NUTRITIVE VALUES AND REQUIREMENTS – CONTINUED

TUTOR TALK: The Learning Outcomes for this assignment are:

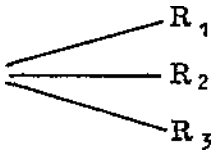
- Summarise the importance of fats and proteins in the diet

FATS

Fats are also compounds of carbon, hydrogen and oxygen but contain less oxygen than carbohydrates. It has already been mentioned that excess carbohydrate is converted into fat and so fats (and oils, which are liquid at normal temperatures) are the forms in which animals and some seeds store their energy.

Fats are found in foods as visible fats, e.g. in butter, margarine, oils and the fat on meat as well as invisible fats in milk, nuts, lean meat, some fish etc.

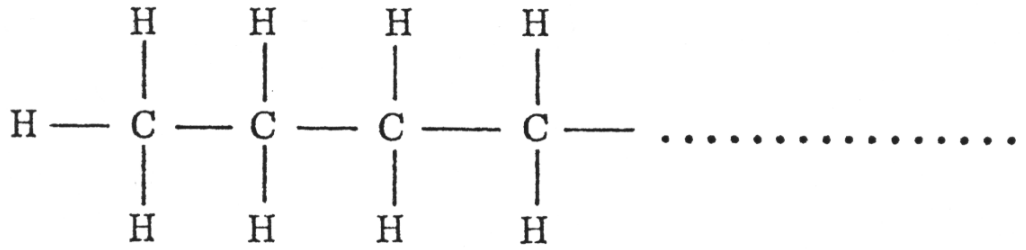
Chemically, fats are mixtures of triglycerides. Each triglyceride is a combination of three fatty acid molecules with one of glycerol.

Glycerol 

R_1, R_2 and R_3 may be the same or different fatty acids and it is the type or types, of fatty acids in the fat which give the fat its flavour, texture melting point and other characteristics.

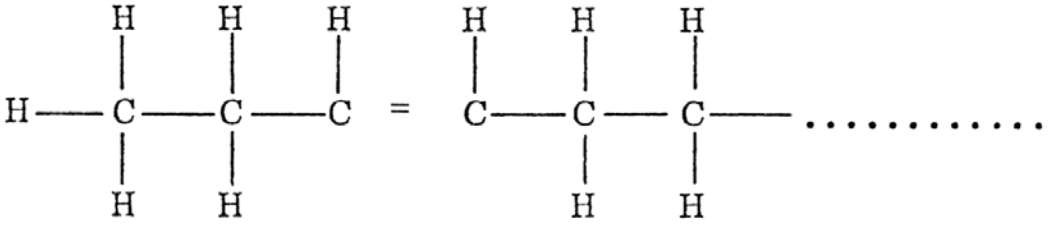
The chemical basis of every fatty acid is a long string of linked carbon atoms, the length of which varies with the fatty acid.

In some fatty acids each carbon atom in the chain has its full complement of hydrogen atoms:



i.e. the carbon atoms are linked by single bonds. These are saturated fatty acids and fats formed mainly of saturated fatty acids are usually (though not always) solid at room temperature. Butter, fat, lard and coconut oil have a high percentage of saturated fatty acids.

In unsaturated fatty acids one or more of the carbon atoms does not have the full complement of hydrogen atoms and so there is a double bond.



When an unsaturated fatty acid has two or more double bonds it is said to be polyunsaturated.

Most fats contain both saturated and unsaturated fatty acids but in widely varying proportions, e.g.

Butter	60% saturated	35% unsaturated fatty acids by weight
Soft Margarine	31% "	66% " " " "
Cheddar Cheese	60% "	35% " " " "
Olive oil	14% "	81% " " " "
Lamb (average)	48% "	43% " " " "

Fats with a high percentage of unsaturated fatty acids are usually liquid at room temperature. Under controlled conditions unsaturated fatty acids can be converted to saturated fatty acids, a process known as hydrogenation and use is made of the process during the manufacture of margarine. The liquid oils used are hardened as a result of the hydrogenation.

Three polyunsaturated fatty acids, linoleic, linolenic and arachidonic acids, are known as essential fatty acids because they are required for normal health but cannot be made in the body.

Linoleic acid occurs in large amounts in vegetable seed oils, e. g. soya bean oil, and in small amounts in some animal fats.

Linolenic acid occurs in small amounts in vegetable oils.

Arachidonic acid occurs in small amounts in some animal fats and can be formed in the body only from linoleic acid.

Fats and oils belong to a larger group of natural substances, *LIPIDS*:

- Oils and fats are derivatives of fatty acids.

- Phospholipids are found in cell protoplasm, e.g. nerve and brain cells. One phospholipid, lecithin, is found in egg yolk and is an emulsifying agent.

- Steroids are quite different from the other lipids. Cholesterol is an important steroid found in body tissue and some foods, e.g. egg yolk. It is a normal constituent of blood. Vitamin D (cholecelciferol) is related to cholesterol.

FATS IN THE DIET

Foods containing fats are useful for their energy value as fat forms a compact energy source (1g. yields 9 Cals.) and can prevent a diet being too bulky. Some fat is stored in the body, provides heat insulation and protection to certain organs, e.g. the kidneys.

Fat is required for the palatability of many foods and to achieve a palatable diet, and to feed well at least 20-25% of the total Calories should come from fat.

In fact, the fat content of the diet more usually provides 25-35% of the total Calories and the more affluent the society the higher the percentage. However, high fat diets are high in energy and do, except for the physically active, lead to obesity.

Fats slow down the emptying of the stomach and give a sense of satisfaction and satiety after a meal and delay the feeling of hunger. Most animal fats provide the fat soluble vitamins A and D.

In plants, the fat is made from carbohydrates; as the seeds ripen the amount of starch decreases and the fat content increases and accounts for the useful amount of oil in sunflower and cotton seeds and in soya beans. Soya bean oil is used in large quantities for cooking oil. The fat content of cereal grains is small as it is of fruits and vegetables, exceptions being nuts, olives and avocado pears.

Fatty fish, e.g. herrings, mackerel, salmon, tuna, have fat in the flesh and the proportion varies with the season of the year. This fat is a useful source of the fat soluble vitamins A and D. White fish contains little oil except in the liver, e.g. cod liver oil, halibut liver oil. The fat content of animal foods is especially variable.

Fish oils differ from vegetable and animal fats in that they contain a much greater proportion of highly unsaturated fatty acids. The ratio of polyunsaturated to saturated fatty acids in the whole diet is normally about 0.2:1 but would be increased if less beef, lamb and dairy foods and more poultry, soft margarine, fish and vegetable oils were eaten.

About 40% of the fat in the diet comes from visible fats, e.g. butter, margarine and cooking fats and oils, and much of the rest comes from protein foods, e.g. milk, cheese, eggs, meat, bacon and fatty fish.

The choice of fat-containing foods, however, is very individual and the figures can only be an approximation. Where the intake of fat is low there may well be a low intake of protein and other important nutrients.

Average fat content of some foods:

	g. per 100 g.
Milk	3.8
Cheddar cheese	33.5
Butter	82.0
Eggs	10.9
Lard	99.0
Peanuts, fresh	49.0
Vegetable oils	99.9
Chicken (dark) boiled	9.9
Beef stewed	11.0
Pork roast (lean)	6.9
Cod, bakes	1.2
Herring, grilled	13.0

Butter, margarine, cooking fats and oils contribute approximately 40% of the total fat intake. Milk, cheese and egg can be expected to contribute some 15%; meat, bacon, poultry and fish 30%. As expected cereal products contain little fat, contributing only about 5%. The remaining 10% comes from miscellaneous sources.

TUTOR TALK: Oils which are true fats must not be confused with mineral oils derived from petroleum. The latter, paraffin oil, etc., are completely indigestible in the body and inhibit the absorption of fat soluble vitamins. They have been banned from foods in Great Britain since 1945.

During digestion, more fully described later, fats are first broken down into smaller particles (emulsified) and then fatty acids are split off from the fat molecule so that there is a mixture of free fatty acids and mono – and diglycerides. As hydrolysis is not complete there is little glycerol produced.

The absorption of fats is not entirely understood but it appears that some fats are absorbed undigested, in the highly emulsified form, into the blood stream; other fats are absorbed in the partially hydrolysed state and are rebuilt into triglycerides and carried in the lymph to the blood stream.