

## **Table of Contents**

An c	verview of Food Preservation	1
1.1 1.2 1.3	Introduction Food Preservation  1.2.1 Importance of Food Preservation  1.2.2 Duration of Preservation  Methods of Food Preservation  1.3.1 Inhibition  1.3.2 Controlling the Water Activity and the Structure.  1.3.3 Inactivation.  1.3.4 Preventing Re-contamination.  Examples of Food Preservation Techniques.  References	1 2 2 3 6 7 8 8 10 10
Post	harvest Physiology of Fruits and Vegetables	13
2.1	Introduction Harvesting: Determinants of Maintaining Quality 2.2.1 Maintaining Quality of Crops before Harvesting	13 14 14
	1.1 1.2 1.3 1.4 1.5 Post	<ul> <li>1.2 Food Preservation <ul> <li>1.2.1 Importance of Food Preservation</li> <li>1.2.2 Duration of Preservation</li> </ul> </li> <li>1.3 Methods of Food Preservation <ul> <li>1.3.1 Inhibition</li> <li>1.3.2 Controlling the Water Activity and the Structure.</li> <li>1.3.3 Inactivation.</li> <li>1.3.4 Preventing Re-contamination.</li> </ul> </li> <li>1.4 Examples of Food Preservation Techniques.</li> <li>1.5 References</li> </ul> <li>Postharvest Physiology of Fruits and Vegetables <ul> <li>2.1 Introduction</li> <li>2.2 Harvesting: Determinants of Maintaining Quality</li> </ul> </li>

	2.3	<ul> <li>2.2.2 Maintaining Quality of Crops During Harvesting</li> <li>2.2.3 Maintaining Quality of Crops after Harvesting</li> <li>Post harvesting: Mechanism of its Physiology</li> <li>2.3.1 Process of Augmentation or Maturity</li> <li>2.3.2 Metabolism and Respiration</li> <li>2.3.3 Activation and Stress of Water Molecules</li> <li>2.3.4 Ripening and Senescence</li> <li>2.3.5 Cytokinin Effects</li> <li>2.3.6 Physiological Disorder and Breakdown</li> <li>Reference</li> </ul>	17 18 20 20 20 21 21 21 22 23
3	Postl	narvest Treatment	24
	3.1 3.2 3.3 3.4 3.5 3.6	Introduction Post Harvest Handling Techniques Transportation Necessity of Pre cooling 3.4.1 Various Methods of Cooling Treatment Given after Post Harvesting Reference	24 25 27 27 28 29 31
4	Postl	narvest Handling of Grains	32
	4.1 4.2 4.3 4.4 4.5 4.6 4.7	Storage and Handling 4.4.1 Grain Storage 4.4.2 Grain Handling Milling of the Grains Summary References	32 33 33 37 38 38 40 41 41 42 42 42 42
5		ew on the Minimal Processing of the Fruits and tables	43
	5.1 5.2		43 44 44 45 45 46 46

of Contents			ix
	of Contents	of Contents	of Contents

		5.2.6 Ascorbic Acid Oxidation Ways to Extend the Shelf Life 5.3.1 Sanitation 5.3.2 1-Methyl Chloropropene Edible Coating Results of Minimal Processing	46 47 47 48 49 50
		References	50
6	6.1 6.2 6.3	Introduction The importance of Fish production, its Utilization and Trade 6.2.1 Global Fish Marketing and Distribution 6.2.2 Utilization of Fish 6.2.3 How Humans Get Benefited by Consumption of Fish 6.2.4 Commercialization of Seafood and Fish Different Kinds of Spoilage in Fish and Seafood 6.3.1 Spoilage due to the Biochemical Changes of Fresh Fish and Sea Food 6.3.2 Characteristics of Fish Spoilage 6.3.3 Damage done due to Improper Mechanical Handling 6.3.4 Some of Biotic, Abiotic Factors for Fish Spoilage 6.3.5 Environmental Factors Physiochemical Changes of Spoilage in Fish and Seafood	51 52 52 53 54 54 55 55 56 56 57 57
7	6.5 6.6	Future Prospects for Fresh Fish and Seafood Preservation References	58 59 60
7	7.1 7.2 7.3 7.4 7.5 7.6 7.7 7.8	Introduction Anatomy of the Framework of Muscle Infection of Carcass of Red Meat Disinfection of Carcass of Red Meat Muscular Contraction Post harvesting Storage System of Red Meat Conclusion Reference	60 61 62 63 65 66 67 68
8	8.1 8.2 8.3 8.4 8.5	Introduction Structure and Composition of Milk Milk'S Quality Criteria Raw Milk's Microflora How to Control Micro-Organisms in Raw Milk? 8.5.1 Sanitizing and Cleaning Process 8.5.2 Process to Cool Down Milk	69 70 71 71 73 74 74

	8.6 8.7	8.5.3 Thermization (Thermalization) 8.5.4 Anti-microbial Constituents Clarification Reference	75 75 76 76
9	Food	Preservation Through Fermentation	77
	9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8	Introduction: Origin of Fermentation Utilization of Fermentation Fermentation as a Preservation Technique 9.4.1 Infection of Food Due to the Various Microorganisms 9.4.2 The Advantages of Fermented Foods: Microorganisms Used in the Fermentation Procedure 9.5.1 Lactic Acid Bacteria: 9.5.2 Acetic Acid Bacteria 9.5.3 Yeasts Classification of Fermented Products Microbial Food Preservatives Reference	77 78 79 80 82 83 83 84 84 84
10	Natu	ral Antimicrobials for Food Preservation	86
	10.3 10.4 10.5 10.6 10.7	Introduction Basic principle for the Utilization of Natural Compounds as Antimicrobial. Natural Antimicrobials (plant Origin) 10.3.1 Phytoalexins 10.3.2 Organic Acids 10.3.3 Phenolic compounds Natural Antimicrobials (Microbial Origin) 10.4.1 LAB a Protective Cultures 10.4.2 Bacteriocins Produced by LAB 10.4.3 Natural Formation of Bacteriocins Producers various aspects of legislation Future prospective Reference	86 87 88 89 90 91 92 93 93 94 95
11	Food	Preservation and Anti-Oxidants.	96
	11.1 11.2 11.3	Rancidity and Rancidification of Food Products. Classification of Rancidity. Anti-oxidant and its Importance. 11.3.1 Dietary anti-oxidants and their Disease Fighting	96 97 98
		Properties.  11.3.2 Synthetic and Natural Antioxidants Used as Food Preservatives.	98 99

Table of Contents	XI

	11.4 11.5 11.6	Antioxidants and Food Preservation.  11.4.1 Preservation of Oils and Fats.  11.4.2 Anti-oxidants and Fat Emulsions.  Anti-oxidants and Food Packaging.  References	103 103 104 105 105
12	pH L	evels of Food and Food Preservation.	106
	12.1 12.2 12.3 12.4 12.5 12.6 12.7		106 108 108 110 110 111 111 111 112 113
13	Nitri	tes in Food Preservation	114
	13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10	Introduction Antimicrobial Characteristics of Nitrites Growth Stage Factors Affecting the Efficacy of Nitrites 13.4.1 pH Effect on Nitrites 13.4.2 Effect of Oxygen 13.4.3 Effects of Other Food Components 13.4.4 Effect of Heating Inhibition of the Phosphoroclastic System Inhibition of Enzyme Systems Nitrites interacting with Food Components Improving Functional and Sensory Properties Health Aspects References	114 115 116 117 118 119 119 119 120 120 121 122
14	Mod	lified – Atmosphere Packaging of Produce	123
	14.1 14.2	Introduction  Modified – Atmosphere Packaging (MAP)  14.2.1 Advantages of Modified - Atmosphere Packaging Technology  14.2.2 Disadvantage of Modified – Atmospheric Packaging	123 124 125
		Technology.	125
	14.3	14.2.3 Different types of Gases Used in MAP Active Packaging	126 126

	14.4 14.5 14.6 14.7	Packaging Materials Used for Modified - Atmospheric Packaging 14.4.1 Nature of the Products 14.4.2 Disposition of Metabolic Products 14.4.3 Permeability of the Packaging Products The working of Modified – Atmosphere Packaging Conclusion Reference	127 128 128 129 130 131
15	Glass	Transition and State Diagram of Floods	132
	15.1 15.2	Introduction 15.1.1 Background 15.1.2 Glass Transition and Glassy state State Diagrams and its Components 15.2.1 Equilibrium and Non-equilibrium State	132 133 133 133 135
	45.5	15.2.2 Metastable Equilibrium	135
	15.3 15.4	Different States of Water in Foods Theoretical Progression	135 136
	15.5	Conclusion	136
	15.6	Reference	137
16		nbranes in Food Preservation and Processing	138
	16.1 16.2 16.3 16.4	Introduction Principles that Govern Membrane Separation Modules of Membranes Membrane Separation System's performance	138 139 140 141
	16.5	Food Preservation and Processing Using Membranes in Food Industry	142
		16.5.1 Application in case of Fruit Juices	142
		16.5.2 Selection of Membrane 16.5.3 Concentration	143 143
		16.5.4 Application in Dairy Industry and Quality of	לדי
	16.6	Ultra-filtered Milk References:	143
	16.6		144
17		iness and Caking in Food Preservation	145
	17.1 17.2	Introduction Structure of Food Solids	145 146
	17.2	17.2.1 Crystalline Structure	146
		17.2.2 Amorphous Structure	146
	17.3	17.2.3 Mixed Structure Adhesiveness of Food Solids	146 147
	.,•,	17.3.1 Industries Producing Cereals	147
		17.3.2 Industries Dealing with Confectionaries	148
		17.3.3 Industries Dealing with Dairy Products 17.3.4 Industries Dealing with Powder Products	148 148

T     ( C	***
Table of Contents	XIII

	17.4 17.5 17.6 17.7	Adhesiveness in Packaging Equipments Caking of Powders 17.5.1 Mechanisms Involved in Caking 17.5.2 Factors which are Responsible for Caking Anti-caking Agents Reference	149 149 149 150 152 153
18	Dryir	ng and Food Preservation	154
	18.3 18.4 18.5 18.6	Introduction Different Methods of Food Preservation Drying as a process of Food Preservation Dehydration as a Source of Drying Methods of Drying for Food Preservation Osmotic Dehydration References:	154 155 156 157 158 161
19	Osm	otic Dehydration of Foods	162
	19.1 19.2 19.3 19.4 19.5 19.6 19.7 19.8 19.9 19.10 19.11	Introduction Working Mechanism Treatment by Salt Curing Osmosis Effects on cells, Tissues and Biological Membranes Application and Advantages of Osmotic Dehydration in Industrial Sector:- Enrichment of Nutrients and Increased Product Shelf Life Cost Cutting in Packaging and Distribution Segments: Curbing the use of Harmful Chemicals Enhancing the Overall Quality of the Product in terms of Colour, Flavour and Texture Energy Efficient The Factors that are Known to exert a Good Amount of effect on the Osmotic Dehydration Process Problems Encountered While Applying Osmotic Dehydration Process in Food Industry References	162 163 165 165 166 166 167 167 167 168
20	20.1 20.2 20.3 20.4 20.5 20.6 20.7	Introduction 20.2 Measurement of Water Activity (a <sub>w</sub> ) Prophecy of Food Spoilage Partially Moisturized Food Tools for Calculation of Water Activity (a <sub>w</sub> ) Recent Advantages of Water Activity and its Quality Alternatives References:	171 171 173 174 175 175 177 179

21		mportance of Edible Coating in Food Preservation Surface Treatment	180
	21.1 21.2 21.3 21.4 21.5 21.6 21.7 21.8 21.9 21.10	Introduction Permeability Properties of the Coating Materials used in the Formulation of an Edible Coating 21.3.1 Lipids 21.3.2 Resins 21.3.3 Carbohydrates Additives in the Coating Formulations 21.4.1 Plasticizers 21.4.2 Emulsifiers and Surfactants 21.4.3 Fungicides 21.4.4 Preservatives 21.4.5 Antioxidants The Process of Fumigation and Treatment Through Gas Quarantine Methods for Fruits Technique of Coating and Preparation of Surface How it is used in Fruits Consumer Behavior References	180 181 181 182 182 183 183 183 184 184 184 185 185 186 186
22	Enca	psulation	188
	22.5	Introduction Basic Principle of Encapsulation Advantages and Different Types of Microcapsules Encapsulation Matrix Techniques of Microencapsulation References	188 189 190 192 192 195
23	The I  23.1  23.2  23.3  23.4  23.5  23.6  23.7	The testing of Pasteurization Instruments of Pasteurization 23.4.1 Post Packaging Pasteurization 23.4.2 Pasteurization of the Unpacked Liquids Ways of Achieving the Desired Pasteurization	196 197 197 198 198 199 201 201 202 202 202 203 203 203 203

Table of Contents xv

24	Steril	lization of Food and Procedures of Canning	204
	24.2 24.3	Introduction Methods used for Sterilization Distribution of Temperature within a Retort System 24.3.1 Retort A (Designed for Water Immersion) 24.3.2 Retort B (Water Spray) The Primary Principles of Canning References:	204 206 207 208 209 209 211
25	Cook	ing	212
	25.5	Introductions Cooking 25.2.1 Ingredients 25.2.2 Health and Safety Methods of Cooking History of Cooking Modern Cooking References	212 213 214 214 215 216 217 218
26	Food	Preservation by Freezing	219
	26.4 26.5 26.6 26.7 26.8	Preservation Mode Frozen Foods Quality 26.3.1 Quality and Rate of Freezing 26.3.2 Microbial Aspects 26.3.3 Physical Alteration and Quality References Introduction Art of Freezing-Melting Process Historical Development Classification of FM Process 26.8.1 Direct Contact Freezing 26.8.2 Indirect Contact Freezing 26.8.3 Comparison between Direct and Indirect FM Process 26.8.4 Vacuum Freezing Application of Freezing-Melting in Food Industry Reference	219 220 220 221 222 225 226 226 227 228 228 228 229 230 230 232
27	Steri	lisation and Microwave Pasteurisation of Foods	233
	27.1 27.2 27.3	Introduction Principles of Microwave Heating 27.2.1 Microwave Generation Benefits of Heating using Microwaves	233 235 236 237

	27.4	Factors which Affect the Heating in Microwaves 27.4.1 Frequency 27.4.2 Dielectric Properties 27.4.3 Content of Moisture 27.4.4 Mass 27.4.5 Temperature 27.4.6 Location and the Geometry of Foods 27.4.7 The Thermal Properties 27.4.8 Secondary Flow inside a Curved Pipe Microwave Heating's Industrial Applications 27.5.1 Tempering of Poultry, Meat and Fish 27.5.2 Bacon's Pre - Cooking 27.5.3 Cooking Sausages 27.5.4 Baking References	238 238 238 239 239 240 240 241 241 241 242 243 243		
28	Ohm	ic Heating in Food Preservation	244		
	28.1 28.2 28.3 28.4 28.5	Introduction Advantages and Disadvantages of the Ohmic heating Applications and Cost of Ohmic Heating 28.3.1 Application 28.3.2 Cost Ohmic Heating Process Modeling 28.4.1 Basic Equations 28.4.2 Microbial Death Kinetics 28.4.3 Vitamin Degradation Kinetics New Utility of Ohmic Heating 28.5.1 29.5.1 Blanching 28.5.2 Evaporation 28.5.3 Dehydration 28.5.4 Fermentation 28.5.5 Extraction References	244 245 246 246 247 247 247 248 249 249 249 250 250 250		
29	Preservation of the Food Using the Light Energy 251				
	29.1 29.2 29.3	Introduction Food preservation by UV rays 29.2.1 Fruits and Vegetables 29.2.2 Juices 29.2.3 Meat 29.2.4 Fish and Seafood Quality Deterioration by the UV rays 29.3.1 Oxidation 29.3.2 UV in Sanitation	251 252 252 253 253 254 255 255		

T     ( C	••
Table of Contents	XVII

		29.3.3 UV mode of Action 29.3.4 Effects on the Flavours Photoreactivation Visible Lights References	256 256 256 257 257
30	Food	Preservation using Magnetic Field	258
	30.1 30.2 30.3 30.4	Introduction The Principles of Magnetic Field and Magnetism Generation of the Magnetic Field 30.3.1 Field Generated by the Electric Current 30.3.2 Technique of utilizing the Static Magnetic Field (SMF) 30.3.3 Technique to use the Oscillation Magnetic field 30.3.4 Ultra-High Magnetic Field Preserving foods with the help of magnetic fields 30.4.1 Pasteurization 30.4.2 Method to inactivate microbial 30.4.3 Sterilization by magnetic field Reference	258 259 262 262 263 263 264 264 264 264 265
31	Coml	pined Techniques Involved in Food Preservation	266
	31.1 31.2 31.3 31.4	Introduction: Hurdle Effect and Hurdle Technology 31.2.1 The chief hurdles used in food preservation 31.2.2 Various Hurdles in Food Preservation Basic Aspects of Food Preservation 31.3.1 Homeostasis 31.3.2 Metabolic Exhaustion 31.3.3 Stress Reaction 31.3.4 Multi-target Preservation Applications of Hurdle Technology in Developed Countries 31.4.1 Food Fermented through Hurdle Technology 31.4.2 Heating of the Foods through Hurdle Technology 31.4.3 Chilling or Freezing of foods through hurdle technology Applications of Hurdle Technology in Developing Countries 31.5.1 Preservation of Fruits in Latin America 31.5.2 Preservation of Fruits in China 31.5.3 Indian Diary Products Reference	266 267 268 269 269 270 271 271 271 272 273 273
32		Process of Hurdle Technology for Gentle and ful Preservation of Foods	276
	32.1 32.2	Introduction Dynamics of Hurdle Technology	276 277

	32.8 32.9 32.10	<ul> <li>Evolution of Hurdle Technology</li> <li>Importance of Maintaining Balance in Hurdle Technology</li> <li>Mechanism of Hurdle Technology for the Preservation of Food</li> <li>Principles of Hurdle Technology</li> <li>Hurdle Effect</li> </ul>			
33	Incor	porating Packaging as a Preservation Technique	284		
	33.3	Introduction Purpose of Packaging 33.2.1 Product Containment 33.2.2 Preservation by Maintaining Quality 33.2.3 Presentation 33.2.4 Protection During Processing Environmental Considerations 33.3.1 Environmental Damage 33.3.2 Reuse 33.3.3 Recycle 33.3.4 Reduce The Road Ahead Reference	284 285 287 288 289 290 290 290 291 291 291		
34	Materials Used for the Packaging of Food				
		Introduction Variety of Materials which are used for Packaging 34.2.1 Usage of Plastic Materials 34.2.2 Usage of Metals 34.2.3 Usage of Glass for Food Preservation 34.2.4 Usage of Papers, Timbers, and Cardboards References	292 293 294 296 297 297 298		
35	Food	Packaging Interaction	299		
	35.1 35.2 35.3	Introduction Safety and Interaction of Food Packaging Migration of Components Present in Product Package 35.3.1 Migrating Substances 35.3.2 Plasticizers 35.3.3 Thermal Stabilizers 35.3.4 Surface Modifying Property and Slip Additives 35.3.5 Antiaging Additives 35.3.6 Optical Modifying Property	299 300 301 301 301 301 301 302 302		

<b>T</b>	( )	
lable of	f Contents	XIX

	35.7 35.8	35.3.7 Oligomers and Monomers 35.3.8 Contaminants Factors of Migration 35.4.1 Polymeric Temperature of Glass Transition 35.4.2 Migrants' Solubility 35.4.3 Dispersion into Bulk of Food Interaction between Food and Materials Used in Packaging Interaction between Food and Paper Interaction between Food and Plastic Packaging and Stickiness Reference	302 303 303 303 303 304 305 305 305	
36	Hygie	enic and Sanitation in Food Industry	306	
	36.3	Introduction Hygienic Design 36.2.1 Improving Design 36.2.2 Factory Sanitation 36.3.1 Need for Sanitation 36.3.2 Establishment of Sanitary Practices References	306 307 307 308 310 310 312	
37	Evalu	ation of Hazards: Food Preservation	313	
	37·3 37·4 37·5 37·6 37·7	Introduction Program of Evaluation of Hazards Scope of HACCP Principles of HACCP Types of Hazards 37.5.1 Hazards of the Chemical Factors 37.5.2 Hazards of the Biological Factors 37.5.3 Hazards of the Physical Factors Sources and Measures of Hazards Conclusion Reference	313 314 315 316 316 316 317 317 318 319	
38	Good Manufacturing Practices			
	38.1 38.2 38.3 38.4 38.5 38.6 38.7	Introduction Activities Compiled Under Gmp Some Basic Principles of Goods and Manufacturing Process Foundation of Good Manufacturing Practices Manufacturing Procedures that Renders a Substantiate Effect Procedures of Food Control that Renders a Substantiate Effect Fundamental Steps Required for Proper Implementation of GMP	320 321 322 323 323 323 323	

	38.8	Activitie	s Practiced Under GmP	324
		38.8.1	Organisation and Personnel Management	325
		38.8.2	Training and Personal Hygiene	325
		38.8.3	Recruitment of the Personnel's	325
		38.8.4	Training of Hygiene Imparted to the Personnel's	325
		38.8.5	Construction of the Infrastructure and other	
			Building Facilities	326
		38.8.6	Equipment's	326
		38.8.7	·	327
		38.8.8		328
		38.8.9	Controls Mandated to be Carried Out	
			During Actual Operation	328
		38.8.10	Control and Monitoring Checks of the Final Product:	329
			Packaging and Delivery Of the Final Product	329
			Appropriate Storing and Distribution of the	
			Final Products	329
	38.9	Quality (	Control	330
		Docume		332
		38.10.1		
			Various Process	332
		38.10.2	Programs	332
		-	Various types of Reports and Records	332
	38.11	-	ess and Sanitation	332
	38.12	Calibrati	ion and Maintenance of the Equipments	333
			er Feedback Redressal	333
	38.14	Audits, F	Redressal and Recalling Procedure	334
	-	Referen	•	334
			. (5. 6. 10. 10.	
39	Mana	agemen	t of Profits and Quality	335
	39.1	Introduc	ction	335
	39.2	Comme	rcial Requirements	336
		39.2.1	Revenue – Cost – Assets	336
		39.2.2	Price, Margins and Costs	337
		39.2.3	Technical Impacts on the Business	338
		39.2.4	Technical Responsibilities	339
	39.3	Quality I	Management	340
		39.3.1	Sources of the Quality Problem	340
			Quality Processes	341
	39.4	Referen	· · ·	341
1				
Ind	iex			342