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Effects of Fast Freezing First Then Thaw-Aging on Quality and Chemical Attributes of Beef Muscles

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Objectives

Freezing is an effective preservation method to extend the shelf life of meat products. Despite of the benefits, quality deteriorations associated with freezing, such as decreases in water holding capacity (WHC) and/or oxidative stability have been well documented. Fast freezing is known to enhance the quality of frozen/thawed meat by inducing the formation of intracellular small ice crystal formation, and thus reducing muscle damage. Aging prior to freezing is a common process to improve the quality of the frozen meat. As positive aging impacts can be shown after freezing/thawing, we hypothesized that fast freezing first then thaw-aging would result in equivalent or better meat quality attributes compared to the conventionally aged/frozen beef products. The objective of this study was to evaluate the effect of different freezing rate and aging/freezing sequence on quality and physicochemical attributes of beef loins.

Materials and Methods

Both loin (*Longissimus lumborum*) and eye of round (*Semitendinosus*) muscles from 1 side of 10 beef carcasses were obtained at 3d postmortem, cut into 4 sections and vacuum packaged. The sections were randomly assigned to 4 different combinations of aging/freezing- (Aging Only (AO), Slow Freezing then Thaw-Aging (SFTA), Fast Freezing then Thaw-Aging (FFTA), or Aging first then Slow Freezing (ASF). Aging was conducted at 2°C for 2 wk. Frozen samples were stored at –20°C for 3 wk. Fast freezing was conducted using a liquid nitrogen freezing cabinet set at –75°C. Conventional blast freezer set at –20°C was used for slow freezing. Frozen samples were thawed at 2°C until the internal temperature reached –1.5°C. Meat quality measurements such as shear force, WHC by assessing purge/thaw loss, drip loss and cook loss, and color stability were conducted. For display color, steaks were overwrapped with PVC film and displayed for 7d under light, and instrumental and visual color evaluations were performed. Other chemical analyses including 2-thiobarbituric acid reactive substance (TBARS), non-heme iron (NHI) content and histology for muscle micro-structure analysis were performed. All data were analyzed using the PROC MIXED of SAS (SAS Inst. Inc., Cary, NC).

Results

FFTA samples took less than 3 h to reach –20°C of internal temperature, while SFTA samples took almost 3 d. Both FFTA and SFTA samples exhibited a higher total moisture loss ($P < 0.05$) when compared to the other treatments. No significant difference in shear force was found between the treatments, although the steak samples from FFTA showed numerically lowest shear force values compared to the others ($P = 0.12$). AO samples maintained the highest a* value during the entire display between the treatments. Rapid increase in discoloration was observed in steak samples from SFTA, followed by FFTA and ASF after 4 d display. Higher TBARS and NHI contents were observed on all frozen/thawed samples compared to non-frozen AO after display ($P < 0.05$).

Conclusion

We found that fast freezing first then thaw-aging did not result in positive impacts on the overall quality characteristics of frozen/thawed meat products. The results also indicate that the order of aging/freezing/thawing sequence could be an overriding factor affecting quality attributes of frozen/thawed meat over freezing rate. Further studies involving various thawing and freezing rate combined with different aging/freezing/thawing sequence would be warranted.

