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Processing Characteristics and Rheological Properties of Mechanically Separated Chicken and Chicken Breast Meat

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Objectives

Addition of mechanically separated chicken (MSC) modifies the texture, flavor, and color of processed meat products; however, there is little modern literature characterizing its behavior in a model system and qualities in applied formulations. The objectives of this study were to determine differences between MSC and chicken breast trim when used as frankfurter raw materials and to identify rheological attributes of their myofibrillar proteins during gelation. An improved understanding of MSC properties will facilitate optimization of its processing parameters.

Materials and Methods

MSC obtained from 2 different separation methods (MSC1 Beehive separator, aged bones; MSC2 Poss separator, fresh bones) were compared to chicken breast trim (BT) as raw materials for frankfurters. Chicken was blast frozen (–44.4°C for 72 h) and stored at –20°C for < 20 d. Frankfurters were produced, vacuum packaged, and stored under display lights (florescent, 2,300 lux) for 98 d; 3 rep. Color (L*, a*, b*), texture profile analysis, and lipid oxidation were evaluated every 2 wk. Dynamic oscillatory rheology (40mm parallel plates, 0.25% strain and 1 Hz frequency) was performed on the solubilized myofibrillar proteins of each raw material. Myofibrillar proteins were isolated by differential centrifugation, solubilized (0.6 M NaCl, 50 mM sodium phosphate, 2.8% (w/v) protein concentration, pH 6) and a temperature sweep (20 to 85°C at 1°C/min) was conducted. Storage modulus (G'), loss modulus (G'') and phase angle (δ) were measured. Protein profile was evaluated using SDS-PAGE. Shelf-life (fixed: treatment, day and treatment × day, random: replication) and rheological (fixed: treatment random: treatment × day) data were analyzed using SAS 9.4 mixed proc (SAS Inst. Inc., Cary, NC).

Results

All raw materials were significantly different in moisture and fat content ($P < 0.05$). Both MSC raw materials contained greater fat and less moisture than BT. MSC2 frankfurters were greatest in fat and lowest in moisture content ($P < 0.05$). Both MSC frankfurters had significantly darker (L*), and redder (a*) external and internal color than BT frankfurters with MSC2 being the darkest and reddest treatment ($P < 0.05$). Greater hardness, cohesiveness, gumminess and chewiness values were documented in MSC2 product than in BT and MSC1 product. All treatments exhibited gelation with increased temperature (decreased δ). A peak, decline, and subsequent increase was observed in all 3 treatments at the 50 to 55°C range in both the G' and G''. G' slopes on both sides of the peak (S2, S3) and following the decline (S4) were significantly different between BT and both MSCs ($P < 0.05$). BT's S3 was significantly steeper indicating a greater instability of the solid-like structure in the temperature range of 50 to 55°C (myosin rod denaturation). BT S2 and S3 were significantly different from MSC treatments in G'' ($P < 0.05$), but not significantly different during S3.

Conclusion

The data demonstrate that physical properties of myofibrillar proteins from MSC and chicken breast meat differ during thermal gelation. This indicates a different protein profile that could be explained by muscle source or by denaturation during isolation of the MSC. The data reveal that properties of different MSC can result in significant variation in finished product quality, underscoring the importance of understanding the features of raw materials that affect processing functionality.