

PG COURSE DETAILS FOR M.Sc. (DAIRY CHEMISTRY)

Aim of the Department:

The mandate of this Department is to impart knowledge of chemistry related to milk and milk products through undergraduate and post graduate courses. The department aims at providing support towards the chemical quality related issues of the dairy industry as well. Another objective of the Department is to develop elite human resource for various managerial positions in quality control department of Dairy Industry in India and abroad. Broadly the research areas of the division includes development of rapid tests for detection of adulteration in milk and milk products, evaluating the role of functional ingredients used for value addition of dairy products, aspects related to micronutrient fortification in dairy products, assessing the physico-chemical properties of milk of different species, evaluating the role of different biofunctional molecules in biopreservation and shelf life enhancement of milk and milk products.

Total Intake: 10 students

Course Curriculum and syllabus:

Courses	Course Code	Name of Course	Credits
Major Courses (25 credits)	DC-701	Chemistry of Milk lipids	3(2-0-1)
	DC-702	Chemistry of milk carbohydrates, vitamins, and minerals	3(2-0-1)
	DC-704	Chemistry of milk protein	3(2-0-1)
	DC-705	Chemistry of milk and milk product processing	3(2-0-1)
	DC-706	Chemistry of functional Dairy foods and nutraceuticals	3(2-0-1)
	DC-707	Chemical Quality Assurance in Dairy Industry	3(2-0-1)
	DC-708	Analytical Techniques in Dairy Chemistry	3(2-0-1)
	DC-709	Advances in Food Chemistry	3(2-0-1)
	DC-880	Seminar I	1
Minor courses (15 credits)	DM-704	Dairy Microbiology	3(2-0-1)
	MAS -815	Experimental Design	3(2-0-1)
	DT-820	Processing of milk and milk products	3(2-0-1)
	DM-708	Microbiological quality assurance	3(2-0-1)
	DC-710	Food and Nutritional Biochemistry	3(2-0-1)
Supporting Courses(05 credit)	MAS – 511	Statistical Methods	3(2-0-1)
	CSIT-701	Computer Orientation	3(2-0-1)
Thesis		Research work	30
Total credits			77
Deficiency courses	DC-301	Physical Chemistry of Milk	3(2-0-1)
	DT-303	Traditional Indian Dairy Products	3(2-0-1)
	DT-402	Fat Rich Dairy Products	4(3-0-1)
	DT-401	Condensed Milk and Dried Milk	5(3-0-2)
	DT-501	Cheese Technology	5(3-0-2)

SEMESTER WISE ALLOTMENT OF COURSES

Semester	Course Code	Name of Course	Credits (L-T-P)
SEMESTER I (18 Credits)	DC-701	Chemistry of Milk lipids	3(2-0-1)
	DC-702	Chemistry of milk carbohydrates, vitamins, and minerals	3(2-0-1)
	DC-707	Chemical Quality Assurance in Dairy Industry	3(2-0-1)
	DM-704	Dairy Microbiology	3(2-0-1)
	DC-710	Food and Nutritional Biochemistry	3(2-0-1)
	MAS – 511	Statistical Methods	3(2-0-1)
SEMESTER II (15 Credits)	DC-704	Chemistry of milk protein	3(2-0-1)
	DC-705	Chemistry of milk and milk product processing	3(2-0-1)
	DC-706	Chemistry of functional Dairy foods and nutraceuticals	3(2-0-1)
	MAS -815	Experimental Design	3(2-0-1)
	CSIT-701	Computer Orientation	3(2-0-1)
SEMESTER III (13 Credits)	DC-708	Analytical Techniques in Dairy Chemistry	3(2-0-1)
	DC-709	Advances in Food Chemistry	3(2-0-1)
	DT-820	Processing of milk and milk products	3(2-0-1)
	DM-708	Microbiological quality assurance	3(2-0-1)
	DC-880	Seminar I	1
SEMESTER IV (30 Credits)	DC-999	Master's Dissertation	
Deficiency courses	DC-301	Physical Chemistry of Milk	3(2-0-1)
	DT-303	Traditional Indian Dairy Products	3(2-0-1)
	DT-402	Fat Rich Dairy Products	4(3-0-1)
	DT-401	Condensed Milk and Dried Milk	5(3-0-2)
	DT-501	Cheese Technology	5(3-0-2)

Eligibility criteria for admission to M.Sc.*(Dairy Chemistry):

B.Tech(Dairy Technology) / B.Sc(Food Technology) / B.Sc(Food, Nutrition and Dietetics) / B.Sc.(Home Science)/ B.Tech(Food Technology) / B.Sc(Chemistry/Life Sciences with chemistry as one of the subject) / B.Tech(Chemical Engineering / B.Sc.(Agriculture)/B.Sc.(Industrial Chemistry)/ B.Tech(Biotechnology)/B.Sc.(Biotechnology)/B.Sc(Biochemistry)

DC-701

Chemistry of Milk lipids

3(2-0-1)

Objectives:

To impart the basic knowledge on all aspects of milk lipids and to project the importance of milk lipids in the quality of milk products as well as in human health.

Theory

Milk lipids: classification, gross composition and physical properties; neutral and polar lipids and their role in milk and milk products.

Fatty acids profile: composition, properties and factors affecting them.

Unsaponifiable matter: composition with special reference to sterols and fat soluble vitamins and carotenoids, chemistry, physiological functions and levels of milk.

Chemical properties: hydrolysis by alkali water and enzymes; hydrogenation and halogenation; transesterification and interesterification; oxidation by chemical reagents.

Auto-oxidation: Definition, theories, induction period, secondary products of auto oxidation, factors affecting, prevention and measurement; antioxidants: Definition, types, reaction mechanism and estimation.

Practical:

Determination of melting point/slip point, peroxide value, TBA value, carbonyl value, unsaponifiable matter; estimation of total cholesterol by direct and indirect method; vitamin A, total phospholipids and free fatty acids in ghee; preparation of fatty acid esters and their analysis on GLC; estimation of antioxidants such as BHA.

Suggested Readings

Fox, P.F. 1983 Development in Dairy Chemistry, Vol. 2, Applied Science Publishers, U.K.

Wong, N.P.; Jenness, R.; Keeney, M. and Elmer, H.M. 1988 Fundamentals of Dairy Chemistry Van Nostrand Reinhold Co., New York, U.S.A.

Walstra, P. and Jenness, R. 1984. Dairy Chemistry and Physics, John Wiley and sons, New York, U.S.A.

Mathur, M.P., Datta, Roy, D. and Dinakar, P. 1999. Text Book of Dairy Chemistry, ICAR New Delhi.

DC-702

Chemistry of milk carbohydrates, vitamins, and minerals

3(2-0-1)

Objectives:

To impart basic knowledge about the importance of milk carbohydrates, minerals and water soluble vitamins and to study the importance of these milk constituents in human health.

Theory

Lactose: occurrence, isomers; molecular structure

Physical properties:- crystalline habits; hydrate; lactose glass; equilibrium of different isomers in solution; solubility; density sweetness

Chemical properties:- hydrolysis; pyrolysis; oxidation; reduction; degradation with strong bases; derivatives, dehydration and fragmentation browning reaction; oligosaccharides in milk

Minerals: major and minor minerals; factors associated with variation in salt composition

Physical equilibrium amongst milk salts; partitioning of salt constituents and factors affecting it; effect of various treatments on salt equilibrium, Salt balance and its importance in the processing of milk; protein mineral interactions; distribution and importance of trace elements in milk;

Water soluble vitamins: thiamin; riboflavin; niacin; pantothenic acid; pyridoxine; biotin; folacin (folic acid) and cynocobalamin;

Molecular structure; levels in milk and milk products; biological significance; factors affecting their levels; ascorbic acid structure; relation to Redox potential (Eh) of milk and milk products.

Practical

Estimation of lactose in milk by volumetric; gravimetric; polarimetric and colorimetric methods; estimation of sodium and potassium by (flame photometry); calcium and magnesium by EDTA method; phosphorus by colorimetric method (Fiske and Subba Rao); citric acid and iron by colorimetric methods; vitamin C in milk by volumetric method and; estimation of brown colouring matter/burnt particles in milk powder.

Suggested Readings

Jenness, R. and Patton, S. 1969 Principles of Dairy Chemistry, John Wiley & Sons, New York.

Wong, N.P.; Jenness, R.; Keeney, M. and Elmer, H.M. 1988 Fundamentals of Dairy Chemistry Van Nostrand Reinhold Co., New York, U. S. A.

Fox, P.F. 1985 Developments in Dairy Chemistry Vol. 3 Applied Science, U.K.

Walstra, Pieter and Jenness, Robert 1984. Dairy Chemistry and Physics. John & Wiley and Sons, New York.

Jenness, Robert, G. 1995. Handbook of Milk Composition. Academic Press, New York, U.S.A.

DC-704

Chemistry of Milk Proteins

3(2-0-1)

Objectives:

To impart knowledge on different aspects of milk proteins

Theory

Major milk proteins: caseins (acids and micellar), methods of isolation; fractionation of casein and heterogeneity, physico-chemical properties, glycosylation, phosphorylation, amino acid composition, primary and secondary structure of different fractions; casein micelle models

Distribution and fractionation of different nitrogen fractions of milk proteins, nomenclature of milk proteins

Alpha-Lactalbumin and beta-lactoglobulin, Bovine Serum Albumin- distribution and methods of isolation and their physico-chemical properties

Denaturation of milk proteins, various factors affecting denaturation; casein-whey protein interactions
Minor milk proteins: proteose-peptone, immunoglobulins, lactoferrin, lipoprotein and fat globule membrane proteins

Indigenous milk enzymes: properties and their significance with particular reference to lipases, proteases, phosphatases, catalase, peroxidase, xanthine oxidase, lysozyme, lactoperoxidase and galactosyltransferase

Practical

Isolation of acid and rennet casein ; urea fractionation of acid casein ; isolation of alpha-lactalbumin and beta-lactoglobulin by ammonium sulphate precipitation; Estimation of different nitrogen fractions of milk by Kjeldahl method. Milk protein estimation by Folin method, estimation of indigenous milk enzymes like protease, lipase, alkaline phosphatase and lactoperoxidase; estimation of hexoses and sialic acid in casein Measurement of degree of hydrolysis of milk proteins, Measurement of denaturation of whey proteins.

Suggested Readings

Wong, N.P.; Jenness, R.; Keeney, M. and Elmer H.M. 1988 Fundamental of Dairy Chemistry, 3rd Ed. Van Nostrand; Reinhold Company, New York.

Walstra, P. and Jenness, R.1984 Dairy Chemistry and Physics, John Wiley & Sons, New York

Fox, P. F. and. Mc Sweeney, P.L.H. 1998. Dairy Chemistry and Biochemistry, Blackie Academic Professional, Chapman and Hall, London

Fox, P.F. 1992. Advanced Dairy Chemistry. Elsevier Applied Science, London.

Mathur, M.P., Datta, Roy, D. and Dinakar, P. 1999. Text Book of Dairy Chemistry, ICAR, New Delhi.

Fox, P. F. 1982. Development in Dairy Chemistry, Vol.1-proteins, Applied Science Publishers, U. K.

DC-705

Chemistry of milk and milk product processing

3(2-0-1)

Objectives

To project the physico-chemical changes and effects of various milk constituents of the milk products during manufacture and storage.

Theory

Heat induced changes in milk leading to coagulation; Heat stability of concentrated milk as affected by different process variables; milk constituents and additives; Age gelation

Physico-chemical changes taking place during manufacturing and storage of concentrated milk; physico-chemical properties of dried milk as affected by different process treatments; storage stability of milk powder; physical properties of instant milk powder

Role of biological active components in human milk, Standards and Compositional properties of infant milk and infant food formulations.

Mechanism of action of stabilizers and emulsifiers in ice cream

Milk clotting enzymes from different sources; Changes taking place during manufacturing and ripening of cheese; chemical defects in cheese. Lactic acid fermentation in cheese and other fermented dairy products.

Size distribution of fat globules and factors affecting it; creaming phenomena; mechanism of churning; grading and standards of butter and physico-chemical characteristics.

Physico chemical constants of ghee, ghee flavour, texture (grains) in ghee,

Practicals

Determination of lactose and sucrose in condensed milk and ice-cream; determination of heat stability of milk and its concentrate; determination of moisture in skim milk powder/infant food by vacuum oven; determination of fat in cream by Gerber and Rose-Gottlieb methods; determination of moisture, fat (Gerber method), curd and salt in butter; determination of diacetyl and acetyl methyl carbinol in butter/cultured products; determination of RM, Polenske value, iodine value, saponification value of ghee; determination of nitrite, nitrate, free amino acids and free fatty acids in cheese; determination of rennet clotting time of milk.

Suggested Readings

1. Wong N.P., Jeness, R., Keeney, M. and Elmer, H.M. 1988. Fundamentals of Dairy Chemistry, Van Nostrand Reinhold Co., New York, U.S.A.
2. Walstra, P. and Jenness, R. 1984. Dairy Chemistry and Physics, John Wiley & Sons, New York.
3. Fox, P.F. 1985. Developments in Dairy Chemistry-3. Applied Science Publisher, U.K.
4. Law, B.A. 1997. Microbiology and Biochemistry of Cheese and fermented milks. Blackie Academic and Professional, Chapman and Hall, 2nd edn.
5. Gurr, M.I. 1981. Comparative aspects of Feeding Human and Artificial milk for infant feeding. J. Dairy Res., 48, 519.
6. Textbook of Dairy Chemistry by M.P.Mathur, D.D.Roy and P.Dinakar.
7. ISI Handbook of Food Analysis S.P. 18 (Part II) Dairy Products. 1981 ISI Specifications (concerned) (ISI)
8. Prevention of Food Adulteration Act (PFA) 1954 and PFA Rules. 1955
9. Official methods of A.O.A.C. (11th and 15th editions)

DC-706 Chemistry of functional Dairy foods and nutraceuticals 3(3-0-0)

Objectives

To impart knowledge about various functional foods, functional dairy ingredients and their interaction with other food constituents

Theory

Definition of functional foods, dietary supplements, types of functional foods, dairy nutraceuticals and functional foods, functional dairy ingredients, regulatory aspects of functional foods.

Bio-functional milk proteins and their therapeutic potential, recent advances in their bio-separation, Generation of bioactive peptides from casein and whey proteins, their isolation and characterization, colostrums as source of nutraceuticals.

Technological and nutritional aspects of milk lipids, conjugated linoleic acids (CLA) in milk, their variation, physiological effects and their importance in dairy foods. Omega fatty acid and their health attributes, strategies to reduce the cholesterol in dairy products.

Mineral fortification in milk and milk products, vitamins fortification as dietary supplements in dairy products. Artificial sweeteners: classification, properties, analysis and applications in dairy products.

Milk oligosaccharides, structural and technological aspects, health promoting aspects of milk oligosaccharides.

Chemistry involved in high pressure processing of milk.

Suggested Reading:

1. IDF Special issue 9701, 1997
2. Dairy Chemistry and Biochemistry (1998) by P.F.Fox and P.L.H McSweeney.
3. Handbook of functional dairy products (2004).Ed by Colette Shortt and John O' Brien. CRC press.
4. Bulletin of the IDF 238, 1989.
5. IDF Special issue, Heat induced changes in milk – second edition.
6. Bioactive components of milk (Ed.Z.Bosze) in —Advances in experimental medicine and biology Vol.606, Springer, 2008
7. Alternative Sweeteners, 3rd ed. (Ed. by Lyn O'Brien Nabors), Marcel Dekker, Inc., New York, N.Y.
8. Intense Sweeteners. Handbook of food analysis, 2nd ed. (Ed. by Leo ML Nollet)

DC-707

Chemical Quality Assurance in Dairy Industry

3(2-0-1)

Objectives: To project the importance of chemical quality assurance and quality control in relation to dairy industry and impart basic knowledge on all aspects of chemical quality assurance.

Theory

Concept of quality assurance and quality control in relation to dairy industry; quality management systems - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP); role of international organisations such as ISO; IDF; CAC; AOAC; WTO and national organisations like BIS; CCFS; Good laboratory practices (GLP), laboratory Accreditation

PFA and Agmark; significance of milk and milk products order (MMPO) and APEDA (Agricultural and Processed Foods Export Development Authority) in dairy industry; guidelines for setting up quality control laboratory; sampling of milk and milk products; dairy detergents and sanitizers; calibration of milk testing glassware; preparation of standard reagents;

Instrumentation in analysis of milk and milk products; detection of adulterants in milk and milk products; Quality of packaging material for dairy products, Chemical contaminants /residues: pesticides; antibiotics; heavy metals; radionuclides etc. in dairy products.

Practical:

Preparation of standard solutions and buffers; testing of available chlorine content in hypochlorites/bleaching powder; determination of purity of common salt for butter and cheese making; detection of common adulterants in milk and foreign fat/oil in ghee; checking the calibration of lactometers; hydrometers; butyrometers; milk pipette and thermometer; qualitative colour tests to distinguish between azo dyes and natural dyes in butter; detection of pesticide residues and antibiotics in milk.

Suggested Readings

IDF - Special Issue No. 9302. Quality Assurance (QA) and Good Lab. Practices (GLP) in Dairy Laboratories.

IDF - Special Issue No. 9701 1997 Monograph on Residues and Contaminants in milk and milk products

Prevention of Food Adulteration Act (PFA) 1954 and PFA Rules 1955.10th Edition Aug. 2006 – revised from time to time.

Official methods of A.O.A.C. (11th and 15th editions- revised from time to time)

ISI Handbook of Food Analysis S.P. 18 (Part II) Dairy Products. 1981 ISI Specifications (concerned) (ISI)

Ralph Early, Guide to Quality Management System for Food Industry; Heinz Bullworth, Establishment and Implementation of HACCP Personal Hygiene Practices

DC-708 Analytical Techniques in Dairy Chemistry 3(2-0-1)

Objectives:

To impart the advanced knowledge on the use of analytical techniques in Dairy Chemistry

Theory

Electrophoresis: principle and types, isoelectric focussing.

Column Chromatography, TLC, GLC, HPLC, gel-permeation, ion-exchange, affinity chromatography

Spectrophotometry: UV, visible, IR and flame photometry; potentiometry: principle, various electrodes; buffers.

Immunobased analytical techniques such as ELISA & Lateral flow assay

Separation of bio-molecules using membranes; ultracentrifugation.

Practical

Paper chromatography, TLC separation of amino acids(; gel-filtration of biomolecules; Preparation of methyl esters of fatty acids of milk fat for GLC ;preparation of a buffer and measurement of its pH electro-metrically and using indicators; SDS gel electrophoresis and molecular weight determination; Separation and detection of different caseins using urea-PAGE; Plot UV-visible absorption spectra of a standard analyte; Demonstration of Beer's law using standard protein; Determination of sodium and potassium by flame photometry; Separation of milk proteins using ion-exchange chromatography and affinity chromatography. Detection of analytes using ELISA and lateral flow assay. Demonstration of working of HPLC, AAS and GLC.

Suggested Readings

Cooper, T.G. 1977. The Tools of Biochemistry, John Wiley & Sons, U.S.A.

Clark, J.M. and Switzer, R.L. 1977. Experimental Biochemistry; W.H.Freeman & Co, U.S.A.

Frank, A. Settle 1997. Handbook of Instrumental Techniques for Analytical Chemistry. Prentice

Nielsen, S. Suzanne 1994. Introduction to the Chemical Analysis of Foods, Jones and Barlett Publishers, Boston, London.

Wilson, Wilson,K and Walker,J--- Practical Biochemistry, principals and techniques,Cambridge Univ. Press.K

DC-709 Advances in Food Chemistry 3(2-0-1)

Objectives:

To impart the advanced knowledge in Food Chemistry

Theory

Nature Scope and development of food chemistry. Water:- Moisture in foods; Role and type of water in foods, Functional properties of water, water activity and sorption isotherm. Food lipids- classification, fat constants, fatty acids in natural foods, crystallization and consistency, Chemical aspects of lipids in autoxidation, thermal decomposition, Chemistry involved in deep fat frying Technology of fat and oil processing; a) Refining, b) Hydrogenations c) Inter esterification

Food protein: Classification, physicochemical properties. Changes involved in processing. Reactions with alkali. Enzyme catalyzed reactions involving hydrolysis and proteolysis. Theories of formation of texturised proteins.

Carbohydrates:- Carbohydrate classification, Functional characteristics of different carbohydrates, Changes of carbohydrates on cooking, Modification of carbohydrates, Dietary fibres and carbohydrates digestibility, polysaccharide. Viz., linear, branched and modified. Properties and utilization of common polysaccharides, viz. Cellulose, glycogen, hemicellulose and pectin. Enzymatic degradation of polysaccharides, viz. agar, alginate, carrageenan, gums and starch. Production of dextrans and malto dextran.

Individual constituents, like proteins, lipids carbohydrates and vitamins in cereals flour and their relationship in dough making. Types of flours, bread making and non-bread making chemical composition influence of additives/minor ingredients on baking properties. physico-chemical changes taking place during malting.

Food Enzymes:- Classification, utilization in food industry, effect of inhibitors, pH and temperature.

Minerals in food :- Main elements, trace elements in food products.

Aroma compounds in foods:- Threshold value, off flavours.

Food additives:- Vitamins, amino acids, minerals, Aroma substance flavour enhancers-sodium glutamate, 5-nucleotides. Sugar substitutes, sorbitol. Sweeteners-saccharin, cyclamate.

Food colour. Anti-nutritional factors and food contaminant: Toxic-trace elements, radio nuclides. Preservation of foods: General principles of food preservation, chemical preservation, preservation through irradiation.

Changes taking place during fermentation; drying and roasting of chocolate and cocoa; chemistry of tea manufacture; composition of coffee beans; physicochemical changes during roasting of coffee bean

Practical

Determination of water activity in foods, Determination of level of artificial sweeteners, Determination of crude fiber in food products; Determination of Antioxidant in fruits, vegetables; Determination of polyphenols in lemon juice; Determination of fat in grains; Determination of proteins in flour; Determination of tannins in coffee/tea, caffeine content in coffee, Determination of Vitamin C; Determination of Iron , calcium in foods; Determination of Ash content in flour; Determination of total soluble solids in fruit juice; determination of reducing and non reducing sugars in food

Suggested Readings

Fennema, O.R. 1985. Food Chemistry, Marcer Dekker Inc., New York

Belitz, H.D. and Grosch, W. 1987. Food Chemistry

Srinivas, D. and Alan Praf, 1997. Food Proteins and their Applications. Marcel Dekker Inc., New York.

Turker, G.A. and Woods, LFJ, 1995. Enzymes in Food Processing. Blackie Academic Professionals.

Williams, P.A. and Phillips, G.O. 2000. Gums and Stabilizers for the Food Industry. Royal Society of Chemistry

DC-710

Food and Nutritional Biochemistry

3(2-0-1)

Objectives: To impart knowledge regarding the biochemical aspects of various nutrients and their interactions in foods during processing, storage and deterioration

Theory

Classification, structure and function of carbohydrates, lipids, amino acids, proteins, nucleic acids. Classification, structure, functions and mechanism of action of vitamins and hormones and enzymes. Vitamins as hormones. Metabolism of carbohydrates, lipids, proteins and nucleic acids.

Fundamentals of human nutrition, concept of balanced diet, biochemical composition, energy and food value of foods with special reference to milk and dairy products. Physico-chemical, functional and nutritional characteristics of carbohydrates, proteins and fats and their interactions (emulsions, gelation, browning etc.). Nutritional quality and evaluation of nutritive value of proteins. Nutritional requirements for different age groups and physiological status, factors effecting nutritional requirements, Biochemical and nutritional aspects of vitamins, minerals. Nutraceuticals, antioxidants, food toxins, antinutritional factors, probiotics and cultured dairy products.

Carbohydrates with special references to nutritional importance of lactose and dietary fibers, Fats-types of fatty acids and their significance in obesity and cardiovascular diseases, role of calcium in hypertension, cancer and osteoporosis, Biological availability of calcium. Effect of cooking, processing and preservation of different food products on nutrients, Biochemical aspect of post harvest storage specifically food spoilage.

Practical

Preparation of standard solutions.; Preparation of buffer solutions; Extraction and estimation of Glucose by Nelson Somoygi Method. Estimation of Fructose using resorcinol. Estimation of Proteins by Lowry's method. Estimation of Ascorbic acid using dye. Determination of dietary fibres in food. Determination of antinutritional factors in food. Determination of enzymes in food. Determination of enzymatic activity in presence of different inhibitors.

Suggested Readings

Hulme AC. (Ed.). 1970. Biochemistry of Fruits and Vegetables and their Products. Vols. I, II. Academic Press.

Ranganna S. (Ed.). 1986. Handbook of Analysis and Quality for Fruits and Vegetable Products. Tata McGraw Hill.

Robinson DS. 1987. Food Biochemistry and Nutritional Value. Longman.

Swaminathan, M.S. Essentials of Foods and Nutrition Vol-I and II