

21. DAIRY CHEMISTRY

Unit 1

Milk constituents, their normal contents and physical and chemical nature. Specific compositional differences among milk from various species; Variations in milk composition due to breed, feed, season, stage of lactation and mastitis; Colostrum and abnormal milks, physical properties of milk; Acid base equilibria, oxidation-reduction potential, density, viscosity, interfacial tension, freezing point, electrical conductivity, thermal conductivity, refractive index, milk buffer capacity, physical equilibria among milk salts; Effect of various treatments on salt equilibria; Salt balance and its importance in processing of milk; Water activity, and its effect on shelf life; Colloids, properties and colloidal stability of milk; Emulsions, foams and gels formation, their stability and importance in dairy processing.

Lactose – structure, isomers, physical, chemical and biochemical properties. Browning mechanisms. Estimation and biosynthesis. Lactose intolerance. Significance of carbohydrates in milk and milk products. Distribution of trace elements in milk and their technological and nutritional importance; Water soluble vitamins – molecular structure and their levels in milk and milk products, biological significance, and factors affecting their levels.

Unit 2

Levels, distribution, isolation and genetic polymorphism of different milk proteins; Casein micelles – structure, size distribution, stability and physico-chemical properties; Casein models. Amino acid composition and physico-chemical properties of different fractions of caseins; Whey process, denaturation of milk proteins as influenced by temperature, pH and additives; Biosynthesis, structure, function and physico-chemical properties of α -lactalbumin and β -lactoglobulin, immunoglobulins, lysozyme, lactoferrins, lipoproteins and fat-globule membrane proteins and their importance; Milk protein allergenicity; Role in immune response; Chemistry of milk enzymes and their significance with reference to milk processing and milk products. Kinetics of chemical reactions and enzyme kinetics; Casein hydrolysate, co-precipitates, and whey protein concentrates; bioactive peptides.

Unit 3

Milk lipids – classification, composition, structure and general physical and chemical properties. Auto-oxidation – definition, theories, factors affecting, prevention and measurement. Antioxidants – mechanism of reaction and estimation. Lipolysis. Fatty acids – profile, properties and affecting factors. Unsaponifiable matter. Cholesterol – structure, forms, importance and level in milk. Chemistry of phospholipids and their role in milk and milk products. Fat – soluble vitamins – chemistry, physiological functions, levels in milk, cream, butter and ghee. Biosynthesis of milk fat. CLA biosynthesis and its nutritional and health benefits.

Unit 4

Milk adulteration and detection methods; Estimation methods for antibiotics, pesticides, heavy metals, lactose, lactate, protein, total solid, fat, salt, vitamin C, calcium, phosphorous, iron, citric acid in milk and milk products. Estimation of vitamin A, total phospholipids and free fatty acids in ghee. Estimation of starch in food. Measurement of BOD and COD in dairy waste.

Unit 5

Cream – Size distribution of fat globules, creaming phenomenon, composition and properties of cream and dry cream. Chemistry of neutralization and ripening. Butter. Mechanism of churning during butter preparation. Desi and creamery butter composition, properties, microstructure, grading, standards and defects. Ghee –

Compositional differences in ghee prepared by different methods and variations in ghee and butter oil, Analytical constants and factors affecting them. Differences in cow and buffalo ghee. Hydrolytic and oxidative deterioration of ghee, their causes and prevention. Adulteration of ghee and methods of detection. Ghee grading, Antioxidants: natural and synthetic. Physico-chemical characteristics of buttermilk and ghee residue.

Unit 6

Heat stability of milk as affected by various milk constituents and additives. Role of protein-protein interaction and age gelation of UHT milk. Physical and chemical changes during preparation of concentrated milk and subsequent storage. Compositional differences between condensed and evaporated milk. Dried milk; Structure and physico-chemical properties. Physical properties of instant powder, Infant food. Spoilage of milk powder and its control. Khoa : composition and changes during manufacture. Composition and changes during preparation of chhana and paneer.

Unit 7

Cheese : Composition and varietal differences. Chemistry of rennin action. Influence of acidity, renneting and heat on the process of cheese manufacture. Changes during manufacture and ripening. Role and mechanism of action of stabilizers and emulsifiers, rheological properties and defects of cheese. Milk clotting enzymes from different sources – microbial, animal and plant. Theories and metabolic pathways of fermentation. Dahi, yoghurt and Acidophilus Milk : Composition and specific differences, chemical changes during fermentation, flavour development. Composition of Lassi and buttermilk. Nutritional and therapeutic significance of fermented milk products.

Unit 8

Ice-cream : Composition and physical structure, changes during ageing, freezing, hardening and defects. Role and mechanism of stabilizers and emulsifiers. Kulfi: composition and differences with ice-cream.

Unit 9

Definition of quality, quality control and assurance. Standards, statutory and voluntary organization. PFA act, sampling, labelling, PFA and AGMARK, BIS, ISO9000 standards for milk products. Total quality management, sensory evaluation of milk and milk products. Calibration of glasswares (lactometer, butyrometer, milk pipette, thermometer) used in Quality control laboratory, legal requirements of packaging material and product information, nutrition labelling.

Unit 10

Spectroscopy – UV – Vis spectrophotometry, IR. Separation techniques : TLC, GLC, HPLC, Ion exchange, size exclusion, affinity chromatography, analytical sedimentation, sedimentation equilibrium, isopycnic ultracentrifugation. Ultrafiltration. Precipitation by salting out agents. Electrophoresis – PAGE, SDS-PAGE, Radio-tracers technique. Flame photometry and potentiometry (principle, various electrodes, electrometric measurements of pH, buffers).

