BLADE TENDERIZATION, AGING METHOD, AND AGING TIME AFFECT EATING QUALITY OF CULL DAIRY COW *Longissimus lumborum* STEAKS

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Abstract – This study was carried out to investigate effects of blade tenderization (BT), two aging methods (dry (D) and wet (W)), and aging time (0 and 21 d) on physico-chemical traits of instrumental tenderness, and sensory properties of *Longissimus lumborum* muscles coming from 12 cull Holstein cows. Blade tenderized steaks tended to have lower (P=0.09) WBSF values than C steaks (33.13 N and 41.46 N, respectively) . WBSF values were decreased by aging. Aging, W-aging, and BT x W-aging resulted in significant improvement in myofibrillar tenderness scores. Aging and/or BT has improved sensory panel tenderness and WBSF of cull cow *Longissimus lumborum* steaks. Therefore, blade tenderization and aging can be used in combination to increase tenderness and value of Longissimus steaks from cull Holstein cows.

Key Words – Aging, Blade tenderization, Cull cow, Palatability

I. INTRODUCTION

Cows are generally culled for various reasons, namely low productivity, poor health or condition, poor temperament, age, failure to reproduce, and (or) management decisions by the producer. In the USA, dairy cows were about 8% of all cattle harvested in 2010 [1]. However, mature cull cows have been reported to have more inferior palatability characteristics than young cattle [2]. Cull cow beef has decreased oxidative stability and darker muscle color as reported by Xiong *et al*. [3]. Thus, it has been underutilized owing to poor eating quality (tenderness, juiciness, flavor) and decreased consistency in tenderness [3, 4]. Blade tenderization improves the tenderness of less tender cuts of meat and has been reported to ensure meat tenderness [5, 6]. More than 85% of all meat purveyors in the USA have been known to blade tenderize meat [7]. Blade tenderization uses closely spaced thin blades having sharpened edges, which cut the muscle fibers into shorter segments and physically disrupts muscle fibers and muscle connective tissues improving tenderness [6].

Cow meat is used in food service as ground beef or part of sausage formula due largely to its inferior palatability and color instability and this makes it unsuitable for use in the form of steaks or roasts for retail. The objectives of our study were to investigate the effects of aging method (dry or vacuum aging), and blade tenderization on physical, chemical, instrumental tenderness, instrumental color, visual cooked color and sensory properties of beef steaks from Holstein cull cows.

II. MATERIALS AND METHODS

Raw material preparation

Subprimals (beef loin, strip loin, boneless, NAMP 180, 1997) from 12 cull Holstein cows were obtained from a large commercial processor. At the Kansas State University meat laboratory, the *psoas major* muscle and all bones were removed to have a boneless strip loin consisting primarily of the *Longissimus lumborum* muscle and associated subcutaneous fat. *Longissimus lumborum* muscles were blade tenderized (model T7001; Ross Industries Inc., Midland, VA) twice, with the external fat side down. Loins were divided transversely into two equal portions and randomly assigned to one of the two aging treatments: (wet aging (W), or dry

aging (D) with equal number of anterior and posterior halves in each treatment. Loin sections were subjected to aging for 21 d at 2.2 °C. Loins were placed on wire racks, with the subcutaneous fat surface down. Four 2.54 cm-thick steaks were cut from the anterior end of all loin half sections and used for Warner- Bratzler shear force determination and sensory analysis. A sample was also taken from the anterior end of the LL for compositional analysis and pH. Steaks for sensory evaluation were frozen at -40ºC until just before they were evaluated by a trained sensory panel.

Weight, trim and combined losses

Each loin section was weighed on day 0 and day 21 of aging time. Weight (shrink) loss (%), trim loss (%, and combined loss (%) was calculated for each loin section on day 0 and day 21 of aging time.

pH, moisture, fat

pH values were obtained with an Accumet glass electrode attached to an Accumet 50 pH meter (Model 6.05, SFK Technology Inc., Peosta, IA). Moisture and fat content were determined using the CEM (CEM, Corporation; Mathews, NC) SMART (moisture) and SMART Trac (fat) systems (AOAC PVM 1:2003).

Shear force

Steaks were thawed at 4ºC for 24 hr and then cooked at 163 °C in a forced-air convection oven (DFG-102 CH3; G.S. Blodgett CO., Burlington, VT) to an internal core temperature of 71.1 °C. Then, steaks were cooled for 24 h at 2 °C following AMSA [8] procedures and six round cores (1.27 cm diameter) per steak were removed parallel to the long axis of the muscle fibers using a mechanical coring device. Each core was sheared once using a Warner-Bratzler shear attachment (V-notch blade) connected to an Instron Universal Testing Machine.

Sensory Analysis

Trained panelists (n=8) evaluated palatability attributes on an eight-point scale for myofibrillar tenderness, juiciness, flavor, overall tenderness, and connective tissue amount (1=extremely tough, dry, bland, tough, and abundant; 8=extremely tender, juicy, intense, tender, and none) for each sample.

Statistical design and analysis

The design was a split-split-plot design with the incomplete assignment of the treatment combinations to the experimental units. The whole plot treatment was mechanical treatment (blade or control), the sub-plot treatment was aging method (dry aging and wet aging), and the sub-sub-plot treatment was aging time (0 or 21 d). The number of replications was six. Data were analyzed using the PROC MIXED procedure of SAS (2009; SAS Institute, Inc., Cary, NC). Least squares means for all significant effects were calculated and means separated when significant ($P < 0.05$) using the PDIFF option. Least significant differences (LSD) for all significant factors were calculated and presented for ease of mean separation.

III. RESULTS AND DISCUSSION

Treatment (blade tenderized or control; BT and C) and aging method interactions affected ($P<0.01$) weight loss, but not trim or combined loss ($P>0.05$; Fig. 1). For W-aged (vacuum packaged loins), BT and C treatment resulted in similar weight loss.

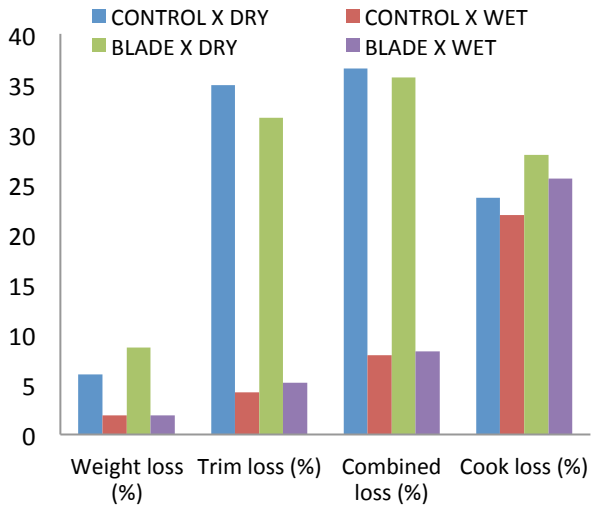

Figure 1. Least square means of treatment and aging methods on weight loss (%), trim loss (%), and combined loss (%), cook loss for cull cow boneless strip loins.

However, dry aged BT loins had higher weight loss (P<0.05) than C loins. This can be attributed to the fact that blade tenderization disrupts and opens up muscle structure allowing moisture to escape from the interior of meat to the exterior more easily when the meat is unpackaged. D-aged steaks had much higher (P<0.01) trim and combined loss as expected (Figure 1). Similarly, Ahnström *et al*. [9] reported higher weight loss with dry aging than that with W aging.

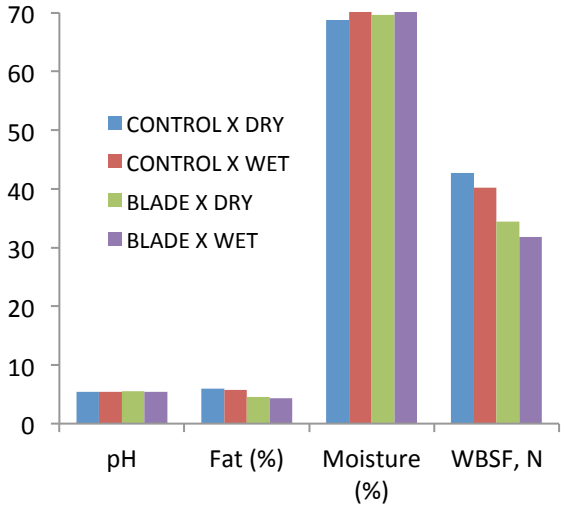

Figure 2. Least square means of treatment and aging methods on pH (%), fat (%), moisture (%), and WBSF (N) for cull cow boneless strip loins.

Treatment x aging time interaction was significant (P<0.05) for pH (Figure 2). For both C and BT steaks, aging increased (P<0.05) pH. An aging method x aging time interaction (P<0.0001) for moisture content was found. Steaks D-aged for 21 days had lower (P<0.01) moisture content than unaged steaks. Fat content was higher for 21 day aged steaks (6.61 vs. 4.64%; P<0.05), but other treatments had no effect (P>0.05) on pH.

Blade tenderized steaks had WBSF value of 33.13 N while C steaks had WBSF value of 41.46 N. Although the difference in WBSF values was not found to be significant (P= 0.09), it likely has practical importance. However, as animals mature, collagen becomes more cross-linked and heat resistant and more variation in tenderness is expected. Aging decreased WBSF values (P<0.05). Similarly, Wheeler *et al*. [10] reported decreased WBSF values with increased aging time. Moreover, Campbell *et al*. [11] investigated effects of dry aging on palatability of beef longissimuss muscle and reported that aging for for 21 d decreased WBSF values as compared to steaks aged for 0, 7, or 14 d. According to the "Standard Practice for Verifying Tenderness Marketing Claims Associated with Meat Cuts Derived from Beef" [12], W-aged and/or BT steaks from cull dairy cows would have qualified for "USDA Certified Tender". Blade tenderized steaks had higher (P<0.05) cook loss than C steaks. Similarly, Obuz and Kropf [13], reported higher cook losses with BT. D-aged steaks had less (P<0.01) cook loss than W-aged steaks due to their lower moisture content to begin with.

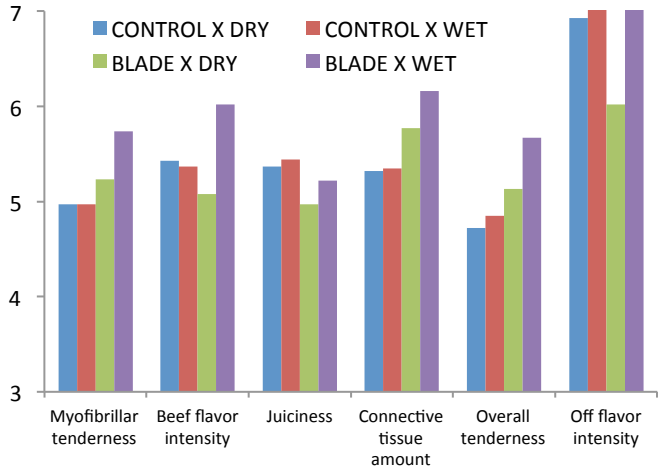

Figure 3. Effects of aging methods on sensory traits. (1=extremely tough, dry, bland, tough, and abundant; 8=extremely tender, juicy, intense, tender, and none, respectively)

Aging and treatment x aging method was significant (P<0.05) for myofibrillar tenderness, overall tenderness, and off-flavor intensity. Myofibrillar and overall tenderness increased and off-flavor decreased for BT x W-aging compared to BT x D-aging (P<0.05) (Fig. 3), which agrees with the result of several studies [14, 15]. Irrespective of aging method used, BT improved myofibrillar tenderness (P<0.05). Juiciness decreased with aging, which can be attributed to increased weight loss with aging time (Fig. 1). Panelists gave higher connective tissue amount scores (less detectable connective

tissue) to aged steaks aged for 21 d as compared to those not aged (0 d) suggesting that aging had a tenderizing effect on connective tissue.

Aging method or aging time affected ($P< 0.05$) overall tenderness. The W-aged steaks were preferred to D- aged steaks by the panelists in terms of overall tenderness. Aged steaks had higher ($P<.0001$) overall tenderness than unaged counterparts (Figure 3). Treatment x aging method was significant ($P<0.05$) for beef flavor intensity and the combination of BT and D-aging resulted in the least flavor intensity. No or minimum differences in beef flavor intensity for D-aged versus W -aged steaks were reported in several studies [14, 15]. In our study, the combination of BT and D-aging and D-aging by itself increased off-flavor intensity (both $P < 0.05$). Aging *Longissimus lumborum* cow steaks for 21 d increases overall tenderness as compared to C, and BT improvs overall tenderness. Also, BT coupled with W-aging improves flavor intensity and reduces off-flavor (both $P<0.05$) with minimal effect on juiciness.

IV. CONCLUSION

Blade tenderization and postmortem aging improved tenderness of cull Holstein cow *Longissimus lumborum* steaks. Generally, wet aging resulted in better palatability attributes than dry aging. The findings might have implications for the meat industry since practices such as blade tenderization and post mortem aging has improved the eating quality of cow meat, which might pave the way for increased use of the longissimus muscle from cull dairy cows as steaks. Sensory and WBSF values were quite acceptable for the combination of blade tenderization, vacuum packaging, and aging 21 d.

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