Evaluation of lipid oxidation in infant formulas

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Infant formulas normally contain a relatively large amount of unsaturated fatty acids together with non-negligible amounts of prooxidant minerals that are required to fulfill nutritional requirements but concomitantly contribute to enhancing the susceptibility to lipid oxidation. The control of lipid oxidation is therefore essential to ensure the nutritional value and safety of infant formulas. However, evaluation of lipid oxidation in infant formulas is a difficult task in great part because the lipids constitute a dispersed or non-continuous phase in a complex matrix. As a result, fluctuations have been usually reported in different oxidation parameters during storage assays. In this lecture, the most recent results obtained in our laboratory through assays carried out in model systems and commercial powdered infant and follow-on infant formulas will be presented. Storage studies were carried out under different conditions, including long-term experiments during the full shelf life (2-4 years at 25ºC) and accelerated oxidation assays at ambient temperatures over 25ºC (30 and 37ºC). The analytical methodology applied to the samples throughout storage started with a differential extraction of free and encapsulated oil fractions, followed by determination of nonvolatile oxidation compounds (oxidized triacylglycerol monomers, dimers and polymers) by SPE-HPSEC-RID and quantification of tocopherols by HPLC-FD. Additionally, alternative extraction procedures such as a modified Folch method as well as methods widely used to evaluate oxidation, such as peroxide value and substrate loss by GLC-FID, were also applied. Among the results obtained, the interferences of extraction procedures with methods for oxidation evaluation, the advantages of the quantification of nonvolatile oxidation products *vs.* other determinations to evaluate the oxidation status and the complementary information provided by tocopherol measurements will be discussed. In particular, the importance of analyzing separately the minor, free oil fraction will be emphasized since results clearly showed that the external oxidation was that responsible for rancidity and hence determined the shelf life of infant formulas in all assays undergone, even though very low oxidation levels were found in the total lipids extracted.