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Supramolecular Organisation of Fat in Dairy Products

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Milk fat is widely consumed in different kinds of products, i.e. milk, cream, ice-cream, cheese, butter and as anhydrous milk fat. The texture, flavour and physico-chemical properties of these products are greatly governed by fat. However, information on the supramolecular organisation of fat in dairy products was scarce. The objective of this work was to characterize the organisation of fat and to identify the mechanisms involved in its evolutions, in situ in dairy products. The microstructural analysis was performed using confocal laser scanning microscopy (CLSM). The original protocols developed to stain both the protein and fat phases allowed to visualise thin optical sections of fresly cut samples without disturbing their internal structure. This study showed that the mechanical and thermal treatments applied during processing of milk, modify the structure of milk fat globules and the composition of their interface following rupture of the milk fat globule membrane (MFGM) and adsorption of proteins. As a result, milk fat can be dispersed in dairy products as (1) fat globules covered by the MFGM (4 μm), (2) aggregates of fat globules (10-50 μm), (3) tiny homogenised fat globules (0.5 μm) mainly covered by caseins, (4) coalesced fat globules (10-20 μm), (5) non-globular fat and (6) a combination of the different organisations. Furthermore, changes in the organisation of milk fat globules were characterised during the manufacture of Emmental cheese and permitted to identify that pressing (0.4 kPa, 4 h, 47°C) results in the greatest disruption of fat globules. Natural milk fat globules are rarely consumed. Thus, the knowledge of the organisation of fat in complex food products is of primary importance regarding its technological, functional, sensorial as well as nutritional properties.