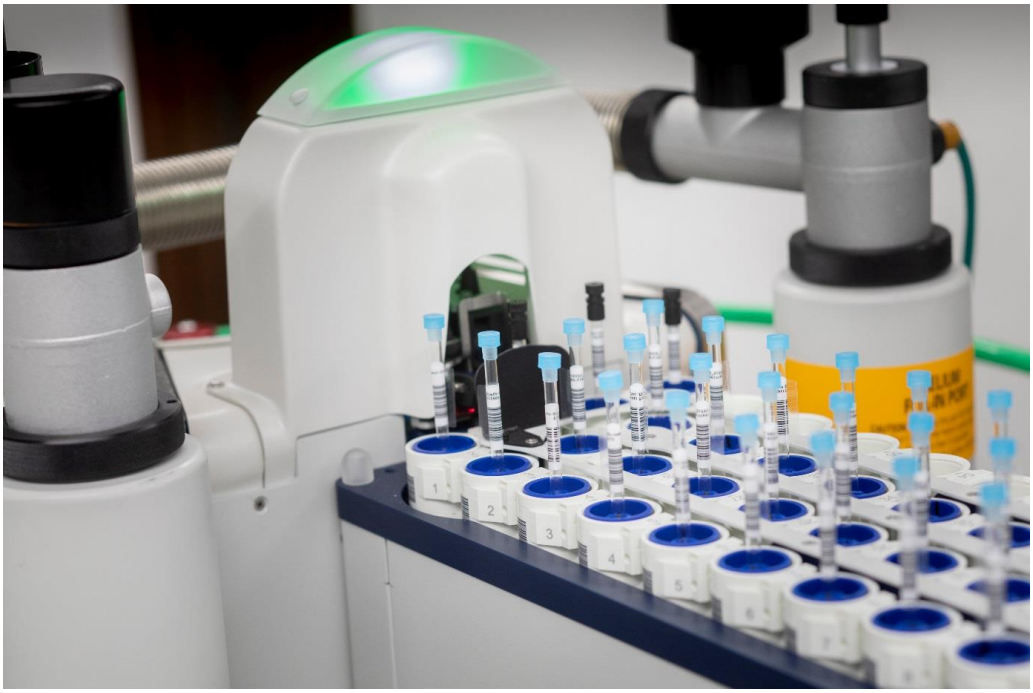
German Institute of Food Technologies enables food authenticity analysis via forward-looking nuclear magnetic resonance (NMR) spectroscopy

This year the new NMR Laboratory was started up at the German Institute of Food Technologies (DIL) in Quakenbrück. With the aid of Nuclear Magnetic Resonance (NMR) spectroscopy, food samples can be examined as regards their origin, authenticity, valuable components and their storage capability.

NMR is characterised by a very safe physical measuring principle which predestines it for application in analyses and food safety. The NMR spectrometer requires a measuring time of only 20 minutes to obtain the diverse information concerning a food sample. The NMR spectrum received is then compared with a database and the required information is available after just one more minute.



The measuring principle of NMR spectroscopy is based on the effect of an outer magnetic field on certain atomic nuclei (e.g. ^{1}H or ^{13}C). Only atomic nuclei that have an intrinsic angular momentum (spin) can orient themselves in a magnetic field. As a result of this orientation the nuclear energy level often splits into different energetic conditions. These energy differences can be overcome by absorption and emission of electromagnetic radiation. This is called resonance. As the nuclei in the molecule possess different bonding partners and thus different intramolecular environments, a specific signal can be obtained for each atomic nucleus through the NMR measurement. In this way, for example, structures of unknown organic compounds can be clarified.

The preparation of samples for such NMR measurements differs widely depending on the food sample. In the case of fruit juice, wine and honey, the preparation is restricted to centrifugation, setting of the pH level and adding of an internal standard and thus does not require any major time input. In the case of meat samples, for example, the sample preparation is more complex, as the meat first has to be ground, weighed and homogenised. After the homogenisation metabolites are extracted by means of precipitation, dried and taken up again in a buffer with an internal standard, which is necessary for the NMR measurement. The setting of the pH value of a sample solution is very important, as for example the signals from acids or bases in the NMR spectrum can shift at different pH values. Following the sample preparation, the food sample is fed into the NMR and measured. An NMR spectrum specific for this sample results from elaborate background processing of the signals recorded. The signals within the spectrum are exported through integration with and setting off against standards and used for statistical evaluations and for determining the concentration.

At present, it is possible to determine the origin, authenticity and composition of honey, fruit juice and wine at the DIL. This is done by comprehensive statistical evaluation and access to the databases designed by Bruker BioSpin GmbH & Partner. After measuring the fruit juice, wine or honey, a test report based on the NMR spectrum is issued, which on the one hand provides information about the origin and nature of the food sample, and on the other hand issues a number of quality parameters. For example high concentrations of certain acids (e.g. formic acid) can indicate that the grapes used to produce the wine were affected by noble rot. Furthermore, possible cases of food adulteration, such as the addition of syrup to honey, can be detected via a lack of amino acid signals.

NMR spectroscopy is also ideally suitable for testing the storage capability or stability of foods. For this, NMR spectra of the samples under different storage conditions are recorded at certain time intervals and compared with each other. If the ingredients become changed, the resulting NMR spectra also change.

A further advantage of NMR spectroscopy, from which DIL will benefit greatly in future, is the analytical support and optimisation of food-technology processes resulting in gentler production methods. This is because with the aid of the NMR spectroscopy, influences on the foods and their ingredients that may be caused by processing can be reliably detected.

The analyses conducted with NMR spectroscopy are characterised by the fact that targeted and non-targeted analyses are carried out within a single measurement. This means that certain ingredients can be detected in targeted fashion through the NMR spectrum and their content levels can be calculated, while at the same time ingredients which were perhaps not sought directly are shown in the NMR spectrum. Such non-targeted analysis allows detection of unexpected or unknown parameters. NMR spectroscopy thus enables qualitative and quantitative statements to be made about the foods being examined.

In this connection controls of, for instance, raw materials and disclosure of adulterations here are possible. Reference spectra can be recorded via reference measurements of previously checked raw materials. New raw materials received can then be measured with the NMR and their spectra compared with the reference spectra. If no deviations are to be seen, the raw material can be considered sound. This means that time-consuming and cost-intensive analyses only become necessary when deviations of the signals are detected in the NMR spectrum. Furthermore, the analysis method using NMR makes it possible to check for compliance with the IFS Standards.

The new NMR spectrometer at the DIL is already being used in ongoing research projects. Within the cooperative project “BioanBak”, antibacterial compounds from pine heartwood were identified via NMR spectroscopy and a quick test was developed to assure the quality of antibacterial pine heartwood.

The DIL will develop the field of NMR analysis particularly in the direction of foods of animal origin and their metabolic fingerprint. At present preparations are underway for further research projects in the field of foods of animal origin, in particular for beef or poultry meat. Within this context the DIL is seeking project partners who are particularly interested in verifying authenticity as a quality criterion of their regional products and would like to support such a research project with regional and authentic samples.

Further information and contact

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