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Analysis of Vegetable Oils using Gas Chromatography

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Fats and oils are parts of normal daily consumptions. As a major source of energy, fats and oils are considered as important nutrients in human diets. Lipids also provide insulation for our bodies, transport vitamins that are not soluble in the water, as well as supply the essential fatty acids.

Fats and oils belong to a class of substance called lipids. Fats differ from oils only in the form they take at room temperature; fats are solid, whereas oils are liquid at room temperature. Almost all of commercially important fats and oils of animal or plant origin consist of the lipid class called triglycerides (or triacylglycerols), which are fatty acids linked by ester bonds to glycerol (see Figure 1 for the chemical structure of triglycerides).

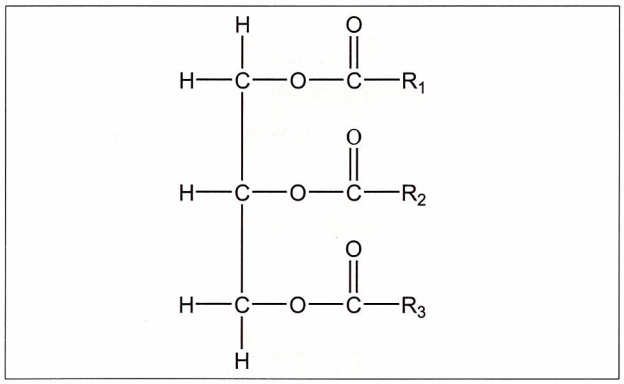

Figure 1. General chemical structure of triglycerides, where R_1, R_2 and R_3 are unbranched hydrocarbon chains.

Gas chromatography (GC) can be used for analysing the lipid or fatty acid content of a vegetable oil. Typically, GC is suitable for the analysis of organic, non-ionic compounds that are vapourisable at 400) ^{0}C or less. Therefore, for the analysis of lipids in edible oils, normally derivatisation of the lipids into their more volatile derivatives is performed prior to GC analysis. However, GC can be used to analyse triglycerides or other components of oils that can be vapourised at 400^{0}C or less, without prior derivatisation. Here we describe the analyses of a few vegetable oils by capillary gas chromatograph (GC). The analytical conditions are shown in Table 1.

Due to the high boiling points of the triglycerides, the injection, column and detector temperatures must be kept higher than those used for general GC analyses. Most commercially available GCs allow for high injection and detector temperatures; Shimadzu GC-2010, for example, has a maximum temperature of 450^{0}C for its injectors, column oven and FID (Flame Ionisation Detector). The limitation would come from the capillary column used for the analysis. Although generally GC capillary columns have maximum temperature limits of around 320^{0}C or less, some capillary columns are designed to have high temperature resistance. Such capillary column was used in the current triglycerides analyses.

The resulting chromatograms are shown in Figures 2 to 5. The main peaks in these chromatograms are likely to represent triglycerides, since triglycerides comprise the main components of a vegetable oil.

In a gas chromatographic analysis, the components in a sample are identified by comparing the *retention times* of the peaks (the time at which the peaks are observed) in the sample chromatogram, to the retention times of standard compounds (compounds of known identity and purity).

Table 1. Analytical Conditions

Instrument	:	GC-2010 equipped with AOC-20i auto injector
Column	:	Rtx-65TG (30m x 0.25mm x 0.1µm)
Carrier gas	:	Helium, 99.9995% purity
Linear velocity	:	40cm/s (constant linear velocity)
Injector temp.	:	365^{0}C
Injection method	:	Split (Split ratio = 40)
Column temp	:	50^{0}C (0.5min) – 50^{0}C/min – 350^{0}C (0min) – 1^{0}C/min – 365^{0}C (5min)
Detector	:	FID
Detector temp.	:	365^{0}C

In the absence of suitable triglycerides standard compounds, different oil samples may be characterised by the different chromatographic patterns obtained under the same analytical conditions.

The chromatographic pattern can be discerned from the presence (or absence) of peaks at particular retention times, and from the peak areas relative to the total peak areas (see Figure 6). These relative peak areas can be obtained by using the *Normalisation* quantitation method.

Alternatively, the patterns can also be compared visually. The *GCsolution* software allows comparison of multiple chromatographic patterns (see Figure 7). The present results show that the chromatographic profiles for canola oil, soya bean oil, olive oil and sunflower oil are sufficiently different for identification of the oils based on their chromatographic profiles.

REFERENCE:

1. Shimadzu Analysis Guidebook, Food Product Analyses, p.9
2. http://scholar.hw.ac.uk/site/chemistry http://scifun.chem.wisc.edu/chemweek/FatsOils/Fats&Oils.html

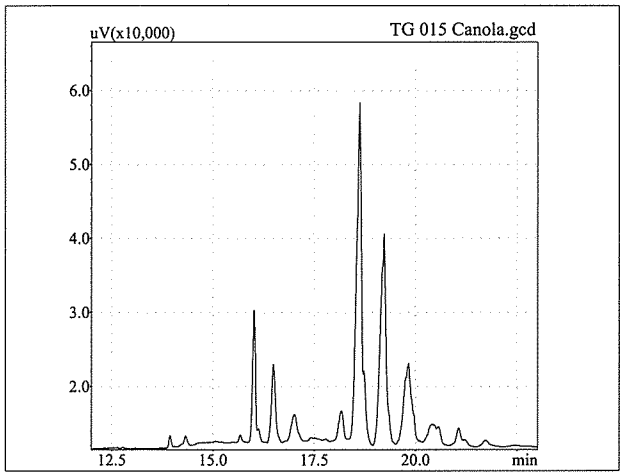

Figure 2. Chromatogram of Canola Oil

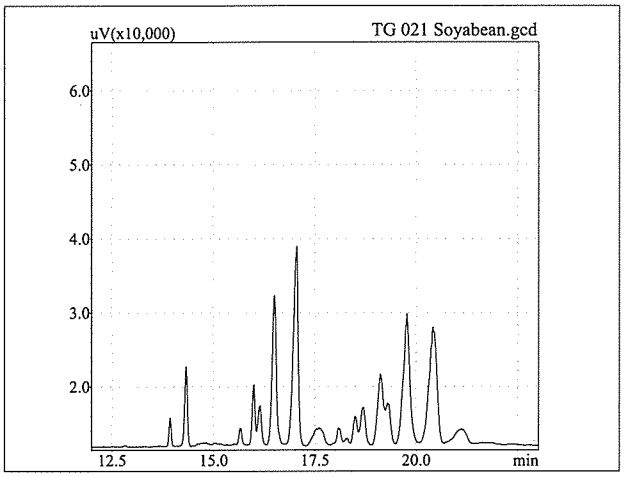

Figure 3. Chromatogram of Soya Bean Oil

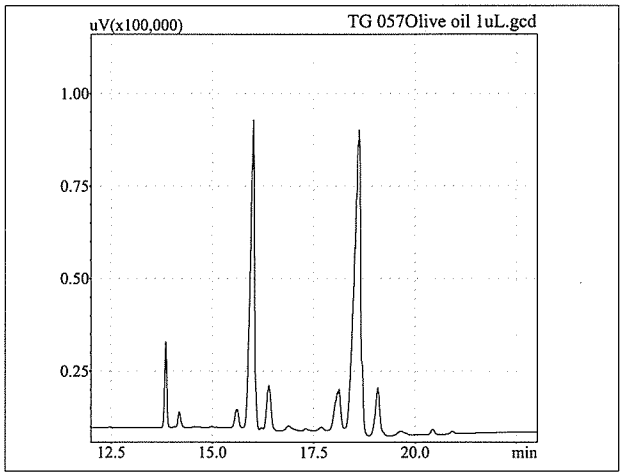

Figure 4. Chromatogram of Olive Oil

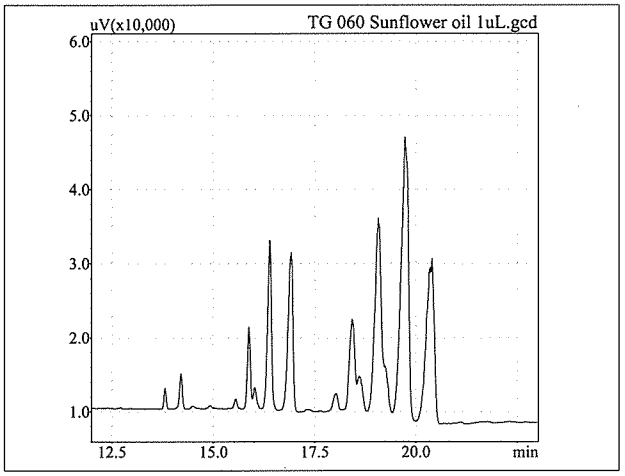

Figure 5. Chromatogram of Sunflower Oil

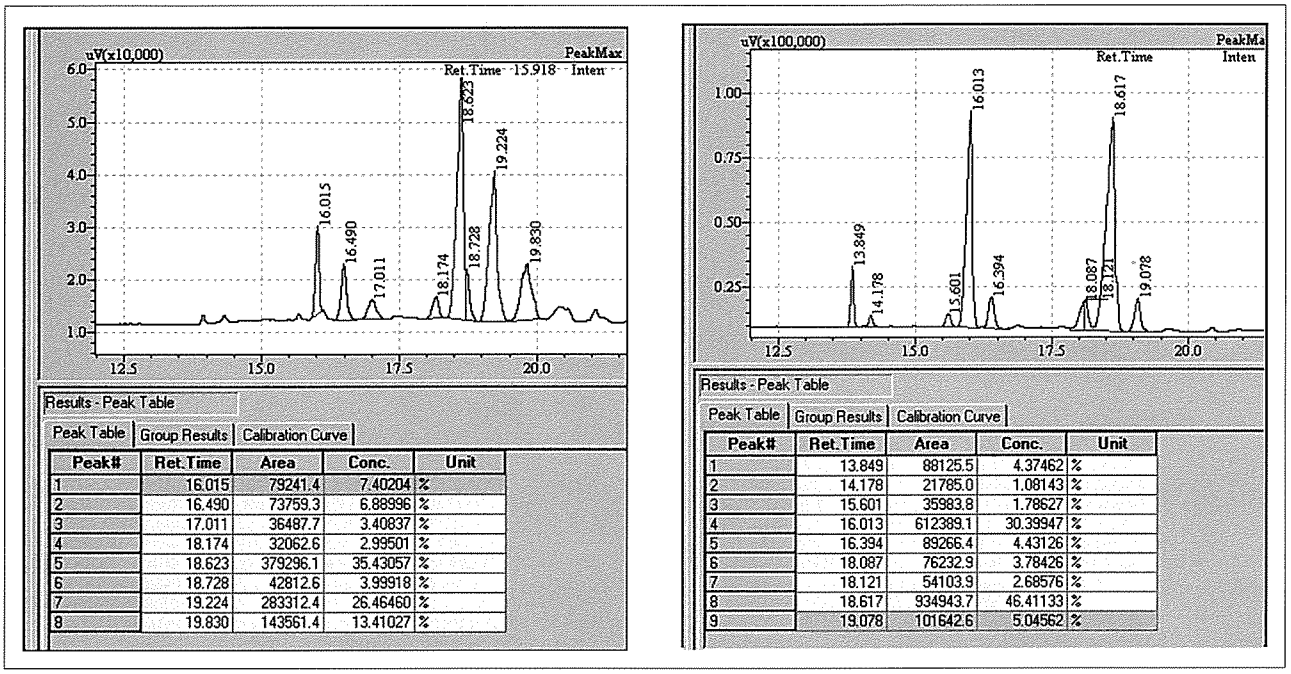

Figure 6. Chromatographic pattern comparison based on relative peak areas.

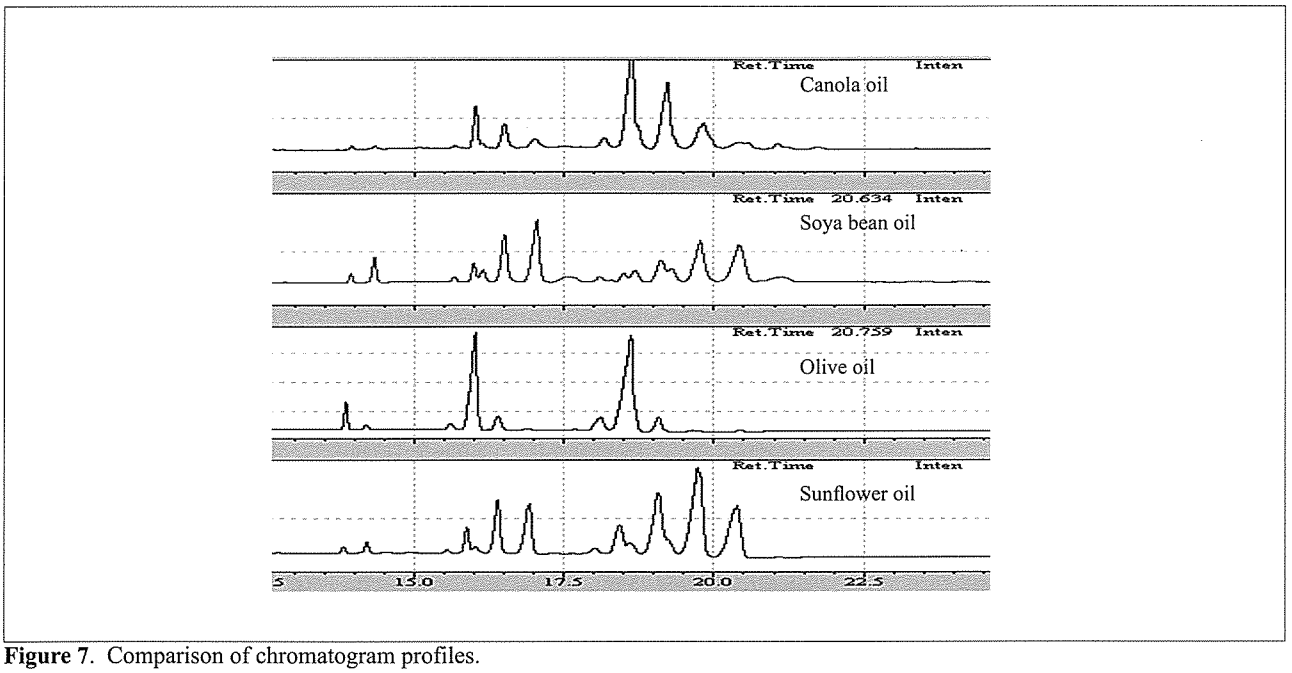

Figure 7. Comparison of chromatogram profiles.

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