

UV/Vis Spectroscopy

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Measurement of Quality of Crude Palm Oils used in Margarine Production by UV/Visible Spectroscopy

Crude Palm Oil (CPO) is a raw material used in the production of margarine and other vegetable oil based food products. CPO is traded and there are quality specifications based on free fatty acids (FFAs) as well as moisture and impurities.^{1,2,3}

Margarine manufacturers also want to assess the CPO's 'fitness for refining' which is measured by the Deterioration of Bleachability Index (DOBI). A DOBI index of less than 1.8 indicates a poor quality oil; a DOBI index > 3 indicates a high quality oil

The DOBI index is defined as the absorbance ratio $A_{446 \text{ nm}} / A_{269 \text{ nm}}$ of around 0.04 g oil dissolved in 25 mL of hexane or 2,2,4Trimethylpentane (iso-octane).

Rather than simply measuring the DOBI at fixed wavelengths, there are advantages in measuring the spectrum between 220 and 500 nm as it means that it is also possible to calculate the carotene content by measuring the CPOs primary and secondary oxidation products. In addition, any adulterants added to enhance the DOBI can be detected by examining the spectrum in more detail.

The primary and secondary oxidation products can be measured at 233 nm and 270 nm, respectively. This is converted into an E1% value by:

$$E_{1\%233 \text{ nm}} = \frac{25(A_{233 \text{ nm}} - S_{233 \text{ nm}})}{100p}$$

Where

$A_{233 \text{ nm}}$ = Absorbance of oil

$S_{233 \text{ nm}}$ = Absorbance of solvent (normally subtracted automatically by the instrument)

p = weight of palm oil

This value (and the similar value at 270 nm) are then further corrected by also recording the $E_{1\%446 \text{ nm}}$ and performing the following correction:

$$E_{1\%233 \text{ nm (corrected)}} = E_{1\%233 \text{ nm}} - 0.06E_{1\%446 \text{ nm}}$$

and

$$E_{1\%270 \text{ nm (corrected)}} = E_{1\%270 \text{ nm}} - 0.18E_{1\%446 \text{ nm}}$$

Finally, the concentration of carotene in oil (in ppm) can be determined according to the procedure of Cocks and van Rede⁴:

$$\text{Carotene} = 383 - E_{1\%446 \text{ nm}}$$

A UV WinLab™ method has been developed to perform these calculations as well as making a pass/fail analysis and is available from PerkinElmer. An example of the software user interface is given in Figure 1.

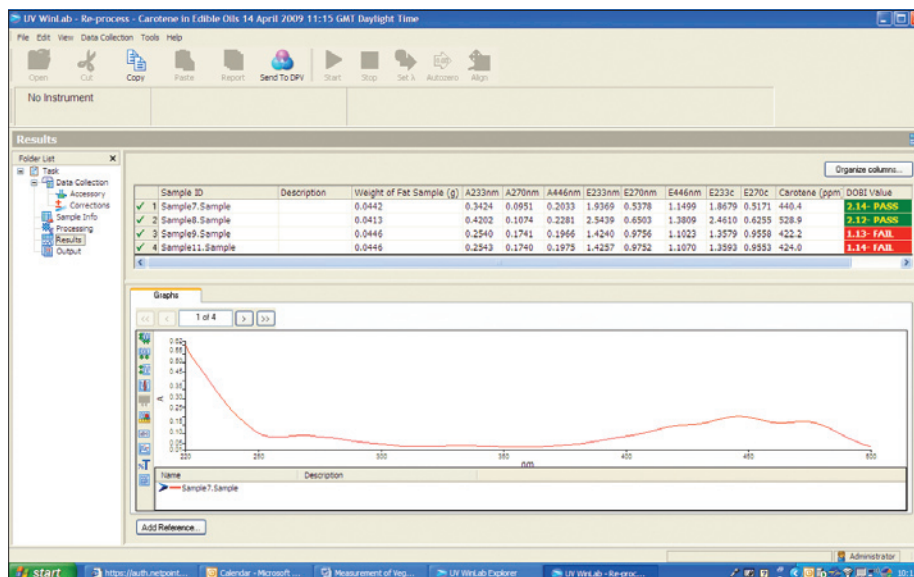


Figure 1. DOBI Analysis using UV WinLab v6 Software.

The method also produces a high quality final report as shown in Figure 2.

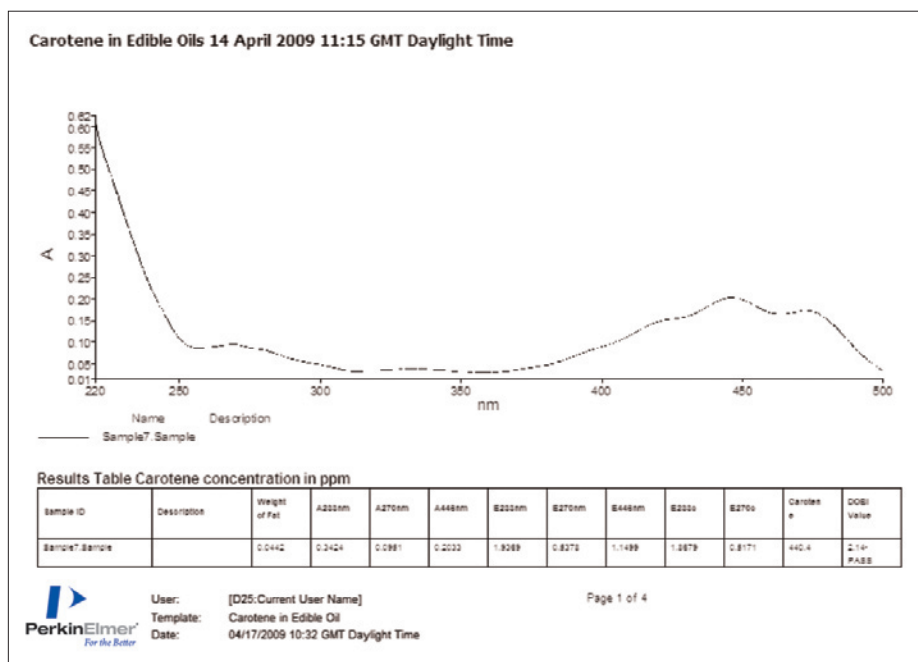


Figure 2. Carotene Concentration and DOBI Index UV WinLab Report.

References

1. Sampling and Analysis of Commercial Fats and oils American Oil Chemists Society Official Methods, AOCS Press, Champaign, Illinois, USA.
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4. Cocks, L.V., and C. van Rede, Laboratory Handbook for Oil and Fat Analysis, Academic Press, London, 1966.