
UNIT 9 FOOD FOR GROWTH AND REPAIR

Structure

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9.0 OBJECTIVES

After reading this unit, you should be able to:

- describe the effect of processing and storage on food quality and how to prevent them;
- state safe limit of preservatives; and
- discuss the health foods.

9.1 INTRODUCTION

Each food, although contains a wide range of nutrients but serves as a major source of one or two main nutrients. Since each food has a different nutritional profile, a judicious use of different foods is desired to maintain good health. The health of an individual is influenced by the utilization of nutrients, called nutritional status. The application of knowledge of nutrition in selecting food, its combination, preparation, storage, physiological need, nutritional knowledge; all affects the overall nutrition of a person and the community.

Food occupies the first position in the hierarchical needs of man but ignorance of basic food facts is still widespread. Consequently, various forms of nutritional disorders result, that can be prevented by proper dietary counselling. There is no known nutritional deficiency disorder that cannot be prevented by appropriate dietary habits. Only the need is to lay adequate

emphasis to this fact and to provide adequate nutritional information to all of us. Food-based approach is the only sustainable way to improve the nutritional status of all.

It is not only the foods but also the quality of foods which is of prime importance for us. Foods if not processed properly, may lose their nutritive properties. Even if stored under improper storage condition or handled carelessly, they may get contaminated with microorganisms. Hence, for proper storage of fresh produce to retain their freshness, nutritive value and acceptability, proper handling, transport and storage of fresh or processed products is of great importance.

9.2 IMPORTANCE OF FOOD FOR GROWTH AND SUSTENANCE

Food provides nourishment to our body. Food is absorbed by the body and used as an energy source. It is also used for growth and regulation. Further it also gives protection against diseases. In short, food is the raw material from which our bodies are made. Right kinds of food in right proportions can ensure good health, which may be evident in our appearance, efficiency and overall well being.

The foods which we use daily include rice, wheat, pulses, vegetables, fruits, milk, eggs, meat, fish, sugar, oils, etc. These foods are made up of a number of chemical substances called nutrients. According to their chemical structure, these nutrients can be classified as carbohydrates, proteins, fats, vitamins, and minerals. Water and fibre are also essential component of foods. Carbohydrates comprise sugars, starches, fibre, and related materials and mainly provide energy to our body. Proteins are nitrogenous compounds and form major component of tissue in our body. Fats provide energy and fatty acids to our body. Vitamins and minerals are required for metabolism and play a protective role in our body. In short, nutrients are essential for each and every voluntary or involuntary activity of the body and must be supplied by the diet.

9.3 FOOD STRUCTURE, TEXTURE, FLAVOUR, COLOUR, KEEPING QUALITY

9.3.1 Food Structure

Fruits and vegetables are important parts of our diet, they play a protective role as they supply the essential components to our body. Fruits and vegetables are living organisms and diverse in structure, in composition and in general physiology.

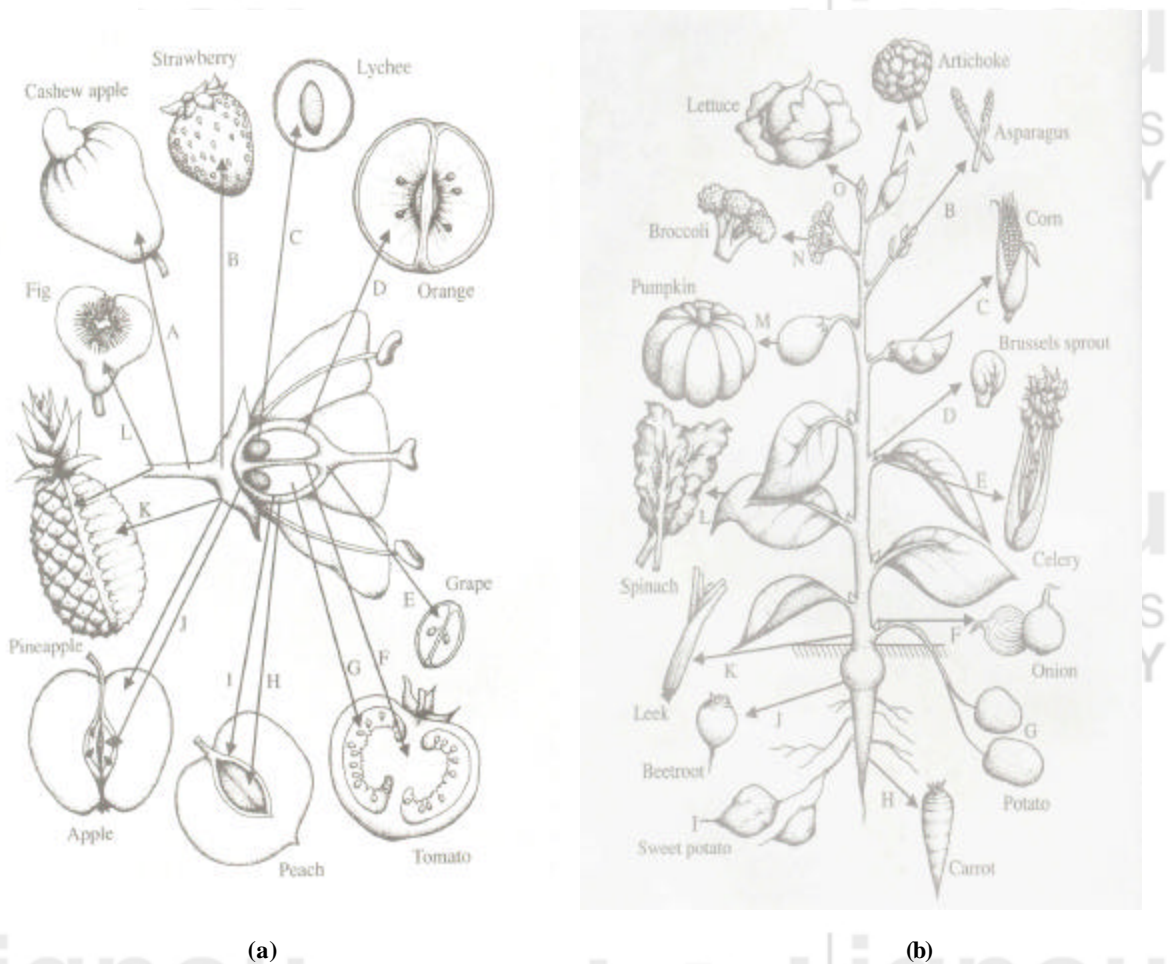


Fig.9.1: a) Derivation of some fruits from plant tissue. The letters indicate the tissues that comprise a significant portion of the fruit illustrated as follows: A) pedicel, cashew apple; B) receptacle, strawberry; C) aril, lychee; D) endodermal intralocular tissue, orange; E) pericarp, grape; F) septum, tomato; G) placental intralocular tissue, tomato; H) mesocarp, peach; I) endocarp, peach; J) carpels, apple; K) accessory tissue, apple and pineapple; L) peduncle, pineapple and fig. b) Derivation of some vegetables from plant tissue. The letters indicate the principal origins of representative vegetables as follows: A) flower bud, artichoke; B) stem sprout, asparagus; C) seeds, corn; D) axillary bud, brussels sprout; E) petiole, celery; F) bulb (underground bud, onion; G) stem tuber, potato; H) swollen root tuber, sweet potato; I) swollen hypocotyls, beetroot; J) swollen hypocotyls, beetroot; K) swollen leaf base, leek; L) leaf blade, spinach; M) fruit, pumpkin; N) swollen inflorescence, broccoli; O) main bud, lettuce.

In general, however, the ovule develops into seeds and the ovary into fruit. Normally three layers are differentiated in the ovary wall or pericarp, these being the outer exocarp or skin, the mesocarp, which may be fleshy, and the inner endocarp. The structural features of fruits and vegetables on the basis of their derivation are shown in Fig 2.1a & 2.1b.

9.3.2 Food Texture

Food texture is a combination of sensations derived from the lips, tongue, walls of the mouth, teeth, and even the ears and touch by hand. The texture of fruits and vegetables depends on the turgor of the living cells as well as on the occurrence of supporting tissues and the cohesiveness of the cells.

9.3.3 Food Flavour

Flavour is the subtle and complex perception that combines taste, smell, heat and cold, and texture. The substances mainly responsible for the flavours of foods are volatile compounds. These may be aliphatic esters, aldehydes or ketones which are present in fruit and other natural foods in very low concentration. Orange, lemon and grapefruit peels contain a number of flavanone glycosides. Terpenoids are major components of citrus oils and contribute to the flavour of citrus fruits. Certain volatile sulphur containing compounds possess powerful and distinctive odours which contribute to both the pleasant and unpleasant aroma of many foods e.g. onion, garlic, cauliflower, broccoli etc.

9.3.4 Food Colour

The characteristic colour of raw food is due to the pigments naturally present in it. The natural colours (pigments) in vegetables and fruits can be classified on the basis of chemical structure as carotenoids (yellow -orange), chlorophylls (green), flavonoids and anthocyanins (red, blue, and purple) and anthoxanthins (cream yellow). Animal foods contain myoglobin and hemoglobin.

Chlorophylls are present in plants and vegetables especially leafy vegetables such as cabbage and lettuce etc.

Carotenoids are present in many vegetables and fruits such as carrot, pumpkin, mango, orange etc. Some of the carotenoids have vitamin A activity.

Anthocyanins - These occur in many fruits and vegetables e.g. coloured grapes, red cabbage, cherries, strawberries, plums, apple and in many flowers.

Flavonoids - Flavones and anthoxanthins are responsible for the yellow-white or creamy white colour of potato and cauliflower. Flavonoids are usually more stable to heat and oxidation than the anthocyanins.

Anthoxanthins – present in some fruits and vegetables.

Poly-Phenols - These are colourless or yellow substances which turn brown when fruits and vegetables containing them, e.g. brinjal, bottle gourd, apple, are cut and exposed to air. *Xanthones* are a group of red and yellow pigments. One well-known member is mangiferin, which occur as a glucoside in mangoes.

Betalains – betalains are a group of red and yellow pigments found in red beet and to some extent in cactus fruits, pokeberries and a number of flowers

9.3.5 Keeping Quality

The quality of fresh fruit and vegetables is related to their appearance, colour, uniformity, taste, flavour, texture, aroma, nutritive value, chemical composition, defective marks on the skin, chemical residue, additives and any other parameter the consumer chooses to be acceptable on the basis of their experience and education. Harvesting of fruits and vegetables disturbs the normal life process. As the fruits and vegetables continue to respire after harvesting, they start losing their vitality, turgidity, colour, appearance and food value and thus overall quality of food during storage at room temperature. Maturity level at the time of harvesting, harvesting practices of fruits and vegetables, handling practices, moisture content of foods, storage temperature,

humidity and other storage conditions (light, oxygen, etc.) affects the keeping quality of the food. Keeping quality or storage stability (to preserve the overall quality during storage) is measured under storage and handling conditions that are set up to stimulate or somewhat exceed the conditions the product is expected to encounter in normal distribution and use.

 **Check Your Progress Exercise 1**

- Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Describe the significance of food for us?

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2. What do you understand by food flavours? Explain in brief.

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3. List the colour pigments present in fruits and vegetables.

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9.4 DEGRADATION OF NUTRIENTS, COLOUR PIGMENTS AND MICROORGANISMS DURING THERMAL PROCESSING AND STORAGE

9.4.1 Effect of Thermal Processing on Nutrients, Colour Pigments and Microorganisms

Almost all foods except fruits and some of the vegetables (used for salads) are subject to some type of heat processing to make them palatable and digestible. Thermal processing has both beneficial and adverse effects i.e. loss of nutrients. The loss of nutrients depends upon the processing temperature, duration of heat treatment and type of nutrients.

Blanching is a process in which dipping of fruits and vegetables in boiling water or exposing to steam for a few minutes stops all enzymatic and biological activities prior to processing. Losses of nutrients due to blanching occur directly from leaching of water soluble vitamins into water used for processing. In blanched vegetables such as asparagus, green beans, peas, spinach, the retention of ascorbic acid (67-95%), niacin (83-94%), riboflavin (88-90%) and thiamine (85-92%) is variable.

Pasteurization destroys pathogenic microorganisms associated with food and increases the shelf life by decreasing the microbial population and inactivates some enzymes. Pasteurization affects the vitamin content to a greater extent than other nutrients, e.g. vitamin C and riboflavin are most sensitive whereas vitamin E and K are slightly affected. Thiamine undergoes 3-20% destruction and riboflavin reduces to about 5%. Niacin content increases by about 10%, probably because of the liberation of protein bound nicotinic acid. Ascorbic acid being most sensitive undergoes oxidation. About 8% loss of vitamin C takes place during pasteurization.

Canning

Heating of canned fruits, juices, soups, vegetables, meat, and meat products etc. to destroy food spoilage microorganisms and enzymes result in some undesirable changes in the nutritive value of food. During canning, denaturation of proteins may occur. Heat, metallic tins and light accelerate oxidative rancidity of fats/ oils. The rate of oxidation of fat is doubled for each degree increase in the temperature. Sugars and starches are degraded by prolonged heating at high temperature. Browning reactions take place in sugars on heating. Canning of vegetables causes losses in nutrients such as vitamin C (33-90%), thiamine (16-83%), riboflavin (25-67%), niacin (0-75%), folic acid (35-84%) and vitamin A (0-84%).

Ionizing Radiations

Effects of irradiation on the nutritional quality of foods vary with doses. Higher doses result in more destruction of nutrients than lower doses. Irradiations produce molecular changes in starch, converting it into sugars. Lipids are very sensitive to radiations. Auto-oxidation of lipids increases peroxide value i.e. the number of peroxides increases leading to off-flavours. Losses of amino acids also occur. During irradiation most of thiamine is found to be lost whereas riboflavin is heat stable and retained upto 91%. Niacin and folic acid are extremely radio-resistant and are fully retained. Vitamin K is sensitive to radiation and is destroyed in significant quantity during irradiation.

Colour Pigments

Vegetables and fruits contribute a variety of colours to the diet. The plant pigments chlorophyll (green leafy vegetables), carotenoids (yellow-orange carrots), flavonoids (white potatoes) and anthocyanins (red beetroot) are present singly or in combination in plant foods. These may be affected by the method of food processing. The soluble pigment such as anthocyanins may leach in the cooking water and changes may occur due to the effect of heat and pH (Table 9.1).

Table 9.1: Effect of heating on colour pigments of plant foods

S. No.	Food source	Name of pigments	Colour	Soluble in	Effect of prolonged heating	In presence of	
						Acid	Alkali
1.	Rice Potato	Flavones Flavanols	White or yellowish red	Water	May darken	White	Yellow
2.	Beetroot	Anthocyanin	Red	Water	Little	Bright red	Reddish purple
3.	Leafy vegetables	Chlorophyll	Green	Fat	Olive green	Olive green	Intense green
4.	Carrot Mango Tomato	Carotene Xanthophyll Lycopene	Yellow - orange	Fat	May darken	No change	No change

9.4.2 Effect of Storage on Nutrients, Colour and Microorganisms

The quality of food deteriorates during storage due to action of microorganisms on them if not stored properly. Deterioration is usually noticed by the presence of rancid odour of fats (caused by oxidation of fats), fermented odour of fruit or fruit juices due to yeast growth, or appearance of mould growth on bread, roti, etc. Hence, proper storage of food and food products is very important to avoid the quantitative and qualitative losses.

Fresh fruits and vegetables continue to respire after they are harvested. Harvesting disturbs the normal life processes, and vegetables start losing their vitality, turgidity and food value. The harvested vegetables continue to respire during transport and storage. This involves the use of oxygen, the metabolism of cell food materials and the release of carbon dioxide, water and energy. Most of the energy is released in the form of heat.

Most of the fruits such as mango, banana, citrus, guava, grapes, papaya, etc. are prone to injuries which become avenues for fungi especially moulds which deteriorate the fruits. The fruit packaging material is infested with organisms, which also act as source of infection. Due to unhygienic practices, fruits are subjected to various diseases causing huge losses. The most common type of spoilage in fruits and vegetables are bacterial soft rot, gray mould rot, blue mould rot, black mould rot, pink mould rot, etc. Fungal spoilage of vegetables often results in water soaked mushy areas, while fungal rots of fleshy fruits like apple and peaches mostly show brown or cream coloured areas in which moulds grow in the tissue below the skin. Whereas bacterial soft rot is commonly spread among the vegetables which are not very acid and among the fruits which are not highly acid.

Sometimes normal changes occur in raw fruit juices at room temperature such as alcoholic fermentation (conversion of sugars to acid, alcohol and gases) by yeasts, which further cause an oxidation of alcohol and fruit acids yeasts and moulds growing on the surface when it is exposed to air. Mostly at temperatures above 32.2^oC to 35^oC lactobacilli would be likely to grow and form lactic acid and some volatile acids.

Vitamin C and thiamine may be lost if canned foods are stored at ambient temperature. At room temperature, there is discolouration of pigments present in vegetables such as anthocyanins, flavanols and flavones very rapidly because of the activity of enzymes. Roots and tubers can be stored in cool ventilated place to avoid sprouting. Storage temperature should be maintained between 3 and 10^oC. Green leafy vegetables after harvest start losing resulting in loss of moisture. These vegetables can be stored at low temperature in clean and dry plastic bags to prevent loss of moisture.

The most common deteriorative changes taking place in milk at room temperature are souring, decomposition of protein, rancidity or bitter taste, off flavour, colour changes etc.

Deteriorative changes in meat can take place in aerobic conditions, anaerobic conditions and also by bacteria, yeasts or moulds. The changes, which take place under anaerobic conditions, are changes in colour, oxidation of unsaturated fats, undesirable flavour, off odour, of taste, etc.

Fish gets spoiled easily because of the rapid autolysis by the fish enzymes. The fat in pork and poultry are more easily oxidized than others.

Eggs are more spoiled by bacteria than moulds. If not properly stored there is a loss of CO₂ gas through the egg shell, loss of moisture and increased air space, loss of moisture from white to yellow, loss of normal firmness of egg white, etc.

Foods when properly stored retain their freshness longer; have better nutritive value and acceptability. Therefore, for better storage and long shelf life, all food and food products should be stored in a proper place according to their requirement.

Check Your Progress Exercise 2



- Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Mention the nutrients, which are sensitive to temperature and light.

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2. How temperature affects the colour pigments? Explain.

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3. Why do the quality of harvested fruits and vegetables deteriorate?

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4. Why do the fruits and vegetables spoil at room temperature?

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9.5 PERMITTED COLOURS

Food Colours

The acceptance of food depends to a large extent upon its attractive colour. The characteristic colour of raw food is due to the pigments naturally present in it. Sometimes, artificial colour is added during the preparation and processing of foods to make them more attractive.

List of Permissible Harmless Food Colours

i) Natural colouring matter that may be used:

According to Fruit Product Order, India (1955), the natural colouring matters, whether isolated from a natural source or synthesized, are

permitted to be added to any food product. Some of these are carmine, carotene and carotenoids, chlorophyll, caramel, annatto, ratanjot, and saffron.

ii) Coal tar dyes which may be used:

No coal tar dyes or a mixture thereof except the following shall be used in fruit products:

Colour	Common name	Colour index (1956)	Chemical class
i. Red	Ponceau 4R Carmosine	16255	Azo
	Fast Red E Amaranth	14720	Azo
	Erythrosine	16045	Azo
		16185	Azo
		45430	Xanthene
ii. Yellow	Tartrazine	19140	Pyrazolone
	Sunset Yellow FCF	15985	Azo
iii. Blue	Indigo Carmine	73015	Indigoid
	Brilliant Blue FOF	42090	Triphenyl-methane
iv. Green	Green S	44090	Triphenyl-methane
	Fast Green FOF	42033	Triphenyl-Methane

Dyes when used in fruit products shall be pure and free from all harmful impurities. The maximum limit of any permitted coal tar colours or mixture of permitted coal tar colours which may be added to any fruit products, shall not exceed 0.20 g per kg of the final products for consumption.

As per the 'Code of US Federal Regulations (1979); and Prevention of Food Adulteration Act (India), Acid Magenta II, Blue VRS, Brilliant Black, Red FB, Red 6B colours have been prohibited for use in the food products.

9.6 HEALTH FOOD, GREEN/ ORGANIC FOOD, TRADITIONAL FOODS, DESIGNER FOODS

9.6.1 Health Food

Health foods are those, which are nutritious, prevent diseases and maintain health. Health foods are also known as 'designer foods'. Such foods must possess characteristics like modified composition, limit the presence of certain potentially harmful components and possibility of including certain desirable ingredients either naturally or by addition. These include vegetable foods, whole grain cereals, food processed without chemical additives, foods grown on organic compost, 'magic' foods (honey, molasses, yoghurt, etc.), and so on.

9.6.2 Organic Foods

Organic foods refer to the foods (either plant or animal foods) that are grown organically. These are grown on soils enriched with compost and manure and without the use of chemical fertilizers, insecticides or pesticides. Organic foods are the need of the hour because these foods offer protection of future generations, prevent soil degradation and erosion, protect water and aquatic life, save energy, protect farmers and farm women, help small farmers, support a true and sustainable economy, promote biodiversity, produce better, tasty, pure and nutritious foods.

9.6.3 Traditional Foods

Traditional foods are different types of food preparations with varying shelf life. These foods had been invented to overcome the monotony in the diet of the people, modified and repetitively processed by human communities. Their composition and preparation were based on the Pak Sastra i.e. Science of cooking. Traditional food processing began when man ceased to be a food hunter. To start with, it was confined to primary processing of food grains. Gradually, primary processing spread to other foods, gathering variety, variegation and velocity. In regions of primitive agriculture, food manufacture and management, man is still engaged in simple food processing practices, passed down through generations of tradition.

Indian traditional foods based on cereals, legumes and fats or oil - both sweets and savories, are innumerable in number, with characteristic features reflecting the diverse socio-cultural environments in different parts of the country. In our country; a nation steeped in culture and tradition dating beyond 5000 BC, these heritage foods for which preparative guidelines passed on from generation to generation are still made by skilled mothers and grandmothers, though many of these products have attained commercial importance during last 20 – 30 years.

Amongst various traditional foods, cereals and pulses based products still occupy an important place in the diets of our people. Historically, legumes are the natural protein supplements to cereals in the Indian diets. 'Khichari' one of the traditional products prepared from rice and pulse to prove a good quality diet, was in practice long before nutritionists and food scientists understood the nutritional importance of mixing grains.

The important traditional foods which are still popular among Indian population can be broadly categorized as: processed grain products, dehydrated foods, pickles/chutneys/sauce/relishes, ground spice/spice mixture, fried food products, confections and sweet dishes, and dairy products. Some popular traditional foods prepared and served at homes, restaurants and public eating places (bus stops, railway stations) with subtle differences in blends and flavours but essentially Indian are listed in Table 2.2.

Table 2.2: Some characteristic traditional foods of India

Major raw material	Products
Cereals/legumes	Papads, Wadian, Vermicelli, Soji, fried snacks.
Milk	Malai, Khoa, Chhana, Paneer, Curd, Butter milk.
Milk and sugar/jaggery	Peda, Burfi, Rasagolla, Jamun, Sandesh, Kheer, Halwa
Gram flour, sugar/jaggery	Mysore Pak, jilebi, Laddu and Chikki
Fruits and vegetables	Pickles chutneys, Murabbas, Patha, candied fruits, Aamchur, Fruit leather, dried fruits, dehydrated vegetables and pickled vegetables.
Spices and condiment	Spice powder, Sambar and Rasam powders and Garam masala
Miscellaneous	Neera, toddy, arrack, feni, vinegar, jaggery, khandasari, Sugar, and honey.

9.6.4 Designer Foods

Designer foods are foods that naturally contain or are enriched with certain specific concentration and proportion of nutrients/ substances that are important to health and prevent certain diseases such as phytochemicals (prevent cancer). The term was first coined in 1989 by Dr. Herbert Pierson, The National Cancer Institute (U.S.). The designer foods are also called as medical foods, fortified foods, nutritional foods, nutraceutical foods, functional foods, indulgence foods, slow foods, premium foods, therapeutic foods and healthier foods. Such foods are most commonly conceived as health foods that have therapeutic or prophylactic characteristics. The term “designer food” is subjected to change based on nutritional labelling regulations, new developments, consumer perceptions and expectations. Therefore it can be said that designer food is an evolving concept meant for reducing or delaying the risk of diseases.

9.7 PACKAGING FOR SAFETY AND QUALITY

Packaging of fruits and vegetables is undertaken primarily to assemble the produce in convenient units for marketing and distribution. The package must be capable of (i) protecting the produce from the hazards of transport, (ii) preventing microbial and insect damage and (iii) minimizing physiological and biochemical changes.

The important consideration in selecting the packaging material are (i) the product itself, (ii) the system of production, (iii) the systems of storage, (iv) the systems of handling, (v) the system of transport, (vi) the systems of merchandising, (vii) the consumer attitude, (viii) requirement of recycling/ reuse/ disposal, etc.

The traditional types of food packaging are boxes, cartons, metal cans, glass bottles and jars whereas the new innovations in packaging are aseptic

packaging, PET containers, microwaveable containers, controlled/ modified atmosphere packaging etc.

a) Packaging for fresh fruit and vegetables

Fresh produce contains 80-90 per cent of moisture or even more and equilibrate humidity as high as 98%. Under normal atmospheric conditions, they will dry rapidly (transpiration). This causes wilting and shriveling due to shrinkage of cells. The existing postharvest loss of fruits and vegetables could be considerably reduced by adopting improved packaging, handling and efficient system of transport. The fresh fruits and vegetables during postharvest phase continue all vital processes. The respiratory heat liberated by fruits and vegetables must be taken out from the pack in order to extend their storage life. For this purpose film thickness, ventilation in the packs plays a very important role.

Modified Atmosphere packaging (MAP)

Plastics play a great role in creation of modified atmospheric (MA) condition around the commodities when the fresh fruits and vegetables are packed in plastic film bags. MA condition was reported to reduce bitter pit reduction and better retention of vitamin C in apples. The acute problem of ripening of Suvernakha mangoes during transit was solved by adopting the MAP technology. However, proper temperature management and postharvest handling practices are required for storing these mangoes for longer duration (30-40 days). Similarly by adopting MAP technology, Mallika and Amrapali varieties of mango fruit could be kept up to 25 days at low temperature. The technology was also successfully applied to enhance the storage life with better quality attributes in many other fruits and vegetables viz. guava, cauliflower etc.

Prepackaging is generally defined as packaging the produce in consumer size units either at producing center/ farm before transit or at terminal markets. Prepackaging protects the produce against the damage and excessive moisture loss, reduce transportation cost by eliminating unwanted and inedible portion of fruits and vegetables, reduces the shopping time of the consumer as the produce is graded before packaging.

b) Packaging for processed products

The packaging materials used for various food products are metal cans, glass bottles/ jars, rigid/ flexible plastic packaging materials etc. Products like fruit jams, jellies, pickles are packed in wide mouthed glass jars. Products like fruit, squashes, syrups, RTS beverages, carbonated beverages etc. are packed in glass bottles.

Packaging for dried or dehydrated products

Dehydrated vegetables absorb moisture; they require a moisture resistant pack. Smaller sized packs of dehydrated vegetables are packed in heat sealable laminates consisting of PE, aluminium foil and paper. Powdered dehydrated products like fruits juice powders, soups, and custard powders require protection against ingress of moisture, oxygen and loss of volatile flavours and colour. They are usually packed in heat sealable laminates containing a layer of Aluminium foil. Cabinet dried, sulphured or sulphited

mango pieces could be stored for 6 months in 400 gauge PE pouches for making Amchur.

Packaging for accelerated freeze dried (AFD) foods

The light, porous and brittle nature of AFD foods renders them susceptible to mechanical damage that affects the reconstitution characteristics. So, AFD foods must be protected against physical breakdown, moisture and oxygen absorption. *Aluminium foil laminates* are the best suited. Glue and cartons with foil laminates secured to the walls by spot gluing are suitable for over-all protection of AFD foods.

Bulk packaging of base products like fruits pulp and other intermediate products in plastics laminated pouches is practiced widely amongst manufacturers and processors. A variety of the finished products of fruits and vegetables viz. tomato products, fruit syrups, carbonated drinks and dehydrated fruits and vegetables are packed in plastic containers/ pouches.

Aseptic packaging

Aseptic packaging refers to a technique in which the product and the containers are sterilized separately and packed in a completely aseptic environment till it comes out of the system. Aseptically packaged juices and puree can be distributed in parts where refrigeration is not common. In aseptically processed 'bag-in-box' packed guava and papaya puree, no loss of vitamin C and flavour was observed but loss in colour took place.

Vacuum packaging

Vacuum packaging is used when the foodstuffs is susceptible to deterioration in the presence of oxygen. The air from the container is removed after filling the container and before sealing. This packaging increases the shelf life and quality of the packed material.

Check Your Progress Exercise 3

- Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. List the permitted colours? What is maximum limit of colour in fruit product?

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2. Briefly describe the health foods.

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9.8 LET US SUM UP

Food is essential to provide nourishment to our body to perform various functions. The appearance, colour, flavour, texture, and all other food qualities affect acceptance of the fresh and processed products. As respiration continues after harvesting, fruits and vegetables lose their vitality, turgidity, colour, appearance and food value, and thus overall quality at room temperature. Improper handling and transport increase the qualitative and quantitative losses. Heating brings several changes in the soluble colour pigment of fruits and vegetables. In order to maintain the wholesomeness of the fresh and processed products, these should be handled properly, transport carefully, stored under appropriate conditions and processed following the standard practices.

The packaging of produce and products is important to protect the produce from the hazards of transport, prevent microbial and insect damages, minimize physiological and biochemical changes and for longer shelf life.

9.9 KEY WORDS

Blanching	:	dipping of fruits or vegetables in boiling water or exposing these to steam for a few minutes to kill enzymatic and biological activity prior to processing.
Canning	:	process of sealing of foodstuffs hermetically (air tight) in containers and sterilizing them by heat for long storage.
Degradation	:	loss of quality.
Denaturation	:	structural change in proteins due to effect of heat, light, change in pH etc.
Deterioration	:	includes adverse changes in organoleptic quality, nutritional value, food safety, aesthetic appeal, colour, texture and flavour.
Growth	:	increase in the physical size.
Oxidation	:	change in a molecule, which involves gain of oxygen, removal of hydrogen or loss of electron.
Quality of fruits and Vegetables	:	often referring to particular flavour characteristics, appearance, size or levels of a particular type of damage.
Turgor	:	pressure of cell contents on the partially elastic wall of a cell, tending to produce rigidity. One of the best known forces affecting cell volume is osmosis.

9.10 ANSWER TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

Your answer should include the following points:

1. Any eatable items provide nutrients is food.

Food contain different nutrients namely carbohydrates, proteins, fats, vitamins, and minerals to perform various functions. See sub-sec. 9.1 and 9.2.

2. Volatile compounds are responsible for food flavour.

Flavour compounds present in different fruits and vegetables. See sub-sec. 9.3.3

3. Different colour pigments with examples. See sub-sec.9.3.4.

Check Your Progress Exercise 2

Your answer should include the following points:

1. Blanching causes loss of water soluble vitamins due to leaching.

Pasteurization (100^0 C) destroys some of vitamin C and Riboflavin.

High temp. during canning destroys water soluble vitamins significantly.

Effect of canning on protein and fat. See Sub-sec. 9.4.1.

2. Effect of heating on colour pigments of plant foods. See Sub-sec. 9.4.1.

3. Respiration continues after harvesting.

Metabolic heat of fruits and vegetables, improper handling and storage conditions causes deterioration in quality. See sub-sec.9.4.2.

4. Room temperature is favourable for growth of microorganisms.

Enzymatic activities in fresh produce are high at room temperature. See Sub-sec.9.4.2.

Check Your Progress Exercise 3

Your answer should include the following points:

1. List of permitted colours.

Limit of colours in fruit product. See sub-sec. 9.5.

2. Definition and characteristic of health foods. See sub-sec. 9.7.1 & 9.7.4.

9.11 SOME USEFUL BOOKS

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4. Mudambi S.R. and Rajagopal M.V. (1982) Fundamental of Foods & Nutrition (Third Edition), Willey Eastern Limited, New Delhi.
5. Potter Norman N. (1978) Food Science (Third Edition), CBS Publishers and Distributors, Delhi.
6. Rick Parker (2003) Introduction to Food Science, Delmar, Thomson Learning, Australia.