MEAT AGING TIME CAN BE PREDICTED BY TD-NMR SPECTROSCOPY

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I. INTRODUCTION

There is an increasing demand for high quality meat around the word. Palatability traits are the most important contributors of overall eating satisfaction. It is well known that aging process can improve those factors and the most common methods to evaluate those traits are through the physicochemical parameters and by sensory attributes. However, the physicochemical methods or sensory panel are destructive, laborious, time consuming and show an inherent subjectivity in the results. In this sense, technology such as Nuclear Magnetic Resonance (NMR) relaxometry has been used to evaluate meat quality traits in a non-invasive way and without destroying the sample [1, 2]. Therefore, our hypothesis is that NMR time-domain nuclear magnetic resonance (TD-NMR) relaxometry data and multivariate models can be use to classify aged meat quality, by the variation of myofibrilar degradation and water mobility. In this sense, the aim of this study was to evaluate the possibility of using TD-NMR relaxometry data and multivariate models to predict quality traits of aged meat

II. MATERIALS AND METHODS

Longissimus samples from 105 feedlot finished Nellore bulls were collected 24 hours postmortem at 12th rib level, vacuum packed and aged for 0, 7, 14 and 21 days. After each aging period, samples were analyzed for color (L*, a*, b*; Minolta Camera Co., Ltd, Osaka, Japan), cooking loss (CL), and Warner-Bratzler shear force (WBSF), according methodology described in AMSA [3]. In addition, meat quality were also evaluated by time-domain nuclear magnetic resonance (TD-NMR) using Carr-Purcell-Meiboom-Gill (CPMG) and Continuous Wave-Free Precession (CWFP) pulse sequences. The CL and WBSF measured by reference methods were analyzed using SAS version 9.1.2 for Windows (SAS Inst. Inc., Cary, NC). The TD-NMR analyses were performed in a SLK-IF-1399 (0.23 T or 9 MHz for 1H resonance frequency) spectrometer, Spinlock (Córdoba, Argentine), using a 10 cm probe, at 23 °C. The principal component of analyses (PCA) of color, CL and WBSF and TD-NMR data were analyzed using MatLab software. The score plots of PCA analysis of physicochemical and TD-NMR data were primary analyzed considering 0,7, 14 and 21 days of ageing. However, the results showed strong overlap between samples aged for 0 and 7 and between 14 and 21 days. Therefore, samples were combined, considering meat aged for 0 and 7 days (group 1) and aged for 14 and 21 days (group 2). The PLS-DA was also performed in order to predict how much the TD-NMR can predict meat changes by aging time.

III. RESULTS AND DISCUSSION

The aging time increased tenderness ($P < 0.001$), and change meat color traits ($P < 0.001$), with no differences for CL ($P = 0.1373$; Table 1). Aging is widely used in meat industry, because it significant improves in meat tenderness. PC1, PC2 and PC3 represent 52.8%, 22.7% and 15.7% of the variance, explaining 91.1% of the total variance (Fig 1; with the red symbols representing meat aged for 0 and 14 days; and the green symbols representing meat aged for 14 and 21 days). Similarly, the PC1, PC2 and PC3 accounted for 65.1%, 13.7% and 3.2% of the variance, explaining 82.0% of the total variance (Fig. 2; with the red symbols representing meat aged for 0 and 14 days; and the green symbols representing meat aged for 14 and 21 days).

Table 1. Effect of aging time on meat quality traits.

Item	Aging time, days				EPM	P-Value
	0	7	14	21		
Tenderness, N	75.2[a]	56.6[b]	46.9[c]	42.2[c]	1.04	<0.001
Cooking loss, %	27.3	28.4	27.8	26.8	0.39	0.1373
Color						
L*	31.2[b]	33.3[b]	35.3[a]	34.5[a]	1.22	<0.01
a*	15.9[a]	16.5[a]	14.9[b]	14,2[b]	0.26	<0.001
b*	15.1[b]	18.3[a]	18.0[a]	17.8[a]	0.28	<0.001

In both cases, there is a presence of clustering between 0 and 7 days aging (red) and 14 with 21 days aging (green) data. These results indicate that PCA of TD-NMR can differ meat according aging period and this difference could be due to the proteolysis post-mortem, water mobility and its distribution in meat [2], with greater time aging can increase proteolysis as consequence affect water mobility on meat. Moreover, 2. Bertram et al. [2] reported a relationship between water mobility and its distribution using transverse relaxation time (T2) measured by the Carr-Purcell-Meiboom-Gill (CPMG) pulse sequence (T2 relaxometry) and the sensory attributes in meat. In addition, the PLS-DA analysis of TD-NMR data was able to identify aging time with 86% of precision.

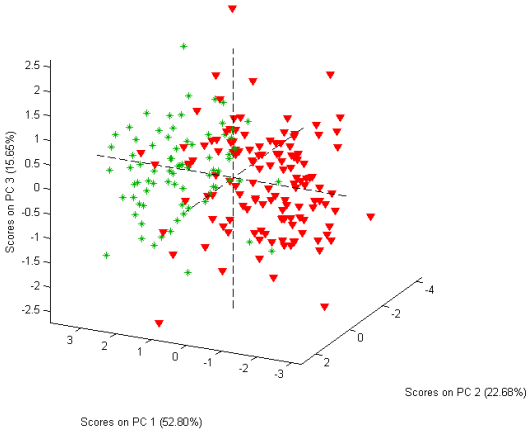

Figure 1. Meat quality traits distributions measured by physicochemical methods.

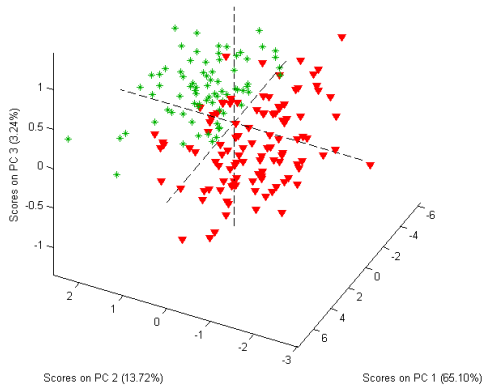

Figure 2. TD-NMR data distribution

CONCLUSION

The TD-MNR can be used as a tool to differentiate ageing period of meat

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