Application Note

Analysis of Ginger root using FT-NIR Spectroscopy in combination with integrating sphere

FTIR

More and more the alternative drugs like homeopathic style are requested in the pharmacies. The natural based materials are claimed as more smooth and healthy then the designed drugs from industrial plants for the so called classical medicine. Even though the Chinese drugs are by age well known since ever they are now a days defined as modern and alternative in our European regions.

Very important for the suppliers of such material is the quality control of this style of drugs.
Prepared as natural products from roots, leaves or wood the content of the drug can vary by the presence of the natural filler material like cellulose, etc. So, a quality control or minimum identification should be possible.

The FT-NIR technique is a tool for quick analysis, less sample preparation and cleaning of analysis tools. It is highly effective to work with different aggregations of samples with one analysis tool. The Chinese drugs are possible to get in powder form or as dried material from a root as it is by nature. See the ginger samples in the picture which shows a part of a root and a powder from ginger root.

Fig. 1: Two typical samples from Ginger root, left side the root in natural appearance and right the powder
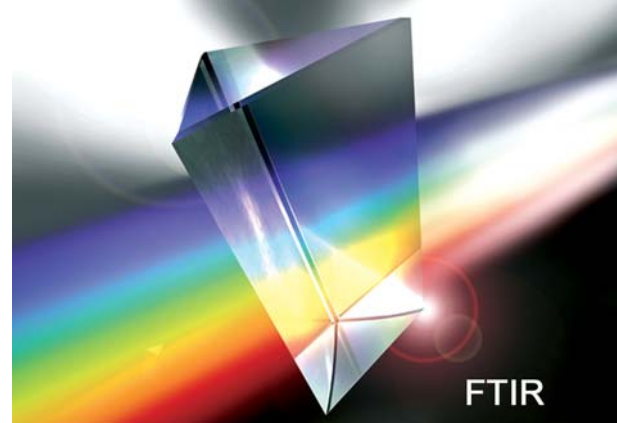
Sample preparation:

Powder – it was used in its particle sizes, without any treatment filled into the glass tube and then pushed for homogeneous packaging of powder particles.
Root – small pieces were manually prepared and filled into the glass tube, pushed to have as much material as possible touching the bottom of the glass tube.
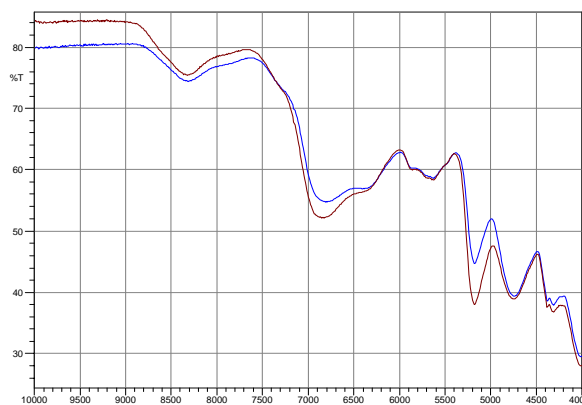At all sample preparation time was approx. 1min.

Fig. 2: FT-NIR spectra from Ginger root in different appearances (blue=powder red=solid), range is 4000 to 10000 cm^{-1}

Diffuse Reflection measurement is by definition a penetration of the beam of 3 mm into the surface of the sample. The beam will be transmitted, reflected and refracted, doing this picking up spectral information from the sample material.

Reproducibility

To have a good confidence with the measurements the reproducibility of the measurement has to be controlled. Repetition measurement and library search are two check criteria to get a confidence level in the analysis.

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Comparison of the two spectra of ginger powder and ginger root shows the sensitivity of the measurement. The spectra are not the same. The cellulose, lignin and remaining water in the root are visible in the spectra of the root in comparison to the powder. Same will be reflected in a search of both, were the system finds easily the ginger powder and not ginger root for the powder material.

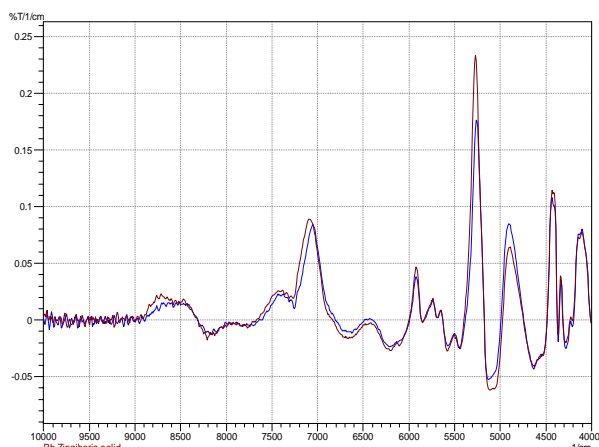Other criteria are the derivative spectra which show very easily differences in both materials.

Fig. 3: FT-NIR derivative spectra from ginger root (see. Fig. 2)

Shift in the signals at different areas are related to differences in the materials. For example the small amounts of water in the cell structure of the wooden material can be one reason making the difference. Another influence will be the particle size as already shown in the literature by Kubelka-Munk which will influence the shape of signals.

Fig. 4: IntegratIR, an accessory with built in InGaAs detector, designed as integrating sphere for the FT-NIR measurement for solid material like powders, etc.

The diffuse reflectance is collected in an integrating sphere made from a rough surface of gold, which is also the mirror coating material for the reference measurement. The built in sensitive InGaAs detector will collect the spectral information. The integrating sphere opening is protected with quartz glass window plate. On the top it is possible to place glass vial or beaker filled with material for the analysis.

Instrument
- IRPrestige-21,
- FT-NIR Kit,
- IntegratIR

Software
- IRsolution
- Chinese Drug Library

Parameter
- Range: 4000 – 10000 cm^{-1} (2.5 µm to 1 µm)
- Resolution: 8 cm^{-1}

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