A rapid analytical method to study the chelation of calcium by complexing agents like emulsifying salts

Fanny BRUNISSEN

Introduction

Processed cheese spread is a common product in the world, and its sales have been growing for over a century. It is a product of second transformation and is also longlife. Its nutritional value and taste make this cheese very pleasant, more particularly to children. However, the role of all the ingredients on the structure of the processed cheese is unknown. The aim of my project is to find the role of the emulsifying salt on the disintegration of the casein micelle. Processed cheese is a very complicated matrix, therefore we have to use skimmed milk to perform analyses.

Background

Milk is composed mostly of water, fat, casein and minerals. There are 4 types of caseins, and they form casein micelles with bonds between calcium and protein. Casein micelles are dynamic structures, sensitive to physical and chemical changes, specially pH. Casein micelles have a diameter of 200 nm, and caseins are approximately 20 nm long.
Emulsifying salts are derived from phosphoric acid, or citric acid, and possibly from tartaric acid. Their action is to chelate cations such as calcium in solution. Calcium bonds chelate to help the casein to form micelles. The consequence of emulsifying salt addition in milk is a dissociation of the micelle because they break calcium bond. Emulsifying salts are buffering as well. Their action is more or less important depending on the temperature and the pH of the solution.
Micelles without modification have a diameter of 200 nm. When the calcium is chelated, caseins are free in solution. Light diffusion is different in milk compared to a milk solution mixed containing emulsifying salts. The solution turns yellow and becomes transparent. This phenomenon can be followed by UV/Vis spectroscopy.

Material and methods

The instrument used to follow the absorbance of the solutions is a Thermo Scientific Evolution 300 UV/Vis spectrometer. The wavelength used is 700 nm and the polypropylene cuvette has a path length of 2 mm. A salt solution at 12.8% of emulsifying salt is added to a solution of milk. The integration time for measuring the absorbance is 3 seconds and a background is done beforehand with deionised water.

Results and discussion

Every emulsifying salt has been tested on milk at 25°C, and the pH was fixed at a value of 5.6.

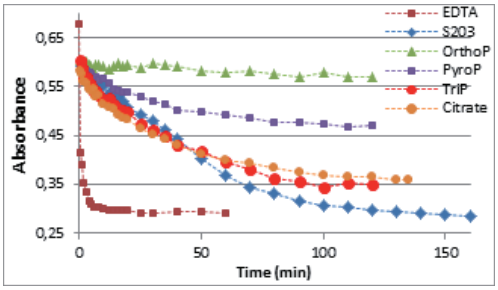

Figure1: *Kinetic monitoring of the chelating ability at 25°C according to the different emulsifying salts*

We can classify emulsifying salts by their ability to chelate the calcium. The salt which decreases the milk absorbance the most at 700 nm is the best chelating agent. As can be seen from figure 1, S203 (polyphosphate) is therefore the best one and OrthoP is the worst. EDTA has been chosen as a control of a total chelation, because it is known as the best calcium chelating agent.

Conclusion

To conclude, experiments were done at different temperatures and have shown that the polyphosphates have the best chelating ability at 50°C, when containing the industrial ratio of emulsifying salt