INTRODUCTION

During frying, edible oils undergo gradual deterioration of quality due to thermal oxidative reactions leading to the formation of oxidation compounds such as hydroperoxides, aldehydes, alcohols and acids which may be harmful to the human body. Oxidation of food can be prevented by addition of synthetic antioxidants but their safety may be put into question. Hence, consumers may prefer the use of "natural" antioxidants by the food industry as a means to reduce lipid oxidation.

In this study, *Nigella sativa* L. (Ranunculaceae), commonly known as black cumin and “Sinouj” in Tunisia, was used to enrich sunflower oil with a view to improving its thermal resistance during accelerated oxidation at 120°C for four hours.

EXPERIMENTAL PARAMETERS AND SOFTWARE

**FLUORESCENCE SPECTRA**

*Fluorescence spectra of non-saturated and saturated fatty acid methyl esters during heating.*

**CHEMOMETRIC METHODS**

**Independent Components Analysis (ICA)**

- IC1 ($\lambda_{ex}=300-350$ nm, $\lambda_{em}=300-350$ nm) and IC2 ($\lambda_{ex}=350-400$ nm, $\lambda_{em}=400-500$ nm) of the enriched samples, corresponding respectively to 1st and 2nd oxidation products, evolve less as a function of heating time.
- IC3 ($\lambda_{ex}=290-310$ nm, $\lambda_{em}=310-360$ nm) and IC5 ($\lambda_{ex}=280-300$ nm, $\lambda_{em}=300-350$ nm) of the non-enriched samples, corresponding to antioxidants (polyphenols and tocopherols), decrease during heating.
- After 4 hours of heating, the difference between enriched and non-enriched oils becomes greater. The antioxidant peak decreases markedly in non-supplemented samples, whereas it persists in the supplemented ones.

**Parallel Factor Analysis (PARAFAC)**

- Factor 1 ($\lambda_{ex}=350-420$ nm, $\lambda_{em}=40-500$ nm) and Factor 2 ($\lambda_{ex}=300-350$, $\lambda_{em}=360-500$ nm) of the enriched samples, corresponding to antioxidants and decomposition products, evolve less as a function of heating time for supplemented oils.
- Factor 3 ($\lambda_{ex}=290-310$ nm, $\lambda_{em}=310-370$ nm) and Factor 5 ($\lambda_{ex}=280-300$, $\lambda_{em}=300-350$ nm) of the non-enriched samples, corresponding to antioxidants, decrease but remain consistently higher in enriched oils. After 4 hours of heating, the antioxidants disappear in the oils without nigella whereas they persist in enriched oils.

**CONCLUSION**

ICA and ICA-PARAFAC give better results than PARAFAC alone. Both ICA and ICA-PARAFAC scores evolve less as a function of heating time for the enriched samples. These methods can thus be used in highlighting the antioxidant effect of *Nigella*.

This analysis shows that the added *Nigella sativa* L. extract acts as an effective antioxidant in vegetable oils. The addition of such an extract to edible oils may improve their thermal stability and shelf-life.

**REFERENCES**