LOQ 1b / PRO 1b: Effect of Processing on Lipid Oxidation in Oils and Fats and Lipid-containing Foods
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Effects of Modified Phosphatidylcholine on Physical and Oxidative Stability of Omega-3 Delivery 70% Oil-in-Water Emulsions Betül Yesiltas*[1], Ann-Dorit Moltke Sørensen[2], Pedro J. Garcia-Moreno[2], Sampson Anankanbil[3], Zheng Guo[4], and Charlotte Jacobsen[2],[1]*National Food Institute, Technical University of Denmark, Denmark;* [2]*Technical University of Denmark, Denmark;* [3]*Dept. of Engineering, Aarhus University, Denmark;* [4]*Aarhus University, Denmark*

The objective of this study was to investigate the effects of modified phosphatidylcholine (PC) with different alkyl chain lengths (C14 and C16) and covalently attached caffeic acid on the oxidative and physical stability of high fat 70% fish oil-in-water emulsions. It is hypothesized that 1) modified PC improves the physical stability of emulsions when used in combination with sodium caseinate (CAS) and soybean PC, by its high surface activity as a surfactant, and that 2) modified PC enhances oxidative stability due to the attachment of caffeic acid to the glycerol backbone of PC, which brings the antioxidant in the vicinity of oil-water interface. Physical stability of the emulsions were analyzed using droplet size, viscosity, zeta potential, interfacial tension, and protein content in the aqueous phase. Peroxide value, changes in tocopherol content and secondary volatile oxidation products were determined to evaluate oxidative stability. Results showed that the physical stability of the emulsions was improved with increasing concentrations of added modified PCs. Modified PC C14 showed higher physical stability compared to modified PC C16 by providing smaller oil droplets and higher viscosity as well as higher zeta potential. On the other hand, oxidative stability was higher for the emulsions produced with modified PC C16; increased concentration of modified PC C16 led to a decrease in formation of primary and secondary oxidation products. Modified PCs in combination with CAS and soybean PC thus improved the physical and oxidative stability of 70% fish oil-in-water emulsions compared to emulsions produced with only CAS as an emulsifier.

Effect of Maillard Reaction Conditions on Physicochemical Properties and Oxidative Stability of Microencapsulated Chia Oil Vanesa Y. Ixtaina[1], Bernd W.K Diehl[2], Claudia N. Copado[1], and Mabel Tomás*[1],[1]*CIDCA (CONICET-UNLP), Argentina;* [2]*Spectral Service AG, Germany*

Chia oil presents a very high content of PUFAs, which are very susceptible to lipid oxidation. Some techniques, such as microencapsulation, have been developed to protect this type of oils. Many studies showed that Maillard reaction products (MRPs) have anti-oxidative properties and can be used as wall material for microencapsulation. The objective of this study was to characterize the physicochemical properties of microencapsulated chia seed oil MRPs, as wall material, obtained by different heat treatments. Chia O/W emulsions were composed by NaCas, lactose, and chia oil (10, 15 % wt/wt). The aqueous phase was heated at different temperatures (60 and 100°C) for 30 min to promote the MRPs formation. Then, the microcapsules were obtained by spray-drying the emulsions. All the systems showed high microencapsulation efficiency (~99%). The moisture content and water activity (aw25ºC) of microcapsules ranged between 0.020-2.998 % (d.b.) and 0.243-0.470, respectively. In terms of oxidative stability, the accelerated oxidative test (Rancimat) and the peroxide values (PV) revealed a very significant influence of the heat treatment, with the highest induction time (ti)

and the lowest PV for microcapsules obtained from emulsions with 15% content oil and aqueous phase submitted to heath treatment of 100°C, 30 min.

Impact of Ratios of Polyunsaturated and Saturated Fatty Acids on Oxidation Kinetics in Oil/Water Emulsions Raffaella Inchingolo[1], D. Julian J. McClements[2], Eric A. Decker[2], and Mitchell D. Culler*[2],[1]*University of Massachusetts, USA;* [2]*University of Massachusetts Amherst, USA*

Recently, demand for clean-label food products has necessitated new strategies for preventing lipid oxidation as consumers become skeptical of synthetic antioxidants. One potential strategy is to dilute more easily oxidized, unsaturated fatty acids with more oxidatively stable oils, thereby decreasing oxidation by increasing the time needed for fatty acid free radicals to diffuse to and oxidize other fatty acids. This strategy has proved effective in bulk oils but not oil-in-water emulsions. The effect of diluting fish oil with increasing concentrations of medium chain triglycerides (MCT) on oxidative stability of oil-in-water emulsions was investigated using thiobarbituric acid reactive substances assay (TBARS), lipid hydroperoxides, and head-space aldehydes. Dilutions up to 1:20 of fish oil in MCT were found to extend the lag phase of lipid oxidation markers from 1 to 5 days in oil-in-water emulsions stabilized by Tween 80. To verify that the dilution was effective, two emulsions were prepared, one with fish oil and the other with MCT, and the 2 emulsions were blended to have the same fish oil:MCT ratios. The same protective effect was not observed when the oils were in separate droplets, indicating dilution is responsible for the protective effect. Emulsions containing high oleic sunflower oil were also examined as a more commonly used oil in food production. The protective effect was again demonstrated in mixed emulsion droplets, but not when the oils were in isolated droplets. These results indicated that dilution with more stable lipids presents an effective strategy to delay lipid oxidation in food emulsions systems.

Effective Prevention of Oxidative Deterioration of Fish Oil by the Combination of Amine-compounds and General Antioxidants Mariko Uemura[1], Masashi Hosokawa[1], Kazuo Miyashita*[1], Ai Iwashima-Suzuki[2], and Hiroaki Kubouchi[2],[1]*Hokkaido University, Japan;* [2]*Megmilk Snow Brand Co. Ltd., Japan*

EPA and DHA, abundant in fish oil, are known to have significant biochemical and physiological effects primarily linked to improvement of human health, especially cardiovascular and brain health. However, the incorporation of fish oil into foods and beverages is often challenging as fish oil is very easily oxidized and can cause undesirable flavors. In the present study, we demonstrate the successful prevention of volatile formation in fish oil oxidation by amine-compounds. Several kinds of amine-compounds such as butylamine, stearylamine, and spermine could show antioxidant activity and this activity increased with increasing the number of amine groups. In addition, their antioxidant activity synergistically increased in the presence of general antioxidants such tocopherols, hydroxytyrosol, and carnosic acid. For example, the volatile formation was completely inhibited by the combination of spermine and α-tocopherol up to 5000 hr after incubation of purified fish oil triacylglycerol at 50°C. On the other hand, amine-compounds having hydroxyl group(s) had no antioxidant activity without any general antioxidants, while they showed a strong antioxidant activity in the presence of tocopherols. The most likely mechanism for the antioxidant activity of amine-compounds is the formation of antioxidants by the amino-carbonyl reaction between the amine group