Application Note
050-AT-0215

Quantitative Analysis of Trans-Fats in Food Products using an FT/IR-ATR Method

Introduction

FT/IR-4000 and 6000 Series
Spectrometers

Trans-fats are formed when liquid oils are chemically modified into solids. These trans-fats are used in a variety of food products. The excessive consumption of trans-fats increases LDL (bad) cholesterol in the blood and decreases HDL (good) cholesterol. Consequently, the consumption of trans-fat products can increase the incidence of ischemic cardiac disease and thus, the trans-fat content in food is of great concern. According to reports by a joint specialists conference of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) of the United Nations, it is proposed that the intake of trans-fats should be limited to less than 1% of the overall caloric intake. As a result of these findings, many foreign countries are now mandating the disclosure of trans-fat content in foods; some EU countries control the content in food and some other countries such as U.S., Canada and Korea are obligated to include the trans-fat content on all food labeling. In Japan, the Consumer Affairs Agency recently announced that food producers will be obligated to state the trans-fats content of all food products.

For these reasons, it is becoming more important to quantify the trans-fat content in food. A quantitative analysis is generally performed according to official methods prescribed by regulatory bodies, with gas chromatography (GC) or infrared spectroscopy being currently used for the official methods for the measurement of trans-fats. The GC method widely used requires some complicated procedures such as separation, extraction and esterification of the sample, and thus requires considerable time and cost. The American Organization of Analytical Chemists (AOAC) formulated a method AOAC 2000.10 using infrared spectroscopy with ATR to evaluate the trans-fat content.

In this application, we demonstrated the quantitative analysis of trans-fats in several types of oil with a calibration made according to the official AOAC ATR method.

Experimental

The AOAC 2000.10 method requires a quantitative calibration be developed and the quantitative analysis of unknown samples performed by measuring the samples using an ATR crystal heated to 65°C to melt the oils completely. The cis- and trans-fats contained in natural fats have IR peaks in the range from 1000 cm^{-1} to 600 cm^{-1}, which is used for the

JASCO INC.
28600 Mary's Court, Easton, MD 21601 USA
Tel: (800) 333-5272, Fax: (410) 822-7526
Application Library: jascoinc.com/applications

quantitative analysis (Figure 1). In the official method, cis-triolein and trans-trielaidin are used as standard samples. The spectrum of cis-triolein in orange and the spectrum of trans-trielaidin in green are overlaid as displayed in Figure 1. Both spectra have similar absorptions in the mid-infrared spectral range except for specific peaks associated with the two different forms as displayed from 1000 cm^{-1} to 600 cm^{-1}.

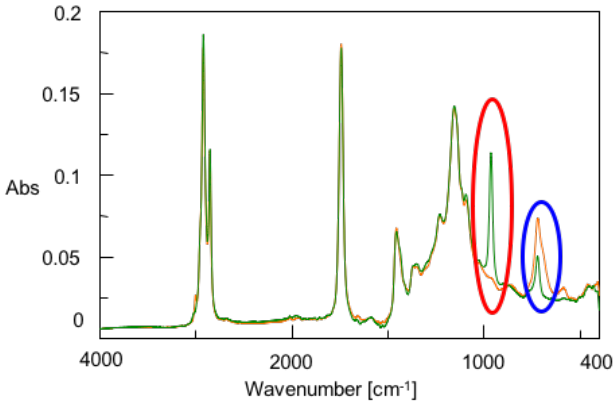

Figure 1. Mid-IR spectra of cis-fats and trans-fats (demonstrating the significant peaks in the highlighted areas)

Measurement Conditions			
Instrument	FT/IR-6100 and a thermostatted single reflection ATR accessory		
Detector	DLaTGS	**Resolution**	4 cm^{-1}
Integration Time	64 scans	**Apodization**	Triangle
Temperature	65 +/- 2°C		
Method	ATR method (Crystal: Diamond) Triolein and Trielaidin (Combination ratio of trielaidin: 0.5, 1, 5, 10, 20, 30, 40, 50 %)		
Standard Samples	Shown in Table 1 (Sample volume: 50 µL or less)		

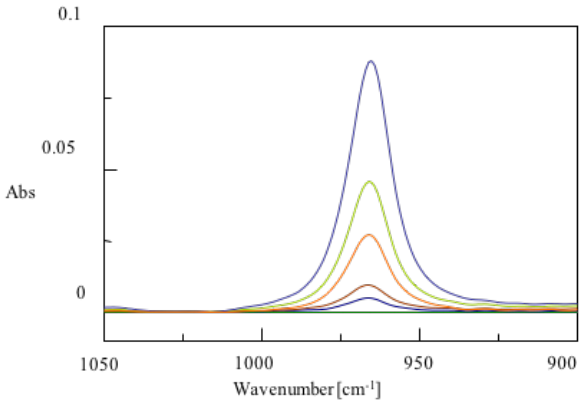

Figure 2. Peaks of trans-fats at 966 cm^{-1}

JASCO INC.
28600 Mary's Court, Easton, MD 21601 USA
Tel: (800) 333-5272, Fax: (410) 822-7526
Application Library: jascoinc.com/applications

Results and Discussion

The trans-fat has a peak due to the C-H bending mode near 966 cm^{-1} and the peak area is used for quantitation in the official method. The overlaid spectra for each concentration at 966 cm^{-1} are shown in Figure 2. Figure 3 is a screen shot of the Quantitative Calibration Program. The calibration curve calculated using the program is displayed in Figure 4. Table 1 outlines the results for the quantitative analysis of several commercial food oils. In general, margarine has a trans-fat content of 1 to 10%, whilst olive oil and sesame oil contain almost no trans-fat. This shows that the system as outlined is effective for the quantitative analysis of trans-fats.

By using the ATR method, the quantity of trans-fats in various types of food oils can be determined simply and quickly without complicated procedures.

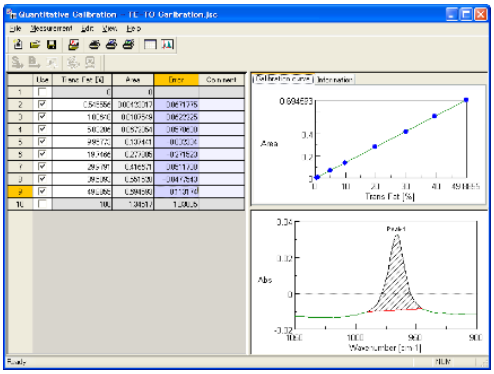

Figure 3. Quantitative Calibration Program

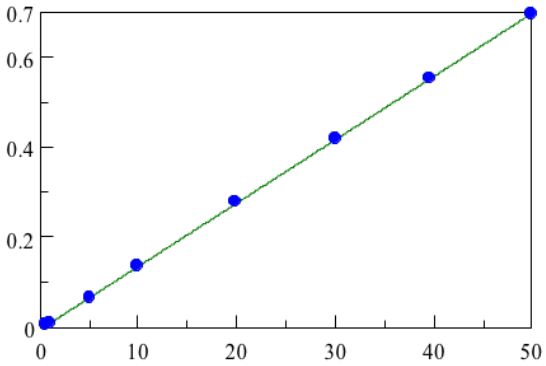

Figure 4. Calibration curve for trans-fat content

Sample	Content Rate of Trans-Fat (%)
Margarine	3.1
Cooking Oil	1.9
Sesame Oil	0.7
Olive Oil	0.8
Chili Oil	1.2

Table 1. Trans-fat content of food oils

JASCO INC.
28600 Mary's Court, Easton, MD 21601 USA
Tel: (800) 333-5272, Fax: (410) 822-7526
Application Library: jascoinc.com/applications