55 FISH NUTRITION AND FEED TECHNOLOGY

Unit 1: Principle of Fish Nutrition

Nutrients, sources, structure, classification, role/ function and biosynthesis; Metabolism of proteins, carbohydrates and lipids; Essential amino acids, their function and deficiency symptoms; Vitamins and minerals, their role in nutrition and deficiency symptoms; Importance of phospholipids and steroids in fish and crustacean nutrition;Strategies for improvement of carbohydrates utilization in fish;Energy Nutrition: Definition of energy, basic fish bioenergetics, energy partitioning & different forms of energy, energy budget equation, metabolic scope, principles of energy estimation, estimation of gross energy of feed and feed ingredients;Sparing action of nutrients; P:E ratio;Role of nutrients on growth and flesh quality: Concept of growth, growth curve, correlation of growth with body weight and length, biotic and abiotic factors affecting growth, critical nutrients for improving flesh quality;Assessing nutritional requirement of larvae, fingerlings, young fish, grow-out of commercially important finfish and shellfish;Methods and factors affecting nutritional requirements in different life stages of fish and shellfish;Food and feeding habits of fish and shellfish;Nutritive value of live food: Algae, artemia, cladocerans, ostracods, rotifers and copepods; Bio-enrichment of live food; Role of nutrients on reproduction.

Unit 2: Feed Formulation, Feed Technology and Feeding Management

Principles and methods of feed formulation; Feed ingredients, classification, evaluation of ingredient quality; Feed additives/supplements: Classification, function, dietary inclusion level; Antinutritional factorsand methods of detoxification, permissible level; Types of feed: Farm-made, commercial feed, experimental diets (reference/ basal diet, purified and semi-purified diet), moist, semi-moist, dry, crumble, pellet, sinking, slow sinking, floating, micro-bound, microencapsulated, micro-coated;Feed processing technology: Grinding, dosing/ weighing, homogenization/ mixing, conditioning (steam or extrusion cooking), pellet making, drying, crumbling, coating; high energy feed with vacuum coating of lipid; Equipments used in feed manufacture: Pulverizer/ grinder, mixer, pelletizer/extruder/expander, crumbler, drier, vacuum coater/ fat sprayer;Effect of processing on nutritional value of feeds;Feed and feed ingredients and quality control: Storage methods and monitoring, quality control of feed and ingredients during storage- physical, chemical and biological methods, prevention of spoilage from rancidity, fungus and associated toxins, vectors of fish disease in feed, nutritional value of feed in relation to storage; Economics of feed manufacturing**;**Fertilization and supplementary feeding, feeding in intensive culture: Feeding methods and devices- broad casting, bag feeding, tray/ basket feeding, raft feeding, box feeding, feeding by demand feeder, automatic feeder, feed blower etc.;Feeding practices: Ration size/feeding rate, feeding frequency, restricted feeding, and mixed feeding;Feeding schedule and Record keeping;Eco-friendly feeds; Legal aspects of feeds;Designer fish production.

Unit 3: Nutritional Physiology and Nutrigenomics

Morphology, anatomy and physiology of various types of fish such as herbivores, planktivores, omnivores, carnivores, detritivores; Nutrient digestion and digestive processes,control and regulation of digestion; Factors affecting feed intake, digestion, absorption, assimilation and digestibility Digestive enzymes in fish: Gastric, pancreatic and intestinal secretions and role of microorganisms in digestion;Transport of nutrients in the body, storage, conversion and utilization; Role of liver and muscles in fat and glycogen storage and release; Digestive hormones, nutrient regulation of endocrine functions;Effects of broodstock diets on eggs and larval quality; Ontogeny of larval digestive physiology; Digestibility: Types, estimation of digestibilityof nutrientsand energy of feed and feed ingredients, factors affecting digestibility; Nutrigenomics: Definition, classification- transcriptomics, proteomics and metabolomics; Nutrient-gene interaction and expression, reverse transcription and cDNA synthesis, real-time PCR, genetic control on metabolic pathways.

Unit 4: Nutrition and Fish Health

Nutrients and their effects on fish health:Nutritional imbalances, nutritional deficiency, nutrients and immunity, hyper- and hypo-vitaminosis;Dietary lipid and stress tolerance in fish larvae; Myco-toxin in fish feed:Factors favouring mycotoxin production, mycotoxins interactions and pathways, toxins binders, detoxification and amelioration methods; Phytase and phytate in feed ingredients;Role of dietary lipid, vitamin C, vitamin E and carotenoidsin stress mitigation and reproductive performance;Nutraceuticals: Role in immunity and disease resistance;Histological features of gut and associated organs during abnormal nutritional conditions.