

Electron Spin Resonance Spectroscopy - Promising Method to Study Lipid Oxidation in Foods?

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Lipid oxidation is a major cause of deterioration of food rich in fats and oils during processing and storage, leading to losses of sensorial and nutritional quality.

The initial steps of oxidation involve chain reactions with radicals as important short – lived intermediates. The extent of these reactions can be followed by chemical (Peroxide Value) and spectroscopic (UV Absorbance of conjugated dienes) procedures but direct detection of transient radicals remains a good overall indicator of lipid oxidation advancement.

In this context, the determination of the oxidation level of oils by electron spin resonance (ESR) spectroscopy is proposed. This method is chosen because it allows:

- To predict the stability of fats and oils from very early measurements;
- To better understand the reaction mechanisms involved and thus to consider a better control of the phenomenon.

In this study, we developed different methods of radical generation in a triglyceride (triolein) and in vegetable oils (rapeseed and sunflower) in order to better identify and follow the reactivity of free radicals (R° , RO° and ROO°) fitted to lipid oxidation.

Two different methods were tested: photolysis and thermolysis.

- Performed at very low temperature, photolysis allows direct identification and quantification of lipid radicals with differentiation of alkyl radicals (R°) and peroxides (ROO°) in an atmosphere more or less rich in oxygen;
- Radicals generated by thermolysis are extremely reactive and their detection uses a special technique called ESR spin trapping. It is based on the reaction of radicals with diamagnetic compounds (spin traps) added to the system to form more stable radicals (spin adducts) detectable by ESR. Detection of these new radical species allows the indirect detection of radicals involved in lipid oxidation.