

Food

Processing and Preservation



SCIENTIFIC
PUBLISHERS

Deepak Mudgil
Sheweta Mudgil

Food Processing and Preservation

Food Processing and Preservation

Deepak Mudgil
Sheweta Mudgil



Published by:

SCIENTIFIC PUBLISHERS (INDIA)

5A, New Pali Road, P.O. Box 91

Jodhpur 342 001, India

E-mail: info@scientificpub.com

Website: www.scientificpub.com

© 2020, Author & Publisher

All rights reserved. No part of this publication or the information contained herein may be reproduced, adapted, abridged, translated, stored in a retrieval system, computer system, photographic or other systems or transmitted in any form or by any means, electronic, mechanical, optical, digital, by photocopying, recording or otherwise, without written prior permission from the publisher. Any breach will attract legal action and prosecution without further notice.

Disclaimer: While every effort has been made to avoid errors and omissions, this publication is being sold and marketed on the understanding and presumption that neither the editors (or authors) nor the publishers nor the printers would be liable in any manner whatsoever, to any person either for an error or for an omission in this publication, or for any action to be taken on the basis of this work. Any inadvertent discrepancy noted may be brought to the attention of the publisher, for rectifying it in future editions, if published.

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the editors and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The editors and publisher have attempted to trace and acknowledge the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission and acknowledgement to publish in this form have not been obtained. If any copyright material has not been acknowledged please write and let us know so that we may rectify it.

Trademark Notice: Publications or corporate names may be trademarks, and are used only for identification and explanation in bonafide intent without intent to infringe.

ISBN: 978-93-89184-90-7

eISBN: 978-93-89184-92-1

Printed in India

PREFACE

Food science and technology is an evolving field with large scope from career view point. In the last decade, many educational organizations including university departments, institutions, colleges and deemed universities have started undergraduate, postgraduate and doctorate degree programmes related to Food Technology, Food Processing, Food Engineering and allied courses such as Dairy Technology, Post-Harvest Technology, Foods and Nutrition, Agricultural and Food Process Engineering etc. Ministry of Food Processing Industries of India (MFPI) is also emphasizing in development of food technology related departments at university and college level. Food preservation is an age old concept and now-a-days food processing is flourishing as an important and interesting topic of discussion and research. This is the main reason for its inclusion as fundamental/core subject in B.Tech, M.Tech, & M.Sc. course curriculum of Food Technology, Food Processing, Food Engineering and allied courses such as Dairy Technology, Post-Harvest Technology, Foods and Nutrition, Agricultural and Food Process Engineering etc. The book “**Food Processing & Preservation**” covers topics such as Heat Preservation and Processing, Cold Preservation and Processing, Freezing and Frozen Storage, Concentration, Drying & Dehydration, Water Activity in Food Preservation, Baking, Food Irradiation, Microwaves Processing, Chemical Preservation, High hydrostatic Pressure Processing, Pulsed Electric Field Processing, Pulsed Light & Ultrasound Processing, Extrusion Processing, Dielectric, Ohmic and Infrared heating, Enzymes in Food Processing, Membrane Processing, Solar Energy in Food Processing. We wish to acknowledge authors for their contribution in the preparation of this book. We also appreciate the assistance and support provided by Scientific Publishers staff members. Last but not least we must thank our family for their love, support and encouragement.

Deepak Mudgil
Sheweta Mudgil

CONTENTS

1. Heat Preservation and Processing	1
<i>(Kamalesh Kumar Meena*, V D Mudgal, S M Chavan)</i>	
2. Cold Preservation and Processing	23
<i>(Krishan Kumar)</i>	
3. Freezing and Frozen Storage	37
<i>(Sunil Bishnoi*, Nisha Singhania, Seema Rani)</i>	
4. Concentration, Drying and Dehydration	59
<i>(Manish Tiwari* and Nilesh Sardar)</i>	
5. Water Activity in Food Preservation	81
<i>(Dharini. V, Neha Halder, Priscilla Mercy Anitha. D, Periyar Selvam. S*, Emmanuel Rotimi Sadiku, Ida Idayu Muhamad, Mahesh Kumar. M)</i>	
6. Baking	99
<i>(Noopur Gautam, Uzma Siddiqui, Sheweta Mudgil* and Deepak Mudgil)</i>	
7. Food Irradiation	115
<i>(Shatabhisa Sarkar*, Yogita V. Chavan)</i>	
8. Microwave Processing	133
<i>(Subhashini. S*, PavaniPavuluri, Niveadhitha. S)</i>	
9. Chemical Preservation	161
<i>(Tanmay Hazra*, Rohit G Sindhav, CHVK. Sudheendra, R. S. Govani)</i>	
10. High Pressure Processing of Foods	187
<i>(Sheweta Mudgil)</i>	
11. Pulsed Electric Field Processing	207
<i>(Preeti Birwal*, Rupesh Datir, Rekha Menon Ravindra)</i>	
12. Pulsed Light and Ultrasound Processing	227
<i>(Parveen Kumari)</i>	

13. Food Extrusion: An Expanding Need Based Technology	257
<i>(Jyoti Rani)</i>	
14. Dielectric, Infrared and Ohmic Heating	293
<i>(Neha Duhan)</i>	
15. Enzymes in Food Processing	317
<i>(Ankit Paliwal, Himjyoti Dutta*)</i>	
16. Membrane Processing	341
<i>(Bindu*, Neeraj)</i>	
17. Solar Energy in Food Processing	361
<i>(Vivek Koshta*, Himanshu R. Patel, Deepak Mudgil)</i>	

CHAPTER 1

Heat Preservation and Processing

*Kamalesh Kumar Meena**, *V.D. Mudgal*, *S.M. Chavan*

Table of Contents

1. Introduction
 2. Methods of Food Preservation
 3. Thermal Preservation
 4. Effect of Heat Preservation on Microbes
 5. Conclusion
- References

1. INTRODUCTION

The losses of food due to spoilage have been estimated between 20-25% in India and other developing countries, which causes the paucity of food in these countries (Kumar & Kalita, 2017). The food spoilage reactions may of any foods is mainly of chemical, physical, enzymatic and microbiological in nature. The spoilage in foods occurs mainly after slaughtering, harvesting or production. The quality deterioration depends on type of food, composition and environmental conditions. The major cause of spoilage is microbes in most of raw and processed foods (Mudgil & Barak, 2018). The microbial degradation occurs in foods by its own natural microflora or by the post processing microbial contaminants at different stages of food handling (Mudgil & Barak, 2017). The microflora of food may cause food spoilages and contamination of various food borne pathogens which affects the safety of food (Rawat, 2015). Therefore, for the increasing shelf-life of food products various heat treatments techniques are invented. The various thermal techniques are commonly used due to their ability to destroy the pathogenic as well as non- pathogenic microbes. The dose (time and temperature exposure) of different microbes differs due to structure and composition and the developed resistance mechanism. There are various traditional thermal techniques like cooking, pasteurization, retort sterilization, blanching and drying are commonly used. Presently there are various electricity based heating systems are also gaining popularity.

2. METHODS OF FOOD PRESERVATION

The various methods used to preserve the foods include:

- (i) Microbial inactivation by using thermal treatments, irradiation, high pressure processing, ultra sound and pulsed electric fields.
- (ii) Creating the barrier for microorganisms to enter in foods by packaging and aseptic packaging
- (iii) Use of filtration or centrifugation process to remove microbes form the foods, and
- (iv) Reducing the growth and metabolic activity of microflora by using techniques like refrigeration, freezing. Reduction of water activity and pH, use of preservatives, O₂ removal and modified atmosphere packaging etc.

3. THERMAL PRESERVATION

Each type of microorganism have its optimum temperature need for its maximum growth and reproduction. If, there is any increase in temperature above optimum growth temperature microbial cells will be injured and killed. At enhanced temperatures cells of microbes killed and injured by inactivation of important cellular structures like Ribosomes, DNA, cytoplasmic membrane, and enzymes (Cebrian et al., 2017). Heat preservation methods designed to achieve desired microbial inactivation needs to consider several parameters like initial microbial load and type of microbes, resistance of cells or its spores, pH and water availability in food, thermochemical properties of package, heating conditions and post heat treatment storage conditions (Ramaswamy & Marcotte, 2006). It also consider factors like other shelf life extension techniques employed and the final effect of heat processing on textural and organoleptic properties of food. The various heat preservation techniques and advances are described below:

3.1 Cooking

The traditional thermal treatments like frying, baking, grilling, boiling, roasting etc., is generally considered in the category of cooking. The different types of food have different cooking temperature as per requirement of consumer acceptance. Generally baking temperature for manufacturing of bread; the internal temperature is kept around or below 100°C to destroy spoilage causing yeast and bacterial cells. In other treatments like frying, boiling, roasting, grilling, the external temperature of food is high but internal temperature lies below 100°C.

3.2 Blanching

The blanching is a type of pasteurization mostly used for vegetables/fruits before canning or freezing to destroy or inactivate enzymes. Blanching also serves the other secondary purposes like removal of tissue gases, cleaning the tissue, increasing the temperature of food and induction of vaccum in fruits/vegetables going to canning