Department Of Dairy Science

Staff Profile and Syllabus of Dairy Science

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Syllabus for M.Sc. (Agri.)

Department of Animal Husbandry and Dairy Science (Dairy Science)

Course Code	Semester	Course Title	Credits
Major Courses:			
DS 511*	I	Advances in Dairy Processing	4 = 3+1
DS 515	I	Advances in Traditional Indian Dairy Products	3 = 2+1
DS 521*	II	Membrane Processing for Dairy Applications	3 = 2+1
DS 522*	II	Advances in Dairy and Food Packaging	3 = 2+1
DS 524*	II	Functional Foods and Nutraceuticals	4 = 3+1
DS 525	II	Production and Applications of Dairy Ingredients	3 = 2+1
DS 591*	III	Master's Seminar	1=1+0
DS 599	III & IV	Master's Research	30=0+30
Minor			

DC 511	I	Physico-chemical Aspect of Milk Constituents	3 = 2+1
DM 514	I	Microbiology of Fluid Milk and Dairy Products	3 = 2+1

I. Course Title : Advances in Dairy Processing

II. Course Code : DS 511

III. Credit Hours : 4=3+1

IV. Theory:

Unit I

Use of bio-protective factors for preservation of raw milk: effects on physico- chemical, micro-bial and nutritional properties of milk and milk products; Present status of preservation of raw milk.

Unit II

of determining lethality of thermal processing; UHT processed milk products, their properties and prospects, types of UHT plants, aseptic fillers, heat stability and deposit formation aspects, effect on milk quality; techno-economic considerations; Nutritional aspects of UHT treated milk vis-à-vis retort sterilized/ HTST treated milk.

Unit III

Principles and equipment for bactofugation and bactotherm processes; Partial homogenization and its application in dairy industry, Low pressure homogenization; Microfluidization of milk: Principle, equipment, effects and applications.

Unit IV

Concentration processes and their impact on quality of finished products; Dehydration: advances in drying of milk and milk products; Freeze dehydration: physico- chemical changes and in-dustrial developments; Glass Transition Temperature and its relevance to dried milks.

Unit V

Water activity; Sorption behaviour of foods, energy of binding water, control of water activity of different milk products in relation to their chemical, microbiological and textural properties; Hurdle technology and its application in development of shelf-stable and intermediate-moisture foods; Use of carbonation in extending the shelf life of dairy products.

Unit VI

Current trends in cleaning and sanitization of dairy equipment; Automation, Ultrasonic techniques in cleaning; Bio-films; Bio-detergents, innovations in sanitizers - chemical,

radiation; Mechanism of fouling and soil removal; Assessing the effectiveness of cleaning and sanitization of dairy equipment, Water conservation methods.

VII. Practical:

- Measurement of thiocyanate in milk system
- LP system for extending the keeping quality of raw milk
- Determination of HCT-pH profile of milk
- Determination of water activity and sorption isotherms of milk products
- Determination of WPNI of milk powders
- Functional properties of milk powders
- Determination of HMF content in dried milks
- Freeze drying of milk and milk products
- Homogenization efficiency
- Cleaning and sanitization efficiency of dairy equipment
- Visit to a UHT Processing plant.

I. Course Title : Advances in Traditional Indian Dairy Products

II. Course Code : DS 515

III. Credit Hours : 3=2+1

VI. Theory:

Unit I

Global prospects and export potential of traditional Indian dairy products.

Unit II

Differences in quality of traditional dairy products from cow, buffalo, goat, camel, and sheep milks; Process innovations in commercial production of heat-desiccated

,coagulated and fermented traditional dairy products; Mechanized production of traditional milk based sweets; Automation for manufacture of ghee, paneer, dahi,lassi and traditional sweetmeats.

Unit III

Composite traditional milk products; Application of membrane technology and microwave processing for industrial production of traditional Indian dairy products.

Unit IV

Technologies for region specific traditional Indian dairy products and their value addition, their application as a vehicle for delivering functional ingredients; Manufacture of dietetic traditional dairy products.

Unit V

Techno-economic aspects for establishing commercial units for traditional products.

Unit VI

Convenience traditional dairy products; Food safety issues; Shelf life extension of food using newer techniques; Novel packaging and preservatives.

VII. Practical:

- Production of reduced calorie, composite and functional traditional Indian dairy products.
- Microwave heating of traditional Indigenous milk delicacies for shelf life extension.
- Membrane technology for improving the quality of traditional Indigenous products made from cow and buffalo milk.
- Preparation of feasibility report for establishing commercial units for traditional dairy products.

I. Course Title : Membrane Processing for Dairy Applications

II. Course Code : DS 521

III. Credit Hours : 3=2+1

IV. Theory:

Unit I

Membrane techniques; Classification and characteristics of filtration processes; types of commercially available membranes; membrane hardware, design of membrane plants, modelling of ultrafiltration (UF) processes, mass transfer model, resistance model; Membrane fouling-problems and mitigation strategies; Cleaning and sanitization of different types of membranes.

Unit II

Factors affecting permeate flux during ultrafiltration and reverse osmosis of milk and sweet/sour whey, energy requirements for membrane processing of milk and whey.

Unit III

Applications of ultrafiltration (UF), reverse osmosis, nanofiltration and microfiltrationin the dairy industry: food and pharmaceutical grade lactose, low lactose milk powder, dairy whiteners, WPC, WPI, MPC, MPI, Native micellar casein powder, etc. Preparation, properties and uses of Milk Protein Concentrate (MPC) and Milk Protein Isolate (MPI); Manufacture of some cheeses and fermented milk products and impact of membrane processing on quality of such products. Use of membrane processing techniques for separating prophylactic biological from milk.

Unit IV

Demineralization: principles, processes, equipment and applications.

Unit V

Functional properties of whey proteins (WPC and WPI), micellar casein and UF

milk retentate and their modifications.

VII. Practical:

- Factors affecting permeate flux during membrane processing (type of feed, temperature, transmembrane pressure, etc.)
- Effect of microfiltration of skim milk and whey on fat content and microbial count
- Preparation of WPC, WPI, MPC, native micellar casein, etc.
- Evaluating the functional properties of milk proteins.

I. Course Title : Advances in Dairy and Food Packaging

II. Course Code : DS 522

III. Credit Hours : 3=2+1

IV. Theory:

Unit I

Trends in packaging industry; designing framework for packaging; Testing of packaging materials.

Unit II

Adhesives; Graphics; Coding (Barcode and Quick Response code), and labeling used in food packaging.

Unit III

Protective packaging of foods; Effect of light, oxygen and moisture on packaged

food.

Unit IV

Packaging of dairy products, convenience foods, fresh produce and fruits and vegetable products, Packaging of fats and oils, spices, meat, poultry, fish and other sea foods.

Unit V

Modified atmosphere packaging, Shrink and stretch packaging; Self-heating and self-cooling cans.

Unit VI

Retort pouch technology, microwavable, biodegradable, and edible packages; Principles and applications of Active Packaging, Smart and Intelligent Packaging, Antimicrobial packaging.

Unit VII

Industrial packaging: unitizing, palletizing, containerizing, distribution systems for packaged foods.

Unit VIII

Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials, packaging and flavour interaction.

VII. Practical:

- Testing of packaging materials for quality assurance: thickness, GSM, grease resistance, bursting strength, tearing resistance, WVTR, puncture resistance
- Estimation and prediction of shelf life of packaged foods
- Development of edible, biodegradable and antimicrobial films
- MAP of perishable foods
- Effect of edible coatings on respiration behaviour of fruits and vegetables
- Application of oxygen scavengers in packaged foods.
- Collection of packaging material and making a album

I. Course Title : Functional Foods and Nutraceuticals

II. Course Code : DS 524

III. Credit Hours : 4=3+1

VI. Theory:

Unit I

Classes of functional foods and their status.

Unit II

Functional ingredients; Classification; Dietary and therapeutic significance.

Unit III

Food fortification; Significance and techniques of fortifying foods with functional ingredients.

Unit IV

Infant nutrition; Dietary formulations, special needs, additives; Geriatric Foods: Design considerations, ingredients, special needs; Sports foods: Significance, strategies and design considerations.

Unit V

Reduced calorie foods: Significance, strategies, additives (fat replacers, bulking agents, non-nutritive sweeteners).

Unit VI

Low sodium and low lactose foods: Nutritional and health significance.

Unit VII

Herbs; Classification; Therapeutic potential, applications; Phytochemicals; Classes; Physiological role; Applications; Bioactive ingredients from animal and marine sources.

Unit VIII

Probiotic, prebiotic and synbiotic foods: Concept and applications.

VII. Practical

- Determination of soluble and insoluble fibre
- Determination of antioxidant activity of functional ingredient/food.
- Determination of in vitro bioavailability of nutrients
- b-galactosidase activity for low-lactose dairy product
- Prebiotic potential of selected plant/milk components
- Probiotic potential of selected microorganisms
- Preparation of functional foods

I. Course Title : Production and Applications of Dairy Ingredients

II. Course Code : DT 525

III. Credit Hours : 3= 2+1

IV. Theory: Unit I

An overview of dairy ingredients for food processing; Composition, nutritive value and health attributes of dairy ingredients; Important quality indices; National and international regulatory standards.

Unit II

Principles of conventional and novel approaches for separation, concentration and fractionation of milk components(Ig, lf, b-Lg): centrifugal separation, concentration, drying, membrane processing, enzyme-assisted separation, supercritical fluid extraction, electric field assisted membrane technique, etc.

Unit III

Chemical, physical and functional characteristics of concentrated and dried dairy ingredients (SMP, WMP, lactose, whey powder, WPC, WPI, MPC, casein and caseinates, cream powder, butter powder, cheese powder, yogurt powder, buttermilk powder, etc.).Miscellaneous dairy ingredients, viz. dairy permeates, hydrolysates, coprecipitates and lactoferrin.

Unit IV

Interactions of dairy ingredients with other food components and its effect on product quality.

Unit V

Applications of dairy ingredients in food industry: bakery and confectionery; Infant, adult and sports nutrition; Processed meat products; spreads; functional Foods; edible films and coatings.

VII. Practical

- Manufacture of whey powder, caseinates, whey protein/milk protein concentrates, lactose, sweet cream butter milk powder, cream powder, yogurt powder and cheese powder.
- Determination of functional and nutraceutical properties of dried dairy ingredients.
- Manufacture of enzyme-modified dairy ingredients
- Production of eggless cakes using WPC
- Production of processed meat products incorporating caseinates
- Visit to a dairy ingredients manufacturing industry.

I. Course Title : Physico-Chemical Aspects of Milk Constituents

II. Course No. : DC 511

III. Credit Hours : 3 = 2+1

IV. Theory:

Unit I: Chemical and Enzymatic reactions

Basics of chemical reaction kinetics, Order and molecularity of a reaction., Kinetics of denaturation of whey proteins and Maillard browning., Kinetics of enzymatic reactions; the role of enzymes as biological catalysts; factors affecting the rate of enzyme reaction: concentration of substrate, concentration of enzyme, concentration of reaction products, pH, temperature, time, activators and inhibitors. Thermal inactivation of enzymes present in milk. Concept of activation energy

Unit II: Physico-chemical changes in milk and milk products

Physical changes taking place during manufacture of various products and in individual milk constituents., Chemical changes taking place during manufacture of various products in individual milk constituents., Desirable and undesirable changes due to processing and storage., Redox reactions and photo-oxidation of milk.

Unit III: Surface Chemistry

Fat globule membrane - physics and chemistry., Factors affecting fat globules size and distribution., Fat globules- creaming phenomena, factors involved in creaming

Unit IV: Foams and Emulsions

Colloidal and surface phenomena in milk; adsorption at solid-liquid and liquidliquid interphases; Gibb's equations., Interfacial tension, surface tension, surface active agents, general aspects of foaming, churning and whipping of cream; emulsion and emulsion stability; coalescence and dispersion; an introduction to the concept of Nano emulsion and Nano micelles.

Unit V: Micelles and Gelation

Micelles: definition, critical micelle concentration, formation and stability; Colloidal stability of casein micelles in milk, zeta potential, size distribution of casein micelles and fat globules; Gels and their formation, structure and stability; acid and rennet gels.

VII. Practical:

- Determination of lactose in milk and milk products by chemical method
- Determination of milk fat by Mojoner method in milk products
- Measurement of hydrolysis of a carbohydrate and measurement of activation energy.
- Analysis of effect of substrate concentration on hydrolysis of p-nitrophenyl phosphate by milk alkaline phosphatase.
- Michaelis constant determination for the digestion of casein by trypsin.
- Measurement of pH and buffering capacity of different types of milk.
- Stability analysis of an oil-in-water emulsion stabilised by milk proteins

- Foaming capacity and foam stability of caseins/whey proteins.
- Study of the gel formation and gel stability of milk proteins.
- Drawing of an adsorption isotherm of water on casein.
- Measurement of thermal inactivation of enzymes (Alkaline phosphatase, Lactoperoxidase).

I. Course Title : Microbiology of Fluid Milk and Dairy Products

II. Course Code : DM-514

III. Credit Hours : 3=2+1

VI. Theory:

Unit I

Common microbes in milk and their significance, Microflora of mastitis milk and its importance in dairy industry, Sources of microbial contamination of raw milk and their relative importance in influencing quality of milk during production, collection, transportation and storage; Clean milk production and natural antimicrobial systems in raw milk, Microbial changes in raw milk during long storage, Microbiological grading of raw milk.

Unit II

Microbiological aspects of processing techniques like bactofugation, thermization, pasteurization, sterilization, boiling, UHT, non-thermal processes (pulsedelectric field) and membrane filtration of milk; Role of psychrotrophic, mesophillic, thermophilic and thermoduric bacteria in spoilage of processed milks, their sourcesand prevention; Heat induced damage in bacteria and role of resuscitation in recovery of injured microbial cells. Microbiological standards (BIS/ FSSAI) of heat- treated fluid milks

Unit III

Microbiological quality of dairy products; fat rich (cream and butter), frozen (ice cream), concentrated (evaporated and condensed milk), dried milks (roller and spray dried), infant dairy foods and legal standards; Sources of contamination and factors affecting microbial quality of these products during processing, storage and distribution; Microbiological defects associated with these products and their control.

Unit IV

Microbiological quality of traditional dairy products in India; heat desiccated (khoa, burfi, peda, kheer, etc.), acid coagulated (paneer, chhana, rasogolla, etc.), fermented (dahi, lassi, srikhand, etc.) and frozen (kulfi); Sources of microbial contaminants and their role in

spoilage; Importance of personnel and environmental hygiene on qualityof traditional milk products; Microbiological standards for indigenous dairy foods.

Unit V

Food poisoning- Food intoXications, Food infections and ToXi-infections, pathogens associated with fluid milks, dairy products and their public health significance; Sources of pathogens and their prevention; Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies.

VII. Practical:

- Grading of raw milk based on SPC, coliforms and dye reduction tests.
- Effect of different storage temperatures on microbiological quality of fluid milk.
- Tests for mastitic milk and brucellosis.
- Microbiological quality evaluation of cream and butter for coliforms, yeasts and moulds, lipolytic and proteolytic bacteria.
- Detection of Cronobacter sakazakii in infant dairy foods.
- Microbial evaluation of burfiand pedafor SPC, S. aureus, yeast and mould counts.
- Detection of Bacillus cereus, Salmonella,Shigella and coagulase positive staphylococci in milk powder.
- Evaluation of ice cream for coliforms and Escherichia coli.
- Microbiological quality of paneer.
- Enumeration of aerobic and anaerobic spores in condensed, sterilized and driedmilks.
- Line testing for determining the source of contamination of dairy products.
- Detection of toXins (staphylococcal, aflatoXins/mycotoXins) in dairy foods