Using TD-NMR relaxometry to evaluate tenderness of Nellore beef

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Introduction: Consumer demand for high-quality meat is constantly increasing, with meat tenderness being the most important sensory property. As consequence, identifying objective technologies that detect meat tenderness remains an important focus of the meat industry. The ability to evaluate this attribute objectively would afford the industry the ability to segregate product on predicted quality and provide consumers with the confidence to enjoy a consistently high quality eating experience. In this regard, time-domain nuclear magnetic resonance relaxometry (TD-NMR) is a simple, low-cost, non-destructive and high-throughput technology that has been explored to evaluate meat quality properties (Pereira et al., 2013; Santos et al., 2014). The aim of this study was to explore the use of TD-NMR relaxometry for detecting differences in Nellore meat tenderness.

Material and methods: Two hundred steaks (Longissimus thoracis, 2.5 cm thick each) from Nellore cattle were evaluated for shear force, according to the methodology outlined by Wheeler et al. (2005), and then samples were divided in two groups: Tender (shear force [SF] values < 50 N) and Tough (SF > 50 N). Samples were also evaluated for TD-NMR relaxometry using the Carr-Purcell-Meiboom-Gill (CPMG) pulse sequence (Monaretto et al., 2015) and Continuous Wave-Free Precession (CWFP-T1) pulse sequence (Moraes et al., 2016). Data were analyzed using R version 4.0.2 with the tenderness group (tender and tough) as the discriminating factor. Partial least squares discriminant analysis (PLS-DA) and canonical correlation analysis (CCA) were performed using the mixOmics package (González et al., 2012). CCA was performed between tenderness and TD-NMR datasets to detect associations between the two datasets. Results: According to the PLS-DA of the D-NMR data, there was no cluster formation in response to tenderness, in either the CPMG data or CWFP-T1 methods. As a consequence, neither CPMG nor CWFP data could differentiate between tenderness. When CCA was used to explore the relationship between the TD-NMR signals and tenderness, individual signals most closely associated with this attribute were displayed in a network graph of CCA for CPMG and CWFP-T1. For the CPMG method, some signals were positively and others were negatively associated with SF. Similarly, a number of CWFP-T1 signals were negatively associated with SF.

Conclusion: The D-NMR data was not suitable for predicting tenderness of Nellore meat; however, the value of these data is due to some specific signal of CPMG and CWFP were associated with SF, which opens an opportunity for further investigations of specific signals of CPMG and CWFP-T1 pulse sequences in order to segregate meat quality.

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