



**Dr. G. Renuka  
Ch. Navya Bhanu  
L. Vijayalaxmi**

# **FOOD SCIENCE AND TECHNOLOGY**

**Kripa Drishti Publications, Pune.**

# **FOOD SCIENCE AND TECHNOLOGY**

**Dr. G. Renuka**

Assistant Professor of Microbiology,  
SR & BGNR Govt. Arts & Science College(A),  
Khammam, Telangana.

**Ch. Navya Bhanu**

Lectures, Dept of Microbiology,  
Pingle GDCW(A), Hanumakonda.

**L. Vijayalaxmi**

Lectures, Dept of Microbiology,  
Pingle GDCW(A), Hanumakonda.

Book Title: **Food Science and Technology**

Author By: **Dr. G. Renuka, Ch. Navya Bhanu, L. Vijayalaxmi**

**Price: ₹600**

1<sup>st</sup> Edition

ISBN: **978-93-48091-34-5**



Published: **Feb 2025**

**Publisher:**



**Kripa-Drishti Publications**

A/ 503, Poorva Height, SNO 148/1A/1/1A,  
Sus Road, Pashan- 411021, Pune, Maharashtra, India.

Mob: +91-8007068686

Email: [editor@kdpublications.in](mailto:editor@kdpublications.in)

Web: <https://www.kdpublications.in>

© Copyright Dr. G. Renuka, Ch. Navya Bhanu, L. Vijayalaxmi

All Rights Reserved. No part of this publication can be stored in any retrieval system or reproduced in any form or by any means without the prior written permission of the publisher. Any person who does any unauthorized act in relation to this publication may be liable to criminal prosecution and civil claims for damages. [The responsibility for the facts stated, conclusions reached, etc., is entirely that of the author. The publisher is not responsible for them, whatsoever.]

## **PREFACE**

Chemistry, biochemistry, nutrition microbiology, and chemical engineering are all part of the multidisciplinary field of food science and technology, which applies scientific knowledge to address issues related to the food system. It emphasises how crucial food science and technology are to people. The entire food technology workflow, including raw material selection, processing, preservation, and distribution, is covered in this book. This monograph, which is divided into five units, begins with a summary of food processing and storage.

The food industry and larger food system depend on the complementary disciplines of food science and food technology. Food technology converts the fundamental knowledge of food science regarding its characteristics and behaviours into useful applications for food production, distribution, storage, and packaging. They work together to guarantee that our food is scrumptious, secure, nourishing, consistent, and sustainable.

Food science has advanced from the fundamental physical, chemical, and biological reactions that occur during processing to the domains of food engineering, biotechnology, packaging, and consumer impact. Modern processing techniques seek to preserve the fresh foods' maximum organoleptic qualities and properties while simultaneously extending their shelf life. Meeting market demands requires a basic understanding of food, including its composition, necessity, effects of processing, etc.

## **Abbreviations**

Adenosine Triphosphate (ATP)  
Alpha-Linolenic Acid (ALA)  
Appearance Quality (AQ)  
Arabinogalactans-I (AG-I)  
Butylated Hydrogen Anisole (BHA)  
Carbon Dioxide (CO<sub>2</sub>)  
Coenzyme A (CoA)  
Crush, Tear, Curl (CTC)  
degree of polymerization (DP)  
Docosahexaenoic Acid (DHA)  
Eating and Cooking Quality (ECQ)  
Eicosapentaenoic Acid (EPA)  
Emulsifying Activity Index (EAI)  
Emulsifying Stability Index (ESI)  
Epigallocatechin (EPGC)  
Epigallocatechin Gallate (EGCG)  
Foam Capacity (FC)  
Foam Stability (FS)  
Food and Agriculture Organization (FAO)  
Form Expansion (FE)  
Free Fatty Acids (FFA)  
Genetically Modified Organisms (GMOs)  
Glycaemic Index (GI)  
High Performance Liquid Chromatography (HPLC)  
High Temperature Short Time (HTST)  
Homogalacturonan (HG)  
Hydrocyanohydric Acid (HCN)  
Least Gelling Concentration (LGC)  
Linoleic Acid (LA)

Low-and Middle-Income Countries (LMIC)  
Microfibril (MF)  
Milling Quality (MQ)  
Monosodium Glutamate (MSG)  
Nutritional Quality (NQ)  
Oil Absorption Capacity (OAC)  
Pasteurized Milk Ordinance (PMO)  
Polyphenol Oxidase (PPO)  
Premenstrual Syndrome (PMS)  
Recommended Daily Intake (RDI)  
Reference Dietary Intake (RDI)  
Required Daily Amount (RDA)  
Rhamnogalacturonan-I (RG I)  
Tertiary Butly Hydro Quivous (TBHQ)  
Textured Vegetable Protein (TVP)  
Tricarboxylic Acid Cycle (TCA)  
United States Department of Agriculture (USDA)

# INDEX

## **Unit 1: Basics of Food Science, Cereals and Millets..... 1**

1.1 Introduction: .....	1
1.2 Definition of Food Science and Food Technology, Brief Objectives of Cooking and Cooking Methods:.....	1
1.2.1 Definition of Food Science:.....	1
1.2.2 Food Technology: .....	2
1.2.3 Cereals & Millets: .....	2
1.2.4 Objective of Cooking: .....	5
1.2.5 Methods of Cooking:.....	8
1.3 Cereals: Rice & Wheat-Structure, Nutritive Value, Composition, Role in Cookery: .....	15
1.3.1 Rice and Wheat Structure:.....	15
1.3.2 Nutritive Value: .....	21
1.3.3 Composition:.....	22
1.3.4 Role in Cookery: .....	23
1.4 Millets: Types, Jowar & Maize- Structure, Nutritive Value, Composition, Role of Cookery: .....	28
1.4.1 Types of Millets: .....	29
1.4.2 Structure of Jowar: .....	33
1.4.3 Nutritive Value of Millets: .....	34
1.4.4 Composition of Millets:.....	35
1.4.5 Millet's Role in Cookery:.....	36
1.5 Milling of Wheat and Corn: .....	38
1.5.1 Introduction of Milling of Wheat:.....	38
1.5.2 Milling of Corn: .....	40
1.6 Role of Gluten Dough Formation, Factors Affecting Gluten Formation: .....	42
1.6.1 Gluten Formation: .....	42
1.6.2 Factors of Affection Glute Formation:.....	44

## **Unit 2: Pulses & Legumes, Milk & Milk Products..... 46**

2.1 Introduction: .....	46
2.1.1 Overview Pulses & Legumes:.....	47
2.2 Pulses & Legumes: Nutritive Value, Germination, Anti-Nutritional Factors, Elimination, Role of Pulses in Cookery: .....	47
2.2.1 Pulses & Legumes:.....	47
2.2.2 Nutritive Value: .....	51
2.2.3 Germination: .....	53
2.2.4 Anti-Nutritional Factors: .....	55
2.2.5 Elimination: .....	59

2.2.6 Role of Pulses in Cookery:.....	60
2.3 Processing: Milling of Pulses, Legume Protein Concentrate, Quick Cooling Legumes: .....	62
2.3.1 Milling of Pulses:.....	63
2.3.2 Legume Protein Concentrate: .....	67
2.3.3 Quick Cooling Legumes:.....	72
2.4 Milk & Milk Products: Types, Nutritive Value, Composition, Processing of Milk, Role in Cookery:.....	74
2.4.1 Types of Dairy Product: .....	75
2.4.2 Nutritional Value of Dairy: .....	78
2.4.3 Composition: .....	80
2.4.4 Processing of Milk: .....	83
2.4.5 Role in cookery:.....	85
2.5 Different Types of Fermented and Non- Fermented Milk Products: .....	86
2.5.1 Fermented Milk Products: .....	86
2.5.2 Non-Fermented Products:.....	92
2.6 Processing of Cheese, Curd, Paneer & Khoa:.....	96

### **Unit 3: Fleshy Foods, Spices, Condiments & Beverages .....100**

3.1 Introduction:.....	100
3.2 Fleshy Foods: .....	101
3.2.1 Meat: Source & Types, Nutrient Composition, Post Mortem Changes & Processing of Meat Ageing, Tenderization and Curing:.....	101
3.2.2 Fish & Poultry: Classification & Types, Selection:.....	123
3.3 Eggs: Structure, Composition, Nutritive Value, Role in Cookery:.....	130
3.3.1 Structure of Eggs: .....	130
3.3.2 Egg Composition and Nutrition:.....	131
3.3.3 Nutritional of Eggs:.....	132
3.3.4 The Role of Egg in Cookery:.....	133
3.4 Spices & Condiments: Various Spices and Condiments Used In Indian Cookery (Cinnamon, Clove, Fenugreek Seeds, Ginger, Garlic, Onion, Turmeric, Fennel Seeds), Active Compounds And Medical Values:.....	134
3.4.1 Various Spices and Condiments Used in Indian Cookery: .....	134
3.4.2 Active Compounds and Medical Values:.....	138
3.5 Beverages: Definition, Classification, Processing-Black Tea, Green Tea and Wine: .....	140
3.5.1 Definition of Beverage:.....	141
3.5.2 Classification of Beverages: .....	141
3.5.3 Processing-Black Tea:.....	142
3.5.4 Green Tea and Wine: .....	146
3.6 Essences and Flavoring Agents, Flavor Enhancers:.....	149
3.6.1 Flavoring Agents:.....	149
3.6.2 Flavor Enhancers: .....	151



**Unit 4: Vegetables & Fruits, Sugar & Jaggery, Facts & Oils ..... 153**

4.1 Introduction: ..... 153

4.2 Vegetables: Classification, Composition-Pigments, Organic Acids, Enzymes, Flavor Compounds & Nutritive Value: ..... 153

    4.2.1 Vegetables: ..... 153

    4.2.2 Classification: ..... 154

    4.2.3 Composition-Pigments: ..... 157

    4.2.4 Organic Acids: ..... 160

    4.2.5 Enzymes: ..... 162

    4.2.6 Flavor Compounds & Nutritive Value: ..... 164

4.3 Fruits: Definition, Classification-Pigments, Water Content, Cellulose & Pectic Substances, Flavor Constituents, Polyphenols, Nutritive Value:..... 166

    4.3.1 Definition:..... 166

    4.3.2 Classification-Pigments in Fruits: ..... 167

    4.3.3 Water Content: ..... 168

    4.3.4 Cellulose & Pectic Substances:..... 170

    4.3.5 Flavor Costituents: ..... 175

    4.3.6 Polyphenols: ..... 176

    4.3.7 Nutritive Value in Fruits:..... 177

4.4 Changes During Ripening of Fruits and Vegetables, Enzymatic Browning: . 178

    4.4.1 Fruit Ripening: ..... 179

    4.4.2 Enzymatic Browning: ..... 183

4.5 Sugar & Jaggery: Sources, Types and Role in Cookery: ..... 187

    4.5.1 Sugar & Jaggery:..... 187

    4.5.2 Sources of Sugar & Jaggery: ..... 187

    4.5.3 Types of Sugar and Jaggery:..... 188

    4.5.4 Role in Cookery: ..... 191

4.6 Fats & Oils: Sources, Types, Spoilage- Rancidity, Oil Refining, Role in Cookery: ..... 192

    4.6.1 Fats and Oils: ..... 192

    4.6.2 Sources of Fats and Oils: ..... 193

    4.6.3 Types of Fats & Oils: ..... 197

    4.6.4 Spoilage- Rancidity: ..... 200

    4.6.5 Oil Refining: ..... 201

    4.6.6 Fats & Oils: Role in Cookery: ..... 202

**References ..... 204**

## List of Figures

Figures Name	Page No.
Figure 1.1: Cereals are Large-Seeded Grasses that are Produced mainly for their Edible Grain Seeds	3
Figure 1.2: Millets	4
Figure 1.3: History of Cooking	7
Figure 1.4: Cooking with Fire	7
Figure 1.5: Baking	8
Figure 1.6: Roasting	9
Figure 1.7: Boiling	9
Figure 1.8: Frying	10
Figure 1.9: Streaming	10
Figure 1.10: Smoking	11
Figure 1.11: Grilling	12
Figure 1.12: Stewing	12
Figure 1.13: Poaching	13
Figure 1.14: Sauteing	13
Figure 1.15: Sous-vide	14
Figure 1.16: Pressure Cooking	14
Figure 1.17: Toasting	14
Figure 1.18: Braising	15
Figure 1.19: Solar Cooking	15
Figure 1.20: Structure of Rice	17
Figure 1.21: Wheat Structure	19
Figure 1.22: Flour Types	20
Figure 1.23: All types of rice	24
Figure 1.24: Wheat	26
Figure 1.25: Types of Millets	28
Figure 1.26: Foxtail Millet (Kakum / Kangni)	29
Figure 1.27: Finger Millet (Ragi)	30
Figure 1.28: Pearl Millet (Bajra)	30
Figure 1.29: Browntop Millet (Korle)	31
Figure 1.30: Barnyard Millet (Sanwa)	31
Figure 1.31: Buckwheat Millet (Kuttu)	32
Figure 1.32: Kodo Millet	32
Figure 1.33: Structure of Jowar	33
Figure 1.34: Traditional milling	39

<b>Figures Name</b>	<b>Page No.</b>
Figure 1.35: Modern Milling	40
Figure 1.36: Milling of Corn	41
Figure 1.37: Dry Milling	42
Figure 1.38: Gluten Formation	43
Figure 2.1: Pulses & Legumes	48
Figure 2.2: Germination	53
Figure 2.3: Antinutritional Factors	56
Figure 2.4: Process flow diagram for production of protein concentrate.	67
Figure 2.5: Process flow diagram for production of protein isolate.	68
Figure 2.6: Milk Products	74
Figure 2.7: Milk	75
Figure 2.8: Cream	76
Figure 2.9: Butter	86
Figure 2.10: Cheese	87
Figure 2.11: Shrikhand	88
Figure 2.12: Ghee	89
Figure 2.13: Rabri	89
Figure 2.14: Khoa	90
Figure 2.15: Kalakand	90
Figure 2.16: Kheer	91
Figure 2.17: Paneer	92
Figure 2.18: Evaporated milk	93
Figure 2.19: Sweetened condensed milk	93
Figure 2.20: Manufacture of milk powder	94
Figure 2.21: Flavored milk	95
Figure 2.22: Curd	97
Figure 2.23: Dahi Processing Flow Chart (Traditional Method)	97
Figure 2.24: Paneer Processing Flow Chart	99
Figure 3.1: Meat	101
Figure 3.2: Red Meat	102
Figure 3.3: White Meat	103
Figure 3.4: Pork	104
Figure 3.5: Beef	105
Figure 3.6: Lamb	105
Figure 3.7: Goat Meat	106
Figure 3.8: Chicken	107

	<b>Figures Name</b>	<b>Page No.</b>
Figure 3.9:	Turkey	108
Figure 3.10:	Duck	109
Figure 3.11:	Rabbit	110
Figure 3.12:	Seafood	110
Figure 3.13:	Veal	111
Figure 3.14:	Pheasant	112
Figure 3.15:	Wild Boar	113
Figure 3.16:	Bison	113
Figure 3.17:	Fish and Shellfish Classification	127
Figure 3.18:	Structure of Egg	130
Figure 3.19:	Composition of Eggs	131
Figure 3.20:	Turmeric	134
Figure 3.21:	Cumin	135
Figure 3.22:	Dhaniya	135
Figure 3.23:	Green Cardamom	136
Figure 3.24:	Black Pepper	136
Figure 3.25:	Cinnamon	136
Figure 3.26:	Mustard Seeds	137
Figure 3.27:	Ginger Paste	137
Figure 3.28:	Garlic	137
Figure 3.29:	Fenugreek Seeds	138
Figure 3.30:	Nonalcoholic beverage	141
Figure 3.31:	Black tea production Process	143
Figure 3.32:	Withering	143
Figure 3.33:	Rolling Procedure	144
Figure 3.34:	Orthodox rolling method	144
Figure 3.35:	CTC (Crush, Tear, Curl) rolling method	145
Figure 3.36:	Oxidation	145
Figure 3.37:	Drying	146
Figure 3.38:	Flavor Enhancers	151
Figure 4.1:	Classification of pigments in vegetables and fruits	158
Figure 4.2:	Schematic and 3D representations of the structure of one chain of cellulose	170
Figure 4.3:	3D structure of a native cellulose crystal that has been "idealized" and is composed of 36 chains.	171
Figure 4.4:	General scheme of the main constituents found in pectins.	172

Figures Name	Page No.
Figure 4.5: Three-dimensional depictions of the interactions that take place between Ca <sup>2+</sup> and one homogalacturonan chain with a two-fold conformation, as well as two homogalacturonan chains that induce the so-called.	172
Figure 4.6: Schematic and 3D representation of the structure of Rhamnogalacturonan	173
Figure 4.7: Rhamnogalacturonans-II (RG II)	174
Figure 4.8: Primary structures of main plant cell wall polysaccharides	175
Figure 4.9: Ethylene is produced from an essential amino acid - methionine	181
Figure 4.10: The colour of apples is due to polyphenols	185
Figure 4.11: Sugarcane Jaggery	189
Figure 4.12: Palm Jaggery	190
Figure 4.13: Coconut Jaggery	190
Figure 4.14: Fats and Oils	192
Figure 4.15: Unsaturated fats	197
Figure 4.16: Process of the oils & fats refining	202

## List of Tables

Table Name	Page No.
Table 1.1: Difference between Cereals and Millets	4
Table 1.2: The lowest carb is found in foxtail millet	35
Table 2.1: In a biological sense, the nutritional content of food might alter according to seasonal variations, age, sexual orientation, interspecies or taxonomic distinctions, and various health issues (resulting in dietary advice and specific diet foods).	51
Table 2.2: Nutrient composition of dairy products (per 100 g)	81
Table 4.1: Fat-soluble and water-soluble.	158
Table 4.2: Flavour components of sulphur containing vegetables	165
Table 4.3: Water Amounts in fruits and Vegetables	169
Table 4.4: The nutritive value of fruits (Range of values per 100 gm)	177
Table 4.5: This will go over the variations between jaggery and sugar.	187

## ABOUT THE AUTHORS



**Dr. G. Renuka**, Assistant Professor of Microbiology SR & BGNR Govt. Arts & Science College(A) Khammam, Telangana. With a passion for unravelling the intricacies of microbial life, Dr. G. Renuka has dedicated 22 years to teaching and 25 years to research in the field of Microbiology. She teaches for Undergraduates and Post Graduates in areas of Introductory Microbiology, Virology, Microbial Physiology, Molecular Biology, and areas of Applied Microbiology, where the focus is on fostering a deep understanding of Microbiological concepts & laboratory techniques and critical thinking skills. She is passionate researcher, and has made a noteworthy contribution in Research on Areas of focus like Agriculture, Environment, and Medical Microbiology which are published in reputed Journals. Dr. G. Renuka, has leveraged her expertise to author the Text Book "Essentials of Microbiology". This comprehensive resource serves as an invaluable guide for students studying Microbiology at both Undergraduate and Post graduate levels. It integrates the latest research findings with practical applications, making complex concepts accessible to learners. She is a recipient District-level and State level Best Teacher Award by the Government of Telangana State. Dr. G. Renuka is committed to nurturing the next generation of Microbiologists, instilling in them, a passion for Scientific inquiry and a strong foundation in the fascinating world of Microbiology.



**Ch. Navya Bhanu**, Guest Faculty in Microbiology, Pingle Govt. College for Women (A), Hanamkonda. She is a dedicated Microbiology teacher with three years of enriching experience in guiding learners through the fascinating world of Microscopic life. With a passion for unravelling the secrets of bacteria, viruses, and fungi. She teaches for Undergraduates and Post Graduates in the areas of Molecular Biology, Microbial Genetics, Biological chemistry, Agricultural Microbiology, Environment Microbiology, Food & Industrial Microbiology and Medical Microbiology, Immunology. Driven by a belief in lifelong learning and teaching she strives to inspire students to view microbiology as a key to understanding the world around them and also combines expertise in microbiology with a commitment to nurturing inquisitive minds.



**L. Vijayalaxmi**, MS.c Microbiology at Pingle Govt. College for Women (A), Hanamakonda. Advanced diploma in Food Microbiology at ITL Academy (Under: Institute of Transgene Life Sciences). With a passion for a vision beyond invisibility, "When the entire world is chasing huge dreams we focus on small things to change the world." She is a passionate researcher and has made a contribution in Research on Areas of focus like Agriculture and Medical Microbiology, which are published in reputed journals. My thoughts are like microorganisms they just can't stop growing and infecting my mind. Microorganisms will give you anything you want if you know how to ask them. I have never been disappointed upon asking microorganisms for whatever I wanted. L. Vijayalaxmi is committed to nurturing the next generation of Microbiologists, instilling in them a passion for Scientific inquiry and a strong foundation in the fascinating world of Microbiology.



### Kripa-Drishti Publications

A-503 Poorva Heights, Pashan-Sus Road, Near Sai Chowk,  
Pune - 411021, Maharashtra, India.

Mob: +91 8007068686

Email: editor@kdpublishations.in

Web: <https://www.kdpublishations.in>

Price: ₹ 600

ISBN: 978-93-48091-34-5



9 789348 091345