Popular Science Abstract

What crystals have to do with the quality of stored food products

Some food components can form crystals when the foodstuff is stored over an extended period of time. These crystals can impair the product's texture and appearance. It is therefore important to control crystallisation in foods to preserve their quality.

When you think of a crystal, you might have a shiny objects in mind, maybe made from water, like snowflakes or ice cubes or made from carbon, like a diamond on an engagement ring. In chemical terms, the crystalline state is one of two solid states that a compound can exist in. Food components such as fats, proteins and sugars can form crystals. In some applications, as for instance ice cream and margarine, crystals are necessary to provide a certain texture.

However, crystals can also form unintentionally in foods such as UHT milk and heavy cream. In these products, the milk fat is initially present as liquid droplets floating around in an aqueous medium. When these products are stored or shipped, the liquid fat droplets can crystallise over time. The fat crystals can grow really big and form sharp edges. The large fat crystals tend to get entangled when they collide. Then they stick together and merge. Eventually, the fat crystals may form one big layer, which floats up. This might make you think that the product has turned bad and make you discard it.

This project was aimed at finding mechanisms to control the fat crystallisation during storage of high fat liquid dairy products. Milk fat is a highly complex natural fat with a varying composition depending on seasonal factors and cow genetics. Therefore, hydrogenated palm oil was used as a model fat. It has a known composition and similar key features to milk fat. After screening the literature, two approaches to control the fat crystallisation were chosen: (a) rapidly cooling the product from the temperatures at which it is processed, i.e. temperatures above the melting point of the fat, to the temperature at which the product is stored and (b) adding certain fats, called phospholipids, because these allow to induce a controlled crystallisation process. Both approaches were expected to lead to the formation of small, equally sized, roundish fat crystals, which would not easily get entangled.

Approach (a) showed no significant effect on any product parameter. Approach (b) on the other hand led to a more uniform crystal size. The benefit of this effect is however outweighed by the costs, that the addition of phospholipids incurs. This is especially true since the quality and the stability of the products were acceptable even without following either approach (a) or (b).

The results of this project suggest that a product formulation without added phospholipids and a cooling process that is not intentionally accelerated are most efficient to reach a stable high fat liquid dairy product.