

HARRICK

Real-Time Monitoring of Thermally Induced *Trans* Fats in Corn Oil Using the FatIR

V. Milosevic and A. Kocak

Harrick Scientific Corp.

New FDA regulations require *trans* fat (TFA) content to be indicated on the Nutrition Facts food labels. This requires routine measurements of the total *trans* fat content in edible oils and fats, and has renewed interest in monitoring the formation of *trans* isomers during oil processing.

Trans fats are unsaturated fatty acids whose carbon chains contain double bonds in the *trans* configuration rather than the more common *cis* configuration. Edible oils have negligible amounts of TFA (1). However, when heated, the *cis* double bonds isomerize to their *trans* configuration. The proportion isomerized depends on temperature, exposure time and degree of unsaturation (2). In this application, we monitor in real-time in situ the thermal isomerization of corn oil at a moderate temperature.

Experimental Conditions

The spectra of heated corn oil were collected in situ using the FatIR prototype in an infrared spectrometer with a DTGS detector. The spectrometer was set for 32 scans at 4 cm^{-1} resolution. Corn oil was placed on the preheated ($30\text{ }^{\circ}\text{C}$) crystal, covering the entire sampling surface, and the spectrum was collected. The temperature was then raised from $30\text{ }^{\circ}\text{C}$ to $102\text{ }^{\circ}\text{C}$ over 15 minutes. Spectra were collected after 0, 5, 30, 70, 115 and 155 minutes. After the sample cooled to $30\text{ }^{\circ}\text{C}$, another spectrum was collected. The spectrum at $102\text{ }^{\circ}\text{C}$ recorded at $t = 0$ minutes was subtracted from the spectra recorded after $t = 5, 30, 70, 115$ and 155 minutes.

Results

Figure 1 illustrates the changes in the *trans* double bond region ($1050\text{--}900\text{ cm}^{-1}$) of the spectrum due to prolonged exposure to moderate heat. There is a marked rise in the 966 cm^{-1} *trans* band with time. In addition, there is an initial increase in the 985 cm^{-1} peak that disappears later. The increase of the *trans* band with time is paralleled with a decrease of the band at 3010 cm^{-1} associated with the CH stretching vibration of *cis* double bonds (Figure 2). The spectra of corn oil at $30\text{ }^{\circ}\text{C}$ before and after moderate heating (Figures 3 and 4) show an increase in the concentration of the *trans* isomer and simultaneous decrease in the concentration of the *cis* isomer.

Conclusion

Single reflection ATR not only provides a fast and easy way for the routine determination of the total *trans* fat content in edible oils and fats, but also enables real-time in situ monitoring of the formation of heat induced TFA. Work is continuing on the optimal design for the dedicated oil analyzer, the FatIR, based on the prototype used herein.

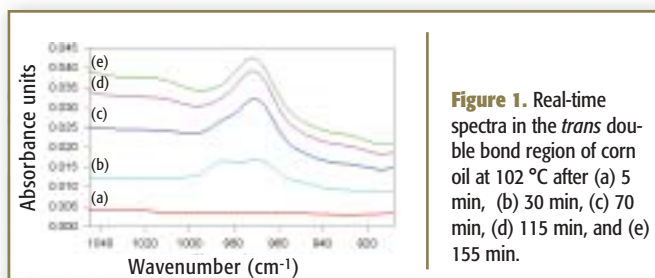


Figure 1. Real-time spectra in the *trans* double bond region of corn oil at $102\text{ }^{\circ}\text{C}$ after (a) 5 min, (b) 30 min, (c) 70 min, (d) 115 min, and (e) 155 min.

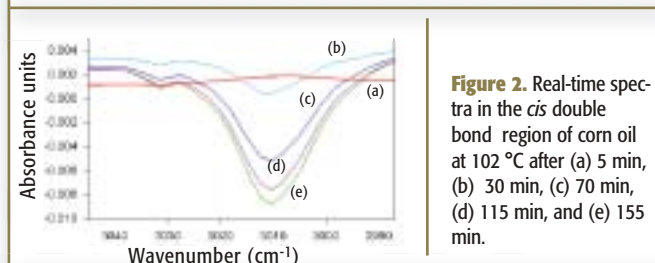


Figure 2. Real-time spectra in the *cis* double bond region of corn oil at $102\text{ }^{\circ}\text{C}$ after (a) 5 min, (b) 30 min, (c) 70 min, (d) 115 min, and (e) 155 min.

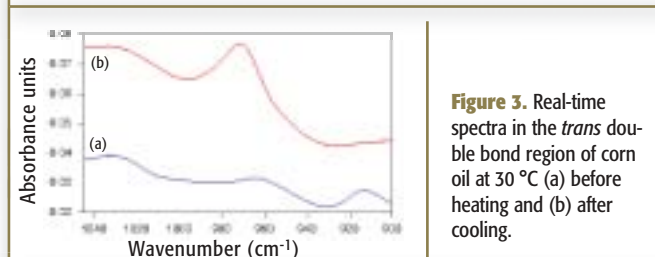


Figure 3. Real-time spectra in the *trans* double bond region of corn oil at $30\text{ }^{\circ}\text{C}$ (a) before heating and (b) after cooling.

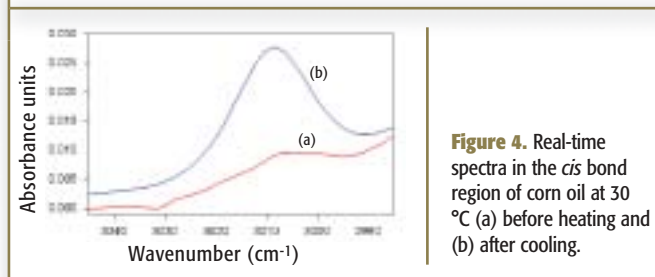


Figure 4. Real-time spectra in the *cis* bond region of corn oil at $30\text{ }^{\circ}\text{C}$ (a) before heating and (b) after cooling.

References

- Masanari Semma, *Journal of Health Science* **48**(1), 7–13 (2002).
- F.R. van de Voort, A.A. Ismail, J. Sedman, and G. Emo, *J. Am. Oil Chem. Soc.* **71**, 243–253 (1994)

Harrick Scientific Corp.

88 Broadway, P.O. Box 1288, Ossining, NY 10562

Tel. (800) 248-3847, Fax (914) 762-0914

info@harricksci.com, www.harricksci.com