

Selected Articles in Food Science & Technology for College Graduate Students

Perkins Muredzi



Selected Articles in Food Science & Technology for College Graduate Students

Perkins Muredzi



SciencePG

Science Publishing Group

Science Publishing Group

548 Fashion Avenue
New York, NY 10018
www.sciencepublishinggroup.com

Published by Science Publishing Group 2015

Copyright © Perkins Muredzi 2015

All rights reserved.

First Edition

ISBN: 978-1-940366-23-4

This work is licensed under the Creative Commons Attribution-NonCommercial 3.0 Unported License. To view a copy of this license, visit

<http://creativecommons.org/licenses/by-nc/3.0/>



or send a letter to:
Creative Commons
171 Second Street, Suite 300
San Francisco, California 94105
USA

To order additional copies of this book, please contact:
Science Publishing Group
book@sciencepublishinggroup.com
www.sciencepublishinggroup.com

Printed and bound in India

Epigraph

“If you are planning for a year, sow rice;
if you are planning for a decade, plant trees;
if you are planning for a lifetime, educate people.”

Chinese Proverb

Dedicated to Mrs Dorothy Stembile Muredzi,
Sean Muredzi, Sheldean Muredzi

and

In loving memory of
Callisto Wunganayi Temba, Anastasia Rudo Bwanya,
and John Tanjani

Preface

Food Science represents the application of the basic sciences, biotechnology, and engineering to the production, processing, packaging, distribution, and evaluation of foods. Food science and food technology complement production agriculture by developing methods that minimize waste and improve the quality, utility, safety, attractiveness, and shelf life of foods. Food scientists strive to improve the efficiency of food processing while ensuring high quality, nutritious, safe, and convenient food products. To this end, they employ the principles of chemistry, physics, biochemistry, microbiology, engineering, nutrition, and management in an integrated manner. Food scientists require specialized education and technical training.

Advanced studies in food science and technology taken by graduate students provide a broader, more varied education than is possible in the other study programmes. Graduate students are more often expected to take courses in food chemistry, food engineering and processing, food microbiology, nutrition, and food marketing as well as in the supporting disciplines and commodity areas in their special interests. Graduate students therefore require exposure to information regards immerging and critical topics in the various areas offered in their studies. To complement taught courses some programmes offer seminars on advanced topics or food research areas. This collection of articles serves to give the graduate student a varied portfolio of articles as reference material for the various disciplines of food science and technology under study thus enriching knowledge in selected critical topics.

Acknowledgement

The author acknowledges use of material emanating from PhD study work undertaken in the school of Science and Engineering, Atlantic International University, USA. Publication is therefore done following consent of Atlantic International University; USA. The author also acknowledges support given by Eng. Q. C. Kanhukamwe, the Vice Chancellor of Harare Institute of Technology, Belvedere, Harare, Zimbabwe.

Contents

Preface	VII
Acknowledgement	IX
Chapter 1 Use of Biotechnology in Traditionally Fermented African Foods.....	1
1.1 Introduction	3
1.2 Description	5
1.2.1 Spontaneous Inoculation of Fermentation Processes	10
1.2.2 “Appropriate” Starter Cultures as Inoculants of Fermentation Processes	11
1.2.3 Defined Starter Cultures as Inoculants of Fermentation Processes..	12
1.2.4 Defined Starter Cultures Developed Using the Diagnostic Tools of Advanced Biotechnologies	13
1.2.5 GM Starter Cultures	13
1.3 General Analysis	14
1.3.1 Socio-Economics of the Consumer Base	14
1.3.2 Changing Consumer Demand Trends	15
1.3.3 The Enabling Environment for Starter Culture Development.....	16
1.3.4 Proactive Industrial Strategies.....	17
1.3.5 Export Opportunities for Fermented Products	17
1.4 Actualisation: Case Study of Flavour Production from Alkaline-Fermented Beans (West Africa)	18
1.5 Discussion.....	19
1.6 General Recommendations.....	22
1.6.1 Regulatory and Policy Issues	22
1.6.2 International Cooperation and Harmonization	23
1.6.3 Education Policy	23

1.6.4	Information-Sharing	24
1.6.5	Legislation and Policy on Technologies	24
1.6.6	Intellectual Property Rights (IPR)	25
1.6.7	Communication and Consumer Perceptions	25
1.6.8	Technical Capacities and Technology Transfer	26
1.6.9	Art of Fermentation	29
1.6.10	Microbiology	29
1.6.11	Upstream and Downstream Processing	30
1.6.12	Biochemistry	30
1.6.13	Fermentation Equipment and Techniques	30
1.7	Conclusion	31
Chapter 2 Applying Cleaner Production and Optimising Heat Process Operations in Dairy Processing Plants		37
2.1	Introduction	39
2.2	Description	42
2.2.1	Impact of Dairy Processing - The Need for Cleaner Production.....	42
2.2.2	Cleaner Production Assessment	45
2.2.3	Approach in Optimising Heating Processes	47
2.3	General Analysis	49
2.4	Actualisation.....	62
2.4.1	Case Study of Pasteurisation (Optimisation of Heating Processes) .	62
2.4.2	Case Study of Cleaner Production - Campina Melkunie Maasdam - The Netherlands	66
2.5	Discussion.....	69
2.6	General Recommendations.....	70
2.6.1	Water Pollution	71
2.6.2	Working Conditions	71
2.6.3	Spoilage.....	72
2.6.4	Solid Waste	72

2.6.5 Poorly Maintained Machinery	72
2.6.6 Water Use	73
2.6.7 Liquid Waste	74
2.6.8 Noises and Odours	74
2.7 Conclusion	75

Chapter 3 ISO 14040 Life Cycle Assessment (LAS) as a Tool for Effective Environmentally Friendly Waste Management in the Food Industry 83

3.1 Introduction	85
3.2 Description	87
3.3 General Analysis	90
3.4 Actualisation: LCA Case Studies Reported – Dairy Processing	95
3.5 Discussion.....	98
3.6 General Recommendations.....	99
3.6.1 Waste Management	99
3.6.2 Life Cycle Assessment	101
3.7 Conclusion.....	102

Chapter 4 Novel Non Thermal Preservation Techniques in Meat Processing: High Hydrostatic Pressure as a Model Technology..... 107

4.1 Introduction	109
4.2 Description	111
4.2.1 Ionizing Irradiation.....	111
4.2.2 Phage Technology	111
4.2.3 High Pressure Processing	113
4.2.4 Hydrodynamic Shockwave Treatment	114
4.2.5 Antimicrobials.....	114
4.3 General Analysis	120
4.4 Actualisation.....	127

4.5 Discussion.....	129
4.6 General Recommendations.....	131
4.7 Conclusion.....	132

**Chapter 5 Application of Statistical Techniques in Food Science:
Chemical Analysis Data 141**

5.1 Introduction	143
5.2 Description	144
5.2.1 The Approach.....	144
5.2.2 Chemical Analysis.....	147
5.3 General Analysis	149
5.3.1 Errors and Measurement Uncertainty.....	149
5.3.2 Accuracy and Precision in Measurement	151
5.3.3 Acceptable Level of Replication	154
5.3.4 Acceptance Level for Precision.....	155
5.3.5 Acceptable Level of Accuracy	160
5.4 Actualisation.....	161
5.5 Reproducibility	163
5.6 Discussion.....	166
5.7 General Recommendations.....	167
5.8 Conclusion.....	168

**Chapter 6 Application of Rheology in Food Engineering;
Concentrated Food Emulsions and Dispersions 175**

6.1 Introduction	177
6.2 Description	178
6.3 General Analysis	180
6.4 Actualisation.....	189
6.5 Discussion.....	191
6.6 General Recommendations.....	193

6.7 Conclusion.....	194
Chapter 7 Active, Intelligent and Modified Atmosphere Packaging: A Model Technology for the Food Industry.....	199
7.1 Introduction	201
7.2 Description	203
7.3 General Analysis	207
7.4 Actualisation.....	209
7.5 Discussion.....	212
7.6 General Recommendations.....	219
7.7 Conclusion.....	220
Chapter 8 Investigating the Effect of Cabbage Variety on the Characteristics of Sauerkraut Produced Using Local Cabbage Varieties.....	227
8.1 Introduction	230
8.2 Cabbage Varieties Mainly Grown in Zimbabwe.....	232
8.2.1 Copenhagen Market	232
8.2.2 Drum Head	233
8.2.3 Green Coronet F1 Hybrid.....	233
8.2.4 Star 3311 F1 Hybrid.....	233
8.2.5 Star 3316 F1 Hybrid.....	233
8.2.6 Marcanta F1 Hybrid	234
8.2.7 Klabish F1 Hybrid.....	234
8.2.8 Golden Cultivar	234
8.2.9 Rotan F1 Hybrid.....	234
8.2.10 Adelita F1 Hybrid.....	234
8.2.11 Cape Spitz	235
8.3 Spoilage and Defects in the Sauerkraut Process.....	235
8.4 Methodology.....	236

8.4.1 Sauerkraut Production	236
8.4.2 The Experiments	237
8.4.3 Lactic Acid and pH Determination	237
8.4.4 Sensory Evaluation Tests	237
8.4.5 Quantitative Descriptive Analysis Tests	238
8.4.6 Paired Comparison Test	239
8.5 Results	239
8.5.1 pH and Lactic Acid	239
8.5.2 Qualitative Descriptive Tests Results.....	242
8.6 Graphical Analysis Results.....	243
8.7 Discussion.....	243
8.8 Conclusion.....	244
Chapter 9 Food Irradiation as a Model Preservation Technique for the Food Industry: The Pros	247
9.1 Introduction	249
9.2 Description	250
9.3 General Analysis	256
9.3.1 Global Perspective.....	256
9.3.2 Consumer Attitude to Food Irradiation	258
9.4 Actualisation.....	261
9.5 Discussion.....	267
9.6 General Recommendations.....	268
9.7 Conclusion.....	269