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# UNIT 14 FOOD STORAGE

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## Structure

- 14.1 Introduction
- 14.2 Food Spoilage
  - 14.2.1 Major Causes of Food Spoilage
  - 14.2.2 Factors Affecting Food Spoilage
- 14.3 Classification of Food Based on Perishability
- 14.4 Food Storage
  - 14.4.1 Methods of Food Storage
  - 14.4.2 Organizing Storage Space
- 14.5 Let Us Sum Up
- 14.6 Glossary
- 14.7 Answers to Check Your Progress Exercises

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## 14.1 INTRODUCTION

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Proper storage of food that is produced, purchased or prepared for the family is the first and the foremost step in effective utilization of family's food resources. It also plays a significant role in the efficient utilization of the family's income and ultimately influences the utilization of the available resources of the nation. As a matter of fact, every item of food needs immediate attention the moment it is harvested, manufactured or slaughtered, unless used immediately because the process of change in the composition of food begin soon after. More often these changes are for the worse and are termed as spoilage. In food storage, our effort is to minimize, if not totally prevent such spoilage.

Do you know which important characteristics of food should be preserved during storage? Food should be stored in such a way that it does not change much if any at all, in its appearance, taste, and composition. It should not only look and taste good but it should also be safe to eat and able to provide us with the nourishment it is supposed to provide. Between safety and nourishment, nourishment quite often, gets sacrificed during storage. Sometimes because it cannot be otherwise, but more often because of ignorance regarding the factors that can destroy the nutritive value of foods and regarding proper methods of storage. It is not enough to be able to select the food you need, it is also important to know how to take care of it and keep it well till you are ready to use it.

This unit deals with various causes of food spoilage, factors which influence food spoilage and home-level storage methods or the methods to prevent or minimize food spoilage.

### Objectives

After studying this unit, you will be able to

- identify the various causes of food spoilage
- list the factors influencing food spoilage
- differentiate between perishable, semi-perishable and non-perishable foods and
- decide the most suitable method of storing various kinds of foods purchased for your family.

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## 14.2 FOOD SPOILAGE

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As you have just learnt, food spoilage leads to lowering of the quality of food. In order to check the extent of spoilage, you should know to judge the quality of a food item. *The quality of a food item is measured in terms of its sensory properties i.e.*

properties that can be detected by our senses of sight, smell, touch and taste — these are appearance, texture, flavour and aroma. In addition to these, three other important quality factors which cannot be judged by our senses alone, are nutritional value, safety and shelf life (keeping quality). Any adverse change in a food's quality, as defined above, may be considered spoilage (deterioration). It is in this sense that we mentioned earlier that most foods from the time they are harvested, slaughtered, or manufactured, undergo progressive deterioration which, depending upon the food, may be very slow or so rapid as to render the food virtually useless in a matter of hours. The degree or extent of spoilage is also significant. It might render a food aesthetically and nutritionally substandard or it might make it positively dangerous for health.

If the spoilage of food is limited to lessening of its appearance, texture, taste, aroma, or its nutritive value, it may still be acceptable as something to eat under certain circumstances. If, however, spoilage renders the food unsafe to eat then it has to be discarded without a second thought.

### 14.2.1 Causes of Food Spoilage

So far, you have learnt about food spoilage and its effect on food. Now, you would be interested in knowing about the causes of food spoilage. *The major causes of food spoilage are microorganisms and natural enzymes. Insects and rodents also play a role in food spoilage.* Let us study about each of them.

- 1) **Microorganisms:** Foods are normally contaminated with microorganisms. They are present everywhere — in the soil, water and air, on the skin of cattle and the feathers of poultry and within the intestine and all other cavities of the animal body. They are also present on the skin and peel of fruits and vegetables and hull of grains and shells of nuts. They are there on all equipment used for cooking, as well as, on the hands, skin and clothing of persons handling food. Fortunately, they are generally not found within healthy living tissue such as flesh of animals or the flesh or juice of plants. However, they are always present near and around ready to invade the flesh of plants or animals through a break in the skin.

Microorganisms include bacteria, yeast, moulds, algae, protozoans and others. Among these *bacteria, mould and yeast* are the major cause of food spoilage. They feed on the food in which they live and cause variety of changes in it. Most of them are harmful and produce changes which lead to spoilage of food. However, some of the microorganisms have desirable effects on the food like in making curds we cultivate bacteria called *lactobacillus* which give curd its distinctive flavour. Vinegar is also a product of bacterial action.

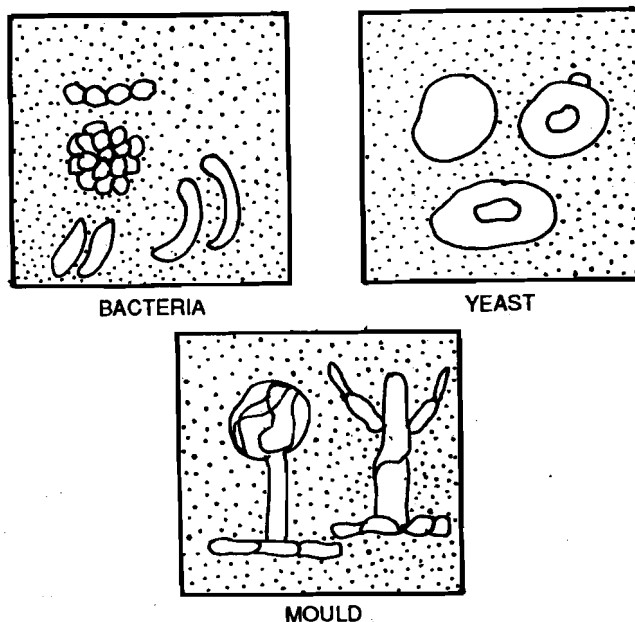


Fig 14.1 : Microorganisms under the microscope

Here, we will just concentrate on the activities of the “little devils” or the harmful microorganisms. Discussion about beneficial microorganisms is outside the purview of this unit. Let us now introduce you to various microorganisms one by one.

a) **Bacteria:** These little microorganisms are of various shapes — curved, long, slender, corkscrew. How interesting and simple they look under the microscope (Figure 14.1). But you may be surprised to know about their deeds — i.e. the variety of complex changes they can bring in foods. They play a major role in spoilage of meat, poultry, dairy and fish products. Bacteria do not thrive on foods which are distinctly acidic or alkaline in nature. They develop rapidly on foods which are neutral or near neutral in reaction such as vegetables, milk, eggs, meat and fish. Some bacteria are destroyed by boiling or by direct exposure to sunlight. Low temperature also affects their growth.

b) **Yeast :** Yeast represent another category of microorganisms. Yeast causes food to ferment. As you know, fermentation by itself is not altogether an undesirable process. It is often used in preparing foods (for example bread, dhoklas, idlis). However, when fermentation progresses beyond a certain point, it causes spoilage. The extent to which fermentation can harm the food is dependent upon the amount of alcohol produced in the food. The more the alcohol produced, more is the extent of spoilage. Fruits especially, the cooked fruit juices which have only small amount of sugar, ferment easily. You can see the carbon dioxide bubbles rising to the surface when you shake the fruit juice. So, when your orange squash or tomato sauce begins to produce bubbles, you can spot spoilage due to yeast fermentation. In sealed cans when this happens you will notice a bulge on top. You can press it down with a 'tick' sound. Now you know, it means the contents of the can are spoilt or fermenting.

c) **Moulds:** Moulds are minute plants. They grow on all kinds of foods and prefer warm, damp and dark places. They do look terribly ugly when growing on food. For example, the black hairy growth of moulds on bread or the grey fuzzy growth on cheese. They do not however, produce harmful substances. Quite often when the growth is slight you can physically remove it and eat the rest of the food without any risk whatsoever. If, however, the growth of the mould is heavy, the whole mass of food may be changed in flavour and sometimes in texture. In such cases you have to discard the food. Fortunately, mould (when in large quantity) is visible and also imparts a noticeable flavour, hence the risk of eating mouldy food knowingly is very small. There are a few moulds that do produce toxic material known as mycotoxins. Aflatoxins produced by moulds growing on groundnuts is one example.

Now you are aware of the fact that bacteria, yeasts and moulds are the most common cause of food spoilage. Fortunately in almost all cases their handiwork can be detected either by sight, smell or taste. There is a special kind of food spoilage that does not change the sensory properties of food and, therefore, cannot be detected. This is much more dangerous. We shall talk about them in Unit 16 under Food Safety.

2) **Natural food enzymes:** Food enzyme is not a new term for you. You are familiar with role of enzymes in the process of digestion. All healthy, food plants and animals have their own set of enzymes which help in the processes that go on inside the living cells — digestion, respiration, germination and so on. These enzymes continue to remain active even after the plant has been harvested or the animal slaughtered and the processes they help will continue. Some of the processes are desirable to a certain degree, for example the ripening of papaya, custard apple (shareefa), mangoes and tomatoes after harvesting. However, ripening beyond a certain point becomes deterioration or lowering of quality. The over-ripe bananas and papayas, the over-matured tasteless corn and peas in the market are examples of deterioration due to naturally present enzymes. Most of the deterioration (spoilage) of food that occurs in the field or in transport or in the markets is due to such enzyme action. Quick transport which cuts down the time and transport at low temperatures, which slow down the rate of enzymes action helps in minimizing such deterioration. Fortunately, these enzymes can also be rendered inactive by heat, chemicals and radiation.

3) **Insects and rodents:** They are particularly destructive to cereals grains and to fruits and vegetables. Worms, bugs, weevils, and moths may damage food items both in the field, as well as, in storage at home. In addition to eating away the food, they damage it and thereby expose it to bacterial, yeast and mould infections. A small insect hole in a mango can result in the total decay of that mango from bacterial invasion.

The problem with rodents involves not only the quantity of food they may consume but also the filth with which they contaminate food. Rodent urine and droppings harbour several kinds of disease producing bacteria, which infect human beings.

Of the almost 10 per cent losses in grains at the farm level in our country insects, rodents and birds are responsible for almost 6 per cent.

**Check Your Progress Exercise 1**

1) List properties or qualities of food that you can detect with either of your five senses.

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2) Indicate if the following statements are true or false. Correct the false statements.

a) Lowering of the nutritive value of food is a kind of deterioration. (True/False)

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b) Deterioration does not always make a food unsafe to eat. (True/False)

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c) Moulds generally do not produce harmful substances in the food they grow on. (True/False)

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d) Enzymes action in plant stops as soon as they are harvested. (True/False)

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e) Fermentation always leads to spoilage of food. (True/False)

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**14.2.2 Factors Affecting Food Spoilage**

Some factors like temperature, moisture affect the growth of microorganisms, action of enzymes and hence effect food spoilage. Let us now study about these factors.

**Temperature:** Each microorganism has an optimum growth temperature i.e. the temperature at which it grows best and multiplies most rapidly. Similarly, enzymes are almost active at an optimum temperature. Microbial growth/enzyme action may be prevented by either decreasing or increasing the optimum temperature. Normally, freezing and chilling are adapted for storing foods at low temperature. Freezing process has a killing effect and bacteria continue to die during storage. Food can also be stored in refrigerator which has lower temperature, however not for a long time.

However, remember that excessive heat, as well as, cold can cause deterioration of food. Excessive heat can destroy proteins and vitamins and dry out food by removing moisture. Similarly excessive cold, if not controlled during freezing breaks the cell walls and membrane of food. Such a food during thawing allows microorganisms to get in and spoil the food.

**Moisture and dryness:** Excessive moisture or dryness plays a very significant role in maintaining optimal quality in stored foods. Foods that are best when moist deteriorate on drying and those that should be kept in a dry state deteriorate when moist. Moisture is necessary for the growth of microorganisms, as well as for enzyme action. Therefore, moisture on the surface of any food encourages multiplication of bacteria and growth of moulds. If temperature is also conducive to such multiplication and growth. Moisture need not be present in equal proportions throughout the food to have an effect on it. The surface moisture need not only come from the outside of atmosphere, the fruits and vegetables give off moisture from respiration and transpiration. When they are kept in a moisture-proof package like a

plastic bag, this moisture gets trapped inside and can support the growth of microorganisms.

**Air and oxygen:** Vitamins, particularly A and C as well as food colours and flavours get destroyed when exposed to air and oxygen. Oxygen also helps growth of moulds. In packaged foods effort is made to remove oxygen by vacuum or by flushing the food containers with nitrogen or carbon dioxide, in order to prevent such deterioration. Air also dries up food items and dryness in turn can cause deterioration in some foods as mentioned.

**Light:** Some vitamins, particularly riboflavin, vitamin A and vitamin C, and many food colours are destroyed by light. Sensitive foods are often protected from light by using containers that keep light out, for example dark coloured bottles and glazed pottery jars used for keeping pickles.

**Time:** Any food is at its peak quality for a certain time after it is harvested, slaughtered or manufactured, and this period is very short, from just a few hours after harvest as in the case of fresh peas and fresh corn, to may be a day or two. It generally depends on the time spent in the field itself after harvesting in view of the inadequate transport facilities in our country. All deteriorating factors like growth of microorganisms, destruction by insects, action of food enzymes, loss of flavour, effects of heat, cold, oxygen, light and moisture progress with time. The longer the time the greater the destructive influences. It is, however, also true that some food items improve with time, for example certain cheeses, wines and pickles, but the majority of foods decrease in quality with time.

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### 14.3 CLASSIFICATION OF FOOD BASED ON PERISHABILITY

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The techniques we need to adopt for preventing spoilage depend upon the quickness with which different foods undergo such spoilage as we have just discussed. Let us, therefore, classify food accordingly before we talk about storage.

Let us give a quick look at the purchasing habits of people. People generally buy milk, egg, fruits etc. daily or once in two/three days or at most once a week. While other foodstuffs like atta, ghee, pulses etc. are bought in bulk once in a week/fortnight/month. Can you give the reason for this? Some food items deteriorate/spoil easily as compared to others and need to be consumed in a day or two after the purchase. While others can be kept for a longer time without being spoilt. In fact, on the basis of the quickness with which a food item gets spoilt, we can place them into three categories:

- i) perishable foods
- ii) semi-perishable foods
- iii) non-perishable foods.

**Perishable foods:** These are foods which spoil easily unless special methods are used to prevent such spoilage. *All animal foods like meat, fish, poultry, eggs, milk and milk products and most vegetables and fruits come in this category.* The speed with which some of these spoil varies with the temperature, moisture and/or dryness of the environment; for example while in the cold season milk can remain at room temperature for a whole day without spoiling, in the hot season it would not last more than 3 to 4 hours. Fresh eggs, meats and fish spoil very fast in the hot weather unless refrigerated. As for vegetables and fruits, they spoil faster as the day progresses. Fresh coriander, lettuce and spinach plucked from the garden wilt within a matter of minutes unless stored adequately.

**Semi-perishable foods:** These are foods that can survive without any perceptible signs of spoilage for a couple of weeks or for a few months. Here again, the temperature and humidity of the environment makes a big difference. *Example of this category are all cereal and pulse products like wheat flour, refined wheat flour, semolina, vermicelli, broken wheat, bengal gram flour, onions, potatoes, garlic, apples, citrus fruits, fats and oils.* If properly handled and stored these will remain unspoiled for a fairly long

period. In the cold climate like in most of the western countries these food items are considered non-perishable, but during the hot and humid seasons in our country they also perish unless we take special care.

**Non-perishable foods:** *Cereals, pulses, sugar come in this category. They do not spoil unless handled and stored carelessly.* Here again, we do need to take special care to make sure that they do not develop insects in storage. In the case of peanuts we have to worry about moulds in the monsoon season.

With the diverse environmental temperatures and levels of humidity prevailing in India, there can be no absolute classification of foods into these categories. With the exception of sugar and salt; there is nothing which would not spoil unless taken special care of. Even sugar and salt absorb moisture and become soggy during the rainy season unless we are careful. This makes the problem of storage even more significant for us, specially in the context of our population, what we produce, our transport facilities, and the low buying power of a large section of our population. Whatever we can produce needs to be looked after carefully till it is ready for use. As a nation and as a people we cannot afford to allow our food to get spoilt. We need to utilize every bit.

**Check Your Progress Exercise 2**

1) Fill in the blanks

- a) ..... and ..... are perishable foods.
- b) Moisture on the surface of food encourages the growth of ..... and .....
- c) Each microorganism has ..... temperature at which it grows best.
- d) The food which can survive without any perceptible signs of spoilage for a couple of weeks are known as ..... foods.
- e) When foods are exposed to air, vitamin ..... and ..... are destroyed.

2) Explain the effect of temperature on spoilage of food by microorganisms?

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## 14.4 FOOD STORAGE

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Proper storage of food is the first major step in assuring adequate food supply not only at the level of the small individual family but at the level of the nation as well.

A loss of grain crop at the harvest point to the extent of 5 to 10 per cent of production in almost all developed countries, to 50 per cent or more in the case of some of the developing countries, is a colossal waste of valuable food resources. The losses in grains at the farm level in our country are approximately 10 per cent. We loose almost 17 million tonnes of grains because of improper storage at the farm level.

### 14.4.1 Methods of Food Storage

For our discussion here we shall limit ourselves to storage facilities at the household level and we shall look at it from the point of view of non-perishable foods, semi-perishable foods and perishable foods, since the requirements of storage for each of these classes of foods are different.

**Storage of non-perishable foods:** Cereals, pulses, sugar, salt and also tamarind and some spices are often stored for a year by people in rural areas, generally from one harvest to another. In town and cities where the consumer buys all his food from the markets the trend is different. The limitation of space, facilities, finance to purchase large quantities at one time, and the fairly dependable marketing facilities, encourage most people to go in for just monthly buying. However, even this amount of food items need to be stored adequately to prevent deterioration.

You must observe the following precautions while storing non-perishable foods like cereals and pulses:

- You should carefully clean them to remove gravel, husk and other foreign matter (if possible wash), and dry thoroughly in the sun.
- You need to store them in clean containers which have tightfitting lids. These containers can be of tin, aluminium, plastic or glass. Clay pots or gunny bags also used in case of large quantities.
- These containers should be put either in the store room or in the storage cupboard in your kitchen.
- It is better to have a storage space away from the kitchen because the temperatures in the kitchen are higher than what is ideal for storage.

**Storage of semi-perishables:** Some of the cereal products, roots and tubers, nuts and oilseeds and fruits come in this category. Let us discuss storage of each one of these.

*Cereal products:* Cereal products like different flours, semolina, vermicelli, or broken wheat develop an off-flavour, or are infested by insects very easily. They should be sieved and cleaned of all such contamination, exposed to the sun for a few hours, allowed to cool, and then stored in tightly covered bottles or other containers.

*Roots and Tubers:* Specially onions and potatoes should be stored in a cool, dry and airy place to prevent them from developing moulds or growing shoots. They are best hung up from the ceiling in a wire or plastic-mesh basket, or kept in mesh containers which keep them exposed to air circulation. Do not keep them in the kitchen. They need a cool place.

*Nuts:* Nuts become rancid and infested with insects very easily, and you should buy them in large quantities only if you can store them, shelled in plastic bags inside a refrigerator. You can also freeze them to make them last for a year or even more.

*Fruits:* Like apples, oranges and semi-ripe mangoes do last for a few weeks and should be put in a basket lined and covered with paper to prevent them from drying up. Ready-to eat oranges and mangoes are best kept in a plastic bag in the refrigerator. They need a cool environment to last long.

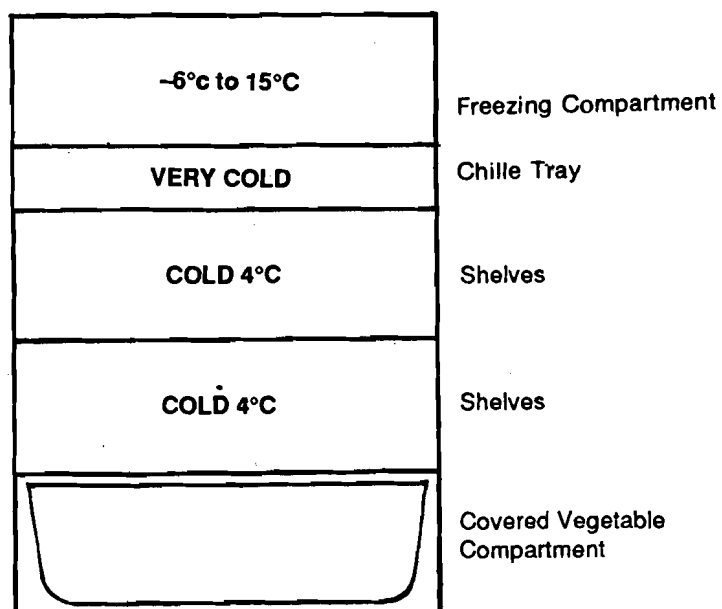


Fig. 14.2 : Various compartments of a domestic refrigerator

**Storage of perishables:** Low temperatures slow down spoilage in perishable foods — both enzymatic, as well as, that caused by microorganisms. Normally, a domestic refrigerator is used at home for storage of perishable foods. The level of temperatures prevailing inside a refrigerator keeps these in check only for a short while.

A domestic refrigerator is normally maintained at a temperature which varies between  $6^{\circ}\text{C}$  and  $10^{\circ}\text{C}$ . Fig 14.2 indicates the various shelves of a refrigerator and the temperature prevailing in them.

Foods can be kept for a longer time in freezing unit than on the shelves. Highlight 3 presents an interesting discussion on care of a domestic refrigerator.

**HIGHLIGHT 3**

**The care of a domestic refrigerator**

You should keep following considerations in mind while making use of a domestic refrigerator.

- Warm foods should always be brought to room temperature before being put into refrigerator.
- The door of refrigerator should never be open for long.
- The foodstuffs should be kept in covered jars, boxes or polythene. This is to prevent the moisture from these foodstuffs to condense as ice on the freezing unit.
- Refrigerator should be regularly defrosted (i.e. ice should be melted from the freezing unit).
- Food to be frozen in the freezing unit should be carefully wrapped in a polythene sheet, aluminium foil or plastic bags to prevent loss of moisture or strong smell from spreading. The food must be completely covered by packaging material and must be handled and packed should be sealed.

Let us now study about storage of some of perishable foods:

**Meat, fish, poultry:** For longer period storage, foods like meat, chicken and fish need to be kept frozen at  $-6^{\circ}\text{C}$  in a deep freeze. These foods should not be kept at room temperature for more than an hour or two. They should be cooked immediately if you do not have refrigeration facilities. Organ meats like liver, kidney and brain spoil faster than meat. Ground meats also spoil faster because a higher surface area is exposed to contamination, and the opportunities of contamination are also more by way of equipment and handling.

**Eggs:** should not be kept at room temperature for more than two days or so even in cool weather. They are best kept in a refrigerator.

**Milk:** The practice of boiling milk destroys the microorganisms as well as the enzymes present in it, and therefore boiled milk can be kept at room temperature for 6 to 12 hours. Giving it a second boil after 6 hours or so during hot weather makes it last longer. It is better to cover it with a netting of some kind to allow for ventilation when kept at room temperature. Inside a refrigerator milk can last 3 to 4 days or even more. The cold temperature of the refrigerator does disturb the emulsified state of the milk allowing the cream to separate and collect at the top.

**Vegetables:** The keeping quality of a vegetable depends upon its nature. Leafy vegetables wilt and deteriorate within minutes of buying unless they are kept wrapped in a damp cloth or inside a plastic bag in the refrigerator. Even here they do not last for more than a day or two. All other vegetables keep well in a cool place with relatively high humidity — in a basket covered with a damp cloth. They last longer in a refrigerator but must be kept in plastic bags to prevent drying by evaporation. Vegetables do continue to ripen even in the cold environment of a refrigerator. Fresh peas and fresh corn lose their sweetness after a couple of days even inside a refrigerator unless they are properly frozen.

So far, we have discussed low temperature or refrigeration for vegetables and fruits.



However, some of you may not have refrigeration facilities at home. In such a situation, one can try Janta fridge.

What is a Janta fridge and how can it help in storing of fruits and vegetables? Read Highlight 4 to find answer to these questions.

#### HIGHLIGHT 4

##### Janta Fridge

*Janta fridge* is an indigenous device for keeping vegetables and fruits fresh for two or three days. Figure 14.3 show what it is.

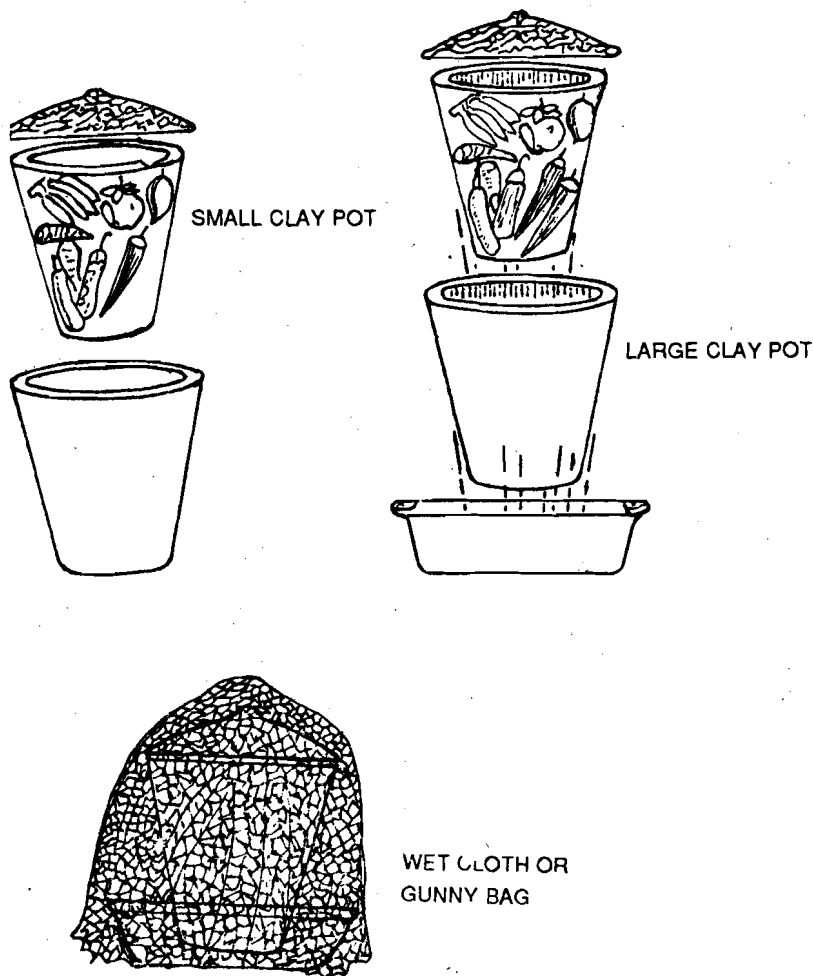


Figure 14.3 The Janta Fridge

As you can see, you need two ordinary flower pots (gamla) of such sizes that one can go inside the other. Put a three to four inch layer of sand at the bottom of the larger flower pot and wet it with water. Make the pot sit in a small basin of water. Put vegetables (firmer ones down and delicate ones at the top, in the small pot) and place it inside the larger pot. Cover the top of the pot and put a wet gunny bag over the janta fridge. Place it in a cool and airy place. Once in a week the sand should be changed. Try and see if this works.

So far we have discussed storage of food with reference to natural enzymes and microorganisms. You have read that insects and rodents or pests also play a role in spoilage of food. You need to keep a check on them as well. The most common insect which needs to be kept out from our houses is the fly. Flies are carriers of harmful microorganisms and are the major cause of almost all food borne diseases and infections. The other source of contamination of food is cockroach. They generally live in dark corners and are known to cause infections leading to diarrhoea and dysentery. Apart from these there are innumerable others which cause serious damage

to food. Of course, we cannot forget rodents when we talk about food storage. Some of the household methods of pest control are discussed in Highlight 5.

### HIGHLIGHT 5

#### Household methods of pest control

Keeping the house clean, particularly the store room and the kitchen is the first step towards controlling pests. Keeping all containers tightly shut, and not allowing food items to spill and remain spilled in the store room or in the kitchen is also essential for keeping pests under control. Keeping a closed container for collecting kitchen garbage is essential. This garbage container should be lined with paper or preferably a plastic bag which can be thrown with the garbage thus keeping the container relatively clean. It should be emptied, if possible twice a day.

To prevent entry of these pests into our house and into our food, some of the following steps would be helpful:

- i) At the time of buying make sure the food item is not infested with any of the pests. The soft drink bottle cases generally have cockroaches in their crevices. Gunny bags from the shops often have insects in them.
- ii) Clean all the grain, pulses and spices, expose them to the sun and cool them before storing them (note that rice should be put in the sun).
- iii) Clean the storage containers regularly, dry them in the sun and cool them before filling up with food items. Containers should have tight fitting lids.
- iv) Make sure all crevices and cracks in the walls and in the windows and doors are sealed. These are favourite places for the insects to breed and multiply.
- v) Can you think of some other method of pest control? You might have seen commercial advertisements for chemical pesticides. These advertisements show beautiful women spraying chemical pesticides in their kitchen without wearing a face mask and gloves. What is your opinion about the chemical pesticides or these advertisements?

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We don't know about your opinion, however, remember that these advertisements are misleading. As a matter of fact, chemical pesticides should never be sprayed in your kitchen. It is not only harmful and dangerous for the person spraying these pesticides but also for all those who are eating the food from the kitchen. Of course, harmful effects are much more serious for the person who is spraying these pesticides. In case, it is very essential to use the pesticides, you should take the help of pest control professionals. Never try to do it yourself.

In case you want, you can use baits of food mixed with poisonous chemicals, to get rid of rodents and cockroaches. However, use of baits also demands caution in their use to prevent any accident. You should take the following precautions while using baits:

- Baits of food mixed with chemicals should be kept out of reach of children.
- In no circumstances shall it get mixed with food consumed by family.
- Best time to use baits in the kitchen is when work is over and kitchen can be left undisturbed for 6 to 8 hours at a stretch. After 6 to 8 hours of putting the bait, you should clean the kitchen properly. Check every corner or crevices for dead bodies of pest. After removing all the filth, kitchen should be washed and mopped properly.
- vi) As an alternative to chemical pesticides you can try household items like turmeric, neem leaves or oil. It is a common practice in certain houses to mix turmeric in rice or put neem leaves in wheat or rice or rub oil on pulses. If you talk to your old grandmother or elders in the house you will get more ideas about such household methods of pest control.

#### 14.4.2 Organizing Storage Space

Facilities for storage vary tremendously from house to house. The following perhaps

are possibilities to choose from:

- a) *A separate store room which should be on the side of the house which gets the least sun:* The room should have good ventilation. It should also be close to the kitchen. Inside the room you should have shelves for storing food containers (with facilities to store large containers on the bottom shelf). The height of each shelf should be such that you can open each container where it is placed. For ease of cleaning, the lowest shelf should be 6 to 8 inches above the floor. If the shelves are wide tall containers should be stored at the back and smaller ones in the front. If the room does not have built-in shelves, wooden or steel ones can be used.
  
- b) *A cupboard with shelves in the kitchen:* This is becoming fairly common in the modern day flats in big cities. You may just have open shelf space without any doors. In either case the shelves should be as far away from the cooking area as possible as the hot air around the cooking area would keep the storage space warm and encourage growth of moths and weevils in the food. Hot air also causes condensation of moisture from the air, increasing humidity which hastens spoilage.
  
- c) *A cellar or an underground room:* This is an ideal storage facility if you are building an independent house. It should be surrounded by a well-insulated wall to prevent dampness, and have good ventilation facilities. Such a room would be best for storage of roots and tubers, bulbs and fruits as well. Being underground, if well insulated and aired, the room would be cooler than any other part of the house. Store should be organized in such a way that you have access to each container, and are able to check its contents periodically.

**Check Your Progress Exercise 3**

- 1) a) List the methods of storage of perishable, non-perishable and semi-perishable foods adopted in your house.

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- b) Based on the information given in Section 14.4, do you think some modification is needed in your methods of food storage at home?

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- 2) What measures do you adopt for control of pests in your house? Comment.

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## 14.7 LET US SUM UP

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In this unit you have learnt processes of change in the quality of food items generally leading to spoilage.

- Spoilage begins immediately after food is harvested, manufactured or slaughtered.
- To minimize or prevent this spoilage, it is important to take proper care of food, as soon as, it is harvested, manufactured or slaughtered.
- The spoilage changes in food are brought about by one or more of the following: microorganisms (principally bacteria, yeast and moulds), insects and rodents, natural food enzymes.
- Certain factors like temperature, moisture or dryness, time, air and oxygen do effect spoilage of food by either of these methods. Methods of preventing or minimizing spoilage of foods vary with the ease and speed with which different foods get spoilt.
- Different methods and facilities are available to store foods that perish very quickly, that perish not so quickly and that can stay for relatively longer period without perishing.
- Careful attention should be paid to requirements for storage of food, and the facilities for storage should be planned keeping in mind the kind of foods one needs to store.

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## 14.8 GLOSSARY

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<b>Aesthetically substandard</b>	: Unpalatable to look at.
<b>Aroma</b>	: A distinctive agreeable fragrance or odour.
<b>Condensation</b>	: Water vapour in the air turning into ice.
<b>Cultivate</b>	: To grow.
<b>Humidity</b>	: Moisture in the atmosphere.
<b>Nutritionally substandard</b>	: With markedly reduced nutritive values.
<b>Perceptible</b>	: Which can be seen.
<b>Rodents</b>	: Rats, mice, squirrels,
<b>Soggy</b>	: Wet with moisture.
<b>Thawing</b>	: Process of bringing frozen food to room temperature.
<b>Transpiration</b>	: The loss of water in the form of vapours from the plants.

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## 14.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress Exercise 1

- 1) Appearance, texture, flavour and aroma
- 2) a) True  
b) True  
c) True  
d) False; enzyme action continues even after harvesting.  
e) False; fermentation does not always lead to spoilage. The extent to which fermentation can harm the food depending on the amount of alcohol produced.

### Check Your Progress Exercise 2

- 1) a) Milk, milk products   b) mould, bacteria   c) optimum   d) semi-perishable   e) A, vitamin C

- 2) Answer with respect to effect of low and high temperature on spoilage of food.  
You will find hints for answering this question in Sub-section 14.2.2.

**Check Your Progress Exercise 3**

- 1) a) Answer on your own experience.  
b) Answer on your own experience.
- 2) Answer on your own experience