

Application Note AN-NIR-155

# Salt content in pickled vegetables by near-infrared spectroscopy (NIRS)

## Determination of the salt content in food in a few seconds

The salt content is one of the most important quality and safety parameters to monitor during the manufacturing process of pickled vegetables. Salt content must be controlled during the production process as well as in the final product. Compared to conventional lengthy wet chemical methods, near-infrared (NIR) spectroscopy can be used for quickly analyzing the salt content in pickled foods.

While sodium chloride (NaCl) has no specific absorption band(s) in the NIR region, the presence of salt in a sample causes changes in the height, width, and position of the absorbance bands of water. For that reason, it is expected to find information about the changes in salt concentration in the NIR spectra. This Application Note demonstrates that NIRS is a good choice for the rapid quantification of salt content in ready-to-eat foods.

## EXPERIMENTAL EQUIPMENT

This application studied 45 samples of pickled peppers and 107 samples of pickled olives. Samples with different concentrations of salt (sodium chloride) were ground and measured with an OMNIS NIR Analyzer Solid (Figure 1) in diffuse reflection mode (1000–2250 nm) using a small cup OMNIS NIR, 60 mm and small holder OMNIS NIR, 60 mm. To compensate for the inhomogeneity of the samples, rotating and multipoint measurement was used.



**Figure 1.** The OMNIS NIR Analyzer Solid.

## RESULT

The NIR spectra (Figures 2–3), along with the corresponding reference values, were used to create prediction models for quantification of salt content.
The quality of the prediction models was evaluating using correlation diagrams (Figures 4–5) which display the relation between the NIR prediction and the reference values of salt content using a wet chemical method. Out of the total, 25% of the samples were selected as the validation set and the other 75% as a calibration set. The respective figures of merit (FOM) display the expected precision during routine analysis.

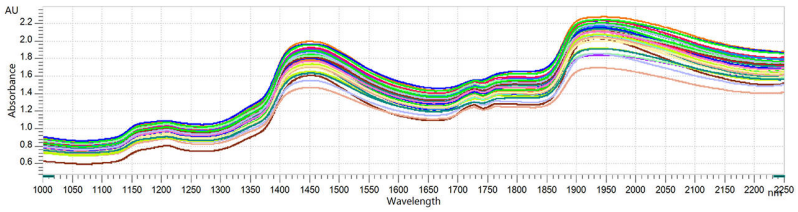



**Figure 2.** NIR spectra of different pickled olives measured on an OMNIS NIR Analyzer Solid.

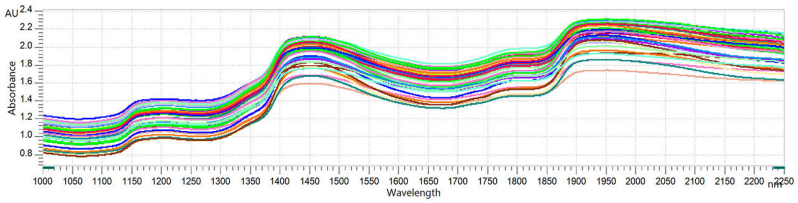



**Figure 3.** NIR spectra of different pickled peppers measured on an OMNIS NIR Analyzer Solid.

## RESULT SALT CONTENT IN PICKLED OLIVES

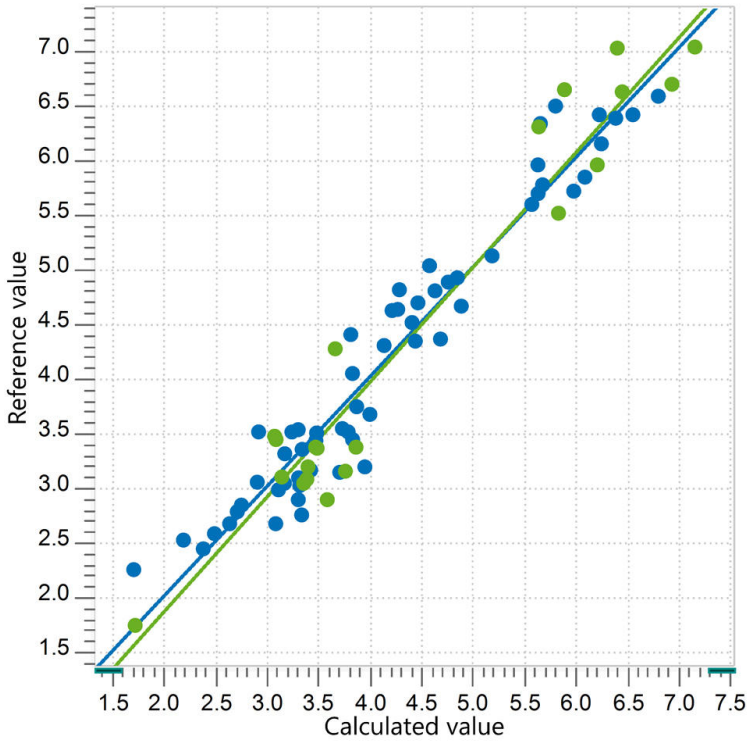



**Figure 4.** Correlation diagram and the respective FOMs for the prediction of salt in picked olives measured in an OMNIS NIR Analyzer Solid. Reference values were measured using potentiometric titration according to Metrohm Application Note AN-T-003. The calibration dataset is shown in blue, and the external validation dataset is in green.

| $R^2P$ | SEC (%) | SECV (%) | SEP (%) |
|---|---|---|---|
| 0.940 | 0.26 | 0.32 | 0.42 |

## RESULT SALT CONTENT IN PICKLED PEPPERS

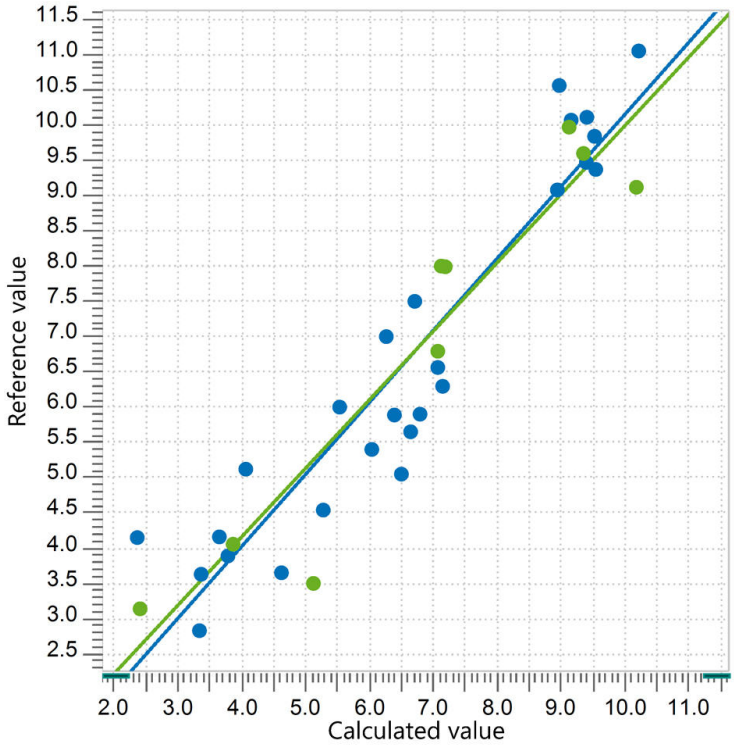



**Figure 5.** Correlation diagram and the respective FOMs for the prediction of salt in picked peppers measured in an OMNIS NIR Analyzer Solid. Reference values were measured using potentiometric titration according to Metrohm Application Note AN-T-003. The calibration dataset is shown in blue, and the external validation dataset is in green.

| $R^2P$ | SEC (%) | SECV (%) | SEP (%) |
|---|---|---|---|
| 0.885 | 0.59 | 0.83 | 0.86 |

## CONCLUSION

This Application Note shows the feasibility of using NIR spectroscopy for the analysis of salt content in ready-to-eat food (i.e., pickled vegetables). By using NIRS, this measurement can be conducted in seconds without the use of chemicals.

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## CONFIGURATION



OMNIS NIR Analyzer Solid

**Near-infrared spectrometer for solid and viscous samples.**

Developed and produced in accordance with Swiss quality standards, the OMNIS NIR Analyzer is the near-infrared spectroscopy (NIRS) solution for routine analysis along the entire production chain. Its application of the latest technologies and its integration in the modern OMNIS Software are reflected in its speed, operability and flexible utilization of this NIR spectrometer.

Overview of the advantages of the OMNIS NIR Analyzer Solid:

- Measurements of solids and viscous samples in less than 10 seconds
- Automated multi-position measurements for reproducible results, even with nonhomogeneous samples
- Simple integration in an automation system or link with additional analysis technologies (titration)
- Supports numerous sample vessels



Small holder OMNIS NIR, 60 mm

Small holder for small sample vessel OMNIS NIR, 60 mm (**6.07402.210**).

Permits unambiguous positioning of the sample vessel and the rotation of the sample vessel.



Small cup OMNIS NIR, 60 mm

Small sample vessel for the spectra acquisition of powders and granulates in reflection at various sample positions.

The glass bottom is made of resistant Gorilla® Glass.

Compatible with:

- Small holder OMNIS NIR, 60 mm (**6.07402.200**)

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### OMNIS Stand-Alone license

Enables stand-alone operation of the OMNIS software on a WindowsTM computer.

Features:

- The license already includes one OMNIS instrument license.
- Must be activated via the Metrohm licensing portal.

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### Software license Quant Development

Software license for the creation and editing of quantification models in a stand-alone OMNIS Software installation.