Droplet Composition Affects the Rate of Oxidation of Emulsified Ethyl Linoleate—Supporting Evidence

Sir:

We recently presented a paper in this journal in which we demonstrated that the oxidation kinetics of emulsified oil depends on the ratio of unsaturated (ethyl linoleate) to saturated (*n*-tetradecane) lipid in the droplets (1). We explained our results by considering ethyl linoleate to be more surface-active than *n*-tetradecane, so that it tends to accumulate at the droplet surface, thereby making it more vulnerable to oxidation by aqueous species. However, we had no experimental evidence to support this hypothesis. Recently, we came across some interesting experimental work from a seemingly unrelated area, which supports our hypothesis (2).

As part of a study on the incorporation of oils into micelles, Graciaa and co-workers (2) measured the partitioning of a polar oil (ethyl oleate) between a bulk aqueous phase that contained nonionic surfactant micelles (polyoxyethylated octyl phenol) and a bulk oil phase (*n*-hexadecane). They found that the percentage of ethyl oleate solubilized by the surfactant micelles increased as the total amount of ethyl oleate in the system decreased. Their results indicate that ethyl oleate is more surface-active than *n*-hexadecane, and therefore tends to accumulate at the oil–water interface or in surfactant micelles. Indeed, measurements of the interfacial tensions of ethyl oleate against water and of hexadecane against water were 30.7 and 41 dyn cm^{-1}, respectively.

In our experiments, we found that the initial rate of lipid oxidation in oil-in-water emulsions increased as the percentage of ethyl linoleate in the droplets decreased. This suggests that ethyl linoleate preferentially adsorbs to the droplet surface and is therefore more susceptible to oxidation by aqueous species, which is supported by the observations of Graciaa *et al.* (2) with a similar system.

Appreciation of the influence of the structural organization, interactions, and dynamics of molecules in emulsions and other microheterogeneous materials will certainly lead to a better understanding of the factors that determine their susceptibility to lipid oxidation and to the development of methods for preventing oxidation. As our example has shown, valuable insights may be gained from diverse fields of study.

REFERENCES

1. Coupland, J.N., Z. Zhu, H. Wan, D.J. McClements, W.W. Nawar, and P. Chinachoti, Droplet Composition Affects the Rate of Oxidation of Emulsified Ethyl Linoleate, *J. Am. Oil Chem. Soc. 73*:795–801 (1996).
2. Graciaa, A., J. Lachaise, C. Cucuphat, M. Bourrel, and J.L. Salager, Interfacial Segregation of an Ethyl Oleate/Hexadecane Oil Mixture in Microemulsion Systems, *Langmuir 9*:1473–1478 (1993).

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