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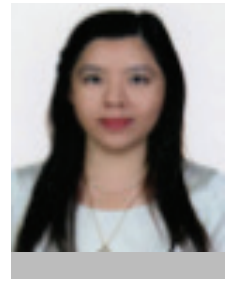

Dissertation

Title *Studies on the Initial Stage of Lipid Oxidation in Bulk Oils*

Faculty Advisor Professor Afaf Kamal-Eldin

Defense Date 15 December 2014

Abstract

During the oxidation of bulk oils, oxidation products (i.e. peroxide values, conjugated dienes and thiobar-bituric acid reactive substances) are formed gradually and increased sharply at the end of the induction period. Tocopherols were consumed, some water was formed, and micelles increased in size during the induction period of vegetable oils oxidized in bulk. The evidence that the evolution of micellar size was in parallel with the end of induction period corroborates the recognition that micelles are the active site of oxidation. The interactions of □-tocopherol and three synergists: ascorbyl palmitate, phosphatidylcholine and L-lysine were studied in cod liver oil, to examine their effects on formation of thiobarbituric acid reac-tive substances. Second order polynomial models were found to satisfactorily represent the slope of changes of conjugated dienes, thiobarbituric acid reactive substances and □-tocopherol during the induc-tion period. The suggested optimized levels of the four additives to protect cod liver oil at 30°C based on the rate of thiobarbituric acid reactive substances formation and loss of □-tocopherol (day 0 to 4) are □-tocopherol (1200 µg/g), ascorbyl palmitate (100 µg/g), phosphatidylcholine at (9000 µg/g) and L-lysine (1000 µg/g). Higher level of □-tocopherol and ascorbyl palmitate did not give better protections to the oils or caused a loss in the antioxidant efficacy, compared to when the additives were added at lower levels. Phosphatidylcholine was effective at a wide range of high concentration while L-lysine improved the pro-tection at levels up to 4000 µg/g.

Research Relevance and Potential Impact

The oxidation of lipids is a very important reaction in foods and biological systems and its implications extend from rancidity in foods to atherosclerosis and other complications in the human body. Understanding the mechanism of lipid oxidation is important for the control and management of this reaction. For about half a decade, the explanation of the initiation, propagation, and termination of lipid oxidation reactions was based on the free radical mechanism. The research presented in this thesis focuses on the involvement of micelles in the catalysis of lipid oxidation and the explanation of the role of different chemical species on the reaction rate. This new understanding will open doors to tailoring of innovative antioxidant and synergistic strategies.

Relevant Publications

- Budilarto E. and Kamal-Eldin A. The Supramolecular Chemistry of Lipid Oxidation and Antioxidation in Bulk Oils. Accepted, European Journal of Lipid Science and Technology, 2015. DOI: 10.1002/ejlt.201400200.
- Budilarto E. and Kamal-Eldin A., Stabilization of cod liver oil with a quaternary combination of □-tocopherol and synergists: Method of assessment. Accepted, European Journal of Lipid Science and Technology, 2015. DOI: 10.1002/ejlt.201400637.
- Budilarto E. and Kamal-Eldin A., Water content and micelle size change during oxidation of sunflower and canola oils. Accepted, European Journal of Lipid Science and Technology, 2015. DOI: 10.1002/ejlt.201400632.

Career Aspirations

I would like to work in scientific based work or projects, either in the academics, a research institution or an industry. I would like to apply the knowledge that I have learned to do research, find solutions and create safer healthier food products.