

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

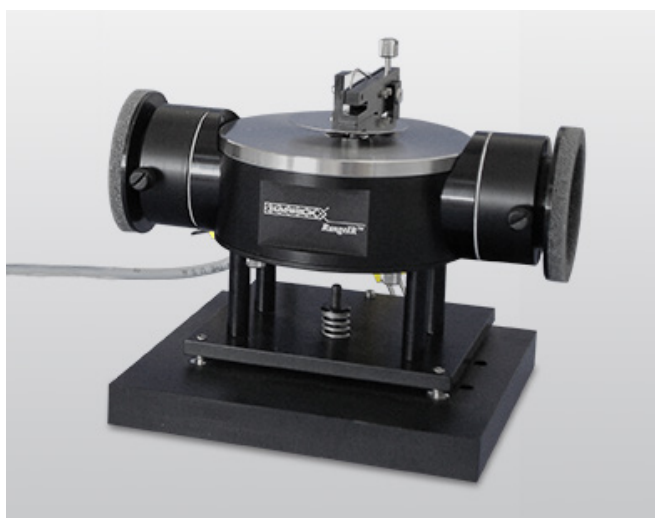


Figure 1. The FatIR™.

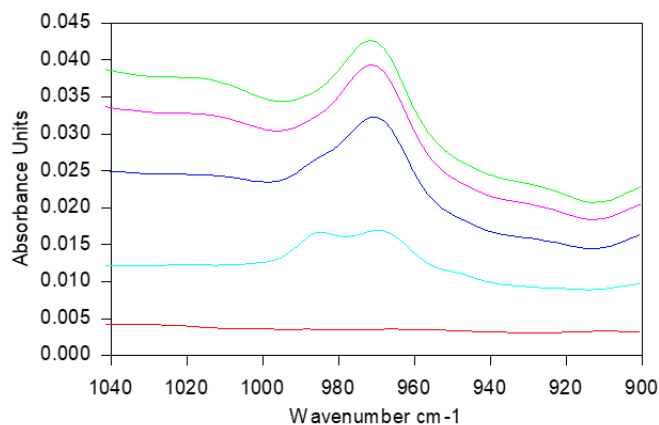


Figure 2. Real-time spectra in the trans double bond region of corn oil at 102°C after 5 min (red), 30 min (light blue), 70 min (blue), 115 min (pink), and 155 min (green).

## INTRODUCTION

*Trans* fats (TFA) are unsaturated fatty acids whose carbon chains contain double bonds in the *trans* configuration rather than the more common *cis* configuration. Edible oils have only negligible amounts of TFA. However, when exposed to heat the *cis* double bonds in oil may be isomerized to their *trans* configuration. The amount of thermal isomerization is a function of temperature, exposure time and degree of unsaturation of the oil. In this application we monitored in real-time *in situ* the thermal isomerization of corn oil at a moderate temperature (102°C).

## EXPERIMENTAL CONDITIONS

The spectra of the heated corn oil were collected *in situ* using the FatIR™ in an infrared spectrometer with a DTGS detector and conditions set for 32 scans at 4 cm<sup>-1</sup> resolution. Corn oil was placed on the slightly preheated (30°C) crystal covering the entire sampling surface. The spectrum of corn oil at 30°C was collected. The temperature of the crystal was slowly raised from 30°C to 102°C over a 15 minute period. Spectra of the corn oil at 102°C were collected after 0, 5, 30, 70, 115 and 155 minutes. The crystal was allowed to cool to 30°C and the spectrum of the cooled corn oil was collected. The spectrum of corn oil at 102°C recorded at t = 0 minutes was subtracted from the spectra recorded after t = 5, 30, 70, 115 and 155 minutes.

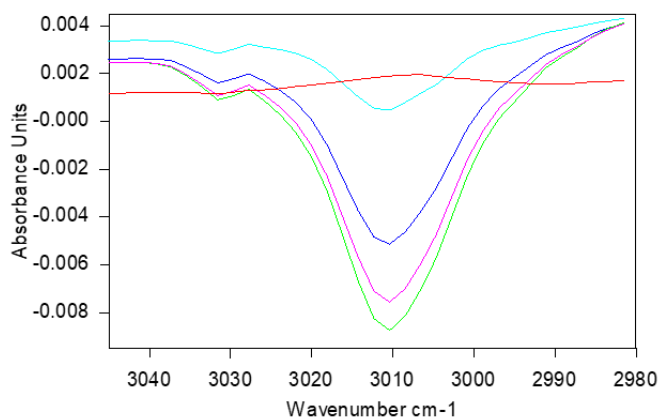


Figure 3. Real-time spectra in the *cis* double bond region of corn oil at 102°C after 5 min (red), 30 min (light blue), 70 min (blue), 115 min (pink), and 155 min (green).

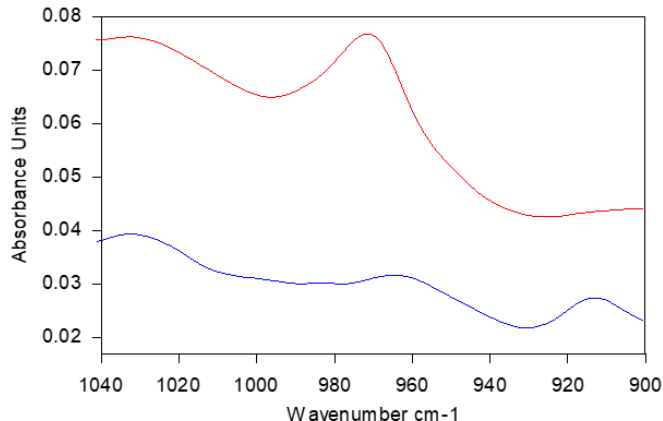


Figure 4. Real-time spectra in the *trans* double bond region of corn oil at 30°C before heating (blue), after cooling (red).

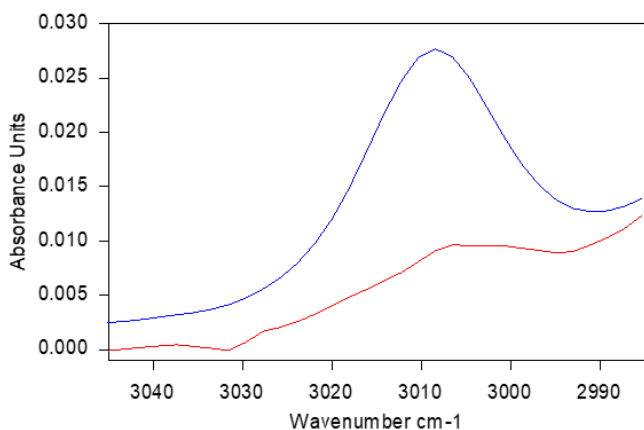


Figure 5. Real-time spectra in the *cis* bond region of corn oil at 30°C before heating (blue), after cooling (red).

## RESULTS

Figure 2 illustrates the changes that take place in the *trans* double bond region (1050-900  $\text{cm}^{-1}$ ) of the spectrum due to prolonged exposure to moderate heat. There is a marked progressive rise in the 966  $\text{cm}^{-1}$  *trans* band with time. In addition to the rise of the 966  $\text{cm}^{-1}$  peak there is also an initial increase in the 985  $\text{cm}^{-1}$  peak that disappears later on.

The increase of the *trans* band with time is paralleled with a decrease of the band at 3010  $\text{cm}^{-1}$  associated with the CH stretching vibration of *cis* double bonds (Figure 3). By comparing the spectra of corn oil before heating ( $T = 30^\circ\text{C}$ ) and after cooling back to 30°C, in the regions of interest (Figures 4 and 5), we see that there are heat induced changes in the *trans* and *cis* regions. Specifically, there is an increase in the concentration of the *trans* isomers and simultaneous decrease in the concentration of the *cis* isomers.

## CONCLUSION

The new FDA requirement that *trans* fats be included in the Nutrition Facts panel has created a need for the routine determination of the total *trans* fat content of edible oils and fats and for the monitoring of the formation of *trans* isomers during processing of vegetable oils.

Harrick Scientific's FatIR™ Oil Analysis System 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.