Using TD-NMR relaxometry to assess the presence and degree of severity of myopathy in broiler breast tissue

Nara Regina B. Cônsolo[1], Luis C.G.S. Barbosa[1], Tiago B. Moraes[2], Luiz A. Colnago[3], Cristiane S. da S. Araujo[4], Guilherme F. Silva[4], Lucio F. Araujo[1]

[1] Faculty of Animal Science and Food Engineering, University of São Paulo, Pirassununga, Brazil
[2] Department of Chemistry, Institute of Exact Sciences, Federal University of Minas Gerais, Belo Horizonte, Brazil
[3] EMBRAPA Instrumentação,, São Carlos, Brazil
[4] School of Veterinary Medicine and Animal Sciences, University of São Paulo, Pirassununga, Brazil

Introduction: To date, the poultry industry has suffered from inconsistency in the way myopathy (wooden breast, WB; and white stripe, WS) is assessed in broiler chickens. The presence and severity of these diseases are usually assessed by visual examination and/or palpation of the breast muscle but this method is inherently subjective, time-consuming, and must to be undertaken by trained people. Time-Domain Nuclear Magnetic Resonance (TD-NMR) potentially offers an objective alternative tool for assessing the presence and severity of WS and WB in chicken meat. Therefore, the aim of this study was to evaluate the potential use of TD-NMR for assessing WS and WB in broiler chicken breast.

Material and methods: A total of 75 broiler breasts were collected from a slaughter house and classified according to the occurrence and severity of WB and WS using the methodology proposed by Sihvo et al. (2013) and Kuttappan et al. (2012). Breasts were divided into three groups based on the presence or absence of myopathy: NB) normal breasts, without the occurrence of myopathies; WB) breasts affected by the presence of WB; WS) breasts affected by the presence of WS. The severity was also evaluated: breasts with high severity of the myopathies received the score 1, and those without myopathies received the score 0. The whole breasts were analysed by 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). The TD-NMR analyses were performed in a SLK-IF-1399 (0.23 T or 9 MHz for 1H resonance frequency) spectrometer (Spinlock, Córdoba, Argentina) using a 10 cm probe at 23 °C. The TD-NMR relaxometric data was analysed using MetaboAnalyst 5.0, according to the presence of myopathies (NB, WB and WS) and the degree of severity (0 and 1). The partial least squares discriminant analysis (PLS-DA) was performed and validated through the validation and permutation test.

Results: For CPMG, three relaxation populations were noted, which are associated with three different locations of water in breast meat. Changes on T2 relaxation times were evident between WB/WS and NB. Breasts affected by WB presented the highest area for T22 (peak around 100 ms) values compared with NB and WS. The peak around 50 ms is known as T21, which has lower area for WS, WB compared to NB. When T2 the relaxation population was tested according to the degree of severity, a similar trend was observed, where the severe case for both myopathies presented higher area for T22. The variation in CWFP-T1 relaxation distributions was less pronounced than that of CPMG (T2) between treatments (NB, WS and WB) and degree of severity. CWFP-T1 spectra was characterized by the occurrence of two relaxation populations, the peak at 100 ms (T12) was higher for WS and WB, while the area of the peak at approximately 500 ms (T13) was lower for WS and WB compared to NB. However, regarding severity, the peak area between NB and severe was quite similar.

Conclusion: TD-NMR relaxometry showed that the occurrence and severity of WS and WB also affects breast water mobilization and might be a promising technology for evaluating and segregating breasts according to myopathies and degree of severity.

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