

Abstract

Application of Nuclear Magnetic Resonance Spectrometry to Coffee Authentication [†]

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Abstract: Food authenticity is becoming increasingly important to consumers, producers, and retailers. Furthermore, more and more food properties considered to be value-relevant are advertised. Food fraud, which is the intentional misrepresentation of a food's true qualities, not only harms buyers but also undermines confidence in entire market segments. Worldwide coffee production has had a rising trend despite some setbacks in recent years. Global consumption is also increasing and has only been slightly attenuated by phases of economic weakness. For example, the appetite for coffee in Germany has been growing over the years, with an average consumption of 450 cups per person in 2022, which is equivalent to 5.4 kg of coffee. The top coffee-loving countries consume around 10 kg of coffee per person per year. The rising demand for higher quality coffee with declared origin, botanical variety, and/or processing methods, combined with the significantly higher market prices for such specialty coffee, are opportunities for food fraudsters. In addition to compliance visits to production and processing sites and to auditing a company's accounting, well-established standardised and efficient laboratory analyses are an important part in fighting food fraud. As a metrological primary method of measurement, nuclear magnetic resonance spectrometry (NMR) has been increasingly used for routine chemical quantitative analysis. The NMR spectra typically show very good signal resolution, excellent reproducibility, and linearity of response independent of the substance. NMR can record signals from most metabolites in a biological sample with a single experiment in just a few minutes. Thus, NMR has a high potential to provide reliable data for the analysis of complex mixtures, such as food extracts. NMR spectra can be used as fingerprints to compare individual samples against databases of authentic references using multivariate analysis. This talk will present recent research on the potential of using NMR with targeted, quantitative analysis and also with non-targeted multivariate analysis to verify several product claims on roasted coffee, i.e. the geographical origin, botanical variety, and farming method (organic/conventional). By using targeted analysis, over a dozen characteristic substances can be quantified with good precision. The chemometrical evaluation of NMR spectra can raise reasonable suspicion about the geographical origin.

Keywords: *Coffea arabica*; *Coffea canephora*; roasted coffee; food control; food fraud; authentication; NMR; chemometrics; 16-O-methylcafestol; multivariate analysis; (non-) targeted analysis; geographical origin; organic foods



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