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Homogenisers

The technology behind disruption of fat globules

Homogenisation has become a standard industrial process, universally practised as a means of stabilising the fat emulsion against gravity separation. Gaulin, who invented the process in 1899, described it in French as "fixer la composition des liquides".
Homogenisation primarily causes disruption of fat globules into much smaller ones (Figure 6.3.1). Consequently, it diminishes creaming and may also diminish the tendency of globules to clump or coalesce. Essentially, all homogenised milk is produced by mechanical means. Milk is forced through a small passage at high velocity. The disintegration of the original fat globules is achieved by a combination of contributing factors such as turbulence and cavitation.
The homogenisation reduces fat globule size from an average of 3.5 µm in diameter to below 1 µm. This is accompanied by a four- to six-fold increase in the fat/plasma interfacial surface area. The newly created fat globules are no longer completely covered with the original membrane material. Instead, they are surfaced with a mixture of proteins adsorbed from the plasma phase.

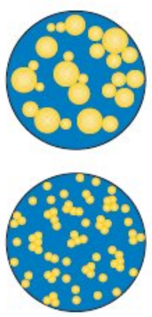

Fig. 6.3.1 Homogenisation causes disruption of fat globules into much smaller ones.

Fox et al.1) studied a fat-protein complex produced by the homogenisation of milk. They showed that casein was the protein half of the complex and that it was probably associated with the fat fraction through polar bonding forces. They postulated further that the casein micelle was activated at the moment it passed through the valve of the homogeniser, predisposing it to interaction with the lipid phase.

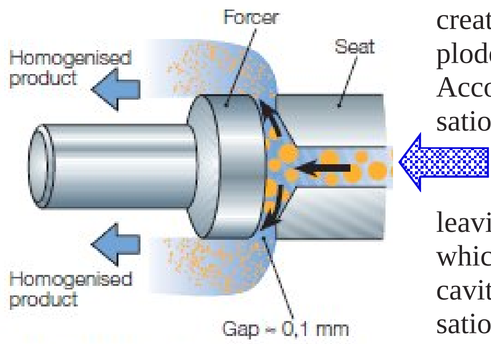

Fig. 6.3.2 At homogenisation, the milk is forced through a narrow gap where the fat globules are split.

Homogenisation theories

Many theories of the mechanism of high pressure homogenisation have been presented over the years. For an oil-in-water dispersion like milk, where most of the droplets are less than one µm (10–6 m) in diameter, two theories have survived. Together, they give a good explanation of the influence of different parameters on the homogenising effect.
The theory of globule disruption by *turbulent eddies* ("micro whirls") is based on the fact that a lot of small eddies are created in a liquid travelling at a high velocity.
Higher velocity gives smaller eddies. If an eddy hits an oil droplet of its own size, the droplet will break up. This theory predicts how the homogenising effect varies with the homogenising pressure. This relation has been shown in many investigations.
The *cavitation* theory, on the other hand, claims that the shock waves created when the steam bubbles implode disrupt the fat droplets. According to this theory, homogenisation takes place when the liquid is leaving the gap, so the back pressure which is important to control the cavitation is important to homogenisation. This has also been shown in practice. However, it is possible to homogenise without cavitation, but it is less efficient.

Effect of homogenisation

The effect of homogenisation on the physical structure of milk has many advantages:
• Smaller fat globules leading to less cream-line formation
• Whiter and more appetizing colour
• Reduced sensitivity to fat oxidation
• More full-bodied flavour, and better mouthfeel
• Better stability of cultured milk products

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