Published February 1, 2019

2017 Reciprocal Meat Conference – Meat and Poultry Processing, Ingredient Technology and Packaging

Meat and Muscle Biology™

Effect of Initial Freezing Rate and Repeated Freezing/Thawing on Quality and Physicochemical Characteristics of Pork Patties

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Keywords:freezing rate, physicochemical charateristics, pork patty
Meat and Muscle Biology 1(3):33 **doi:10.221751/rmc2017.031**

Objectives

Freezing is one of the most effective methods for meat storage. However, repeated freezing/thawing during meat processing could lead to detrimental impacts on quality attributes of final meat products. Fast freezing has been known to reduce quality defects of frozen/thawed meat by minimizing structural damage to muscle related to ice crystal formation during freezing. However, little information is available on how the initial freezing rate would affect the final quality attributes of meat products undergone repeated freezing/thawing process. Therefore, the objective of this study was to evaluate the effect of initial freezing rate of sub-primals and subsequent freezing/thawing on quality characteristics of ground pork patties.

Materials and Methods

At 8 d postmortem, pork ham muscles from each side of pork carcasses (n = 6) were removed, cut into 4 sections, assigned to 3 initial freezing rates [operating temperatures at –20°C (slow), –30°C (medium) or –80°C (fast)] and unfrozen control, and stored at –18°C for 3 wk. After thawing, the ham muscle sections were ground and manufactured for ground patties using a hand-held patty maker. The pork patties were then randomly assigned to 3 subsequent freezing conditions [unfrozen, air-freezer (–20°C) or blast freezer (–30°C)] and stored in –18°C for 3 wk. Once patties were thawed in a cooler at 2°C, water-holding capacity, moisture, pH, color (CIE L*, a* and b*), texture profile analysis, 2-thiobarbituric acid reactive substances (TBARS) and thiol content were evaluated. The experimental design was a split-plot design with initial freezing rate (whole-plot) and subsequent freezing conditions of patties (sub-plot) with 3 independent batches. All data were analyzed using the PROC MIXED procedure of SAS (SAS Inst. Inc., Cary, NC).

Results

Both initial freezing rate and subsequent freezing conditions significantly affected thawing, cooking and total losses of frozen pork patties. Pork patties prepared with the sub-primal section assigned to slow freezing (–20°C) showed the highest total loss ($P < 0.05$), regardless of subsequent freezing conditions. The initial freezing rate and/or subsequent freezing condition had no impacts on pH, moisture and texture of frozen/thawed pork patties ($P > 0.05$). The pork patties formulated with the sub-primal section assigned to slow freezing (–20°C) exhibited higher TBARS value but lower thiol content compared to patties made with the muscle sections assigned to medium or fast freezing ($P < 0.05$). Frozen/thawed patties had lower L*, a* and b* values compared to the unfrozen control patties, irrespective of freezing rate and/or subsequent freezing conditions ($P < 0.05$).

Conclusion

This study shows that initial freezing of sub-primals at –20°C (slow freezing) resulted in increases in total water loss and lipid/protein oxidation of further processed pork patties, regardless of repeated freezing condition of patties. Thus, our findings indicate that the initial freezing rate of sub-primal sections could have a dominant impact on quality attributes of final meat products when undergone subsequent freezing/thawing. Further studies determining effects of different thawing conditions coupled with different freezing rate on meat quality would be warranted.

