

Fats — Functional and chemical properties 2.2.3

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'

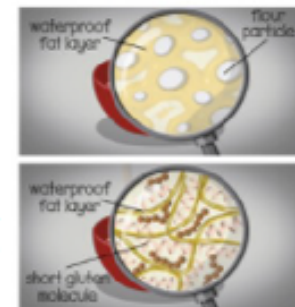
Plasticity:

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.

