

**SCHOOL OF AGRICULTURE**

**Ph.D. IN FOOD SCIENCE & TECHNOLOGY**

**Courses Offered:**

- 1. FOOD TECHNOLOGY**
- 2. FOOD SCIENCE AND NUTRITION/HUMAN NUTRITION**

# 1. FOOD TECHNOLOGY

## 1. Introductory Food Technology

Introduction to food technology, Food processing industries/institutions/food scientists of importance in India, Food attributes *viz.* colour, texture, flavour, nutritive value and consumer preferences, Causes of food spoilage, sources of microbial contamination of foods, food borne illnesses, water activity and its relation to spoilage of foods, Spoilage of processed products and their detection, Principles and methods of food preservation. Food fortification, Composition and related quality factors for processing. Methods of food preservation such as heat processing, pasteurization, canning, dehydration, freezing, freeze drying, fermentation, microwave, irradiation and chemical additives. Refrigerated and modified atmosphere storage. Aseptic preservation, hurdle technology, hydrostatic pressure technology and microwave processing. Use of non-thermal technologies (microfiltration, bacteriofugation, ultra high voltage electric fields, pulse electric fields, high pressure processing, irradiation, thermosonication), alternate-thermal technologies (ohmic heating, dielectric heating, infrared and induction heating) and biological technologies (antibacterial enzymes, bacteriocins, proteins and peptides) in food processing. Role of Food additives and processing aids.

## 2. Technology of Foods of Plant Origin

**Fruits and Vegetable Processing:** Post harvest handling and storage of fresh fruits and vegetables. Preparation of fruits and vegetables for processing. Minimally processed products. Cold chain logistics. ZECC (Zero Energy Cool Chambers), CCSR (Charcoal cool storage Rooms). Thermal processing and process time evaluation for canned products, process optimization, aseptic canning, methods for canning of different fruits, and vegetables; Dehydration and associated quality changes during drying and storage of dehydrated products. Solar drying. Intermediate moisture foods. Preparation and utilization of fruits and vegetables juices in non-fermented/fermented/ aerated beverages, health drinks. Role of membrane technology in juice processing. Chemistry and manufacture of pectin, role of pectin in gel formation and products like jellies, jams and marmalades.

Technology of Preserves, Pickles, Chutneys and Sauces. Nature and control of spoilage in these products, Re-structured fruits and vegetables, Byproducts utilization in fruits and vegetable processing industry, Processing methods of frozen fruits and vegetables, IQF products, packaging, storage and thawing, Role of Pectinases. Tomato products such as juice, puree, paste, soup, sauce and ketchup, Other convenience foods from fruits and vegetables. Beverages, tea, cocoa and coffee processing. Spent coffee ground. Medicinal and aromatic plants: their therapeutic values. Spice processing *viz.* cleaning, grading, drying, grinding, packaging and storage. Oleoresins and essential oils.

**Food grain Processing:** Structure, composition of different grains like wheat, rice, barley, oat, maize and millets, Anti-nutritional factors in food grains and oilseeds, Milling of grains. Wheat flour/semolina and its use in traditional/non-traditional foods like breads, biscuits, cakes,

doughnuts, buns, pasta goods, extruded, confectionary products, breakfast and snack foods. Rheology of wheat and rice flour, Preparation of vital wheat gluten and its utilization, Instant ready mixtures, Enzymes (amylases and proteases) in milling and baking, Milling and parboiling of rice; by-products of rice milling and their utilization, Processed products from rice, Pearling, malting, brewing and preparation of malted milk feeds from barley, Significance of  $\beta$ -glucans, Milling of oats and its processing into flakes, porridge and oatmeal, Wet and dry milling of corn, manufacture of corn flakes, corn syrup, corn starch, corn steep liquor and germ oil, Structure and composition of pulses and their importance in Indian diet. Milling and processing of pulses viz. germination, cooking, roasting, frying, canning and fermentation. Use in traditional products, protein concentrates and isolates. Modified starches and proteins. Oilseeds: edible oilseeds, composition and importance in India. Oilseed processing. Oil extraction and its processing, byproducts of oil refining. Production, packaging and storage of hydrogenated vegetable fat (Vanaspati), peanut butter, protein concentrates, isolates and their use in high protein foods. Soybean protein concentrates and isolates. Soy lecithin extraction. Export of oilseed cakes. International market and consumer preferences for quality in cakes for use in textured vegetable proteins. Millets: composition, nutritional significance, structure and processing. Dairy analogues based on plant milk.

### **3. Technology of Foods of Animal Origin**

**Technology of Milk and Milk Products:** Milk and Milk production in India. Importance of milk processing plants in the country. Handling and maintenance of dairy plant equipment. Dairy plant operations viz. receiving, separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk. Problems of milk supply in India. UHT, toned, humanized, fortified, reconstituted, recombined and flavoured milks. Technology of fermented milks. Milk products processing viz. cream, butter, *ghee*, Cheddar and mozzarella cheeses, condensed milk, evaporated milk, whole and skimmed milk powder, malted food, ice-cream, butter oil, *khoa*, *channa*, *paneer* and similar products. Concept of composite dairy foods. Judging and grading of milk products. Cheese and dairy-based fat spreads. EMC (Enzyme modified cheese), Enzymes in dairy processing. Sanitization viz. selection and use of dairy cleaner and sanitizer. In plant cleaning system. Scope and functioning of milk supply schemes and various national and international organizations. FSSAI specifications and standards of milk and milk products. Dairy plant sanitation and waste disposal.

**Technology of Meat / Fish / Poultry Products:** Scope of meat, fish and poultry processing industry in India, Chemistry and microscopic structure of meat tissue, Ante mortem inspection, Slaughter and dressing of various animals and poultry birds, Post mortem examination, Rigor mortis, Retail and wholesale cuts, Factors affecting meat quality. Curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Sausage making. Microbial factors influencing keeping quality of meat. Processing and preservation of fish and its products. Handling, canning, smoking and freezing of fresh water fish and its products. Meat tenderization and role of enzymes in meat processing. Utilization of by-products. Zoonotic diseases. Structure and composition of egg and factors affecting quality. Quality

measurement. Preservation of eggs using oil coating, refrigeration, thermo stabilization and antibiotics. Packing, storage and transportation of eggs. Technology of egg products viz. egg powder, albumen, flakes and calcium tablets. Industrial and food uses. Physiological conditions and quality of fish products.

#### **4. Food Quality Management**

Objectives, importance and functions of quality control. Quality systems and tools used for quality assurance including control charts, acceptance and auditing inspections, critical control points, reliability, safety, recall and liability. The principles and practices of food plant sanitation. Food and hygiene regulations. Environment and waste management. Total quality management, good management practices, HACCP and codex in food. International and National food laws including food recall regulations. US-FDA, EFSA, ISO-9000 and FSSAI. Food adulteration. Sensory evaluation, panel screening, selection methods. Sensory and instrumental analysis quality control. Quality control of food at all stages and of packaging materials. Non-destructive food quality evaluation methods. Biosensors and their use in quality evaluation of food products. Aspects of food safety.

#### **5. Food Engineering/Packaging and Labeling**

Unit operations of food processing viz. grading, sorting, peeling and size reduction machineries for various unit operations, energy balance in food processing. Functions and levels of food packaging. Packaging materials: properties and testing procedures. Metal cans: types, mechanism of corrosion and protective coatings. Packaging requirements and practices of fresh and processed foods. Shelf life studies. Recent trends in packaging, aseptic, modified atmosphere, vacuum and gas packaging, active and intelligent/smart packaging, antimicrobial packaging, edible films and coatings, biodegradable and nanocomposite materials for food packaging. Food packaging and labeling requirements as per FSSAI regulations. Principles of package design.

#### **6. Food Microbiology & Biotechnology**

Fermentation technology, fermented food products (animal and plant based including cereal), microbial spoilage of foods, bacterial growth curve, hurdle technology. Role of biotechnology in productivity of plants, livestock and microbes of improved nutrition and quality. Use of biotechnology in production of food additives viz. preservatives, colorants, flavours. Use of biotechnologically improved enzymes in food processing industry, biomass production using industrial wastes. Single cell proteins, Single cell oils, Food contaminants viz. aflatoxins. Food intoxication and infection. Consumer concerns about risks and values, Biotechnology and food safety.

## **7. Flavour Chemistry Technology**

Flavour composition of foods/beverages (identification and quantitative analysis of the flavour precursors and their products, characterization of the staling reaction using stable isotopes). Flavour composition of foods/beverages in relation with maturation and microbial activity/or the processing conditions (e.g. fermented dairy products, beer, wine, honey, fruits). Analysis of odour-active compounds of food/beverages (Charm analysis). Synthesis of flavour by microorganisms and plant cells. Lipid derived flavours. Investigation of equilibrium of key flavour compounds that govern the flavour stability of beverages. Natural antioxidant constraints in spices. Role of microorganisms in flavour development. Flavor emulsions, flavour composites, essential oils and oleoresins.

## **8. Consumer Sciences/Food Product Development/Health Foods**

Socio-cultural, psychological and economical consideration for food appearance, domestic and export marketing. Consumer trends and their impact on new product development. Product development viz. to conceive ideas, evaluation of ideas, developing ideas into products, test marketing and commercialization. Role of food in human nutrition. Nutritional disorders, natural contaminants and health hazards associated with foods. Diet therapy. Therapeutic / Engineered / Fabricated and Organic foods/ Nutraceutical and functional foods. FSSAI regulations related to food fortification, nutraceuticals and organic food.

### **1. Food and Food Groups**

Food production and consumption trends in India and their consequences on nutrition situation. Cereals, millets, pulses, oilseeds, vegetables, fruits, milk, eggs, meat and other animal foods. Nutritional value of these food groups and their contribution towards nutrients in Indian diets.

### **2. Food Preservation and Packaging**

Principles and methods of food preservation and storage. Preservation of fruits, vegetables, meat, milk and milk products. Food packaging, packaging material, labelling, food laws and regulation. International food standards and codex alimentarius, FSSAI, 2011

### **3. Cooking methods and Food Processing**

Food processing-physical and chemical changes in foods during processing including cooking and preservation with special reference to sensory characteristics and nutritional value. Traditional methods of processing such as parboiling, germination, malting and fermentation and their nutritional advantages. Food colours, flavours and enzymes, and their importance. Food additives: need for food additives and types of additives.

### **4. Food Safety**

Food safety-natural toxicants, pesticide residues, common adulterants and mycotoxins, their harmful effects on health, and methods of eliminating their harmful effects. Food borne diseases and their prevention. Food spoilage: perishable, semi-perishable and non-perishable.

### **5. Macro and Micro Nutrients in Human Nutrition**

Macro and micro-nutrients in human nutrition. Carbohydrates, lipids, proteins, vitamins, minerals and trace elements. Requirements, sources, functions and effects of deficiency. Energy-methods of assessing energy requirement and factors influencing requirement. Qualitative differences in food proteins and methods of assessing protein quality. Factors influencing availability of minerals. Nutrients inter-relationships. Importance of fibre in human nutrition. Water and electrolyte balance. Metabolism of carbohydrates, proteins and lipids. Roles of vitamins and hormones in metabolism.

### **6. Community Nutrition**

Major nutrition problems in India – causes, magnitude and distribution. Nutritional problems of vulnerable segments – pregnant and lactating women, and pre-school children. Food nutrition programmes to combat malnutrition-strategies, targets and progress. Assessment of community nutritional status-anthropometry, diet survey, biochemical and clinical methods. Indicators/parameters and standards used for assessment by different methods. Growth norms for pre-school children and importance of growth monitoring.

## **7. Nutrition during Life Cycle**

Nutritional requirements of pregnant and lactating women and pre-school children. Consequences of chronic nutritional deficiencies in these groups. Infant and child feeding practices in India and importance of promoting good feeding practices. Nutrition for elderly.

## **8. Clinical Therapeutic Nutrition**

Relationships between clinical biochemical results and nutritional status. Drug nutrient interaction. Nutrition in disease, therapeutic modifications of normal diets, and their use in treatment of diabetes, cancer, obesity, burns, fever and infections and diseases of gastrointestinal tract, cardio-vascular, renal, hepatic. Metabolic and febrile disorders.

## **9. Institutional Food service management**

Menu planning for industrial canteen, hospital canteen, snack bar, residential hostel, fast food outlets and cafeteria. Food safety, safety hazards and risks, food related hazards, microbiological considerations in food safety, effect of processing and storage on microbial safety, microbiological methodology, HACCP as method to prevent food borne illness, chemical hazards associated with foods.

## **10. Food Analysis**

Principles and methods of proximate analysis- moisture, ash, crude fiber, crude fat, crude protein and carbohydrates by difference, Basic Principles of HPLC, GLC, spectrophotometry, electrophoresis, refractometry, densitometry, minerals and vitamins estimations. Methods for determining physical and rheological properties of foods.