AN INVESTIGATION OF THE RELATIONSHIP BETWEEN MUSCLE FIBER CROSS-SECTIONAL AREA AND MEAT TENDERNESS

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I. OBJECTIVES

Cross-sectional area (CSA) of muscle fibers represent the amount of myofibrillar substances the consumer's teeth must bite through during chewing. Therefore, it is logical to expect that CSA is positively correlated to meat tenderness. However, past studies speculated that this relationship between CSA and meat tenderness may be muscle specific, and the exact relationship is unclear. Therefore, the objective of this study was to investigate the relationship between Warner-Bratzler shear force (WBSF) and muscle fiber CSA of 10 different beef muscles with 2 aging periods.

II. MATERIALS AND METHODS

Two separate studies were conducted. In the first study, *triceps brachii* (TB), *supraspinatus* (SS), *longissimus thoracis* (LT), *rectus abdominus* (RA), *rectus femoris* (RF), *semitendinosus* (ST), and *gluteus medius* (GM) were collected from 10 USDA Choice beef carcasses. Each sample was fabricated into steaks and assigned to a 2- or 21-d aging period ($n = 140$). The second study examined *longissimus lumborum* (LL), *gastrocnemius* (GC), and *tensor fascia latae* (TL) from 10 USDA Low Choice beef carcasses. Each sample was fabricated into steaks and assigned to a 5- or 21-d aging period ($n = 60$). For each sample, two 10-µm cryosections were collected, and dystrophin was detected using the immunofluorescence method. An average of 400 muscle fibers per sample were analyzed for CSA and diameter. In addition, WBSF was measured for each sample. Correlation analysis was conducted to elucidate the relationship between CSA and WBSF.

III. RESULTS

No interaction was found between muscles and aging time for both studies. For the first study, SS and ST had the highest WBSF values followed by RA, GM, TB, and RF, with LT presenting the lowest WBSF values ($P < 0.01$). On the other hand, RA and SS had the greatest CSA and diameter, followed by LT, TB, GM, and ST, with RF possessing the lowest CSA and diameter values ($P < 0.01$). The SS and TB samples demonstrated a positive correlation ($r = 0.59$, $P < 0.01$ and $r = 0.50$, $P < 0.05$, respectively) between CSA and WBSF. In contrast, ST had a negative correlation ($r = -0.64$; $P < 0.01$) between CSA and WBSF. There was a minor but significant negative correlation ($r = -0.22$; $P < 0.01$) between CSA and WBSF for all cuts in the first study. In the second study, GC had the highest WBSF values, followed by TL, whereas LL had the lowest WBSF values ($P < 0.01$). The LL had the greatest CSA and diameter, and CSA and diameter for GC and TL were lower ($P < 0.01$). The LL had a positive correlation ($r = 0.61$; $P < 0.01$) between CSA and WBSF. There was also a negative correlation for CSA and WBSF ($r = -0.55$; $P < 0.01$) for all cuts in the second study. No relationship was documented between CSA and WBSF for GM, LT, RA, RF, GC, and TL in the 2 studies ($P > 0.10$).

IV. CONCLUSION

The results confirmed that the relationship between CSA and meat tenderness is muscle specific. However, it was interesting to note that both studies exhibited an overall negative correlation between CSA and WBSF. Although no aging effect was found for CSA, the steady decrease of WBSF values from early postmortem to 21 d postmortem may lead to this negative correlation with CSA. However, one cannot overlook the potential effect of muscle fiber fracture and tearing as enzymatic degradation takes places, leading to the detection of slightly larger CSA.

Keywords: beef, cross-sectional area, diameter, muscle fiber, tenderness