

Application Note AN-NIR-116

Determination of iodine value in frying oils with NIR spectroscopy

Straightforward quality control of soybean-palm oil blends

Vegetable oil is an important widely used lipid source for food preparation. A variety of different vegetable oils is available for cooking, but no pure oil simultaneously combines high nutritional properties, mild taste, and oxidative stability. Soybean oil is the second most consumed oil, but it degrades when heated. To overcome this issue, blending different oil types together is a common practice in the food industry. The determination of the iodine value (IV) allows the oil blending process to be monitored and adjusted accordingly. Oil blends with lower IV contain fatty acids with a large number of saturated bonds and are therefore less susceptible to oxidation. Standard analysis techniques to determine the degree of saturation in oils include titration or gas chromatography. Both methods are time-consuming and need trained personnel. In contrast to these methods, the IV can be analyzed via near-infrared spectroscopy (NIRS) without any sample preparation or toxic chemicals.

EXPERIMENTAL EQUIPMENT

In total, 21 soybean-palm oil blends with an iodine value from 60 g/100 g to 130 g/100 g were measured on the Metrohm NIRS DS2500 Liquid Analyzer (Figure 1). To ensure all mixtures were liquified, the samples were preheated at 60 °C using the NIRS XDS Vial Heater. The spectra were collected in transmission mode using 8 mm disposable vials at the same temperature to ensure consistent measurement performance. Data acquisition and prediction model development were performed with the Metrohm software package Vision Air Complete.

Table 1. Hardware and software equipment overview.

Equipment	Article number
DS2500 Liquid Analyzer	2.929.0010
NIRS XDS Vial Heater	2.921.9010
DS2500 Holder 8 mm vials	6.7492.020
Vision Air 2.0 Complete	6.6072.208



Figure 1. Metrohm NIRS DS2500 Liquid Analyzer used for the measurement of iodine value in soybean-palm oil blends.

RESULT

The measured Vis-NIR spectra (Figure 2) were used to create a prediction model for quantification of iodine value. The performance of the prediction models was evaluated using correlation diagrams which display a very high correlation (R^2 > 0.999) between the Vis-NIR prediction and the standard reference method. The displayed standard error of cross validation (SECV) shows the expected accuracy during routine analysis in QC laboratories (Figure 3).

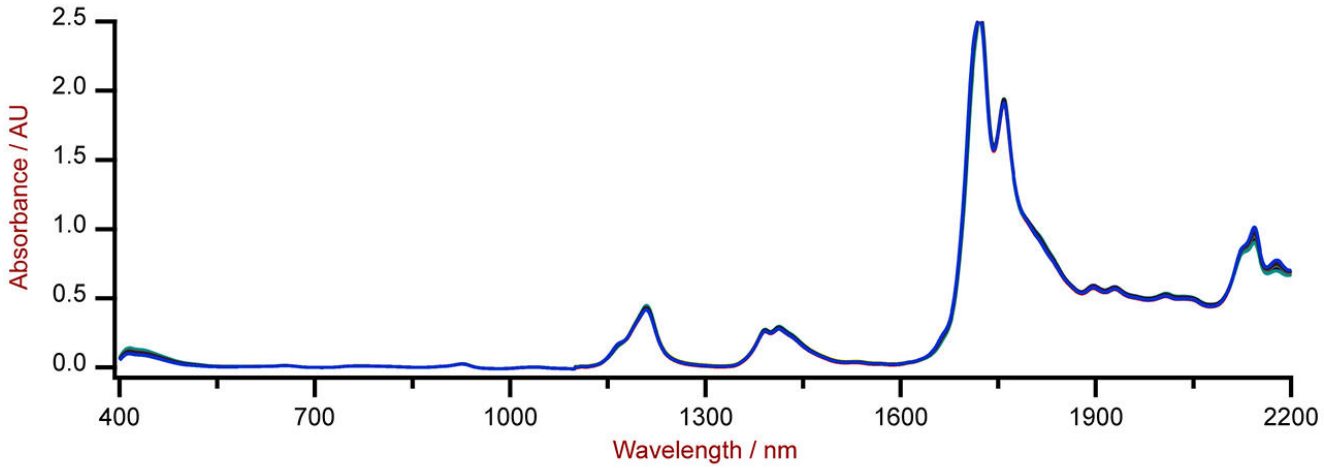


Figure 2. Selection of Vis-NIR spectra of soybean-palm oil blends analyzed on a DS2500 Liquid Analyzer with 8 mm disposable vials.

RESULT IODINE VALUE

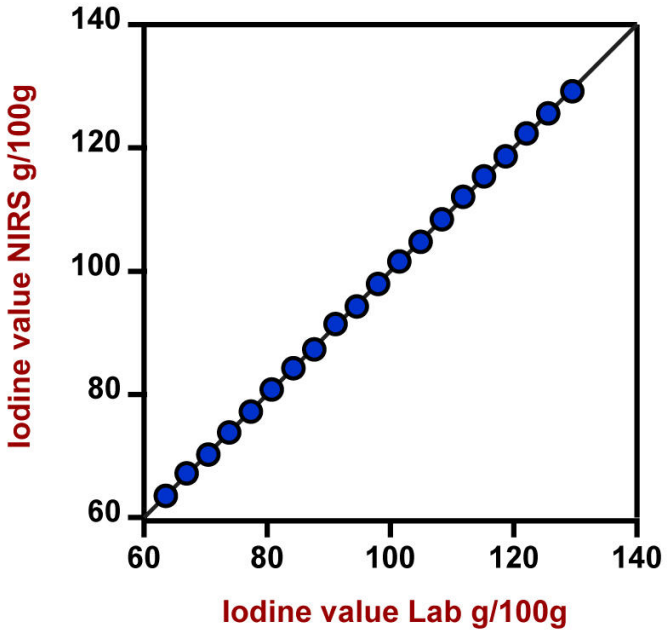


Figure 3. Correlation diagram and the respective figures of merit for the prediction of iodine value in frying oil using a DS2500 Liquid Analyzer. The lab value was measured using titration according to AOCS Cd 1b-87.

Figures of Merit	Value
R^2	0.999
Standard Error of Calibration	0.20 g/100 g
Standard Error of Cross-Validation	0.22 g/100 g

CONCLUSION

Monitoring the iodine value in edible oil blends is crucial to produce vegetable oils with the desired properties for preparing food. This Application Note displays the benefit of using the Metrohm NIRS DS2500 Liquid Analyzer for quality control in food laboratories. Compared to other conventional methods, measurements performed with NIR spectroscopy according to the AOCS Cd 1e-01 standard save time and avoid the production of chemical waste. A sample measurement can be performed within one minute. This ultimately leads to a workload reduction (Table 2) and minimization of running costs in the laboratory as a result.

Table 2. Time to result overview for the measurement of iodine value in edible oil blends by a titration method.

Parameter	Method	Time to result
Iodine value	Titration (AOCS Cd 1b-87)	1 to 2 hours

Internal reference: AW NIRS SG-0003-052018

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CONFIGURATION



DS2500 Liquid Analyzer

Robust near-infrared spectroscopy for quality control, not only in laboratories but also in production environments.

The DS2500 Liquid Analyzer is the tried and tested, flexible solution for routine analysis of liquids along the entire production chain. Its robust design makes the DS2500 Liquid Analyzer resistant to dust, moisture and vibrations, which means that it is eminently suited for use in harsh production environments.

The DS2500 Liquid Analyzer covers the full spectral range from 400 to 2500 nm, heats samples up to 80°C and is compatible with various disposable vials and quartz cuvettes. The DS2500 Liquid Analyzer is thus adaptable to your individual sample requirements and helps you obtain accurate and reproducible results in less than one minute. The integrated sample holder detection and the self-explanatory Vision Air Software also ensure simple and safe operation by the user.

In the case of larger-sized sample quantities, productivity can be considerably increased by using a flow-through cell in combination with a Metrohm sample robot.