Interactions of Emulsifiers and Solids in a Lipophilic Environment

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Lipophilic suspensions contain fine solids dispersed in a lipophilic, continuous phase. Chocolate masses or peanut butter are typical examples for food applications of such systems. In the case of milk chocolate, sugar, milk powder and cocoa particles form the disperse phase. Due to varying solid surface polarities, interactions of solids with the lipid phase and among each other differ significantly. These interactions mainly determine suspension properties, e.g. flow behavior and fat immobilization at particle surfaces. Additionally, a grinding step of the solids is often required for sensory reasons (smoothness) and may result in an activation of particle surfaces influencing these interactions, too.

To control the interactions and to obtain desired suspension properties, e.g. low viscosity and yield value, food-grade and fat-soluble emulsifiers like lecithin are added. It is assumed that the emulsifiers move to the solid surfaces and cover them resulting in a release of previously immobilized fat from the surfaces. However, the real interactions of the emulsifiers with the different solid surfaces are not known in detail yet.

To obtain more information on these effects, investigations were carried out. Suspensions of sucrose and milk powder in cocoa butter as examples for milk chocolate were ground by a roller refiner and treated mechanically according to the conching process of chocolate mass. Phospholipids (lecithin), polyglycerol polyricinoleate (PGPR) and citric acid esters were added as emulsifiers before and after the grinding step. Fat immobilization and flow behavior of the suspensions were determined. The solids differed in the amount of fat being immobilized on their surfaces and the amount of fat being released from the surfaces by emulsifier addition. Presence of emulsifier during grinding resulted in a reduced fat immobilization at solid surfaces compared to an addition after grinding. This effect was more pronounced for milk powder than for sugar. Degree of fat immobilization correlated significantly with suspension viscosity independent of added emulsifier. An optimum degree of fat immobilization could be detected resulting in the lowest yield value of lipophilic suspension. Chocolate manufactures can use these data to choose appropriate emulsifiers and an adapted processing regime to obtain the required flow properties with lowest consumption of raw materials and energy.