

A PRACTICAL GUIDE TO FOOD PRESERVATION

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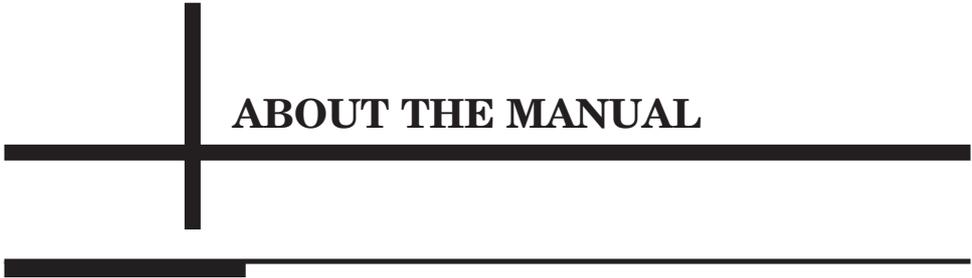
PREFACE

Preserving food is more than an art; it is a science. Scientists and home economists have established certain procedures which are essential for a given food to make it safe, as well as retain its color, flavor, texture and most importantly, nutrients until it reaches the consumers. Food is preserved by using methods that arrest moisture, inactivate enzymes and destroy or hinder the growth of microorganisms, such as molds, yeast and bacteria. These microorganisms may be present in soil, on food, in environment, on equipments being used or on work surfaces. Yeasts, molds and bacteria must be destroyed by processing so as to prevent the food from spoiling. The correct duration and type of processing varies with the kind of food and the product desired. Processing also includes securing the food by proper packaging, thus avoiding contact with microorganisms during transport and storage. Preventing enzymatic changes in food is another concern while preserving food. Enzymes, chemical substances found in all animals and plants, aid in the maturing and ripening processes. If not destroyed or inactivated at the right time, they cause undesirable changes in color, flavor and texture.

Thus, food preservation by various techniques ensures availability of food products and improves food and nutrition security. Preservation enables us to add variety to meals, reaches areas where certain food items are not grown, makes transport and storage easier, facilitate off-season availability and takes care of excess agricultural produce.

This manual has been designed to provide standard recipes and, when carefully followed, ensure both high-quality and good product. It is anticipated that this compilation will be helpful to food technologists, nutritionists and general public for gaining knowledge regarding principles and techniques of food preservation. Recipes written in this manual are time tested and can be beneficial to a small scale or self entrepreneur as well. Although we have taken enough care to include the necessary details of preservation in this manual, suggestions for further improvement are always welcome.

Authors



ABOUT THE MANUAL

"A Practical Guide to FOOD PRESERVATION" is a manual intended to serve as a guide for preservation of fruits and vegetables through appropriate, practical, cost-effective, and safe strategies, minimizing the risk of damaging food and thus maximizing the utilization of agricultural outputs. The book dissects the exact mode or mechanism involved in each method of preservation by highlighting the effects on food properties.

This manual begins with an overview of scope and importance of food preservation, causes of spoilage, principles and methods of preservation, selection of fruits and vegetables, etc. The chapters following have an extensive description of systematic, step-by-step and detailed preservation techniques. It also details methods of physical manipulation involving freezing and drying of fruits and vegetables. The recipes incorporated for preparation of jam, jelly, preserves, pickles, squashes, candies, etc. are time tested and reliable

Containing fundamental and practical aspects of preservation techniques, this guide will help in understanding and learning how to process vegetables and fruits, how one can use them, why failure in preservation may occur and how these failures may be avoided. It approaches to the needs of students of the Indian universities pursuing courses on food, nutrition, food science and technology, dietetics. This manual is also of value to the teachers, researchers, small scale food processing units and others having concern with the field.

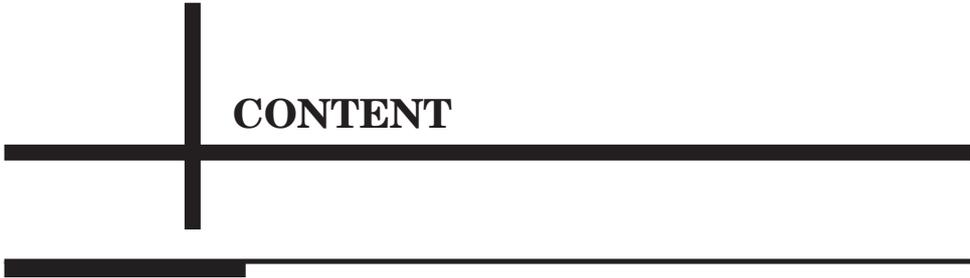
Authors

ABOUT THE AUTHORS

Prof. Arti Sankhla, a renowned name in the field of Food Science and Nutrition, has a vast teaching, research, extension and successful administrative experience. Presently working as Dean, College of Home Science, MPUAT, Udaipur. She has more than ten books/booklets and more than 100 research papers published in her name. She is a recipient of a number of National and International Awards, to name a few: Subbaraw Memorial Award 1993, Honorary Member of Professional Women's Advisory Board, American Biographical Institute, USA 2000, Best Publication Award 2005. The author has seven research projects to her credit. She has visited Canada, USA, and Europe in personal and profession capacity. She has also organized national level workshops and seminars.

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Dr. Prachi Avinash is M.Sc., PGDDHFS, PGDPPHC and Ph.D. in Foods and Nutrition. She is presently working as a Research Fellow in College of Home Science, MPUAT, Udaipur, in a project funded by Department of Science and Technology (GoR). She has a number of publications including research papers, technical and popular articles, booklets and posters. The author has also received awards and recognitions including those in academics and paper presentations and has attended national and international conferences, workshops, and trainings on Preservation of fruits and vegetables, Bakery and confectionary and the likes.



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Scope and Importance of Fruits and Vegetable Preservation in India

India ranks amongst the toppers in fruit and vegetable production, accounting roughly 10 and 15 per cent, respectively, of the total global produce. India has a strong and dynamic food processing sector playing a vital role in diversifying the agricultural sector, creating surplus food and improving value addition opportunities for agro-food products. Presently, a mere 2.2 per cent of fruits and vegetables are processed in the country, even though the country ranks among the top in the world in terms of production. This is comparatively low when compared to other countries like Brazil (30 per cent), USA (70 per cent) and Malaysia (82 per cent). The National policy aims to increase the percentage of food being processed in the country to 25 per cent by 2025.

Fruits and vegetables are an important supplement to the human diet as they provide the essential minerals, vitamins and fiber required for maintaining health. Major vegetables grown in India are potato, onion, tomato, cauliflower, cabbage, bean, cucumber, peas, garlic and okra. The major fruits grown in India are mango, grape, apple, apricot, orange, banana, avocado, guava, litchi, papaya, sapota and water melon. Mango, accounts for 40 per cent of the national fruit production and India is one of the leading exporters of grapes to the global market. The changing food habits are discernible. There has been a positive growth in the processed food products like ready-to-serve beverages, fruit juices and pulp. The various processed fruits and vegetable products available in market include preserved and dehydrated vegetables and fruits, sauces, brine preserved onions, cucumbers, jerkins, green pepper, dehydrated ginger and garlic powders, dries garlic and ginger, tomato products, pickles, chutneys, processed and packaged mushrooms, broccoli, asparagus, etc., truffles, curried vegetables, syrups, canned and candied fruits.

The varied agro climatic conditions in our country make it possible for us to produce several types of tropical, subtropical and temperate fruits and vegetables. It has been variously estimated that 20 to 30% of the horticultural produce is lost before consumption which accounts for Rs.5000 crores because of poor harvesting, handling, storage, transportation and marketing practices. The fruits and vegetables are highly perishable commodities and the ambient high temperature makes them more susceptible for rapid development of senescence, decay and rotting. Both respiratory and transpiratory rates are proportional to temperature increase and the produce quickly dries, wilts and spoils unless properly preserved.

Two approaches are possible for solving this problem. One is the creation/ expansion of cold storage facilities in the fruit and vegetable producing regions themselves, as also in the major urban consumption centers, to ensure supply of fresh fruits and vegetables throughout the year. Another approach is to process the fruits and vegetables into various products which could be preserved for a long time and add to the value of the product. With increasing urbanization, rise in middle class purchasing power, change in food habits and the dying out of the practice of making preserves in individual homes, there is an increasing demand for factory made jams, jellies, fruit beverages, dehydrated foods, pickles, etc. in the domestic market. Moreover, there is considerable demand for some of these products in foreign markets as well. For example mangoes both fresh and canned, fruit juices, salted cashew are good foreign exchange earners. Thus we can see an enormous scope and potential for the expansion of fruit and vegetable industries in India in the future.

Meaning of Food Preservation

A process, by which certain foods like fruits and vegetables are prevented from getting spoilt for a long period of time, is known as Food Preservation. The color, taste and nutritive value of the food is also preserved.

- i. Food preservation involves the practices to prevent the growth of bacteria, fungi and other micro-organisms and retarding the oxidation of fats/oils causing rancidity.
- ii. The dictionary meaning of the word “preserve” is to keep safe, retain quality and prevent decomposition or undesirable fermentation.

- iii. The science of extending shelf life of food while maintaining its nutritional quality as much as possible and avoiding the growth of unwanted micro-organisms.
- iv. The term food preservation refers to any one of a number of techniques used to prevent food from spoilage. It includes methods such as canning, pickling, drying, irradiation, pasteurization, sterilization, smoking and the addition of chemical additives.
- v. The process of treating and handling food in a way to stop or cut down spoilage to prevent the food borne illness without hampering the texture, nutritive value and flavor of food.
- vi. Food preservation is a method of preparing food to be stored for future use.

Need of food preservation

1. To convert perishable foods to non perishable food products.
2. To store excess foods in safe form for future use.
3. To enhance nutritive value of meals and provide variety to it.
4. To make the food available to remote areas.
5. To reduce the bulk of food for easier transport and storage.
6. To assure off season availability of perishable food and thereby food security.

Causes of Food Spoilage

The process of spoilage begins soon after harvesting of food. The deterioration may be very slow, as in the case of nuts or so rapid that the food becomes inedible within few hours or few days, as in the case of milk, vegetables and fruits. Food is said to be spoiled if there is rotting (bad smell), fermentation (bubbles/ gas in the food) or mold growth (spongy growth) on the food stuff. Foods get spoiled mainly due to the presence of moisture, micro organisms, enzymes, chemical activity, insects, pests, rodents and physical injuries.

1. **Presence of micro-organisms:** Micro organisms like bacteria, yeast and molds, spoil food when they get appropriate conditions for growth, like -
 - high moisture content
 - low salt, sugar or acid content
 - damaged skin of fruits and vegetables
 - food stored for long time at ambient temperature
 - contaminated air at storage place
2. **Presence of enzymes:** Enzymes are chemical substances which help in ripening of fruits and vegetables. When the action of enzymes for ripening of fruit and vegetable continues due to improper storage, it leads to over ripening, leading to undesirably soft fruit with black spots on skin and bad smell.
3. **Insects, pests and rodents:** A number of living organisms like beetles, weevils, moths, mites, ants, cockroaches, rats and squirrels damage the food during handling and storage and deteriorate its quality. This results in contamination

as well as loss in weight, nutritional quality, acceptability and appearance of the fruit and vegetable. Apart from these, it leads to national wastage and economic loss to the country.

4. **Physical injury:** Many fruits and vegetables are damaged by mechanical equipments used during harvesting, improper packaging, transportation and distribution. When the food materials (raw or processed) are handled carelessly, damage occurs to their appearance, cell structures and nutritive quality. Damaged foods are more liable to be infected by pathogens as cut surfaces provide a point of entry to the microbes and other harmful substances in foods.

Thus, air, water, soil and unhygienic and careless practices in handling the food are the main sources of microbial contamination that lead to spoilage of food, which in turn causes un-healthfulness to the consumers. Metabolic changes in raw foods like lypolysis, oxidation, putrefication, etc. are the other causes of deterioration of food in respect of flavor, color, body and texture. Insects, mites and rodents are the carriers in transmitting micro organisms responsible for spoilage of food and producing diseases.

Exercise:

1. What are bacteria? How can bacteria be classified depending on their tolerance to temperature?

Principles and Methods of Preservation

Food deteriorates due to unfavorable environmental conditions, physical damage, action of enzymes and growth of microorganisms. Principles of preservation are derived from the knowledge of conditions required by food spoiling agents. Preservation aims at increasing the shelf life of food by careful handling, altering the conditions favorable for the growth of food spoilage microorganisms, arresting the enzymatic activity and understanding other reasons of food spoilage, thus providing safe food to the consumers. The principles of preservation are:

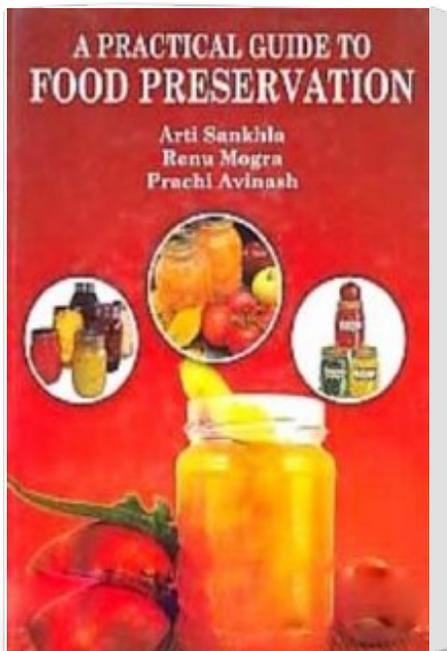
- 1. Prevention or delay of microbial decomposition :**
 - i. Asepsis i.e. keeping out microorganisms
 - ii. Filtration i.e. removal of microorganisms
 - iii. Lowering of moisture, providing anaerobic conditions and use of chemicals or antibiotics hinder the growth and activity of microorganisms
 - iv. Destruction of microorganisms by heat or radiation.
- 2. Prevention or delay of self decomposition:**
 - i. Blanching i.e. inactivation of enzymes
 - ii. Addition of antioxidants to prevent or delay oxidative chemical reactions
- 3. Prevention of damage by poor handling, insects and mechanical means:**
 - i. Use of proper harvesting tools to prevent physical injuries to raw fruits and vegetables and avoid spoilage

- ii. Damage by insects, worms or rats prevented by proper storage of foods in dry and air tight containers.

Methods of preservation: Based on the above principles, there are various methods of preservation. The method selected for preservation can be used in isolation or in combination depending on nature of the food or extent of desired enhancement in shelf life.

1. **Drying:** Microorganisms require moist environment for their existence and growth. When moisture content is reduced to a certain level, the microbial growth is arrested and shelf life of food products is increased. Drying produces concentrated form of food, inhibits microbial growth & autolytic enzymes, and reduces the size and weight of the food product making it more portable. Fruits and vegetables can be dried by using vacuum, roller, spray and freeze drier.
2. **Low temperature or freezing:** Freezing is an effective form of food preservation where temperature is lowered to inhibit growth of microorganisms and enzyme action is reduced. There is also good retention of nutrients. Fish, meat, poultry, and citrus fruit juices are commonly preserved by this method.
3. **High heat processing:**
 - i. **Pasteurization (temperature below 100°C):** Pasteurization is a heat treatment that kills all the disease producing organisms and reduces the number of other spoilage organisms to safe level in certain liquid foods like milk, fruit juices, and vinegar. Pasteurization can be done in following ways:
 - (a) **Ultra high temperature system (UHTS):** The liquid food is heated at 93.4°C for 3 seconds and at 149.5°C for 1 second, rapidly cooled to 7°C or lower.
 - (b) **High temperature short time method (HTST):** The liquid food is heated at higher temperature for shorter time. For example, milk is pasteurized by heating at 72°C (161°F) for 15 sec.

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