



Need a coffee break?

- Analyzing coffee and milk samples using NMR

The process of using NMR for molecular structure identification and verification can be applied to many real-world examples to enhance a student's learning experience. In these protocols, students are given the chance to apply NMR technology to evaluate samples many of them are probably very familiar with; coffee and milk.

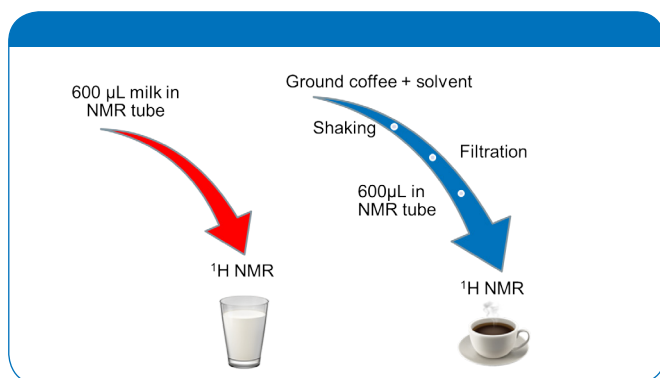
Students will be able to answer questions like "Is there caffeine in my coffee?" or "Am I drinking lactose-free milk?" The students will gain hands-on experience with some basics of NMR and how to apply this technology to a broad range of real-world examples. One unique aspect to this application is fraud detection. Students will learn the importance of discerning arabica from robusta coffee types and how that is impacting the coffee industry today.

Key Learnings

- Differences in NMR sample preparation
- How to quantify using NMR
- The power of solvent suppression
- Fraud detection possibilities

Sample preparation is key

Coffee beans and milk are great examples to show students the importance of precise sample preparation to allow for optimum NMR results. For example, to differentiate arabica from robusta coffee beans by a specific marker (16-OMC), ground coffee samples need to go through a specific extraction process in order to sufficiently evaluate a liquid coffee sample. In contrast, milk samples can be analyzed as is to allow the analysis of fat and sugar content without the need to 'manipulate' the samples.



While the milk is simply poured into an NMR tube, the coffee samples need to follow a dedicated extraction protocol, which is explained step by step in the experiments sections the students will work with.

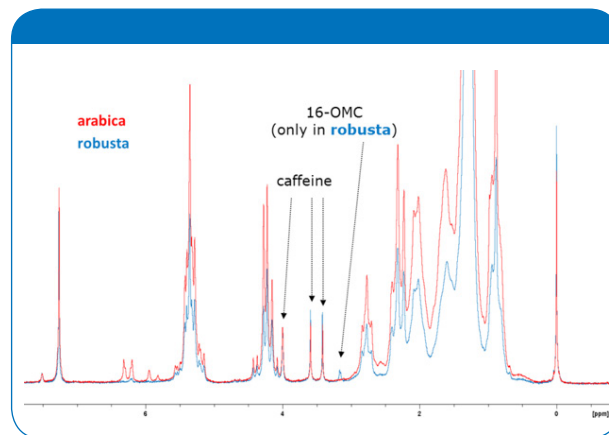
Why solvent suppression is a basic NMR tool?

When working with samples in non-deuterated solvents, the predominant ¹H NMR signal derives from the solvent itself, which often superimposes with the usually much smaller signals of interest. In case of the milk samples, the question whether a milk sample contains lactose or not, can only be answered after suppressing the water signal with dedicated NMR methods, which are part of this practical training.

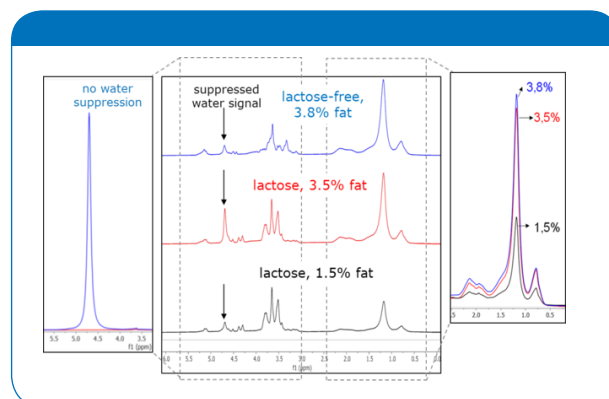
Where to find more information

These, as well as many other experiments, are included in the Fourier EduLab. In addition to detailed step by step protocols for students, we deliver an instructor's guide featuring additional information.

Contact us for details!



¹H NMR spectra of arabica (red) and robusta (blue) beans extracts can be easily differentiated via the robusta marker signal obtained from 16-OMC. In addition, caffeine can be quantified.



Left: The blue spectrum contains mainly ¹H signal deriving from water due to missing solvent suppression. Middle: Solvent suppressed ¹H NMR spectra of different milk samples. Here, the difference between a lactose-free (blue) and lactose-containing milk samples is easily observed in the solvent suppressed signal region. Right: Spectral region used to quantify the fat content in the different samples as indicated by the numbers.