M.F.Sc & PhD Programs in Fish Processing Technology - Syllabus

Indian Council of Agricultural Research
New Delhi
## COURSES

### M.F.Sc. (Fish Processing Technology)

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAJOR - CORE COURSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>FPT 501 Technology of Freezing and Storage</td>
<td>2+1</td>
</tr>
<tr>
<td>2.</td>
<td>FPT 502 Thermal Processing of Fishery Products</td>
<td>2+1</td>
</tr>
<tr>
<td>3.</td>
<td>FPT 503 Quality Assurance, Management and Certification</td>
<td>2+1</td>
</tr>
<tr>
<td>4.</td>
<td>FPT 504 Applied Fish Biochemistry</td>
<td>2+1</td>
</tr>
<tr>
<td><strong>MAJOR - OPTIONAL COURSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>FPT 505 Techniques in Microbiology</td>
<td>1+1</td>
</tr>
<tr>
<td>2.</td>
<td>FPT 506 Cured, Dehydrated and Smoked Fishery Products</td>
<td>1+1</td>
</tr>
<tr>
<td>3.</td>
<td>FPT 507 Handling, Storage and Transport of Fresh Fish</td>
<td>1+1</td>
</tr>
<tr>
<td>4.</td>
<td>FPT 508 Technology of Mince-based Fish Products</td>
<td>1+1</td>
</tr>
<tr>
<td>5.</td>
<td>FPT 509 Additives in Fish Processing</td>
<td>1+1</td>
</tr>
<tr>
<td>6.</td>
<td>FPT 510 Fish By-products and Waste Utilization</td>
<td>1+1</td>
</tr>
<tr>
<td>7.</td>
<td>FPT 511 Microorganisms of Public Health Significance</td>
<td>1+1</td>
</tr>
<tr>
<td>8.</td>
<td>FPT 512 Design, Maintenance of Fish Processing Plants and Instrumentation</td>
<td>1+1</td>
</tr>
<tr>
<td>9.</td>
<td>FPT 513 Packaging of Fish and Fishery Products</td>
<td>1+1</td>
</tr>
</tbody>
</table>
# PhD (Fish Processing Technology)

<table>
<thead>
<tr>
<th>CODE</th>
<th>COURSE TITLE</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAJOR - CORE COURSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>FPT 601 Biochemical Techniques in Fish Analysis</td>
<td>2+1</td>
</tr>
<tr>
<td>2.</td>
<td>FPT 602 Functional Properties of Proteins from Fish and Shellfish</td>
<td>2+1</td>
</tr>
<tr>
<td>3.</td>
<td>FPT 603 Quality Management Systems</td>
<td>2+1</td>
</tr>
<tr>
<td><strong>MAJOR - OPTIONAL COURSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>FPT 704 Lipids of Aquatic Origin</td>
<td>2+1</td>
</tr>
<tr>
<td>2.</td>
<td>FPT 705 Microbial Hazards in Fish Processing</td>
<td>2+1</td>
</tr>
<tr>
<td>3.</td>
<td>FPT 706 Vitamins, minerals and flavour bearing components in aquatic organisms</td>
<td>2+1</td>
</tr>
<tr>
<td>4.</td>
<td>FPT 707 Toxins and Contaminants</td>
<td>2+1</td>
</tr>
<tr>
<td>5.</td>
<td>FPT 708 Nutritional Aspects and Nutrition Labeling</td>
<td>2+1</td>
</tr>
<tr>
<td>6.</td>
<td>FPT 709 Environmental Impact of Fishery Industries</td>
<td>2+1</td>
</tr>
<tr>
<td>7.</td>
<td>FPT 710 By-products, Specialty products and Value Added products</td>
<td>2+1</td>
</tr>
</tbody>
</table>
FPT 501 TECHNOLOGY OF FISH FREEZING AND FROZEN STORAGE 2+1

Objective
1. To give detailed insight on various aspects of freezing of fish
2. 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**

Filletting 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**

8. Hall G. M. (Ed), Fish Processing Technology (1992), Blackie Academic and Professional, London

**Journals**

1. Journal of Food Science and Technology
2. Fishery Technology
3. Journal of Food Processing and Preservation

**Broad Research Areas**

1. Macro and micromolecular changes in muscle during freezing
2. Interaction of food protein with other food constituents during freezing and frozen storage
3. Structural and functional changes of fat and protein
4. Development of method to improve shelf life
5. Freezing and frozen storage of novel product
FPT 502 THERMAL PROCESSING OF FISHERY PRODUCTS 2+1

Objective
1. To provide information on various aspects of thermal / heat processing
2. To compare cold sterilization with thermal processing
3. 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 – $F_0$ 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, radicidation, 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, $F_0$ 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

Journals
1. Indian Journal of Meat Science and Technology
2. International Journal of Food Science and Technology
3. Journal of Food Science and Technology
4. Fishery Technology
5. Journal of Food Processing and Preservation

Broad Research Areas
1. Micromolecular interactions during thermal processing
2. Canning of novel products
3. Thermal processing in novel packaging materials.
4. Study of nutrient losses during thermal processing and/or storage
5. Study of combination effect of irradiation and thermal processing.
6. Study of hurdle effect in canned preservation.
FPT 503 QUALITY ASSURANCES, MANAGEMENT AND CERTIFICATION 2+1

Objective
1. Knowledge about various aspects of quality assurance system, quality management and national / international certification system.
2. Information regarding factory sanitation and hygiene, water quality and standards.
3. To deal with parameters affecting quality.

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

Unit IX Food laws in India, integrated food law.

Practical
Suggested Readings


Journals

1. Journal of Food Science and Technology
2. Fishery Technology

Broad Research Areas

1. Evaluation of quality standards of processing plants
2. Establishment of critical limits for novel hazards and development of corrective action in HACCP protocol

FPT 504 APPLIED FISH BIOCHEMISTRY 2+1

Objective

1. To impart knowledge about macro and trace constituents and nutritive value of fish
2. To create basic understanding about toxins and toxic substances and their toxic effects
3. To give a detailed insight of various 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, quarterammonium 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 & prostaglandins- beneficial effects on human health.

Unit IX  Fatty acid composition of fish liver and body oils, auto-oxidation of fatty acids, rancidity, lipasas 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 & column chromatography, spectrophotometry, colorimetry, flame photometry, atomic absorption spectrophotometry, paper, disc & 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 & 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**


**Journals**

1. Meat Science
2. Indian Journal of Agricultural Biochemistry
3. Indian Journal of Meat Science and Technology
4. International Journal of Food Science and Technology
5. Journal of Food Science and Technology
6. Fishery Technology
7. Journal of Food Processing and Preservation

**Broad Research Areas**

1. Functionality of proteins
2. Interactions between protein and lipid
3. Molecular markers development for identification of products
4. Development of sensors for quality detection

## M.F.Sc. (Fish Processing Technology)

### OPTIONAL COURSES

**FPT 505** Techniques in Microbiology  

**Objective** Knowing basic techniques in microbiology

**Theory**

Unit 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 nutritions, different types.

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


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

Suggested Readings


Journals

1. Meat Science
2. Indian Journal of Meat Science and Technology
3. International Journal of Food Science and Technology
4. Journal of Food Science and Technology
5. Fishery Technology
6. Journal of Food Processing and Preservation

Broad Research Areas

1. Microbial spoilage of fish
2. Antimicrobial agents in fish and fishery products.
3. Biological preservation of seafoods
4. Effects of processing methods on micro-organisms
FPT 506  CURED, DEHYDRATED, SMOKED FISHERY PRODUCTS  1+1

Objective  1. To create understanding on various scientific preservation techniques of fish.
2. To impart knowledge on changes during storage of products

Theory

Unit 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.

Readings


Journals

1. Journal of Food Science and Technology
2. Journal of Food Processing and Preservation
3. Fishery Technology

Broad Research Areas

1. Establishing scientific basis for traditionally cured fish products.
2. Development of novel freeze dried product
3. Use of combination additives in cured product for better shelf life

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

Objective

1. To teach scientific techniques of handling, storage and transport of fresh fish
2. 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 centres, 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**


**Journals**

1. International Journal of Food Science and Technology
2. Journal of Food Science and Technology
3. Fishery Technology
4. Journal of Food Processing and Preservation

**Broad Research Areas**

1. Effect of good handling practices and proper storage techniques and transportation on fish quality.
2. Establishment of fresh fish quality parameters
3. Development sensors for fresh fish quality analysis
FPT 508 TECHNOLOGY OF MINCE BASED FISH PRODUCTS

Objective
To provide the necessary knowledge of 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 Batted 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, nitrates and nitrates. Fortification of fish products with vitamins and minerals. Quality standards and recent developments.

Practical

Suggested Readings

Journals
1. Indian Journal of Meat Science and Technology
2. Journal of Food Science and Technology
3. Fishery Technology
4. Journal of Food Processing and Preservation

Broad Research Areas
1. Processing of different type of products using advanced technology.
2. Utilisation of waste from mince preparation
3. Development of new analog products

FPT 509 ADDITIVES IN FISH PROCESSING 1+1

Objective To familiarize 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 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
3. New Delhi.

Journals
1. Indian Journal of Meat Science and Technology
2. International Journal of Food Science and Technology
3. Journal of Food Science and Technology
4. Fishery Technology
5. Journal of Food Processing and Preservation

Broad Research Areas
1. Changes in additives during processing and storage.
2. Effect of additives on product quality
3. Efficacy of additives from natural sources

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 its 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 & 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

Journals
1. Meat Science
2. Indian Journal of Meat Science and Technology
3. International Journal of Food Science and Technology
4. Journal of Food Science and Technology
5. Fishery Technology
6. Journal of Food Processing and Preservation
FPT 511  MICROORGANISMS OF PUBLIC HEALTH SIGNIFICANCE  1+1

Objective  To acquaint 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 parahaemoliticus, 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 & 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


Journals

1. Advances in Applied Microbiology
2. Annual Review of Microbiology
3. Canadian Journal of Microbiology
4. Food Microbiology
5. Letters in Applied Microbiology
6. Indian Journal of Microbiology
7. International Journal of Food Microbiology

Broad Research Areas

1. Development of Molecular methods to detect pathogens in food.
2. Survival strategy of pathogens in processed food.
3. Development of toxin identification methods
4. Isolation of Viruses occurring in seafoods

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

Objective

To expose the students about design, maintenance of fish processing plant, machinery and also 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 flotation, 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.


Suggested Readings


MFSc & PhD Syllabus: Fish Processing Technology 23
Journals

1. Fishery Technology
2. Food Microbiology

Broad Research Areas

1. Designing of instruments used in fish processing plants
2. Biological and chemical treatment of fish processing wastes

FPT 513 PACKAGING OF FISH AND FISHERY PRODUCTS 1+1

Objective
To acquaint with 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/gauge 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

| Journals | 1. International Journal of Food Science and Technology  
2. Journal of Food Science and Technology  
3. Fishery Technology  
4. Journal of Food Processing and Preservation |
| --- | --- |
| Broad Research Areas | 1. Effect of different packaging materials on quality and shelf-life of fish and fish products  
2. Effects of gas composition on shelf life  
3. Development of suitable packaging for fish products  
4. Processing tolerance of packaging material |
Ph.D. (Fish Processing Technology) SYLLABUS

MAJOR - CORE COURSES

FPT 601 BIOCHEMICAL TECHNIQUES IN FISH ANALYSIS 2+1

Objective
To provide knowledge in detail about 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, spectrofluorimetry, 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

Suggested Readings
1. B.S.Larsen & C.N. McEwen, (1988), Mass Spectrometry of Biological materials Marcel Dekker Inc


Journals

1. Indian Journal of Agricultural Biochemistry
2. Meat Science
3. Indian Journal of Meat Science and Technology
4. International Journal of Food Science and Technology
5. Journal of Food Science and Technology
6. Fishery Technology
7. Journal of Food Processing and Preservation

Broad Research Areas

1. Biochemical characterization of macro molecules with respect to processing requirements

FPT 602 FUNCTIONAL PROPERTIES OF PROTEINS FROM FISH AND SHELLFISH 2+1

Objective

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

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


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—Sucinyl ination and acetylation procedures.


Suggested Readings

Journals
1. Meat Science
2. Indian Journal of Meat Science and Technology
3. International Journal of Food Science and Technology
4. Journal of Food Science and Technology
5. Fishery Technology
6. Journal of Food Processing and Preservation

**Broad Research Areas**

1. Micromolecular interactions
2. Structural and functional changes of fat and protein during processing
3. Use of chemicals and biochemicals for modifying functional properties
4. Modification of proteins for processing needs
5. Rheology of fish and shellfish proteins

**FPT 603 QUALITY MANAGEMENT SYSTEMS 2+1**

**Objective**

1. To familiarize students with different aspects of quality management system and evaluation techniques for seafood
2. 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 comparision, 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


Journals

1. Indian Journal of Meat Science and Technology
2. International Journal of Food Science and Technology
3. Journal of Food Science and Technology
4. Fishery Technology

Broad Research Areas

1. Evaluation of quality standards of processing plants
2. Risk assessment of high priced products
3. Establishment of critical limits for novel hazards and development of corrective action in HACCP protocol

Ph.D. (Fish Processing Technology)

OPTIONAL COURSES

FPT 604 LIPIDS OF AQUATIC ORIGIN 2+1

Objective

To give 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  

Journals  
1. Journal of Food Science and Technology
2. Fishery Technology

Broad Research Areas  
1. Lipid- protein interaction
2. Changes in lipid during processing and storage
3. Microbial alterations of lipid during fermentation
4. Lipid as fish species identification tool

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 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.


Suggested Readings


Journals

1. Advances in Applied Microbiology
2. Annual Review of Microbiology
3. Canadian Journal of Microbiology
4. Letters in Applied Microbiology
5. Indian Journal of Microbiology
6. International Journal of Food Microbiology

Broad Research Areas

1. Risk analysis of sea food
2. Incidences of pathogens in sea food
3. Processing survival of pathogens
4. Efficacy of antimicrobial agents
FPT 606  VITAMINS, MINERALS AND FLAVOUR BEARING CONSTITUENTS OF AQUATIC ORGANISMS  2+1

Objective  To give knowledge on 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.


Suggested Readings


Journals

1. Indian Journal of Meat Science and Technology

2. International Journal of Food Science and Technology

3. Journal of Food Science and Technology

4. Fishery Technology

Broad Research Areas

1. Distribution of vitamins and minerals in commercially important tropical fishes.

2. Changes in vitamin and mineral during processing

3. Extractable flavouring components in fish and shellfish waste
**Objective**

1. To teach about various types of toxins and contaminants and their tolerance limit
2. To teach 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**

**Unit VI**
Contaminants of the Aquatic Environment - Heavy metals (Hg, Cd, Pb, Cr, Ni, As etc.).

**Unit VII**

**Practical**
Analysis of bacterial and fungal toxins, Analysis of heavy metals and common pesticides. Biogenic amine estimation, Estimation of LC$_{50}$.

**Suggested Readings**


**Journals**

1. Indian Journal of Meat Science and Technology
2. International Journal of Food Science and Technology
3. Journal of Food Science and Technology
4. Fishery Technology
5. Journal of Food Processing and Preservation

**Broad Research Areas**

1. Anthropogenic contaminants in fish and their residence time
2. Pharmacology of marine toxins
3. Development of methods for detection of toxins and cotaminants
4. Risk assessment of seafood with respect to algal, fungal and biological toxin
5. Conditions affecting toxin production

**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/ Neutraceuticals 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**


**Journals**

1. Meat Science
2. Indian Journal of Meat Science and Technology
3. International Journal of Food Science and Technology
4. Journal of Food Science and Technology
5. Fishery Technology

**Broad Research Areas**

1. Development of functional foods
2. Modern methods for nutritional evaluation of foods

---

**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).


**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

Journals
1. Fishery Technology
2. Journal of Food Science and Technology

Broad Research Areas
1. Environmental impact assessment
2. Resident time of industrial pollutant
3. Effect of pollutants on pre-harvest fish quality
4. New methods of waste treatment from processing industries

FPT 610 FISHERY BY-PRODUCTS, SPECIALTY PRODUCTS AND VALUE ADDED 2+1 PRODUCTS

Objective
To explain the possibilities of 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.


Journals  1. Indian Journal of Meat Science and Technology
2. Journal of Food Science and Technology
3. Journal of Food Processing and Preservation

Broad Research Areas  1. Utilization of processing waste and trash fishes
2. Development of PUFA enriched foods product
3. Development of novel products