

NMR and food products

Identification

Key words	NMR spectroscopy, quality control, phase composition, water content, porosity, permeability, non-invasive, non-destructive
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How does it work?

Primary objective	Non-invasive analytical tool for: <ul style="list-style-type: none">• Identification of the structure of organic compounds• Detailed structural information about chemical compounds• Detection of contaminants in food
Working principle	<p>Nuclear Magnetic Resonance (NMR) is based on the measurement of absorbed radiofrequency waves by a sample magnetized into a magnetic field. Modern NMR spectrometers using strong magnets (1 to 20 T) were developed since stronger magnetic fields improve the measurements resolution. Low magnetic field equipments were developed, too, leading to the low cost, robust and easy-to-use benchtop NMR spectrometers. These equipments provide useful information on the surface of solid, soft solid, jelly and liquid samples, on water movement in samples, etc.</p> <p>The variation of the intensity of absorbed radiofrequency in a sample versus the magnetic field represents the NMR spectrum of the sample. The NMR technique offers information related to the chemical composition and molecular structure of the studied material. NMR spectroscopy permits the study of various physical, chemical, structural and dynamic properties of samples which contain ^1H, ^{13}C, ^{17}O, ^{23}N nuclei.</p> <p>Specific applications are:</p> <ul style="list-style-type: none">• Characterization of the energetic status of microbial cells to monitor the fermentation of yoghurts (using phosphorus ^{31}P LR NMR)• Examination of cell cultures in the mashing of beer (using proton NMR)• Cooking of various types of rice (proton NMR).• Determination of solid fat by NMR <p>NMR can also be used to examine in vitro dynamic processes or structure like textures without the use of any marker compounds or any physical incursion at all beyond a magnetic field.</p>
Images	
Additional effects	There are no additional effects.
Important process parameters	temperature, aging, degradation, viscosity, permeability.
Important product parameters	water content, food composition

What can it be used for?

Products	The ¹ H NMR technique can be used for solid, liquid, semi-liquid and semi-solid food products such as fat, sugar, flour, juices, cheeses, emulsions (basically all products containing hydrogen in their composition).
Operations	Quality control, process monitoring (during the manufacturing, packaging, shipping or storing of food products).
Solutions for short comings	<ul style="list-style-type: none">• Use as complementary control method or may replace traditional control methods that are time consuming or are related to some undesired additional effects.• Versatile, rapid and precise analysis.

What can it NOT be used for?

Products	The use of NMR investigation is limited to products containing active NMR nuclei (H, N, Na, P, Si, etc).
Operations	No.
Other limitations	Price of high resolution NMR and all installation requirements including liquid He are considerable limitations; application of low resolution NMR is restricted because the resolution in low fields is very weak for many products.
Risks or hazards	There are no risks for the food products associated to the use of NMR technique. The use of NMR technique for food quality control does not change the product properties. When high magnetic field NMR equipments are used, the presence of persons with pacemakers or other metallic implants or carrying metallic objects in the vicinity of the magnets is forbidden.

Implementation

Maturity	The NMR spectroscopy is a well developed and efficient analytical method for high fields. However, new progresses are reported in the field of applications such as food technology. The use of portable NMR spectrometers is in full progress. Such portable NMR spectrometers are available ready-to-install, with calibration standards and traceable multi-language softwares.
Modularity /Implementation	Mobile NMR equipments were developed to be implemented on production lines. The use of such portable equipments is simple and do not require special conditions or modifications of the production line.
Consumer aspects	NMR is a non-invasive control technique. Since the consumers are familiarized with the use of NMR equipments in medicine as a non-invasive diagnostic technique, they perceive positively its use in food technology [1,2].
Legal aspects	There is no EC regulation related to the use of NMR technique in food technology.
Environmental aspects	No environmental problems are related to the use of NMR technique.

Facilities that might be interesting for you

Title	Institute/company
Field Flow Fractionation INPT - El Purpan	INPT - El Purpan
Fruit & vegetable analysis INRA	INRA - SQPOV
Gas analysis INRA	INRA - SPO
Mastersizer FBR	Wageningen UR - FBR
Microbiological analysis INRA	INRA - SQPOV
Multi-user olfactometer INRA	Ecole des Mines d'Alès
PlantLipPol-Green INRA	UMR IATE

Further Information

Institutes

DIL, KU Leuven LFT, UTCN, IRTA

Companies

ARTEC.System, Bruker

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