, odour, effect of post-mortem condition on sensory qualities.

UNIT VII

Water holding capacity, time temperature tolerance, temperature and duration of storage on quality and shelf life.

UNIT VIII

Arrangements within a cold storage, handling and stacking systems, space requirement, precautions to reduce temperature increase in a cold storage.

UNIT IX

Filleting of fish, treatments, glazing, packaging and freezing. Processing of prawns, lobster, squid, cuttle fish, crab etc. for freezing.

UNIT X

Different methods of thawing frozen fish, advantages and disadvantages. Recent advances in fish thawing.

Practical

Filleting of fish, treatments, glazing, packaging, freezing, Processing of Prawns, Lobster, Squid, Cuttle Fish, Crab etc. in different styles, Packaging and Freezing, Freezing curve, determination of freezing point. Studies on physical, chemical and sensory changes.

Suggested Readings

Andrew CC. 1990. *Food Refrigeration Processes*. Elsevier.

Balachandran KK. 2001. *Post-harvest Technology of Fish and Fish Products*. Daya Publ. House.

Clucas IJ. 1981. *Fish Handling, Preservation and Processing in the Tropics*. Parts I, II. FAO.

Fennema K, Powrie WD & Marth EH. 1973. *Low Temperature Preservation of Foods and Living Matter*. Marcel Dekker. Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.

Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.

Nambudiri DD. 2006. *Technology of Fishery Products*. Fishing Chimes. Regenssein JM & Regenssein CE. 1991. *Introduction to Fish Technology*. Van Nostrand Reinhold.

Rudolf K. 1969. *Freezing and Irradiation of Fish*. Fishing News (Books). Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.

FPT 502 **THERMAL PROCESSING OF FISHERY PRODUCTS** **2+1**

Objective

To provide information on various aspects of thermal / heat processing. To compare cold sterilization with thermal processing.

To impart knowledge on various types of packaging techniques and materials used in thermal processing.

Theory

UNIT I

Principles of thermal processing. Mechanism of heat transfer: conduction, convection, radiation and dielectric and microwave heating, unsteady state of transfer, heat resistance of bacteria and spores, decimal reduction time, thermal death time, "Z" and "F" values, 12D concept, heat penetration, cold point, can size, shape, contents etc. on heat penetration, determination of process time. Significance of thermal death curve, graphical, formula, nomogram methods – F₀ value, cook value, D value, integrated F value and their inter-relationship. Heating equipment.

UNIT II

Classification of foods: low acid, medium acid and acidic foods, absolute sterility, statistical sterility, commercial sterility, pasteurisation and sterilisation.

UNIT III

Canning process, steps involved, process flow, additives, HTST processing and aseptic canning, principles and process details, canning machinery and equipment, canning process for fish/shellfish, value added and ready to use canned products.

UNIT IV

HACCP and Safety of canned foods and unreliability of post process sampling of canned foods to ensure sterilization. Status of a batch of canned foods identifying CCPs and their monitoring by specially trained personnel.

UNIT V

Spoilage of canned food, physical, chemical and microbial, Thermobacteriology, death of bacteria, autosterilisation bacteriology of canned/heat processed fishery products, examination of cans and seams.

UNIT VI

Canning plant location: Practical considerations, canning plant facilities, layout design.

UNIT VII

Flexible packing, retort pouch processing of fish and fishery products principles and techniques. Combination and synergistic effects.

UNIT VIII

Hurdle technology: Combination with heat, heat and hydrostatic pressure, heat and low pH, heat and NaCl and nitrite, combination with ionising radiation, irradiation and hydrostatic pressure, irradiation and NaCl, irradiation and other adjuncts, heat and irradiation, irradiation and low temperature, low pH and specific acids, low a_w and adjuncts like Nisin to reduce severity of heat processing.

UNIT IX

Irradiation: Radiation sources, units, dose levels, radappertization, radacidation, radurization, effects of irradiation on protein, lipids, vitamins, bacteriological aspects, physical properties, shelf life and irradiated fish products.

Practical

Evaluation of pasteurisation and sterilisation, determination of TDT and F value Examination of canned foods, can seams, testing sterility, isolation of *Bacillus* and *Clostridium* Spp., spore staining, heat penetration curve and cooling curve, canning operations for different fish/shellfish products. Double seam profile, Heat Penetration Curve, F₀ Value, Z value, Process time, Canning of table fishes, Bivalves, Crustaceans in different containers, Operation of over pressure autoclave, Canned culinary preparations, Examination of canned fishery products.

Suggested Readings

- Balachandran KK. 2002. *Fish Canning Principles and Practices*. CIFT, Cochin.
Gopakumar K. 2002. *Text Book of Fish Processing Technology*. ICAR. Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.
Hersom AC & Hulland ED. 1980. *Canned Foods*. Chemical Publ. Co. Larousse J & Brown BE. 1997. *Food Canning Technology*. Wiley VCH. Nambudiri DD. 2006. *Technology of Fishery Products*. Fishing Chimes.
Stumbo. 1973. *Thermo Bacteriology in Food Processing*. CRC, AcademicPress.
Thorne S. 1991. *Food Irradiation*. Elsevier.
Venugopal V. 2006. *Seafood Processing*. Taylor & Francis.
Warne D. 1988. *Manual on Fish Canning*. FAO Fisheries Tech. Paper 285. Zeathen P. 1984. *Thermal Processing and Quality of Foods*. Elsevier.

FPT 503 QUALITY ASSURANCES, MANAGEMENT AND CERTIFICATION 2+1

Objective

To understand various aspects of quality assurance system, quality management and national / international certification system.

To learn factory sanitation and hygiene, water quality and standard

Theory

UNIT I

Quality management, total quality concept and application in fish trade.

UNIT II

Quality assessment of fish and fishery products - physical, chemical, organoleptic and microbiological quality standards.

UNIT III

Inspection and quality assurance: Fish inspection in India, process water quality in fishery industry, product quality.

UNIT IV

Water quality and standards.

UNIT V

Sensory evaluation of fish and fish products, basic aspects, different methods of evaluation, taste panel selection and constitution, statistical analysis.

UNIT VI

HACCP and Good manufacturing practices. HACCP principles, practical aspects of planning and implementation, verification, validation and audit.

UNIT VII

National and International standards: ISO 9000: 2000 series of quality assurance system, *Codex alimentarius*, USFDA and EU regulations for fish export trade, IDP and SAT formations in certification of export worthiness of fish processing units, regulations for fishing vessels, pre-processing and processing plants, EU regulations. ISO 22000:2006.

UNIT VIII

Factory sanitation and hygiene: National and international requirements, SSOP, Sanitary and Phytosanitary measures.

UNIT IX

Food laws in India, integrated food law.

Practical

Evaluation of fish / fishery products for organoleptic, chemical and microbial quality. Methods for analysis for bacterial quality parameters, chemical parameters and filth. Evaluation of sanitary conditions in fish processing units. Analysis of typical hazards. Study of correction and corrective action. SQC: Introduction, statistical principles involved, process control, control charts, variable and attribute control charts, Acceptance sampling, basic ideas, sampling by attributes single and double sampling plans, Basic concepts of decision making. Familiarization with water quality analysis.

Suggested Readings

- Anthony TT. 1988. *Handbook of Natural Toxins. Marine Toxins and Venom*. Vol. III. Marcel Dekker.
Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ. House.
Connell JJ. 1995. *Control of Fish Quality*. Fishing News Books.
Fennema K, Powrie WD & Marth EH. 1973. *Low Temperature Preservation of Foods and Living Matter*. Marcel Dekker.
Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.
Hall GM. (Ed). 1992. *Fish Processing Technology*. Blackie.
Hui YH, Merle DP & Richard GJ. (Eds.). 2001. *Food Borne Disease Handbook. Seafood and Environmental Toxins*. Vol. IV. Marcel Dekker.
Huss HH, Jakobsen M & Liston J. 1991. *Quality Assurance in the Fish Industry*. Elsevier.
John DEV. 1985. *Food Safety and Toxicity*. CRC Press.
Krenzer R. 1971. *Fish Inspection and Quality Control*. Fishing News. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ. Vincent K & Omachonu JER. 2004. *Principles of Total Quality*. CRC Press.

FPT 504

APPLIED FISH BIOCHEMISTRY

2+1

Objective

To impart knowledge on macro and trace constituents and nutritive value of fish.

To create basic understanding about toxins and toxic substances and their toxic effects.

To give a detailed insight into experimental techniques used in food analysis.

Theory

UNIT I

Seafood proteins: Classification. Sarcoplasmic proteins: Heme proteins, Myoglobin, Hemocyanins, parvalbumins, antifreeze proteins, pigments, enzymes- hydrolases, oxidoreductases, and other enzymes.

UNIT II

Myofibrillar proteins: Myosin – isolation, sub-unit composition, actin, allergins, tropomyosin, troponins, paramyosin, connectin.

UNIT III

Stroma proteins: Connective tissue in the muscle, collagen in fish muscle and skin: location, characteristics of seafood collagen, collagen on the quality of seafoods, gaping.

UNIT IV

Functional properties of seafood proteins: Solubility, emulsification, viscosity, water holding, stability, gelation, texture profile analysis.

UNIT V

Changes in proteins during processing: Denaturation- At high and low temperatures and kinetics, dissociation / aggregation / coagulation, reversibility, significance to processing and quality. Hydrolysis and hydrolysates: Process and applications, proteinases.

UNIT VI

Post mortem biochemical changes, rigor mortis, K-value, TMAO and its decomposition products, demethylase.

UNIT VII

Non-protein nitrogenous compounds: Free amino acids, peptides, nucleotides, guanidins, urea, quaternary ammonium compounds etc.

UNIT VIII

Seafood lipids: Composition and nutritive value, lipid types and their variations, lipid fractionation, estimation of lipid fractions, triglycerides, phospholipids, non-saponifiables including sterols and vitamins. Polyunsaturated fatty acids and prostaglandins- beneficial effects on human health.

UNIT IX

Fatty acid composition of fish liver and body oils, auto-oxidation of fatty acids, rancidity, lipases and phospholipases, pro- and anti-oxidants, oxidation indices, lipid-protein interactions, oxidized lipids-protein interactions and their impact on quality.

UNIT X

Macro and trace elements in fish and shellfish; Vitamins and Minerals of nutritional significance, toxic metals and their harmful effects and metallothionines.

UNIT XI

Flavour and pigments; amines, volatile fatty acids, carbonyls, sulphur containing compounds, carotenoids, isoprenoids in fish.

UNIT XII

Biogenic amines, Aflatoxins in cured fish.

UNIT XIII

Principles and methods involved in the separation and analysis of fish muscle constituents: Thin layer, paper and column chromatography, spectrophotometry, colorimetry, flame photometry, atomic absorption spectrophotometry, paper, disc and slab electrophoresis.

Practical

Molarity, normality, acid-base, redox titration, buffers. Lipids – Fractionation by TLC and other chromatographic techniques. Fatty acid composition by GLC, Amino acid analysis by HPLC. Protein purification methods: (NH₄)₂SO₄/solvent precipitation. Ultracentrifugation, dialysis and ultrafiltration, gel filtration, electrophoresis, PAGE and SDS-PAGE, Marine polysaccharides for food use, molecular biology techniques in fish and bacterial identification, and topical subjects.

Suggested Readings

- George MP & Barbec WT. 1990. *Seafood: Effects of Technology and Nutrition*. Marcel Dekker.
- Joe MR & Carrie ER. 1984. *Food Protein Chemistry*. Academic Press.
- Lehninger AL. 1982. *Principle of Biochemistry*. Worth Publ.
- Michael ENA. 1990. *Biochemistry of Foods*. Academic Press.
- Nettleton J. 1985. *Seafood Nutrition*. Van Nostrand Reinhold.
- Owen RF. 1996. *Food Chemistry*. Marcel Dekker.
- Pare JRJ & Belanger JMR. 1997. *Instrumental Methods in Food Analysis*. Elsevier.
- Pomeranz Y & Meloan CE. 1994. *Food Analysis Theory and Practice*. AVI Publ.
- Rao R. 1980. *Textbook of Biochemistry*. 2nd Ed. Prentice Hall of India.
- Regenstein JM & Regenstein CE. 1984. *Food Protein Chemistry*. Academic Press.
- Robert GA. 1989. *Marine Biogenic Lipids Fats and Oils*. Vol. II. CRC Press.
- Roy EM & George JF. 1990. *The Sea Food Industry*. Van Nostrand Reinhold.
- Roy EM, George JF & Donn RW. 1982. *Chemistry and Biochemistry of Marine Food*. Van Nostrand Reinhold.
- Shahidi F & Botta JR. 1994. *Seafoods: Chemistry, Processing Technology and Quality*. Blackie.
- Smith EL, Hill RL, Lehman IR, Lefkowitz RJ, Handler P & White A. 1983. *The Principles of Biochemistry*. McGraw-Hill.
- Stewart KK. (Ed). 1984. *Modern Methods of Food Analysis*. AVI Publ.
- Suzuki 1981. *Fish and Krill Protein Processing Technology*. Applied Science Publ.
- Whitaker JR & Tannenbaum SR. 1977. *Food Proteins*. AVI Publ

FPT 505**TECHNIQUES IN MICROBIOLOGY****1+1****Objective**

To learn basic techniques in Microbiology.

TheoryUNIT I

Safety in Microbiology laboratory – Prevention of contamination, aerosol sampling, disinfection and evaluation of disinfectants.

UNIT II

Microscopy – bright-field, fluorescence, phase-contrast, dark ground and electron microscope.

UNIT III

Staining techniques – Types of stains and chemistry of staining.

UNIT IV

Sterilisation – Principles of various physical and chemical methods of sterilisation.

UNIT V

Nutritional requirements of microorganisms – constituents of growth media, requirement of fastidious organisms alternate nutrition, different types.

UNIT VI

Isolation, enumeration, preservation and maintenance of cultures - growth curve, different types of cultures, population estimation techniques.

UNIT VII

Routine tests for identification of bacteria - morphological, cultural, biochemical and serological. Anaerobic bacteria - methods of anaerobiosis. Basics of mycological and virological techniques. Introduction to molecular techniques in Microbiology.

Practical

Microscopic techniques, isolation, enumeration and identification of microorganisms, serological techniques, anaerobic bacteria, mycological, virological and molecular techniques.

Suggested Readings

Chakraborty P. 1995. *A Text Book of Microbiology*. New Central Book Agency.

Criusted J. 1986. *Methods in Microbiology*. Academic Press.

Harry WSJR, Paul JV & John JL. 2000. *Microbes in Action*. Freeman & Co. II (ICMSF). Academic Press.

James M. 1978. *Modern Food Microbiology*. 2nd Ed. D. Van Nostrand Co.

Michael J, Pelizar JR & Chan ECS. 1998. *Microbiology*. McGraw Hill. Paul JH. 2001. *Marine Microbiology- Methods in Microbiology*. Vol.XXX. Academic Press.

Samuel CP & Dunn CG. 1959. *Industrial Microbiology*. McGraw Hill. Silliker JH, Elliof RP, Baired AC & Boyan FL. 1980. *Microbial Ecology of Foods*. Vol.II. (ICMSF). Academic Press.

William CF & Dennis CW. 2000. *Food Microbiology*. McGraw Hill.

FPT 506**CURED, DEHYDRATED, SMOKED FISHERY PRODUCTS****1+1****Objective**

To create understanding on various scientific preservation techniques of fish.

To impart knowledge on changes during storage of products.

TheoryUNIT I

Free and bound water in foods, water activity and sorption behaviours of foods, storage characteristics, microbial spoilage, effects of water activity on chemical deterioration, enzymatic reaction, non-enzymatic browning, lipid oxidation, reaction between lipids and proteins, dry fish, control of micro-organisms.

UNIT II

Principles of drying and dehydration: Psychometrics, drying calculation, constant rate and falling rate, drying time in air, moisture transport mechanism, natural drying, solar drying and mechanical drying. Different types of dryers: tunnel drier, vacuum drier, drum drier, solar drier etc.

UNIT III

Freeze drying, preparation and its nutritive value.

UNIT IV

Dehydration of fish products: dehydration ratio, precautions to be taken in fish drying; denaturation of fish protein.

UNIT V

Cured fish, types of salt curing, use of salt, factors affecting salt uptake by fish, lean and fatty fish, whole, gutted or split open, type and size of salt crystals, source of salts and impurities in salts, effect of impurities on salt penetration, temperature of salting.

UNIT VI

Spoilage of dried / cured fish, physical, chemical and microbiological changes, methods to prevent / control spoilage, extension of shelf life.

UNIT VII

Fermented products: different methods of fermentation, indigenous products and their principles of preservation.

UNIT VIII

Smoke curing, chemistry of smoke, composition and properties, smoking methods: cold and hot method, use of smoke liquids, production of smoke, type of wood used, methods of smoke generation, carcinogens in smoke, smoke kilns.

UNIT IX

Marinades: Principles; processing of cold, cooked and fried marinades, shelf life and spoilage.

UNIT X

Fish and shellfish pickles: production, shelf life.

UNIT XI

Packaging requirements for dry, cured and fermented products.

Practical

Preparation of dried, cured and fermented fish products, examination of salt, protein, moisture in dried / cured products, examination of spoilage of dried / cured fish products, marinades, pickles, sauce.

Suggested Readings

Gopakumar K. 2002. *Text Book of Fish Processing Technology*. ICAR. Hall GM. 1992. *Fish Processing Technology*. Blackie.

Hui YH, Merle DP & Richard JG. 2001. *Food Borne Disease Handbook. Seafood and Environmental Toxins*. Vol.IV. Marcel Dekker.

Oefjen G, Wilhelm H & Peter. 2004. *Freeze Drying*. Wiley-VCH GmbH & Co.

Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ. Wheaton FW & Lawson TB. 1985. *Processing Aquatic Food Products*. John Wiley & Sons.

FPT 507 HANDLING, STORAGE AND TRANSPORT OF FRESH FISH 1+1

Objective

To teach scientific techniques of handling, storage and transport of fresh fish.

To teach various post harvest changes during chill storage of fish.

Theory

UNIT I

Structure of fish myosystems, Postmortem changes - Structural and chemical.

UNIT II

Fish as raw material for processing: Body structure, physical properties, shape, specific weight, bulk weight, angle of slip, weight composition.

UNIT III

Factors affecting quality of fresh fish: intrinsic and extrinsic factors.

UNIT IV

Handling of fish onboard fishing vessels, Unit operations.

UNIT V

Unloading fish, Fish pumps.

UNIT VI

Post-harvest Fishery losses, Methods to reduce losses.

UNIT VII

Handling of fish in landing centers, defects and modifications needed.

UNIT VIII

Chill storage of fish: Heat load calculation, storage methods. insulated boxes and insulation thickness, different types of ice, physical, chemical, microbiological and sensory changes during chill storage, iced storage shelf life, cold shock, physical, chemical and sensory methods of analysis.

UNIT IX

Different types of ice and their advantages.

UNIT X

Sous-vide technology.

UNIT XI

Melanosis and its prevention, discolouration in aquatic products, non- enzymatic browning.

UNIT XII

Depuration of bivalves.

UNIT XIII

Transportation: Live fish/shell fish, Transportation of raw fish to local markets and processing centres, Improvements needed in transportation, Refrigerated transport systems, Classification of transport vehicles, Cold chain.

Practical

Chill storage studies: Chemical, physical and sensory analysis, determination of shelf life. Handling of fish, bivalves, prawns, mollusks, Depuration, treatment with chemicals, evaluation of freshness of fish.

Suggested Readings

Aitken A, Mackie M, Merritt SH & Windsor ML. 1982. *Fish Handling and Processing*. Ministry of Agriculture, Fisheries and Food, Edinburgh.
Anon. 1965. *Fish Handling and Preservation*. Proc. Meeting on Fish Technology, Scheveningen. Organisation for Economic Co-operation and Development, Paris.
Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ.
Connell JJ. 1980. *Advances in Fish Sciences and Technology*. Farnham Surrey.
Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.

FPT 508 TECHNOLOGY OF MINCE BASED FISH PRODUCTS 1+1

Objective

To provide knowledge on basic principles and advanced technologies in processing of mince based fish products.

Theory

UNIT I

Composition of muscle proteins in fish and their role in emulsification and elasticity formation.

UNIT II

Factors influencing denaturation of muscle proteins and their theories. Methods to testing protein denaturation.

UNIT III

Factors influencing elasticity formation and theories of gel formation. Minced meat preparation from different varieties of fresh water and marine water fishes.

UNIT IV

Improvement of colour of meat using bleaching and certain additives. Use of anti-denaturants to prevent denaturation of proteins of fish mince during storage. Changes in meat during mincing and mixing operations and cooking and setting phenomena.

UNIT V

Technology of processing and preservation of gel forming fish flour (AFPP), its property and utilisation. Unit operations in analog product preparation- Crab sticks analogs, moulded lobsters and crabs.

UNIT VI

Battered and breaded products: different types and their preparation, nutritional and economic significance of products.

UNIT VII

Use of emulsifiers, binders, seasonings, spices, antioxidants, smoke extract, Preservatives, natural and artificial casings, nitrites and nitrates. Fortification of fish products with vitamins and minerals. Quality standards and recent developments.

Practical

Measurement of viscosity of fish proteins by Ostwald viscometer, effect of water washing on the quality of meat, colour fixation of red colour meat and estimation of nitrite. Studies on setting of fish meat. Estimation of starch in the final paste product. Fundamentals of controlled stress Rheometer. Effect of two stage heating of fish sol on gel strength.

Suggested Readings

Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ.
Bligh EG. 1992. *Seafood Science and Technology*. Fishing News Book. Lanier TC & Lee C. 1992. *Surimi Based Product Technology*. Marcel Dekker.
Matsumoto JJ. 1980. *Chemical Deterioration of Proteins*. American Chemical Society, Washington.
Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ. Suzuki. 1981. *Fish and Krill Protein Processing Technology*. Applied Science Publ.

FPT 509 ADDITIVES IN FISH PROCESSING 1+1

Objective

To familiarize with the use of different additives, their effects, levels and detection.

Theory

UNIT I

Introduction to food additives-definition-technical benefits of food additives-intentional and incidental additives.

UNIT II

Relationship of great revolutions in history to the development of food additives – Agricultural Revolution-Industrial revolutions – urbanization.

UNIT III

Intentional additives – use of specific nutrients as food additives – Requirements and considerations. Minerals, vitamins, amino acids and nutrient concentrates as additives, Incidental additives.

UNIT IV

Policy considerations in the use of food additives. Flavours and colour as additives.

UNIT V

Antioxidants – Mechanism of antioxidants; commercial antioxidants and selections.

UNIT VI

Analytical methods for antioxidants.

UNIT VII

Acidulants in food processing; Sequestrants in food processing; Polyphosphates in fish processing.

Practical

Determination of food additives such as preservatives, antioxidants, curing agents, chelating agents, acidulants and phosphates in various food products. Detection of certain intentional and unintentional food additives in foods.

Suggested Readings

Branen AL, Davidson PM & Salmivien S. 1990. *Food Additives*. Marcel Dekker.

Middle KRD & Shubik P. 1989. *International Food Regulation Handbook*. Marcel Dekker.

Rahman MS. 2007. *Handbook of Food Preservation*. 2nd Ed. CRC Press. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ.

Wheaton FW & Lawson TB. 1985. *Processing Aquatic Food Products*. John Wiley & Sons.

FPT 510

FISH BY-PRODUCTS AND UTILIZATION OF FISHERY WASTE

1+1

Objective

To provide information on various fish by-products, utilization of fishery wastes and their nutritional value.

Theory

UNIT I

Fish meal: Production - dry and wet process, machinery, control of quality of products, specifications, packaging and storage.

UNIT II

Fish body and liver oils: Extraction, purification, preservation and storage, industrial and nutritional applications of fish oils. Vitamin A and D.

UNIT III

Essential fatty acid functions of fish oils, poly-unsaturated fatty acid (PUFA), production of concentrates of polyunsaturated fatty acids, preparation of fatty alcohol and amides.

UNIT IV

Utilisation of shark: Processing of shark meat, removal of urea in meat, filleting, curing and dehydration, extraction of shark liver oil, Vitamin A, D, squalene, ambergris, curing and tanning of shark skin, shark cartilage.

UNIT V

Shrimp waste, crab shell and squilla utilisation: Resources and composition, conventional uses, feeds and manure, conversion to useful materials like chitin, chitosan, glucosamine hydrochloride, shrimp extract, commercial production, production and use of protein isolates from squilla and shrimp waste.

UNIT VI

Fish protein concentrate: Different methods of production, functional properties, different types of FPC, texturised products and comparison of FPC to fish meal.

UNIT VII

Fish silage: Acid silage and fermented silage, advantages over fish meal, nutritional value of silage.

UNIT VIII

Fish hydrolysates: Production and utilisation, biochemical composition and importance in food and nutrition.

UNIT IX

Miscellaneous by-products: Fish maws and isinglass, pearl essence, fertilizer, beche-de-mer, processing of snail meat and jelly fish.

Practical

Preparation of fish meal, FPC, fish oils, chitin, chitosan, glucosamine hydrochloride, fish maws, isinglass, agar, alginic acid, , glue, pearl essence, fish sauce.

Suggested Readings

- Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ.
Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.
Hall GM. (Ed.). 1992. *Fish Processing Technology*. Blackie.
Nambudiri DD. 2006. *Technology of Fishery Products*. Fishing Chimes. Sen DP. 2005. *Advances in Fish Processing Technology*. Allied Publ. Wheaton FW & Lawson TB. 1985. *Processing Aquatic Food Products*. John Wiley & Sons.
Windsor M & Barlow. 1981. *Introduction to Fishery Byproducts*. Fishing News (Books).

FPT 511 MICROORGANISMS OF PUBLIC HEALTH SIGNIFICANCE 1+1

Objective

To acquaint students regarding bacteria, virus and parasites; food-borne diseases and their prevention.

Theory

UNIT I

Infection and immunity; diseases and their classification, spreading and contamination, host resistance.

UNIT II

Bacteria of public health significance in fish/fishery products/environments- *Salmonella*, *Clostridia*, *Staphylococcus*, *E. coli*, *Streptococcus*, *Vibrio*, *Aeromonas*, *Listeria*, *Yersinia*, *Bacillus*. Laboratory techniques for detection and identification of food poisoning bacteria.

UNIT III

Food-borne bacterial infections. Food infections by *Salmonella*, *Clostridium perfringens*, *Vibrio parahaemolyticus*, Enteropathogenic *E. coli*, *Aeromonas hydrophila* etc., the nature of causative agent, its source, incidence, foods involved, the diseases, conditions for outbreak and prevention. The etiology of diseases: Conditions for outbreak and prevention.

UNIT IV

Botulism and staphylococcal food poisoning, organism responsible and their origin, growth and toxin production, nature of toxins, incidence of poisoning, foods involved.

UNIT V

Food borne non-bacterial infections and intoxications: Aflatoxins, patulin, ochratoxin and other fungal toxins found in food, toxin producer, source, nature of toxin, toxicity and significance in foods.

UNIT VI

Virus and Parasites found in foods.

Practical

Laboratory techniques to detect and identify pathogens in fish - *E.coli*, *Staphylococcus aureus*, *Streptococcus faecalis*, *Clostridium perfringens*, *Clostridium botulinum*, *Salmonella*, *Listeria*, *Vibrio cholera*, *Vibrio parahaemolyticus*, *V. vulnificus*, Animal bio-assay of bacterial toxins.

Suggested Readings

- Anon. 2001. *Food Borne Disease Handbook*. 2nd Ed. Vol. IV. *Seafood and Environmental Toxins*. Marcel Dekker.
Davis BD, Dulbecco R, Eiser HN & Ginsberg HS. 1980. *Microbiology*. Harper & Row.
Doyle MP, Beuchat LR & Montville TJ. 1997. *Food Microbiology - Fundamentals and Frontiers*. American Society for Microbiology.
Harry WSJR, Paul JV & John JL. 2000. *Microbes in Action*. Freeman & Co.
Michael J, Pelizar JR & Chan ECS. 1998. *Microbiology*. McGraw Hill.
Samuel CP & Dunn CG. 1959. *Industrial Microbiology*. McGraw Hill.
Silliker JH, Elliof RP, Baired AC & Boyan FL. 1980. *Microbial Ecology of Foods*. Vol. II. (ICMSF). Academic Press.
William CF & Dennis CW. 2000. *Food Microbiology*. McGraw Hill.

FPT 512 DESIGN, MAINTENANCE OF FISH PROCESSING PLANTS AND INSTRUMENTATION 1+1

Objective

To expose the students to design, maintenance of fish processing plant, machinery and the instruments used in fish processing plants.

Theory

UNIT I

Plant design: Fundamentals of processing plant design: Site selection, design and preparation of layout of processing plants - freezing plant, cold storage, canning plant, dryers etc.

UNIT II

Functions and construction of refrigeration system: Tests and inspection, Operation and handling, P-H diagram and basic calculation - Application of P-H diagram, size and required power of compressor, maintenance of refrigerating machine, troubles and causes.

UNIT III

Preventive maintenance of machinery and equipment of fish processing plants, IQF, Canning plant, sausage plant, artificial dryers, smoking chambers etc., safety controls for freezing and canning plant.

UNIT IV

Effluent treatment: Legislation and standards of effluent discharge, water pollution control measures in the food industry, waste water treatment process; dissolved air floatation, sedimentation, chemical treatment, biological treatment, aeration, carbon adsorption, granular media filtration and sludge handling. Boilers - Classification and selection of boilers, Boiler mounting and accessories.

UNIT V

Measurement techniques; Sensors, active and passive sensors, characteristic of sensors for the measurement of temperature, relative humidity, a_w value, gel strength, moisture, freshness, pH, conductivity, DO, redox potential, salinity, air velocity, solar energy and brine concentration.

UNIT VI

Thermometers: Different types of thermometers, characteristics and application.

UNIT VII

Instrumentation techniques: General configuration of instrumentation system. Instrumentation for measurement of a_w value, temperature, pH, freshness, gel strength, salinity, brine concentration.

UNIT VIII

Thermal properties of foods: Calorie, heat loss, heat gain, specific heat, Newton's laws of cooling, heat transfer, latent heat, laws of fusion, thermal conductors, thermal diffusivity.

Practical

Design and Maintenance of Fish Processing Plants; Operation and maintenance of machinery and equipment for cold storage plant, freezing plant, canning plant, sausage making, dryers, boilers etc. Assembly of a refrigeration unit and charging refrigerant. Instrumentation; Measurement of temperature inside cold storage / freezer, fish during freezing and thawing. Estimation of Gel strength. Measurement of solar radiation, air velocity, air temperature. Measurement of salinity, conductivity, pH. Estimation of water activity.

Suggested Readings

Chupakhim V & Dormenko V. 1985. *Fish Processing Equipments*. MIR Publ.

Heid JL & Joslyn MA. 1980. *Food Processing Operations*. AVI Publ.

Slade FH. 1997. *Food Processing Plants*. Leonard Hill.

Wheaton FW & Lawson TB. 1985. *Processing Aquatic Food Products*. John Wiley & Sons.

FPT 513

PACKAGING OF FISH AND FISHERY PRODUCTS 1+1

Objective

To learn about different packaging materials, their appropriate use and benefits.

Theory

UNIT I

Food packaging, its purposes and procedures; technological aspects of packaging fishery products; packing of fresh and frozen fish for consumers; packaging for transport, shipping and institutional supplies; packaging standards for domestic and international trade.

UNIT II

Packaging materials; basic films and laminates, their manufacture and identification; resistance of packaging materials; development of protective packaging for fishery products.

UNIT III

Methods of testing for packaging materials for their physical properties; containers and their testing and evaluation; package designs; resistance of packages to hazards in handling; transport and storage.

UNIT IV

Modified atmosphere packaging, controlled packaging and aseptic packaging.

UNIT V

Labelling and printing of packaging materials.

Practical

Assessment of quality parameters such as moisture permeability, grease resistance, thickness/guage of basic plastic films and laminates. Quality assessment of paper and board and the products prepared from them. Evaluation of packages with regard to the resistance to handling, transportation and storage.

Suggested Readings

Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ.

Gopakumar K. 1993. *Fish Packaging Technology - Materials and Methods*. Concept Publ.

FPT 601

BIOCHEMICAL TECHNIQUES IN FISH ANALYSIS 2+1

Objective

To provide knowledge on various biochemical techniques in fish analysis.

Theory

UNIT I

General principles of separation of micro and macro molecules, selection of appropriate tools for analysis of fish samples. Outlines of common techniques involved in biochemical analysis.

UNIT II

Centrifugation techniques: types of centrifugation, concept of Svedberg unit, analytical ultracentrifuge.

UNIT III

Filtration technique: different types of filtration, types of filters and means of using them.

UNIT IV

Spectroscopic techniques: Principles, UV, Visible and IR spectroscopy, spectro-fluorimetry, flame photometry, atomic absorption spectrophotometry, ICP- AES, mass spectrometer.

UNIT V

Electrophoretic techniques: General principles, Classification, Paper electrophoresis, Native and reduced PAGE, IEF, capillary electrophoresis, 2D Gel electrophoresis.

UNIT VI

Chromatographic Techniques: General principles, types of chromatography- adsorption, partition, ion-exchange, molecular sieve, affinity, gas chromatography, thin layer chromatography.

UNIT VII

Gas chromatography: Theory and instrumentation.

UNIT VIII

High performance Liquid chromatography, LC MS-MS: Theory and instrumentation.

Practical

Isolation of proteins: sarcoplasmic, myofibrillar, and stromal. Estimation of proteins: Biuret, Lowry and Dye binding technique. Amino acid analysis, non-protein nitrogen. Extraction and estimation of lipids: Measurement of oxidation and hydrolysis of lipids, Fatty acid profile. Minerals and heavy metals: Estimation by Atomic Absorption Spectroscopy and flame photometer. HPLC- determination of histamine. Demonstration of GC-MS-MS, Separation of protein by electrophoresis.

Suggested Readings

Ewing GW. 1997. *Analytical Instrumentation Handbook*. Marcel Dekker. Jean IJ & Ikim WJ. 1995. *Analysis of Food for Nutrition Labeling and Hazard Contaminants*. Marcel Dekker.

Lampman P & Saunder K. 1979. *Introductory Spectroscopy*. College Publ.

Larsen BS & McEwen CN. 1988. *Mass Spectrometry of Biological Materials*. Marcel Dekker.

Pare JRJ & Belanger JMR. 1997. *Instrumental Methods in Food Analysis*. Elsevier.

Peary JA. 1981. *Introduction to Analytical Gas Chromatography*. Marcel Dekker.

Robyt JF & White BJ. 1990. *Biochemical Techniques - Theory and Practice*. Waveland Press.

Wilson K & Walker J. 2000. *Practical Biochemistry - Principles and Techniques*. Cambridge University Press.

Wilson RH. 1994. *Spectroscopic Techniques for Food Analysis*. VCH Publ.

FPT 602

FUNCTIONAL PROPERTIES OF PROTEINS FROM FISH AND SHELLFISH

2+1

Objective

To provide knowledge on those biochemical properties known to affect product property.

Theory

UNIT I

Definition of functional properties and their importance in proteins from fish. Typical functional properties of proteins in food system.

UNIT II

Protein structure and function: Protein folding and non-covalent forces stabilizing protein structure with special reference to hydrophobic interactions. Free energy and entropy concept in relation to hydrophobic interaction. Surface hydrophobicity and its relation to functional properties. Estimation of surface hydrophobicity and total hydrophobicity.

UNIT III

Solubility and water sorption of proteins: Factors affecting protein hydration. Viscosity in relation to protein hydration: Methods of estimating viscosity.

UNIT IV

Gelation: Definition of gel, mechanism of formation of gel, factors affecting the gel formation. Evaluation of gelling capacity- thermal, rheological and microscopy.

UNIT V

Surfactant properties: emulsifying and foaming. Importance of emulsifying properties of proteins. Theoretical concept of emulsion capacity and stability. Interfacial properties, adsorption from solution. Methods of estimating surface tension.

UNIT VI

Emulsion instability: Creaming, sedimentation, aggregation vs Brownian aggregation. DLVO theory, microemulsions. Methods for estimation of emulsion capacity and stability.

UNIT VII

Macromolecular absorption and different stages of foaming. Foam stability in relation to proteins structure. Foaming ability of different protein systems with case studies.

UNIT VIII

Denaturation and functionality: Changes in functional properties of proteins as affected by icing, freezing, drying, salting and heating. Modification of proteins for improving functionality- Succinylation and acetylation procedures.

Practical

Evaluation of different functional properties like water absorption, fat absorption, gelling, emulsification capacity and stability of fish/shell fish proteins. Effect of pH, temperature and ionic strength on various functional properties. Prediction of functional properties using model compounds.

Suggested Readings

Cherry JP. 1991. *Protein Functionality in Foods*. American Chemical Society, Washington, D. C.

Damodaran S & Paraf A. 1997. *Food Proteins and Their Applications*. Marcel Dekker.

Hill SE, Ledward DA & Mitchell JR. 1998. *Functional Properties of Food Macromolecules*. 2nd Ed. Aspen Publ.

Nakai S & Modler HW. 1996. *Food Proteins Properties and Characterisation*. VCH Publ.

Phillips LG, Whitehead DM & Kinsella J. 1994. *Structure, Function Properties of Food Proteins*. Academic Press.

Suzuki. 1981. *Fish and Krill Protein Processing Technology*. Applied Science Publ.

Venugopal V. 2006. *Seafood Processing*. Taylor & Francis.

FPT 603

QUALITY MANAGEMENT SYSTEMS

2+1

Objective

To familiarize students with different aspects of quality management systems and evaluation techniques for seafood.

To teach Seafood Quality Assurance and Quality Assurance Systems.

Theory

UNIT I

Quality Management Systems: The concept of total quality management. The principles of TQM. Zero defect planning, Quality circle, Quality link, Quality culture. Statistical Quality Control. Quality as related to preprocess handling, transportation, processing and storage.

UNIT II

Quality evaluation techniques for seafood: Physical, chemical. Bacteriological and Instrumental methods of quality evaluation. Sensory evaluation.

UNIT III

Quality standards: National and International – Codex, USFDA, EU norms, ISO, BIS etc. standards for fish and fishery products.

UNIT IV

Seafood Quality Assurance and Quality Assurance Systems: Good Manufacturing (GMP) and Good Hygiene Practices (GHP) - Codex guidelines. The concept of HACCP in seafood safety. HACCP team Management role and CCPs and implementation procedure for HACCP- ISO 22000 FSMS. ISO 9000 series of standards. Cold schedule and hotschedule for handling perishable commodities.

UNIT V

Validation of methods for quality assurance- Method selection, Quality check, inter-lab comparison, proficiency testing. Primary standards. Reference standards. Reference material (RM), Certified Reference Material (CRM) and Standard Reference Material (SRM), Uncertainty and Calculation of Uncertainty of Measurements.

UNIT VI

Sample Accountability: Sampling plan -probability sampling and non- probability sampling.

Practical

Developing flow charts and exercises in identification of hazards- preparation of hazard analysis worksheet, plan form and corrective action procedures in processing of fish. Analysis of typical hazards, study of correction and corrective action. Detection and estimation of important toxic chemicals in food, quality defects.

Suggested Readings

Anon. 1992. *TQM in New Product Manufacturing*. McGraw Hill. Anon. 1994. *Introduction of Total Quality*. Prentice Hall.

- Anon. 1994. *Principles of Total Quality*. St. Leuie Press.
- Gorbutt J. 1997. *Essentials of Food Microbiology*. Arnold Hodder Headline Group.
- Huss HH. 2003. *Assessment and Management of Seafood Safety and Quality*. FAO Tech. Paper No. 444.
- Kanduri L & Eckhartt RA. 2002. *Food Safety in Shrimp Processing*. Fishing News Books.
- Kreuzer R. 1971. *Fish Inspection and Quality Control*. Fishing News Books.
- Shukla RK. 2006. *Total Quality Management Practicing Manager*. New Royal Book.

FPT 604 **LIPIDS OF AQUATIC ORIGIN** **2+1**

Objective

To impart knowledge on aquatic originated lipids, their metabolic activities and biological significance.

Theory

UNIT I

Lipid classification: Triglycerides, phospholipids, steroids and other lipids. Lipid micelles and bilayer.

UNIT II

Fatty acids: Classification, stereochemistry, nutritional significance of fatty acids.

UNIT III

Source of lipids: Biosynthesis of lipids, lipid metabolism including that of phospholipids, typical properties of marine lipids.

UNIT IV

Lipids in Biological membranes: Membrane proteins, lipoproteins, transport across membranes.

UNIT V

Lipid metabolism: Fatty acid oxidation, ketone bodies, lipid biosynthesis, regulation of cholesterol metabolism. Biological significance of marine lipids. Ether lipids and Eicosanoids- their significance.

UNIT VI

Modern analytical techniques employed in lipid chemistry. Methods of extracting poly-unsaturated fatty acids.

Practical

Extraction and fractionation of lipids. Fatty acid composition of different lipid fractions. Evaluation of oxidation product of fish lipid during processing and storage.

Suggested Readings

Akoh CC & Min DB. 1998. *Food Lipids*. Marcel Dekker.

Gurr MI, Harwood JL & Frayn KN. 2002. *Lipid Biochemistry*. 5th Ed. Blackwell.

Jinsel P, Turna RE & Ross D. 2001. *Nutrition*. Jones & Bartlet.

Simpson DS. 1987. *Food Biochemistry and Nutritional Value*. Longman.

Voet D, Voet JG & Praff CD. 1998. *Fundamentals of Biochemistry*. JohnWiley.

FPT 605 **MICROBIAL HAZARDS IN FISH PROCESSING** **2+1**

Objective

To provide theoretical and practical knowledge on various microbiological related hazards in fish processing.

Theory

UNIT I

Public health microbiology- Food borne pathogens: *Salmonella*, *Shigella*, Entero-pathogenic *E. coli*, *Clostridium botulinum*, *Listeria monocytogenes*, *Staph aureus* and *Vibrio cholerae*, *V. parahemolyticus*. Emerging food- borne pathogens. Water- borne, Air-borne and food-borne diseases.

UNIT II

Microbial virulence- infectious diseases. Virulence.

UNIT III

Microbial toxin production-opportunists and true pathogens.

UNIT IV

Methods for detection: Rapid detection and indirect detection methods of pathogens and parasites. Method validation.

UNIT V

Antimicrobial systems and food preservation: ecological concepts: Lactoperoxidase. Nisin, Lysozyme, Bacteriocins.

UNIT VI

Norms for using antimicrobial systems in food processing and preservation. Food Safety, Risk analysis. Potential health hazards and risks associated with fish products.

UNIT VII

Packaging and modified atmosphere on the microbiology and shelf life of fishery products.

UNIT VIII

Predictive modeling in quality and safety assurance of fishery products.

Practical

Antibiotic assay, sensitivity tests, evaluation of antibacterial properties. Analysis of fish product constituents. MIC, MCC, Risk analysis of seafood.

Suggested Readings

Cary JW, Linz JE & Bhatnagar D. 2000. *Microbial Food Borne Diseases*. Technomic Publ.

Doyle MP, Beuchat LR & Montville TJ. 1997. *Food Microbiology - Fundamentals and Frontiers*. American Society for Microbiology.

FPT 606 VITAMINS, MINERALS AND FLAVOUR BEARING COMPONENTS IN AQUATIC ORGANISMS 2+1

Objective

To study the compounds responsible for flavor and colour of fish and shellfish.

Theory

UNIT I

Vitamins, minerals, pigments, flavour bearing constituents and other components in aquatic organisms

UNIT II

Vitamins: Metabolic functions of vitamins, water-soluble and fat-soluble vitamins. Vitamins from sea food.

UNIT III

Minerals: Role of trace elements in metabolism, trace elements of seafood, toxic heavy metals in seafood.

UNIT IV

Pigments and flavour bearing compounds of aquatic origin, chemistry, biochemical role, changes during processing of seafood.

UNIT V

Metabolic functions of hormones.

UNIT VI

Nucleoprotein, nucleic acids, nucleotides, nucleosides.

Practical

Modern methods for analysis of vitamins, minerals and nucleic acids. Organoleptic evaluation of flavours and pigments. Extraction of flavours and pigments and evaluation.

Suggested Readings

Ashurst PR. 1999. *Food Flavourings*. 3rd Ed. Aspen Publ.

Belitz HD & Grosch W. 1999. *Food Chemistry*. 2nd Ed. Springer. Hutching JB. 1999. *Food Colour and Appearance*. 2nd Ed. Aspen Publ. Teranishi R, Buttery RG & Shahidi F. 1989. *Flavour Chemistry - Trends and Developments*. American Chemical Society, Washington, D. C.

FPT 607 TOXINS AND CONTAMINANTS

2+1

Objective

To understand various types of toxins and contaminants and their tolerance limit.

To understand various analytical methods to estimate toxins and contaminants.

Theory

UNIT I

Public health problems due to food borne contaminants.

UNIT II

Factors contributing to outbreaks of food poisoning.

UNIT III

Aflatoxins in fishery products. PAH in smoked fish. Biogenic amines and its significance to human health, Different types of marine bio-toxins such as Ciguatoxin, Paralytic shellfish toxins diarrhetic shell fish toxins, DSP toxins, Scomberotoxins, Brevitoxins, etc. Symptoms, treatment, pharmacology, detection.

UNIT IV

Overview of toxicity of marine animals.

UNIT V

Analytical methods for different types of marine toxins and its tolerance limits: Stability, bioassays, pharmacology assays, immunoassays, Instrumental methods.

UNIT VI

Contaminants of the aquatic environment - Heavy metals (Hg, Cd, Pb, Cr, Ni, As etc.).

UNIT VII

Pesticide contaminants: PCB, organochlorine etc., their source, bioaccumulation, magnification and toxicity. Persistent pollutants. Toxicity evaluation. Measurement of LC50 and factors affecting LC50, Animal tissue analysis.

Practical

Analysis of bacterial and fungal toxins, Analysis of heavy metals and common pesticides. Biogenic amine estimation, Estimation of LC 50.

Suggested Readings

Anon. 1988. *Handbook of Natural Toxins*. Vol. III. *Marine Toxins and Venom*. Marcel Dekker.

Anon. 1988. *Handbook of Natural Toxins*. Vol. IV. *Bacterial Toxins*. Marcel Dekker.

Anon. 2001. *Food borne Disease Handbook*. 2nd Ed. Vol. IV. *Seafood and Environmental Toxins*. Marcel Dekker.

Edward PR. 1984. *Seafood Toxins*. American Chemical Society, Washington, D.C.

Hashimoto Y. 1979. *Marine Toxins and Other Bioactive Marine Metabolites*. Scientific Society Press, Tokyo.

Moss J, Iglewski B, Vaughan M & Ju AT. 1995. *Bacterial Toxins and Virulence Factors in Disease*. Vol. VIII. Marcel Dekker.

FPT 608 NUTRITIONAL ASPECTS AND NUTRITION LABELING 2+1

Objective

To create basic understanding about labeling of different products, guidelines and enforcement.

Theory

UNIT I

Labeling requirements - national and international, legislation on labeling.

UNIT II

Labeling for product traceability.

UNIT III

Components of traceability code – nutrition facts and nutrition labeling, specific requirements of nutrition labeling, food meant for specific age groups and convalescing people.

UNIT IV

Serving size, calculation of nutrition facts based on nutrient composition and serving size.

UNIT V

Type of labeling for organic foods, specific foods like organic foods, GM foods, irradiated foods, vegetarian and non-vegetarian foods.

UNIT VI

Label design specification – size, colour.

UNIT VII

Major nutrients Minor nutrients, Essential nutrients, Function (or note) of nutrients - (providing energy, tissue building) Nutritional research - Nutritional aspects of fish proteins, lipids, vitamins and free minerals Functional foods/ Nutraceuticals for health, Effect of food processing on nutritive values of foods. Antinutritional factors, Nutrition labeling, (Energy value of foods).

Practical

Analysis of major and minor nutrients, calculation of nutrition facts, preparation of labels for typical food items. Analysis for total calorie, calorific value of fats, protein and carbohydrates. PER, BV, NPU analysis of different products.

Suggested Readings

Jansel P, Turna RE & Ross D. 2001. *Nutrition*. Jones & Bartlet.

Seshadri V. 1998. *Introduction to Clinical Nutrition and Nutritional Labelling*. Marcel Dekker.

Simpson DS. 1987. *Food Biochemistry and Nutritional Value*. Longman.

FPT 609 ENVIRONMENTAL IMPACTS OF FISHERIES INDUSTRIES 2+1

Objective

To provide theoretical and practical exposure on Environmental Management Systems in fisheries industry.

Theory

UNIT I

Environmental Management Systems: Environmental issues, (Ozone depletion, global warming etc.) pollution, long term ecosystem degradation etc in aquaculture and processing industries.

UNIT II

Environmental impact assessment studies of fisheries industry and control measures, Sources of environmental concerns (physical, chemical and microbiological).

UNIT III

Techniques for the identification of environmental aspects. IS/ISO 14000 and its relevance to Environmental Management System in fisheries industry: Background, policy and planning, implementation, checking and review, International and European Laws for Environmental Protection, National Environmental Laws.

Practical

Composition analysis of fish processing waste, analysis of pollution aspects of solid and liquid wastes – bacterial load, TDS, BOD, COD, pH, temperature, oil and grease . Resident time analysis for processing waste at the site of disposal.

Suggested Readings

Anon. 2000. *Manual of Chemical Methods*. 2nd Ed. Bureau of Indian Standards: IS/ISO 14000:1996 on Environmental Management System US-EPA.

Cesceri LS. 1998. *Standard Methods for Examination of Water and Waste Water*. APHA.

Hurst CJ. 2002. *Manual of Environmental Microbiology*. 2nd Ed. ASM Press.

Wise DL. 1994. *Process Engineering for Pollution Control and Waste Minimization*. Marcel Dekker.

FPT 610

BY-PRODUCTS, SPECIALTY PRODUCTS AND VALUE ADDED PRODUCTS 2+1

Objective

To explain the preparation of products from low cost fish.

Theory

UNIT I

Nutritional importance of fish meal and quality requirements -Raw material quality and changes during processing and storage.

UNIT II

Nutritional importance of fish oil and methods to impart stability to fish oils on storage, Unsaponifiables in fish liver oils.

UNIT III

Production of fish flour, quality standards and applications.

UNIT IV

Different methods of production of FPC, Different types of FPC, and their specifications.

UNIT V

Enzyme hydrolysis of fish, fish hydrolysates, fish peptones, hydrolysates enriched food beverages.

UNIT VI

Food flavour from tiny prawns and non-penaeid prawns.

UNIT VII

Formulation of pet food.

UNIT VIII

Chitin, Chitosan and protein extract from shrimp and crab shell and squilla, Quality requirements and assessment of chitin and chitosan, Application of chitin and chitosan. Conversion of chitin and chitosan to high value products – glucosamine hydrochloride, glucosamine sulphate and their use.

UNIT IX

Extraction of collagen from fish processing wastes, properties and application. Preparation of biological membranes using collagen and chitosan for biomedical applications.

UNIT X

Value added products: Present market trends, scope of value addition, Types of value addition, Important value added products.

UNIT XI

Coated products – Principles and type of coating, coating functions, in gradients, batter classification, mechanical properties of batter, bread crumbs, flavorings, seasonings and hydrocolloids in coatings, Fat and oils in coated food and their chemistry, Trouble shooting techniques for batter and breading systems, application of batters and breading to seafood.

Practical

Preparation of glucosamine hydrochloride and glucosamine sulphate. Preparation of isinglass, collagen powder and collagen and chitosan. Preparation of fish wafers, fish fingers, cutlets etc.

Suggested Readings

Balachandran KK. 2001. *Post Harvest Technology of Fish and Fish Products*. Daya Publ.

Gopakumar K. (Ed.). 2002. *Text Book of Fish Processing Technology*. ICAR.

Hall GM. (Ed.). 1992. *Fish Processing Technology*. Blackie.