

Structural investigations of nuts by NMR

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Nuts contain a large amount of oil ($\approx 60\% \text{ ww}^{-1}$) mainly stored in subcellular structures (oleosomes) [1-3]. They play a key role in the shelf life and quality of nuts, especially in chocolate products. Nuts in chocolate products usually undergo specific processes inducing thermal and mechanical stress. The stability and integrity of oleosomes is hereby crucial, as potential instability leads to undesirable effects such as fat bloom or oil syneresis [4]. Changes in these microscopic structures due to thermal and mechanical stress must be considered. In-situ MRI measurements were carried out and complemented by PFG-NMR (PFG-STE) for diffusion measurements [5]. MRI detects macrostructural changes on length scales ranging from $50\text{ }\mu\text{m}$ to millimeters above the length scale of cells. Special equipment allows for the analysis of nuts during roasting or blanching under controlled temperature conditions in the magnet. The spatially resolved MRI measurements determine the oil distribution

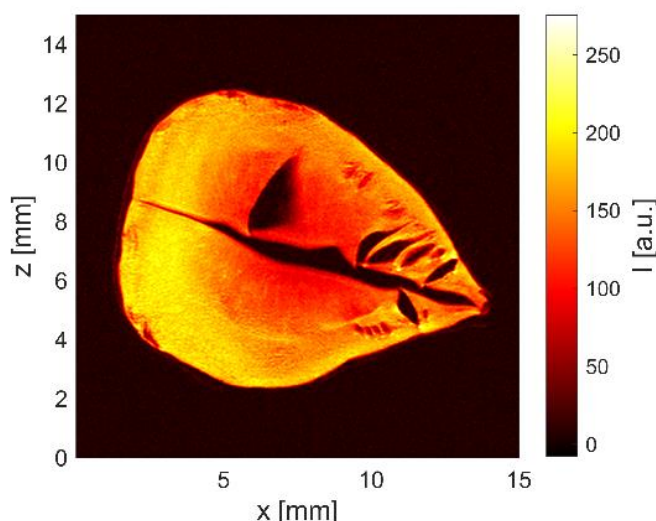


Fig. 1: MR Image of a roasted hazelnut.

in the coarse structure of the nut. Diffusion measurements provide additional information on the microstructure ($100\text{ nm} - 10\text{ }\mu\text{m}$). Thus, insight into the type of oil mobility was obtained. A model was developed for the size determination of oleosomes based on droplet size determination in emulsions [6-8], which needed to be extended by a term describing quasi-free diffusion oil. The investigations show the potential of the quasi-non-destructive measurement of the microstructure in nuts using PFG-STE. The influence of thermal process parameters such as roasting temperature and duration were deduced on the micro- and macrostructures of the nut.

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