Fat —as a macro nutrient

Key Words

Fat: a macro nutrient supplying the body with a concentrated energy source

Oils: Fats liquid at room temperature e.g. sunflower oil

Solid fats: Fats solid at room temperature e.g. butter + lard

Visible fat: Fat in food seen easily e.g. fat on bacon

Invisible fat: Fat in food that cannot easily be seen e.g. butter in cooked pastry, oils in fried foods I.e. doughnuts and crisps

Fatty acid: part of a fat molecule

Triglyceride: fat molecule made up of 1 part glycerol + 3 fatty acids

What is it and what is it made of? - a macronutrient found in animal and plant foods. Fat is solid at room (ambient) temperature/oil is liquid. Exactly the same energy value: 9kcal/37kJ per gram

Functions in the body. (what it does in the body):

- Provides an energy store (in the adipose tissue under the skin)
- Insulates to keep the body warm
- Protects bones and kidneys from damage providing a cushion layer
- Provide fat soluble vitamins A, D, E and K.

Similarities and differences between a fat and an oil

- **Similarities**: – Both: are made of triglyceride molecules: 3 fatty acids + 1 glycerol. Have exactly the same energy value: 9kcal/37kJ per gram. Are made of a mixture of fatty acids.

- **Differences**: Fat is solid at room (ambient) temperature/oil is liquid. Fats can be spread (they are plastic), creamed, rubbed in/oils are poured. Fats contain a lot of saturated fatty acids/ oils contain a lot of monounsaturated and polyunsaturated fatty acids.

Sources of solid animal fats:
- **Visible** fat in meat, cheese, butter, lard, suet
- **Invisible**: cheese; butter in cakes, pastries and desserts. Meat products e.g. sausages + burgers. Marbling in meat. Processed meals and take away.

Sources of solid plant fats:
- **Visible:** white vegetable fats, veg. fat spreads, (margarines), coconut cream, cocoa butter
- **Invisible:** Processed foods. Chocolate + pastries, cakes, biscuits, dougnuts and breads made with hydrogenated white veg. spreads. oils in tuna, block vegetable fat, ghee, plant oils e.g. palm, olive and sunflower

Sources of liquid animal oils:
- **Visible:** animal oils, cod liver oil, oily fish, e.g. mackerel + sardines
- **Invisible**: milk, cream, egg yolk, oily fish

Sources of liquid plant oils
- **Visible:** plant oils, nuts and seed oils (e.g. sunflower, sesame, rapeseed, corn, olive, almond)
- **Invisible:** many processed foods, ready meals + take away foods

What are fatty acids?

Monounsaturated fatty acids: fatty acid found mainly in solid fats and liquid oils

Saturated fatty acids: fatty acids found mainly in solid fats e.g. butter, lard, suet, block margarine, ghee, fat on meat, palm oil, coconut and chocolate

Unsaturated fatty acids: fatty acids found mainly in liquid plant oils e.g. olive, rapeseed, sunflower, + corn; oily fish, avocado pears, nuts, seeds + some veg. fat spreads

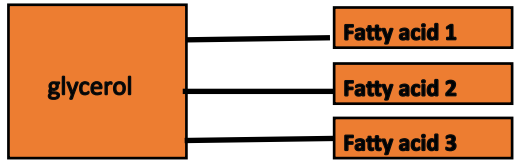
Essential fatty acids: when we eat food, our body breaks up (digests) the fat molecules they contain to make new fatty acids and fat molecules for our body to use. The two essential fatty acids needed by adults and children that cannot be made by the body and have to be eaten in the form of food are found in oily fish, plant and seed oils, eggs and fresh meat.

Effects of deficiency

- If carbohydrate intake is also reduced, body weight will be lost because the body uses its energy store from its fat cells + it will not be replaced
- The body will chill quickly because there is not enough fat to insulate
- The body will easily bruise as there is not a thick enough cushion of fat for protection
- Body will not receive enough vitamins A, D, E and K as these are found in foods containing fat

Effects of excess: Fat is energy dense – 9kcal per gram. Eating too much can lead to weight gain. Could contribute to developing cardio vascular disease (CVD) and coronary heart disease (CHD)

Chemical structure of fats:



Amount needed for different life stages

The amount needed is calculated as a percentage of our total daily energy intake. The recommended healthy adult amount is:

Type of fat	% of food energy every day
Total fat of which:	**No more that** 35%
Saturated fatty acids	11%
Monounsaturated fatty acids	13%
Polyunsaturated fatty acids	6.5%
Trans fatty acids	No more than 2%

Fats —Functional and chemical properties

Remember: All fats and oils are all made of triglycerides – three fatty acids and one part glycerol.

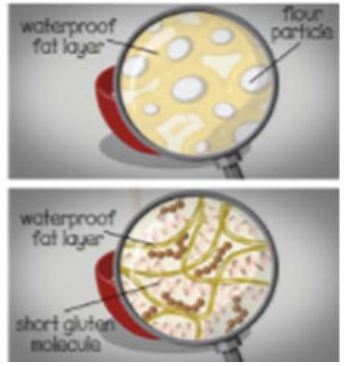
Key words:

Aeration: fat can trap lots of air bubbles when beaten together with sugar e.g. cakes
Emulsification: Prevents oil in water or water in oil colloidal structures from separating out due to its hydrophilic and hydrophobic ability.
Plasticity: fat can be softened over a range of different temperatures so that it can be shaped and spread with light pressure
Shortening: fats shorten the length of the gluten molecules in pastries and cookies making a 'melt in the mouth texture'

Plasticity:
Fat can be spread on bread and crackers due to the plasticity of the fat. Plasticity means: the ability to be shaped and spread with light pressure. The plasticity of fats is due to their chemical structure. All fats are a mixture of triglycerides, containing different fatty acids. The triglycerides all have different melting temperatures. This is why fat will soften and melt over a range of temperatures, for example, chilled butter is very hard and so difficult to spread. When chilled the butter has little plasticity. At room temperature, the butter softens and becomes more plastic and which means it can spread easily. Saturated fats, such as butter, ghee and solid coconut oil tend to be more solid at room temperature and so have less plasticity. The more unsaturated fatty acids a fat contains the less solid it is and the more plasticity it has. Some vegetable fat spreads are made using triglycerides with a low melting temperature, which means we can spread them as soon as they come out of the refrigerator. A recipe that demonstrates plasticity is chocolate mousse, made with butter and plain chocolate.

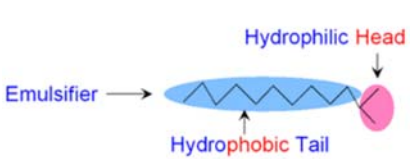
Shortening:
Shortcrust pastry, shortbread and biscuits rely on fat to give them their characteristic crumbly texture. The fat coats the flour particles and prevents them from absorbing water giving them a waterproof layer. This reduces the formation of gluten development, which would cause the dough to become elastic. When water is added, the gluten strands can only form short lengths because of the waterproofing of the fat. The texture of pastry and rubbed in biscuit mixtures is therefore 'short' and tender. When rolled, the pastry does not spring back like a bread dough does due to the **short gluten molecules.**

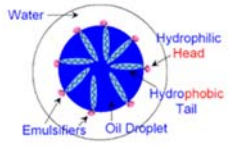
Fats such as pure vegetable fats are suitable for shortening because of their low water content. There are distinctive colours associated with the type of fat used, for example, butter produces a golden colour. Fats are also best used chilled because butter will soften in warm conditions due to plasticity. If it is too warm, it will quickly become oily when rubbed in and the pastry will be hard to handle. If it is chilled, it can be rubbed in more effectively.



Emulsification:
Food products e.g. mayonnaise, milk, butter and Hollandaise sauce are emulsions of either oil-in-water or water-in-oil.

- Oil and water will not mix together permanently. If shaken together the oil will eventually rise to the top (less dense)
- Oil and water can be made to mix together by adding an emulsifier. The emulsifier used in mayonnaise is called lecithin, which is found in egg yolk.
- Emulsifiers are molecules with two ends. One end is attracted to water (it is hydrophilic) and the other end is attracted to oil (it is hydrophobic – it doesn't 'like' water).
- When an emulsifier is added to a mixture of oil and water, its molecules arrange themselves so that they prevent the oil and water from separating. The mixture is now an **emulsion.** This is why mayonnaise does not separate when it is stored.





Aeration:

- Fats such as butter and vegetable fat spreads are able to trap air bubbles when they are beaten together with sugar for a cake mixture.
- They can do this because they have plasticity, which means they can be beaten, spread and mixed easily with a wooden spoon or whisk.
- Cooking oils do not trap air as effectively.

Mixing fat and sugar together is called **creaming** because, as the air bubbles are trapped, the mixture becomes lighter in colour and texture and its volume increases.

- The ability of the fats to aerate the mixture in this way is really important for producing a light, spongy texture in the baked cake
- Raw cake mixture consists of flour, fat, protein, sugar crystals and water (from egg white). These are interspersed with trapped air bubble, egg protein molecules (which are in tight coils) and starch granules (in the flour). As the mixture bakes, the fat melts; sugar crystals dissolve; egg protein molecules uncurl; as the y star to coagulate; starch granules in the flour swell and absorb melted fat and water from eggs; baking powder releases CO2; the air and CO2 bubbles expand with heat causing mixture to rise up and outwards. The mixture sets **as** the egg proteins become solid **(coagulate)** and the starch granules completely expand as it sets and the gases escape from the mixture**.**