

Unit 1: Fish Biochemistry

Proteins: Classification, pigments, heme-proteins, hemocyanins, antifreeze proteins; Functional properties of seafood proteins and their significance to processing and quality; Lipids: Composition and nutritive value, lipid types and their variations, fatty acid composition of fish liver and body oils; Triglycerides and phospholipids; Polyunsaturated fatty acids and their beneficial effects on human health; Autooxidation of fatty acids, pro- and anti-oxidants, oxidation indices, lipid protein interactions, rancidity, lipases and phospholipases; Carbohydrates: Classification and biological significance of carbohydrates, structure and properties of monosaccharides, disaccharides and polysaccharides; Uses of modified starch and other carbohydrates as food additives (as thickening and binding agents); Changes in carbohydrates during processing and relationship of carbohydrates to food stability, gelatinization; Non-protein nitrogenous compounds: free amino acids, peptides, nucleotides, guanidines, urea, quaternary ammonium compounds; Enzymes in fish: Their classification and mechanism of action; Vitamins in fish: vitamin deficiency diseases; Minerals and trace elements in fish; Toxins and toxic substances in fish, their bioaccumulation and bio magnification; Biogenic amines; Seafood flavours and pigments, chemical basis of flavor perception, influence of processing on flavours; Fundamental techniques in food analysis; Principles and applications of spectrophotometry, chromatography including GC-MS.

Unit 2: Low and High Temperature Preservation

Postmortem changes, factors affecting quality of fresh fish (intrinsic and extrinsic factors); Depuration of bivalves; Chilled storage of fish, different types of ice, changes during chill storage, melanosis and its prevention; Freezing of fish and shellfish: structure of water and ice, phase equilibria and freezing curves for fish, crystallization, nucleation- homogeneous and heterogeneous nucleation; Super cooling, crystal growth, eutectic point, location of ice crystals in tissue, changes during freezing; Technological aspects of freezing, packing of fresh and frozen fish for consumers, modified atmosphere packaging, controlled packaging; Frozen storage: Physical, chemical, bacterial, sensory changes; Prevention of quality loss during frozen storage, theories of cryoprotection, glazing (importance and methods); Heat load calculation; Canning: Principles of thermal processing; mechanism of heat transfer, heat resistance of bacteria and spores, decimal reduction time, thermal death time, "Z" and "F" values, heat penetration, cold point, heat processing and heating equipment, process value calculation; Classification of foods, pasteurization and sterilization, unit operation in canning process; Spoilage of canned food; Flexible packing, retort pouch processing of fish and fishery products principles and techniques.

Unit 3: Fish Curing, Value Addition and by Products

Principles of fish preservation; Factors affecting spoilage of fish; Preservation of fish by curing (drying, salting, fermentation and smoking); Water content, psychometrics, water activity and sorption behaviour of foods; Sous-vide, freeze drying and accelerated freeze drying (AFD);

Modified atmosphere packaging (MAP) of fish and fish products; Irradiation: Radiation sources, units, dose levels, radappertization, radicidation, radurization; Surimi and fish-mince: Preparation and uses; Quality evaluation of surimi, Kamaboko and analogue products; Battered and breaded products; By products: Fish meal, fish silage, fish oil, chitin, chitosan, glucosamine hydrochloride, carotenoids from shellfish wastes and its applications, fish protein hydrolysate; Shark liver oil, squalene, shark cartilage, ambergris, collagen, gelatin; Mechanism of extrusion, mechanical and chemical changes during extrusion, parameters affecting quality of extruded products; Cook-chill products; Edible seaweeds: nutritive value of seaweeds, products from seaweeds; Fish processing wastes; Liquid and solid wastes in fish processing and their disposal; Fish wastes utilization: Recovery of proteins, enzymes and pigments; Packaging and transportation: Aim and objectives of packaging and transportation of preserved and processed fish, temperature modeling and relationships in fish transportation, transportation containers; Safety, quality and spoilage of fish during transportation; Labeling requirements, intelligent packaging, edible packaging; disposal and recycling of packaging materials; Additives: Classes of additives, preservatives, antimicrobial additives; Emerging technologies in Fish Processing. Fishery products and byproducts exported from India;

Unit 4: Microbiological and Quality Aspects of Fish and Fishery Products

Microbial changes during icing, freezing and curing, chemical control of microbial spoilage, effect of preservatives on microflora; Fermentation: Batch wise and continuous; Important fermented products, microbial injury, inactive physiological states; Microorganisms of public health significance- Sources of pathogens in seafood, infection and intoxication; Microbial food poisoning, bacteria of public health significance in fish & fishery products; Epidemiology; Botulism and staphylococcal food poisoning, food infections by *Salmonella*, *Clostridium perfringens*, *Vibrio parahaemolyticus*, *V. vulnificus*, pathogenic *E. coli*, *Listeria monocytogenes*, *Campylobacter*, *Arcobacter* (Virulence mechanisms, sources, incidences, foods involved and prevention measures); Histamine poisoning, aflatoxins, patulin, ochratoxin and other fungal toxins found in food, virus and parasites found in foods. Fish quality evaluation and different indices of quality; Sanitary and phytosanitary requirements for maintenance of quality; Hazards in sea foods; Risk assessment; National and international standards; HACCP and ISO 9000 series of quality assurance system, ISO 22000:2006, Codex alimentarius, ICMSF; Food Safety and Standards Act of India 2006; Role of BIS and EIA; Role of MPEDA in export trade; Export documentation and certification: Certificate for export (CFE), health certificate and other certifications; Traceability issues for farm reared and wild aquatic products in international trade; Dealing with returned consignments; Foreign trade policy of Fish and Fishery Products in Indian and World contexts; Foreign trade regulations in India.