QUALITY ASSESSMENT IN APPLES
USING LOW FIELD MAGNETIC RESONANCE IMAGING

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Quality assessment in apples often requires the application of non-destructive methods for detecting symptoms that are not visible externally. Various techniques such as NMR, MRI, X-ray CT and time-resolved reflectance spectroscopy have been used to analyze the internal quality of fruits \cite{1,2,3}. We report preliminary results showing that low field MRI has a potential for the internal quality inspection application.

The low-field MRI system is based on a permanent magnet, built from a new-generation Nd-B-Fe magnetic material. It produces the homogeneous magnetic field of 0.088T in the 10cm diameter sphere. The magnetic field gradients of 30mT/m are generated by a set of biplanar, actively shielded gradient coils. A cylindrical rf coil of 12cm diameter is used and the whole experiment is controlled by the SMIS console \cite{4}.

Internal browning, core breakdown, presence of worms, and the rotten areas in apples have been studied using the SE and FSE sequences with variable 90-180° pulse spacing. An affected tissue has usually lower water density than the healthy tissue, as observed on the proton density images. Moreover, the T\textsubscript{2}-weighted images reveal early damages (browning) in apples.

Our results show that MRI performed at 0.088T provides similar information as high field MRI. As an example, the proton density images presented below illustrate the damages inside the apple that were caused by the apple worm.

Typical proton transverse, sagittal and coronal slices obtained using SE sequence.

References:

\cite{1} Wang S.Y. et al., Non-destructive detection of water-core in apple with nuclear magnetic resonance imaging. Scientia Horticulturae 35:224-234; 1989.