POSTMORTEM CHANGES IN WATER PROPERTIES OF WOODEN BREAST MEAT

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I. INTRODUCTION

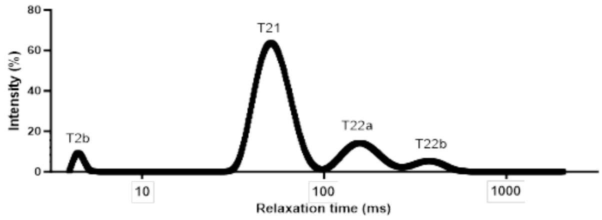
The wooden breast (WB) condition is a myopathy occurring in the breast muscle of broilers that causes substantial losses to the industry due to product discards and downgrades. Breast meat exhibiting the WB myopathy is characterized by abnormal muscle hardness and rigidity. Compositionally, WB has greater moisture and connective tissue content and decreased protein content [1]. Previous research has shown that WB not only has undesirable texture attributes but also diminished water-holding capacity (WHC) [1]. The underlying factors controlling WHC in WB are not well understood. Changes in the mobility and distribution of water in muscle during the postmortem transformation of muscle to meat are thought to play important roles in determining meat WHC [2]. Thus, the objective of this study was to compare changes in water properties throughout the first 24 h postmortem in WB and normal breast meat using time domain nuclear magnetic resonance (TD-NMR).

II. MATERIALS AND METHODS

Broilers (56 day old, Cobb 500) were electrically stunned and bled. Breast muscles (*Pectoralis major*) were removed at <5 min postmortem from 15 normal carcasses and 15 carcasses exhibiting severe WB. Samples (10×10×2 cm) were removed from the cranial-ventral portion of each breast fillet. Samples were placed in plastic bags, chilled on ice, and stored at 4°C until 24 h postmortem. At 0, 0.5, 1, 2, 3, 5, 7, 12, and 24 h postmortem, transverse relaxation time (T2) was measured on samples using a time domain 1H NMR analyzer (LF 90II Proton-NMR, Bruker minispec). The T2 relaxation decays were analyzed using CONTIN software to estimate the time constants and relative proportions of water populations. At multiple time points throughout first 24 h postmortem samples were reweighed to calculate purge loss and pH measurements were recorded. Effects of WB condition, postmortem time, and their interaction were analyzed using a two-way ANOVA with repeated measures.

III. RESULTS AND DISCUSSION

Analysis of T2 data revealed 4 water populations in meat samples (Figure 1): T2b (4-5 ms, water bound to macromolecules), T21 (40-60 ms, intramyofibrillar water), T22a (140-210 ms, extramyofibrillar water with lower mobility), and T22b (350-550 ms, extramyofibrillar water with higher mobility). Water properties (mobility and distribution) changed most rapidly during the first 3-5 h postmortem and were then relatively steady until 24 h postmortem for both normal and WB meat (Figure 3). Similarly, purge loss increased most rapidly during the first 3 h postmortem, particularly for WB samples (Figure 2). With the progression of postmortem time, relative proportions of bound (P2b) and intramyofibrillar (P21) water increased ($P<0.05$) whereas extramyofibrillar (P22b) water decreased ($P<0.05$). The postmortem time point at which intramyofibrillar water changes (T21 and P21) leveled off was earlier in WB than normal samples. All 4 water populations exhibited greater ($P<0.05$) mobility in WB compared to normal meat. The relative proportions of bound and intramyofibrillar water were greater ($P<0.05$) in normal meat and the relative proportions of extramyofibrillar water were greater ($P<0.05$) in WB meat, similar to previous reports [3]. Maximum differences in water properties between WB and normal samples occurred ~3 h postmortem. The most dynamic changes in water distribution and mobility, purge loss, and pH (data not shown) occurred early postmortem suggesting that physical changes associated with rigor mortis likely play a key role in controlling water distribution and WHC characteristics in breast meat.



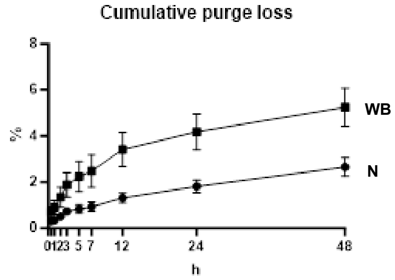


Figure 1. Continuous T2 relaxation spectra.

Figure 2. Cumulative purge loss of normal (N) and WB meat.

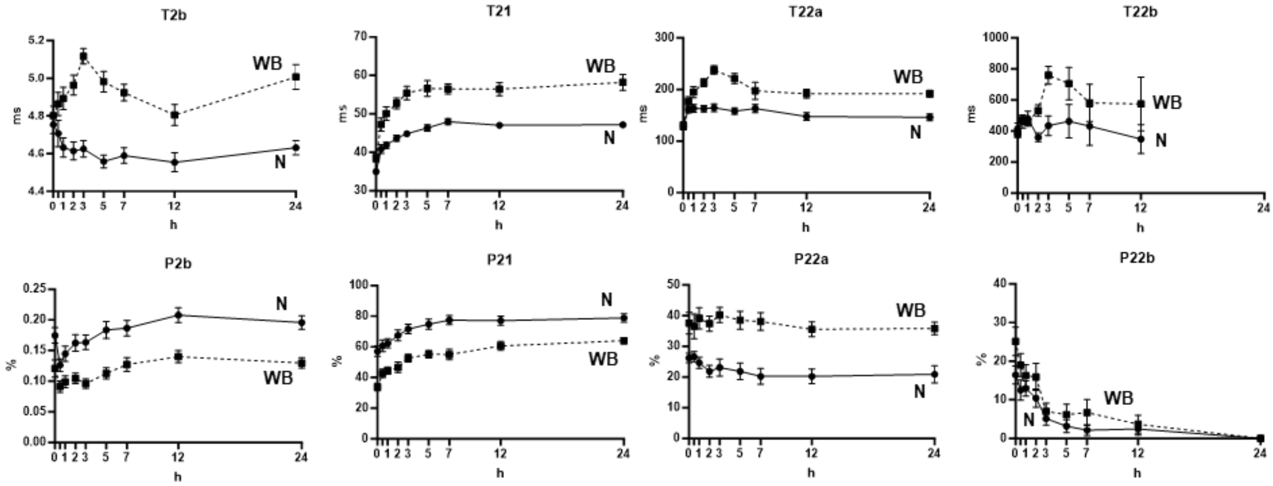


Figure 3. Water properties (mobility and relative proportions) of normal (N) and WB meat during 24 h postmortem: bound water (T2b, P2b), intramyofibrillar water (T21, P21), extramyofibrillar water with lower mobility (T22a, P22a), extramyofibrillar water with higher mobility (T22b, P22b).

IV. CONCLUSION

These findings demonstrated that broiler breast meat undergoes significant changes in water distribution within the tissue during the early postmortem phase (3-5 h). These postmortem water changes are more drastic in WB meat compared to non-WB meat and may be related to differences in the progression of rigor mortis development. Water in WB meat exhibited greater mobility than water in normal meat. These data provide further insight into the underlying mechanisms that control WHC and quality characteristics in broiler breast meat.

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