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Wooden breast myopathy on water-holding capacity, rheological and gelling properties of chicken broiler breast batters (#440)

Yulong Zhang, Xinglian Xu, Changbo Tang, Peng Wang, Zhen Li, Tianjiao Zhao

Nanjing Agricultural University, College of Food Science and Technology, Nanjing, China

Introduction

Wooden breast condition, characterized by hardened areas, pale and ridge-like bulges at the caudal end, raised increasing concerns in poultry industry [1]. This meat was downgraded in poultry industry for commonly manufacturing processed products to result in economic loss [2]. Studies showed that raw wooden breast fillets exhibited poor water-holding capacity (WHC) and bad hardness [3]. This could be related to histological structure, which revealed that wooden breast presented muscle fiber fragmentation, myofibril swelling, necrotic muscle fiber replacement with connective tissue, and interstitial connective tissue accumulation [4]. Moreover, wooden breast also exhibited different composition and protein functionality. As wooden breast myopathy worsened, chicken broiler breast exhibited poorer water-holding capacity, harder areas of raw meat and textural properties [1,5]. This study aimed to investigate the effect of the severity of wooden breast myopathy on water-holding capacity, rheological and gelling properties of chicken breast batter, which was used to provide a theoretical basis for an effective application of wooden breast in meat industry.

Methods

Broiler breast selection and preparation of meat batter and gels Chicken breast fillets were assessed as normal, mild, moderate and severe according to the criteria of Tijare et al. [6], and were cut into two parts: cranial part with the removal of visible fat and connective tissues for meat batter; caudal part that was discarded. Cranial parts of normal, mild, moderate and severe wooden breasts were minced at 4000 rpm, 10 s (3 times) for meat batters using HM100 Knife Mill, which were labelled as Normal, Mild, Moderate and Severe, respectively.

Meat batter was injected into 50-mL centrifugal tubes and heated for 30 min in a 70°C water bath to obtain meat gels. Thereafter, the color, water distribution, texture and light microscopy were analyzed.

Water-holding capacity Simply, breast batter was packaged and heat-treated to an internal temperature of 70°C in a 70°C water bath. Cooking loss was calculated based on difference in weight of meat batter before and after cooking.Breast batter was frozen at -24°C in a refrigerator for 24 h. After 24 h, the samples were thawed at 4°C until they were completely thawed. After the removal of water from meat batter surface, thawing loss was calculated as the difference in weight of meat batter before and after thawing.

Dynamic rheological measurement Dynamic rheological measurement was conducted according to Kang et al. [7]. Rheological measurement was carried out within the linear range at a strain of 0.25% and a constant frequency of 1 Hz. The probe was set with the gap of 0.5 mm. The edges of all batter samples were covered with paraffin oil to prevent dehydration. Heating was performed from 20°C to 85°C at a scan rate of 2°C min^{-1} using a temperature control unit. The storage modulus (G′) and loss modulus (G″) were recorded during the measurements.

Light microscopy Small samples were cut from meat gels, and light microscopy of meat gels was carried out using Carl Zeiss microimaging (Carl Zeiss, Germany).

Results

Water-holding capacity

Cooking loss of severe wooden breast batter was significantly higher than that of moderate wooden breast batter ($P < 0.05$), but no significant difference was observed between mild and moderate wooden breast batters. Thawing loss of wooden breast batters showed no significant difference between each other. Compared to that of normal breast batter, the cooking loss and thawing loss of wooden breast batters significantly increased ($P < 0.05$). As wooden breast myopathy worsened, the water-holding capacity gradually decreased, revealing that the water-holding capacity of meat batter was related to composition and microstructure of meat batter.

Dynamic rheological property

The storage modulus of all meat batters gradually decreased from 20°C to 50°C. The G′ of meat batters reached the peaks at the range of 50°C to 55°C. From 56.3°C to 71.2°C, the G′ of meat batters sharply increased, indicating a gel-forming network structure formed. Afterward, the changes of G′ might be due to release and denaturation of proteins in muscle. The G′ of meat batter reduced both at the beginning and the end of heating treatment as wooden breast myopathy worsened. The lower elasticity of meat during heating was related to lower protein content, affecting the gel network and protein matrix formation. The changes in G″ for both wooden and normal meat batters were similar to those in their G′ up to about 75°C. It demonstrated that wooden breast meat batter had lower viscosity than normal meat, and the G″ of meat batter reduced as wooden breast myopathy worsened.

Light microscopy

Meat gels of normal breast showed tight structure and large small bubbles in

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number. As wooden breast myopathy worsened, meat gels of chicken breast revealed loose structure and many big bubbles.

Conclusion

The incidence of wwooden breast myopathy influenced water-holding, rheological and gelling properties of breast batters. As wooden breast myopathy worsened, water-holding, rheological and gelling properties of breast batters gradually reduced, affecting the quality of breast batter and processing.

References

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Notes

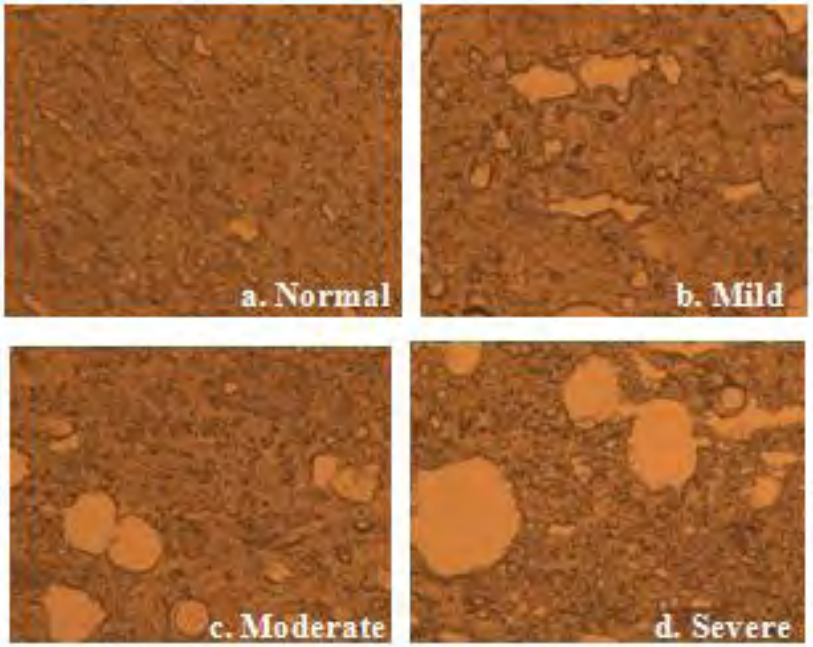

Figure 2
Microscopic structures of batter gels from chicken breasts under wooden breast conditions

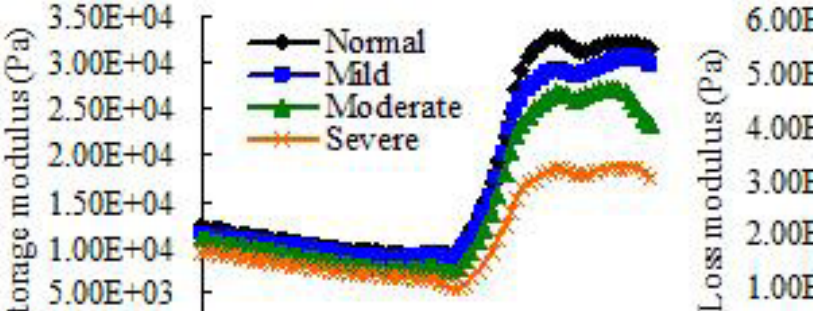

Figure 1
Rheological properties of chicken broiler breast batters under wooden breast myopathy

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