

A study of post mortem conversion of turkey muscle to meat by MR quantitative microscopy

C.L. Hansen¹, V. Santé, A.H. Karlsson¹, J.P. Renou², J.M. Bonny²

⁽¹⁾ Department of Food Science, The Royal Veterinary and Agricultural University (KVL), Denmark

⁽²⁾ QuaPA/STIM, INRA-Theix, St-Genès Champanelle, 63122, France

christia@dsr.kvl.dk

General objectives

Using high field (here 9.4 T), the gain of signal to noise ratio allows to perform dynamic experiments by quantitative magnetic resonance imaging. Such quantitative mapping is helpful for giving information about tissue microstructure, while continuously repeating these measurements allows identifying structural changes during conversion of muscle to meat.

In the present study, T_2 relaxation and diffusion decays were mapped using increasing echo times (TE) and increasing b-values respectively. *Pectoralis superficialis* of male turkeys was used due to its susceptibility to exudate. The experiments were performed at 15°C on normal and PSE muscles with a first measurement at 3 hours post mortem. Diffusion decays were acquired in parallel and perpendicularly to the muscle fibre direction.

Main results

T_2 maps allow differentiating regions of exudation, for which less-bounded water is localized in reservoirs. In myofibers, the T_2 decays always exhibit a mono-exponential behaviour. In contrast, bi-exponential behaviour of diffusion decay is observed in both directions which persists post mortem during ageing. Even if acquisitions were performed rapidly enough to obtain T_2 and diffusion quantification every 10 min, T_2 and apparent diffusion coefficients (ADC) were stable from 30 minutes to 2 hours post mortem. However, the standard deviations of ADCs and T_2 measured on parametric maps revealed higher heterogeneity in the PSE group compared to the normal one.

Discussion/Conclusion

By imaging at high field, T_2 relaxation behaviour was monoexponential in contrast with results obtained by low field relaxometry (1). Possible reasons for these discrepancies are; (i) T_2 times more hard to resolve because of the shift to lower times at high field and of the scale of the measurement (voxel volume = 0.22 mm³) (ii) the difference between methodologies of T_2 measurement (i.e. signal-to-noise ratio, single echo for each TE).

The stable T_2 and ADCs from 30 min to 2 hours PM suggest that the major structural changes concerning water dynamics (e.g. drip channel formation) have occurred prior to the first measurements due to a fast ageing process. Enzymatic breakdown of the cell membrane during 3 days presumably causes water to move freely between the intra- and extracellular space. No change in the fast fraction of ADCs over this period indicates that bi-exponential diffusion fractions cannot be simply attributed to intra- vs. extracellular water, according to (2).

Larger heterogeneity within both T_2 and ADC maps is presumably consequence of a larger degree of drip channel formation for PSE meat. It suggests the use of two-dimensional NMR experiments combining relaxation and diffusion of water (3) for the identification of PSE meat.

References:

- (1) Bertram, Magn. Reson. Imaging (2004) 22, pp 557-563
- (2) Thelwall et al, Magn. Reson. Med. (2002) 48, pp 649-657
- (3) Godefroy and Callaghan, Magn. Reson. Imaging (2003) 21, pp 381-383