# 11

# Oils and Fats

In both animal and plant foods, three groups of naturally occurring organic compounds are very important oils and fats, carbohydrates and proteins. These are essential nutrients which sustain life.

Fats and oils have a simple molecular structure. Oils and fats belong to a naturally occurring substances called **lipids**. The common characteristics of lipids are:

- They are soluble in organic solvents (ether, acetone etc.)
- They are insoluble in water
- Most of them are derivatives of fatty acids

Some important examples of lipids which are derivatives of fatty acids are oils, fats, phospholipids and waxes. **Steroids** which are also lipids, are an exception in that these are not derivatives of fatty acids. Cholesterol, a steroid is an important constituent of body tissues and is present in animal foods. Vitamin D and bile acids are other important steroids, which are related to cholesterol.

In this chapter, we will be dealing with oils and fats. One of the phospholipids, lecithin, which is an important natural emulsifier, will also be discussed.

In every day use, the group oils and fats has a definite meaning. It includes such familiar substances as:

***Vegetable oils*** Groundnut, sesame (gingelly), mustard, coconut, safflower, coconut, corn, cotton seed, soyabean and palm oil.

***Animal fats*** Butter, ghee and cream from milk, lard from hogs and tallow from cattle.

***Manufactured fats*** *Vanaspati* and margarine.

Some plants store fat in the seeds, for example, oil seeds and nuts. Animals secrete fat in the milk, which is extracted as cream and butter and later clarified to yield ghee. Animals store fat in adipose tissues from which it can be extracted, e.g., lard from hogs and tallow from cattle.

Most cereals, vegetable and fruits contain very little fat. The only exceptions are the grain corn, and the fruit palm, which contain sufficient fat to permit commercial production.

Both oils and fats are extracted from vegetable and animal foods by various processes. Thus, these are processed foods, and their quality is affected by the process used to extract these. Fats have been used for a much longer time in man's dietary, than oils, which gained commercial importance only at the end of the nineteenth century.

In Chapter 3, it was mentioned that oils and fats are the most concentrated sources of energy in our diet. A gramme of oil or fat supplies nine calories in contrast to starchy foods, which provide only four calories per gramme. They are prized for the flavour and richness they impart to foods. Oils and fats provide 10 to 30 per cent of our daily energy intake.

Oils and fats are similar in composition, but physically, fats are solid at normal temperatures (18–25°C), whereas oils are liquids.

Fats and oils are widely distributed in nature and are found in almost every natural food. Oilseeds and nuts are rich sources of oils (Table 11.1) and are used in the commercial manufacturing of oils. Corn, olives and fruit palm are also used as sources for oil extraction. Whole grain cereals and legumes contain 1 to 6 per cent of fat. Even fruits and vegetables contain between 0.1 and 1 per cent of total fat (Fig. 11.1).

Animal foods, milk and its products, eggs, fowl, fish and meat are natural sources of fat in our diets.

Oils and fats are added in food preparation as spreads, shortening, as flavour enhancers and as seasonings. They are also used as a medium of cooking in shallow and deep fat frying of foods.

Even when no oil or fat is added to the diet, the natural fat in the foods provides 10 to 12 per cent of the total energy intake (Fig. 11.1)

**TABLE 11.1 Fat Content of Foods[1]**

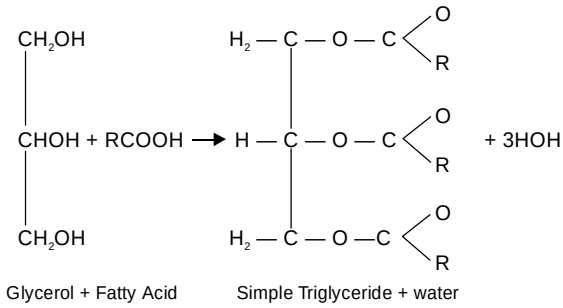
| S. no. | Food | Total fat (%) |
|---|---|---|
| 1. | Ghee | 99 |
| 2. | Butter | 81 |
| 3. | Coconut | 62 |
| 4. | Sunflower | 52 |
| 5. | Gingelly | 43 |
| 6. | Groundnut, Mustard | 40 |
| 7. | Safflower | 26 |
| 8. | Soyabean | 20 |
| 9. | Fatty fish | 5 to 21 |
| 10. | Egg | 13 |
| 11. | Meat, Poultry | 1 to 13 |
| 12. | Milk | 1.5 to 7 |
| 13. | Cereals and Pulses | 0.5 to 6 |
| 14. | Corn | 4 |
| 15. | Vegetables | 0.1 to 1 |

1. *Nutritive Value of Indian Foods*, NIN, p 47–58, 2000.

## Composition and Classification

Oils and fats are composed of the elements carbon, hydrogen and oxygen. Fats are built up by linking together a number of individual fatty acids with glycerol.

Glycerides are formed by the combination of glycerol and fatty acid with elimination of water as shown below:




The kind of glyceride formed is indicated by the prefix attached to the word glyceride. Thus, the union of one molecule of glycerol and one molecule of fatty acid forms a *Monoglyceride* (mono-one); in the process one molecule of water is freed. If two fatty acids are attached to glycerol, it is called a *Diglyceride* (di-two), and if three fatty acids are attached to glycerol, it is a *Triglyceride* (tri-three).

In a mixed glyceride, more than one kind of fatty acid is present. When three fatty acids in a triglyceride are of the same kind, the fat is a *Simple Triglyceride*. If the fatty acids are different, the fat is a *Mixed Glyceride*.

Edible fats are complex mixtures of mixed triglycerides and small amount of other associated substances occurring naturally in plants and animals. This may account for the wide variation in the flavour and consistency of food fats.

Fats may be classified into solid and liquid fats according to saturation of the fatty acids they contain.

Solid fats are so called because they are solid at room temperature. This is partly because they contain a high proportion of saturated fatty acids. Some examples of solid fats are butter, vanaspati and margarine. Vanaspati and margarine are hydrogenated fats and hence are solid at room temperature.

Liquid fats better known as *oils*, are liquid at room temperature. They contain a high proportion of unsaturated fatty acids. Oils such as corn, soyabean, cottonseed and safflower contain a fairly large proportion of polyunsaturated fatty acids. The fatty acid composition of some fats is presented in Table 11.2.

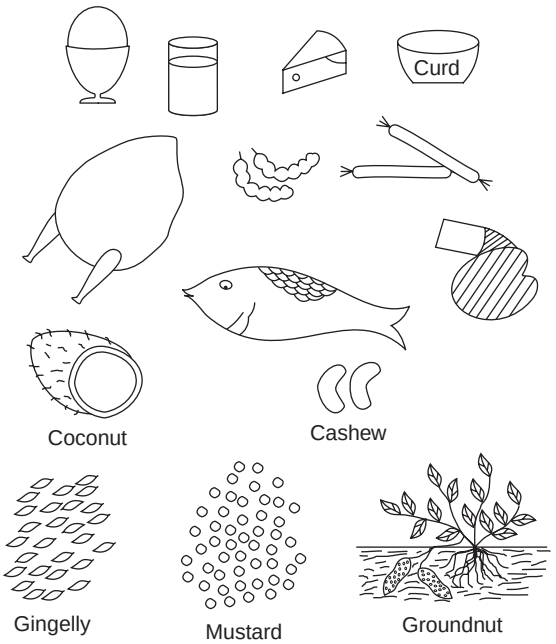



**Fig. 11.1** Sources of Hidden Oils and Fats

**TABLE 11.2 Fatty Acids in Food Fats**[1]

| No. of carbons | Fatty acid | | Coconut oil (%) | Groundnut oil (%) | Corn (%) | Cotton seed (%) | Lard (%) | Mutton tallow (%) | Butter (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Saturated | Unsaturated | | | | | | | |
| 4 | Butyric | | – | – | – | – | – | – | 3 |
| 6 | Caproic | | 0.5 | – | – | – | – | – | 2 |
| 14 | Myristic | | 18 | – | – | 1 | 1 | 2 | 10 |
| 16 | Palmitic | | 9 | 6 | 6 | 21 | 28 | 34 | 30 |
| 18 | Stearic | | 2 | 5 | 2 | 2 | 8 | 19 | 11 |
| 18 | | Oleic | 7 | 61 | 37 | 25 | 56 | 43 | 30 |
| 18 | | Linoleic[2] | 2 | 22 | 54 | 50 | 5 | 2 | 3 |
| | Other acids | | 61.5 | 6 | 1 | 1 | 2 | – | 11 |
| | Total | | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

1. Meyer Lilian, *Food Chemistry*, AVI Pub., 1978.
2. This is an essential fatty acid.

Fatty acids are composed entirely of carbon, hydrogen and oxygen atoms. They are found in all simple and compound lipids. Some common fatty acids are palmitic, stearic, oleic and linoleic acid. Fatty acids differ from one another in their chain length (the number of carbon atoms in each molecule) and the degree of saturation. There are short chain fatty acids (with a chain length of 10 or fewer carbon atoms), examples of which include acetic acid found in vinegar and butyric and caproic acid in butter. Long chain fatty acids have a chain length of 12 to 18 carbon atoms and include palmitic and stearic acid found in lard and beef tallow respectively. Oleic acid and linoleic acid (18 carbon atoms) are also long chain fatty acids. They are found in olive and corn oils respectively.

Fatty acids may be saturated or unsaturated. Certain fatty acids contain as many hydrogen atoms as the carbon chain can hold. They are called *saturated fatty acids*; of which stearic acid is an example. Other fatty acids have only one double bond linkage (two hydrogen atoms missing) in the carbon chain. They are referred to as monounsaturated fatty acid, e.g., oleic acid.

A third group the polyunsaturated fatty acids, may have two, three, four or more double bond linkages in their carbon chain. An example of this group is linoleic acid. As mentioned in Chapter 3, vegetable oils contain several polyunsaturated fatty acids, of which linoleic is essential for human beings.

Naturally occurring unsaturated fatty acids have a low melting point and are liquid at normal temperatures.

Oils have a large amount of olein (a triglyceride of oleic acid—18 carbon unsaturated fatty acid) and hence are liquid at ordinary temperature.

## Selection and Buying of Oils and Fats

A number of household fats and oils are available in India. The choice depends on the food preparation in which the fat is to be used, the family needs, the food budget and regional preference.

Ghee is preferred for its delicate flavour, in preparation of sweets and to serve with rice or snacks. Butter is used as a spread and in some baked products for the same reason.

Oil is normally used for seasoning vegetables, *dals* and as a frying medium. The choice of oil varies from one region to another e.g., mustard oil is used in Bengal, coconut oil in Kerala, groundnut oil in Gujarat and gingelly (til) oil in Tamil Nadu.

A large amount of oil is marketed as unrefined or crude oil. Criteria for selection of oil are presence of the natural characteristic aroma, natural colour, clarity, freedom from admixture with other kinds of oils, freedom from solid particles and flat or rancid odour.

All the oils and fats supply energy irrespective of their source. Most of the vegetable oils supply unsaturated fatty acids. The animal fats, ghee and butter, supply some vitamin A also. Refined oils have a longer shelf-life than unrefined oils of the same kind. As impurities are removed in refining, the smoke-point of refined oils during frying is higher than that of unrefined oils. Refined oils are used in bakery products (bread, biscuits etc.) by large bakeries.

Hydrogenated fats (vanaspati) are also available for use in food preparation. Hydrogenated fat is more stable than the vegetable oil from which it is made. The hydrogenation process is designed to produce characteristics most desired in terms of use and consumer acceptance. In India, it is made as a substitute for ghee, and therefore its physical appearance and texture resembles ghee. It is also fortified with vitamin A to the same level as ghee (or 2,500 I.U. per 100 g) to protect the consumer. Hydrogenated fats have a higher smoke point than refined oils, and are used for frying bland foods. These are also used in pastries as a shortening agent.

## Nutritive Value and Digestibility

Fats and oils are concentrated sources of energy. Each gramme of pure fat or oil supplies nine kilocalories. Fats and oils have other functions in the body besides supplying energy. They carry fat soluble vitamins A, D, E and K into the body and assist in the absorption of these vitamins. Some vegetable oils contain an essential fatty acid, which is necessary for normal body functions. Essential fatty acid is not synthesized in the body.

Fats impart special flavour and texture to our foods, thus increasing the palatability. Fats are also valuable for the satiety value that they give to meals. They are slow in leaving the stomach and hence may delay the recurrence of hunger pangs. Fats that are ordinarily consumed as constituents of common foods do not differ greatly in digestibility being utilized to the extent of 95–98 per cent.

Digestion is the process which prepares food for assimilation by the body. The digestion of fat starts in the small intestine. When the food enters the first part of the small intestine called the duodenum, the gall bladder is stimulated to release some *bile* and the pancreas a fat splitting enzyme called *lipase*. These fluids enter the duodenum through a common duct. Bile neutralizes the acidity of the food mass and provides the alkaline pH necessary for the action of the pancreatic enzymes. It emulsifies the fat and increases their surface area which helps the lipase hydrolyze part of the fat to glycerol and fatty acids and the rest to mono-and di-glycerides. The bile salts disperse the fatty acids and glycerol into small units called *micelles* in the small intestine so that they are easily absorbed through the intestinal walls. The remaining partly hydrolyzed products viz., mono-and di-glycerides are broken down completely to fatty acids and glycerol by the intestinal lipase and are also absorbed, after being converted to micelles.

When fat is oxidized in the body, it releases more energy than carbohydrate but utilises more oxygen.

## Physical and Chemical Properties

A study of the properties of fats is important in that, they influence the role of fats in cookery. The following are some of the physical properties of fat which play an important role in food preparation:

***Melting Point*** All food fats are mixtures of triglycerides, and therefore, do not have a sharp melting point, but melt over a range of temperatures.

***Creaming of Fats*** Solid fats like butter and margarine can be creamed or made soft and fluffy by the incorporation of air. Fat and sugar are usually creamed together in the preparation of cakes.

***Plasticity of Fats*** Fats are mouldable and can be creamed to exhibit plasticity. Such fats do not have the ability to flow at room temperature and are thus solid fats. The spreading quality of butter is the result of its plastic nature. Plastic fats are composed of a mixture of triglycerides and not of one kind of a molecule. They, therefore, do not have a sharp melting point and are plastic over a fairly wide range of temperature.

***Emulsification*** The specific gravity of oils and fats is about 0.9, which indicates that they are lighter than water. Though insoluble in water, they can form an emulsion with water when beaten up with it to form tiny globules in the presence of suitable emulsifying agent. Butter is an emulsion, so also is cream. The presence of minute amounts of milk protein helps to stabilise these emulsions. Lecithin, a phospholipid from egg yolk helps to stabilise mayonnaise, a salad dressing made from vegetable oil. Emulsification of fats is a necessary step in a number of products such as cakes, ice cream and other frozen desserts.

***Smoke Point*** The smoke point is the temperature at which a fat or oil gives off a thin bluish smoke. Foods that are fried are added to the hot oil just before it reaches its smoke point. Fats and oils with low molecular weight fatty acids (those with a short chain length) have low smoke point. Normally, oils that are selected for deep fat frying are those, which have a high smoke point. If oils with low smoke points are used for deep fat frying, then the foodstuff is fried at a lower temperature and thus will take a longer time to acquire the stage of doneness. In this case, the exposure of the foodstuff to the oil is increased thereby increasing its oil absorption.

Repeated use of the same sample of oil for frying results in a decrease in its smoke point and ultimately in its decomposition. The effect of prolonged heating on the nutritive value of oils and fats is dealt with later in this chapter.

Chemical properties of fats (such as iodine value, acid number and saponification number) are useful in that they have been widely used in the identification of different kinds of fats and oils, and in the detection of adulteration of refined oils with other oils that are cheaper and of poorer quality.

**Iodine Number** measures the degree of unsaturation in the oil and thus gives an estimate of the total amount of unsaturated fatty acids present.

$$CH = CH + I_2 \rightarrow CHI - CHI$$

One molecule of iodine is needed to saturate each double bond. Iodine value is expressed as the number of grams of iodine required to saturate 100 grams of oil.

**Reichert- Meissel Number** (RM Number) : The Reichert-Meissel number is a measure of the volatile water soluble fatty acids present in the fat. It is an important parameter to detect adulteration of butter, especially with coconut oil. The RM number is defined as the number of mls of 0.lN alkali (e.g., KOH) needed to neutralize the volatile fatty acids in a 5 g sample of fat. The volatile acids will be those from butyric to myristic acid. (C4 to C14). The RM test measures the amount

of butyric, caproic, caprylic and capric acids present. The RM value of butter is between 24 and 34 (variation is due to season, nutrition and stage of lactation), which is higher than other edible oils.

***Saponification Number***: is defined as the number of mg of potassium hydroxide needed to sponify 1 g of fat or oil. The fat containing lower molecular weight fatty acids will have a high saponification number. Butter which contains high percentage of butyric acid has the highest saponification number, i.e., 17.

## Refining of Crude Oils

About 80 years back, oils used to be extracted from oilseeds and nuts in small pressure extraction units. The extracted oil was used in the human diet and the oilseed concentrate was used as cattle feed. Now most of the oils used in human diet are refined.

In the refining process the impurities in oils are removed. The impurities in the oils include moisture, free fatty acids, colouring pigments, resins, gums and sometimes vitamins. The colour, flavour, odour and clarity as also the shelf-life of the oil are affected by impurities. Hence, the impurities are removed by refining to increase the shelf-life and acceptability of oils. The refining process consists of the following five steps:

1. *Degumming* Some impurities in the crude oil form gums in the presence of water. Such impurities are removed by adding water to the warm oil and centrifuging it to remove the denser gum particles. Thus, a clarified oil is obtained as an upper layer, which is siphoned off.
2. *Neutralising* All crude oils contain some free fatty acids formed due to spoilage. The oil is neutralized with caustic soda solution and the insoluble soaps formed from the free fatty acids, which settle at the bottom are removed.
3. *Washing and Drying* The last traces of soap from the oil are removed by washing. The lower aqueous soap layer is run off and the oil layer is dried under vacuum. The oil thus obtained has a yellowish colour and a distinct odour. To remove these, the oil is bleached and deodourised.
4. *Bleaching* To absorb the colouring matter from the oil, adsorbing substances such as activated carbon and fuller's earth are added to the warmed oil. The mixture is stirred with maintenance of partial vacuum. After, all the coloured matter is adsorbed, the mixture is put through filter presses to get a clear colourless oil.
5. *Deodourising* Finally the oil is deodourised by injecting steam with agitation to remove all odourous material as vapour. The deodourised oil is packed as such or blended with other oils and packed. The refined oil has to be stored under an inert gas such as nitrogen or vacuum packed to prevent oxidation.

## Role in Cookery

The role of different types of fats and oils in cookery is largely based on their composition and properties. Thus, liquid fats or oils with a high smoke point are used for deep-fat frying purposes and likewise, solid fats like butter and margarine are used as shortening and tenderizing agents in foods.

Fats are used in food preparation

(i) as a medium of cooking.
(ii) as a shortening as in *chakali, puri, shankarpala,* biscuits, pastry and cakes.
(iii) to add richness and flavour as in *shira, halwa,* seasoning of vegetables and salads.

### As a Medium of Cooking

Fat and oils have a high boiling point as compared to water. Therefore, foods get cooked in fat in shorter time than when cooked in water. Fried foods, such as *Wafers* and *Chivda,* have a crisp texture and a delectable flavour. The high temperature used in frying destroys harmful bacteria, thus making the food safe for consumption. Some fat is absorbed by the food and the calorific value of the food is increased when it is cooked in fat or oil.

### As a Shortening

In many preparations, such as cakes, biscuits *chakali* and *chirote*, fats or oils are added to improve the texture. The fat covers the surface of the flour particles and prevents the sticking of particles together. Many factors such as the nature of the fat or oil, the amount added, the temperature, presence of other ingredients, manipulation and the extent of mixing, affect the shortening power.

### As a Seasoning

Fats and oils are used to season most food preparations. In sweet preparations, fats, such as butter, ghee, vanaspati are used, as they have mild flavour, which blends with the sweet preparation.

In most parts of India, oils are used to season savoury preparations. The choice of oil varies with the region. In Kerala, it is coconut oil, in Madras, Mysore, Gujarat, Andhra Pradesh and Maharashtra, groundnut oil and sesame oil are used and mustard oil is preferred in Bengal. Each of these oils impart a characteristic flavour to the food.

In a typical method of seasoning vegetables and salads, the fat or oil is heated, a few whole grains of mustard or cumin seeds are popped, and a number of other spices such as chillie pieces, turmeric, asafoetida etc., are added as desired. Since most of the flavour components of spices are fat soluble, this addition in fat is an excellent way of extracting and dispersing these in the food preparation.

### Changes in Fat Used for Cooking

When fat is used to fry foods, due to the interaction with food, several changes occur in its physical and chemical properties. Part of the fat is absorbed by the food.

Some of the changes noted in fat used for frying are:

(i) The free fatty acid value increases, indicating partial decomposition of fats
(ii) The temperature at which the fat smokes is lowered
(iii) The fat polymerises
(iv) The fat darkens in colour

The increase in free fatty acids can be measured in the laboratory. When fried foods are prepared at home it is noted that the fat smokes a lot towards the end even though the rate of heating is not changed, indicating that polymerization has occurred. Darkening of fat used for frying is noted whenever a large batch of fried preparation is made. In fact, light coloured foods fried in such medium absorb the brown colour.

## Factors Affecting Absorption of Fat During Cooking

A number of factors affect the amount of fat absorbed during frying. Fat absorption is proportional to the surface area of the product, when all other factors are kept constant.

The time of cooking affects the fat absorption. The absorption, in general, increases with longer cooking period. There may be some exceptions to this statement. Foods, which harden at the frying temperature may not absorb more fat with a longer cooking period.

Temperature of cooking affects fat absorption indirectly. If a food is added to frying medium, before it reaches the desired temperature, it needs to be fried for a longer time to reach the stage of doneness and hence may absorb more fat.

The composition and nature of food affects the amount of fat absorbed. For example, hard wheat flours show less fat absorption as compared to soft wheat flour. When sugar and/or water in the recipe is increased, more fat is absorbed.

## Effect of Prolonged Heating on Nutritive Value of Fats and Oils

A lot of emphasis was laid on the effect of heat on the deterioration of fats and oils in the earlier research studies. In the recent research work attention has been focussed on the nutritional aspects of use of overheated fats in the diets.

It must be emphasized that continuous heating of fats and oils for over eight hours results in thermal oxidation. In the normal use of fats and oils in the home, such damage is not likely to occur unless fats and oils left over from earlier frying are routinely added back to the stock. But in eating houses or large scale preparation of fried snacks, heat damage may occur. A number of factors may speed up the thermal deterioration. These include use of large amounts of soda in the recipe,

addition of water to the fryer during preparation to reduce the temperature and addition of fats and oils leftover from the day's frying to the next day's lot and so on. In this manner, though the hours of frying in one day may not be sufficient to cause thermal damage, there is a build up of hours, as fresh fat or oil is added to that leftover from the previous day.

The effects of using thermally oxidized fats and oils have been studied in the last forty years. It is found that the requirements for nearly all vitamins is increased. Adaption to reduced caloric intake is poor. Certain organs, such as liver are enlarged. Functions of certain enzymes are altered, resulting in increased susceptibility to certain diseases.

In India, many fried snacks are used in everyday life. The tendency to buy these ready-made is on the increase. Therefore, the effect of intake of thermally damaged fats and oils is an important aspect from the point of view of the consumer.

## Changes in Fats During Storage

Fats and oils undergo certain undesirable changes during storage, which result in spoilage. The major kind of spoilage is known as *rancidity*. Rancidity implies development of undesirable odour and flavour in fats and oils. It occurs in a number of foods and is not restricted to pure fats and oils or foods with high fat content. In fact, the spoilage of foods containing very small percentage of fat such as cereals, flours, infant foods is brought about by change in the fat fraction.

***Flavour Reversion*** The fats undergo a peculiar change before the onset of rancidity. The characteristic flavour is lost and the fat or oil has a flat taste and a greasy feel on the tongue. This is known as flavour reversion and precedes rancidity changes.

***Rancidity*** Spoilage of fats results in off flavour and renders the fat inedible. These changes are known as rancidity of fats. Fats and oils can get rancid by the action of

(a) air (oxidation),
(b) water (hydrolysis) and
(c) enzymes (enzymatic breakdown).

Let us look at these in detail:

1. Hydrolysis is the decomposition of fats (triglyceride molecules) to glycerol and free fatty acids. Presence of moisture, microorganisms and the enzyme lipase hastens the hydrolytic breakdown. This kind of spoilage is known as **hydrolytic rancidity**.
   The unpleasant odour and flavour of rancid fats is due to the release of free fatty acids of low molecular weight. For example, the butyric acid produced in the hydrolysis of butter is responsible for the rancid odour of spoiled butter. Even when a small amount of butyric acid is released, the butter has a disagreeable flavour and odour which indicates the onset of rancidity.

Oils containing combined fatty acids with more than 14 carbon atoms do not develop hydrolytic rancidity as the free acids are flavourless and odourless. Oils should be stored in completely dry, airtight containers to prevent hydrolytic rancidity.

2. Oxidation of unsaturated fats leads to oxidative rancidity. Thus, oils or fats containing more double bonds (unsaturation) are more likely to develop oxidative rancidity than those with few double bonds. This oxidation is a chain reaction initiated by the production of free radicals.

   Addition of small quantities of antioxidants suppresses the production of these free radicals and improves the shelf-life of fats and oils. Some of the antioxidants used in fats and oils are vitamin E (tocopherol), butylated hydroxy toluene (BHT) and permitted gallates.
3. Enzymatic breakdown normally accompanies hydrolysis as indicated above.

## Prevention of Fat Spoilage

Storage of fats and oils so as to minimise possibility of spoilage is a very important aspect.

The following points must be noted to prevent spoilage of fats:

Keep fats and oils in dry, tightly covered containers to ensure exclusion of air and moisture. Keep the container sealed until needed. Keep fat in a container having a narrow opening to prevent undue exposure. Store in a cool, dry place away from cooking area, where the temperature and humidity fluctuations are not great.

Addition of antioxidants, such as tocopherols, and other phenolic compounds such as BHA[1], BHT[2], or propyl gallate, are used to retard rancidity in commercial fatty products.

## Hydrogenation

Plant oils contain a large percentage of unsaturated fatty acids and hence have a tendency to become rancid.

These unsaturated glycerides in the oil can be converted to more saturated glycerides by addition of hydrogen. This process is known as **hydrogenation**. Hydrogenated fat is manufactured from vegetable oils by the addition of molecular hydrogen to the double bonds in the unsaturated fatty acids in the presence of a catalyst (finely divided nickel). The product formed is a solid fat with higher melting point than that of the oil used as a starting material. Hydrogenation is of great economic importance, because it allows oils to be converted into fats, which have better keeping quality. The various brands of Vanaspati we find in the market are prepared by this process.

1. BHA—Butylated hydroxy anisole.
2. BHT—Butylated hydroxy toluene.

## Points to Remember

Oils and fats include vegetable oils, animal fats and manufactured fats used in human dietary.

***Oils and Fats*** Are composed of carbon, hydrogen and oxygen. These are built by linking fatty acids and glycerol.

Oils are liquid at 20°C, while fats are solid at this temperature. Fatty acids may be saturated or unsaturated. Linoleic acid is essential for nutrition.

***Selection*** Choice of oils and fats depend on the use, family needs, budget and regional preference. Selected for colour, clarity, characteristic aroma, and absence of bad odour.

***Nutritive Value*** Concentrated sources of energy, carry and help absorption of fat-soluble vitamins. Supply essential fatty acid, impart flavour, texture, palatability and satiety to foods, digestibility 95–98 per cent. Bile and pancreatic lipase aid digestion of oils and fats.

***Properties*** Creaming, plasticity, smoke point are considered to decide use of oils and fats.

***Role in Cookery*** Used as a cooking medium, a shortening and to season foods.

***Changes in cooking*** Partially hydrolyse to release free fatty acids, smoking point is lowered, polymerises and darkens.

***Absorption of Fat in Frying*** Varies with surface area, period of frying, temperature of frying, composition and nature of food.

***Prolonged Heating*** Leads to thermal damage, which is accelerated by the addition of soda and water. Consumption of thermally damaged fat is harmful.

***Spoilage*** Leads to flavour reversion, and rancidity.

***Hydrogenation*** Conversion of unsaturated fats to saturated one by the addition of hydrogen, in order to alter its properties and extend storage life.

## Study Questions

1. What are the different kinds of oils and fats used in our dietary?
2. (a) What elements are fats made up of?
   (b) What are monoglycerides, diglycerides and triglycerides?
3. What are saturated and unsaturated fatty acids? Give example of each.
4. Write a short note on smoke point of oils and fats.
5. What are the roles of oils and fats in food preparation?
6. What nutrients are contributed by oils and fats?

7. What is rancidity? What are the different kinds of rancidity?
8. What precautions should be taken when storing oils and fats?
9. List the changes that oils and fats undergo when used in food preparation.
10. List the factors that increase the absorption of fat during frying foods.
11. What are the effects of continuous heating on the nutritive value of oils and fats?
12. What does the choice of oils and fats depend on?
13. List the desirable characteristics of fat used for deep fat frying.