Crystallization and Oxidation of Dairy Model Emulsions

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Milk fat is a complex material which exhibits a large solid-liquid phase transition between 5 and 40°C. Within this temperature range, and depending on crystallization conditions, *i.e*. bulk *vs* emulsified fat (Relkin et al., 2005), milk fat is a mixture of liquid and solid fats, the liquid fraction containing the most unsaturated triacylglycerols. Indeed, despite its high content in saturated fatty acids, milk fat also contains up to 50 % unsaturated fatty acids, These unsaturated fatty acids can be oxidized, especially when the lipids are dispersed as oil droplets in emulsion systems. In fact, crystallization at sub-zero temperatures was found to modify the oxidative stability of emulsified sunflower oil (Calligaris et al., 2007),

In this study, we considered the milk fat as a relevant material to evidence the impact of the solid or liquid state of lipids on their oxidation. Model milk fat emulsions made of several milk fat fractions were designed and kept in temperature conditions (5 to 50 °C) aimed at varying the physical state of the lipids. Differential scanning calorimetry (DSC) was performed to determine the solid fat content of the emulsions. Oxygen consumption was measured in the head-space of the emulsions to evaluate their oxidation initiated by Fe(III)-ascorbate.

Very interestingly, we observed unexpected high temperature-shifts in the solid-liquid phase transition of the emulsified milk fat fractions, the percentage of solid fat fraction in the emulsions being less than in the bulk. The results also confirm the major effects of temperature and fatty acid unsaturation on oxidation kinetics. However, deviation in Arrhenius plot can be attributed to milk fat liquid/solid ratio.

This work was carried out with the financial support of the « ANR- Agence Nationale de la Recherche - The French National Research Agency » and the French dairy board (CNIEL, Paris) under the « Programme National de Recherche en Alimentation et nutrition humaine », project AGILAIT, ANR-06-PNRA-012.