RELATING MUSCLE FIBER MORPHOMETRICS AND PROTEIN DEGRADATION TO MEAT QUALITY IN A MULTIBREED HERD

Shelby Wright, Dwain Johnson, Jason Scheffler, Mauricio Elzo, Tracy Scheffler
Department of Animal Science, University of Florida, Gainesville, FL

RMC 2016 American Meat Science Association June 19th - 22nd

Abstract ID #: 104

Introduction

- Brahman and Brahman-influenced cattle provide integral adaptations that benefit the cattle herd in the sub-tropical United States. Their heat tolerance and parasite resistance makes them ideal for warmer climates; however, they tend to exhibit less desirable carcass and palatability traits.
- When compared to Angus, Brahman are lower marbling, less tender, and have more connective tissue.[1]
- Cattle used in this study were part of a long-term genetic study involving Angus, Brahman, and Angus-Brahman crossbreeding. Although these cattle represent a continuous spectrum of Angus-Brahman genetic variation, they were divided into six breed groups for analysis: Angus; ¾ Angus, ¼ Brahman; Brangus; ½ Angus, ½ Brahman; ¼ Angus, ¾ Brahman; and Brahman.

Objective

The objective of this study is to determine the influence of Brahman genetics on muscle contractile and metabolic phenotype and postmortem proteolysis.

Methods

- Steers (n=6 per breed group) were harvested and samples from *longissimus lumborum* muscles were collected at 0h, 24h, and 14d post-mortem.
- Western blotting was used to assess proteolysis during the 14d aging period, including degree of autolysis of the proteolytic enzyme, µ-calpain, and the extent of degradation of troponin-T.
- Tenderness was determined objectively by Warner-Bratzler shear force (WBSF).
- Immunohistochemistry was used to determine the percentage of myosin heavy chain (MHC) isoforms and muscle fiber cross sectional area (CSA).
- Citrate synthase activity of muscle tissue and succinate dehydrogenase (SDH) staining of muscle histology cross sections were used as markers of oxidative capacity.
- The data was analyzed using multivariate methods in SAS-JMP Pro 11. Nonparametric correlations were used to calculate the relationships between 24 h µ-calpain autolysis, WBSF, citrate synthase activity, 24h and 14d troponin-T degradation, muscle fiber cross sectional area, and breed group.

Results

As the percentage of Brahman genetics increases, WBSF increases as expected (R = 0.45, P <0.01). The degree of µ-calpain autolysis at 24h decreases as WBSF values increase (R = -0.49, P <0.01), and autolysis decreases as the percentage of Brahman increases (R = -0.43, P < 0.01).

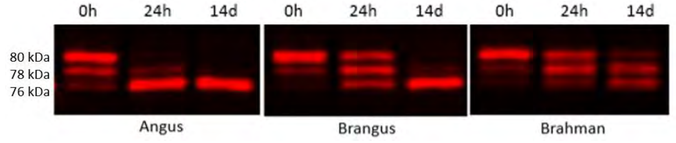


Fig. 1 Western blot of µ-calpain autolysis at 0h, 24h, and 14d

The extent of troponin-T degradation[2] was significantly lower in Brahman cattle (P <0.0001). Troponin-T degradation at 24h post-mortem increases as the degree of autolysis increases (R = 0.83, P <0.0001). As troponin-T degradation increases at 14d, WBSF decreases indicating more tender steaks (R = -0.35, P = 0.04).

Click on images to enlarge.

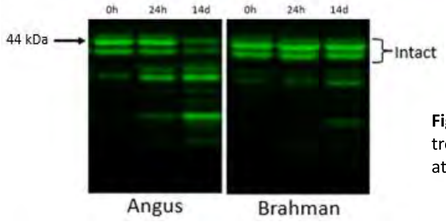


Fig. 2 Western blot of troponin-T degradation at 0h, 24h, and 14d

Brahman genetics tended to influence oxidative capacity (P =0.06), as citrate synthase activity increased with greater percentage of Brahman genetics. Greater oxidative capacity is shown by a more intense SDH stain with Brahman muscle compared to Angus muscle. More intense stain indicates greater activity of SDH, a mitochondrial enzyme.

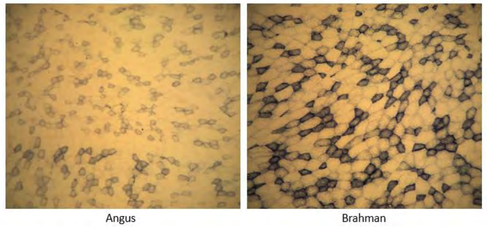


Fig 3. SDH stain of muscle sections

There is no significant difference between breed groups in the percentage of muscle fiber types or the CSA of type 1 and type 2a fiber types. However, as Brahman genetics increases the CSA of type 2x fibers increases (R = 0.49, P = 0.007).

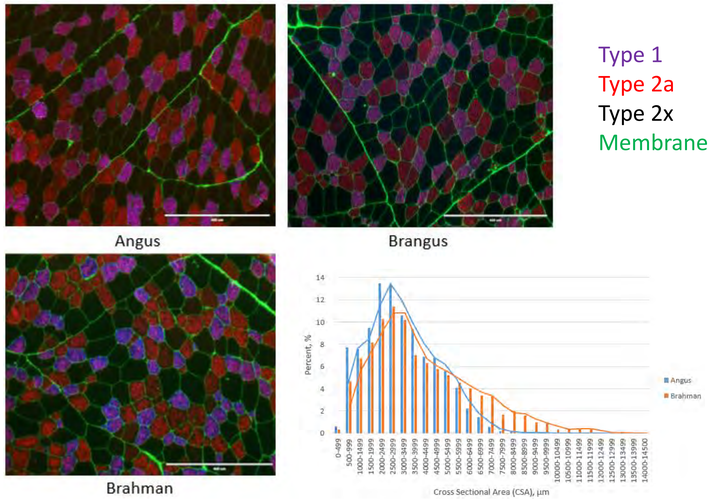


Fig. 4 Immunohistochemistry of MHC isoforms, scale bar = 400 µm. Distribution of CSA across all muscle fiber types

Conclusions

Brahman influenced cattle produced tougher steaks, evidenced by higher WBSF and decreased protein degradation. Brahman also posses larger type 2x muscle fibers, which had no affect on glycolytic capacity. Postmortem proteolysis and muscle fiber type will be utilized to establish predictors for the optimum breed group that provides desirable meat quality and palatability traits, while having enough Brahman influence to thrive in sub-tropical climates.

References

[1]Elzo, M. A., D. D. Johnson, J. G. Wasdin, and J. D. Driver. 2012. Carcass and meat palatability breed differences and heterosis effects in an Angus-Brahman multibreed population. Meat Sci 90: 87-92.

[2]Mohrhauser, D. A., K. R. Underwood, and A. D. Weaver. 2011. In vitro degradation of bovine myofibrils is caused by µ-calpain, not caspase-3. J Anim Sci 89: 798-808.

RMC 2016
American Meat Science Association
June 19th - 22nd

RELATING MUSCLE FIBER MORPHOMETRICS AND PROTEIN DEGRADATION TO MEAT QUALITY IN A MULTIBREED HERD

Shelby Wright, Dwain Johnson, Tracy Scheffler, Jason Scheffler, Mauricio Elzo
Department of Animal Science, University of Florida, Gainesville, FL

Abstract ID #: 104

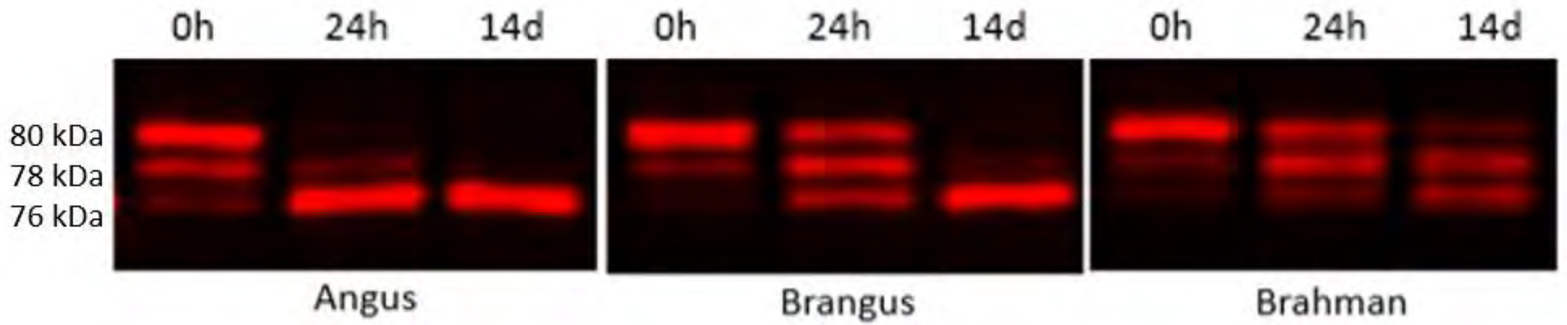


Fig. 1 Western blot of μ-calpain autolysis at 0h, 24h, and 14d

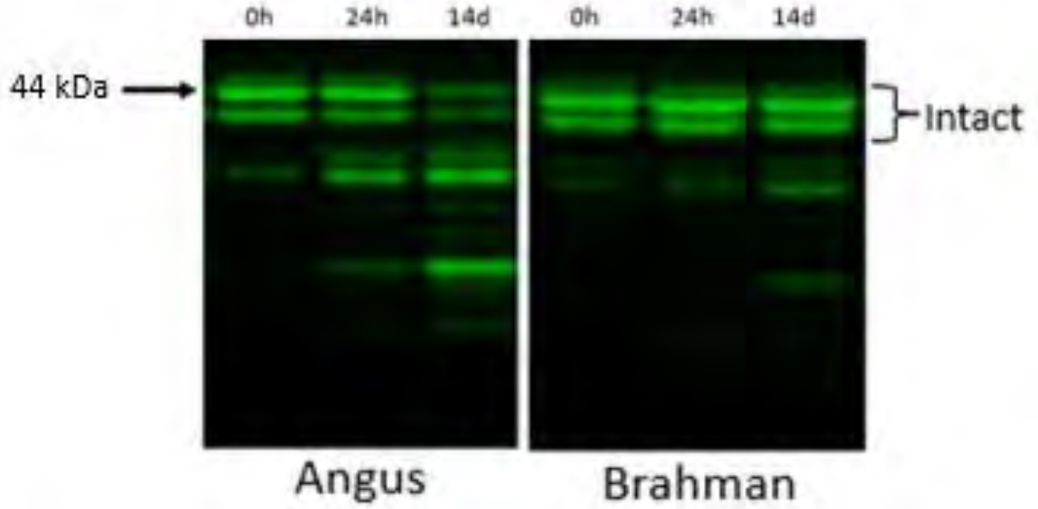


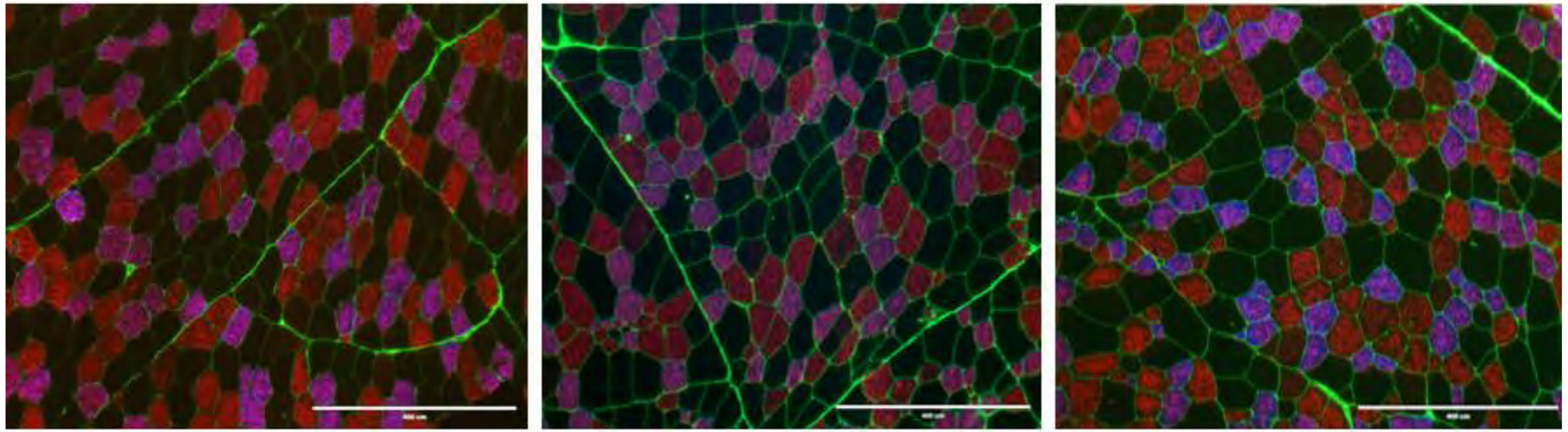
Fig. 2 Western blot of troponin-T degradation at 0h, 24h, and 14d

RMC 2016
American Meat Science Association
June 19th - 22nd

RELATING MUSCLE FIBER MORPHOMETRICS AND PROTEIN DEGRADATION TO MEAT QUALITY IN A MULTIBREED HERD

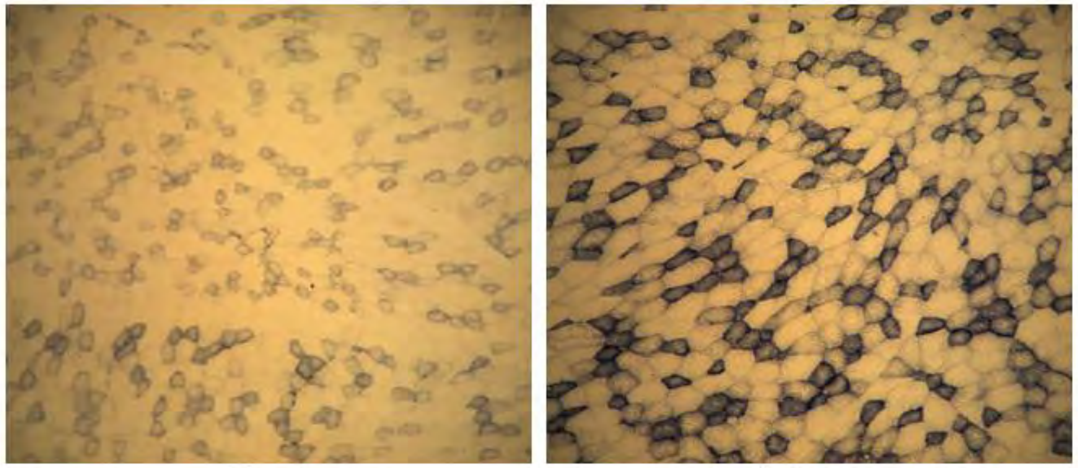
Shelby Wright, Dwain Johnson, Tracy Scheffler, Jason Scheffler, Mauricio Elzo
Department of Animal Science, University of Florida, Gainesville, FL

Abstract ID #: 104



Angus Brangus Brahman

Fig. 4 Immunohistochemistry of MHC isoforms; scale bar = 400 µm



Angus Brahman

Fig 3. SDH stain of muscle sections

RELATING MUSCLE FIBER MORPHOMETRICS AND PROTEIN DEGRADATION TO MEAT QUALITY IN A MULTIBREED HERD

Shelby Wright, Dwain Johnson, Tracy Scheffler, Jason Scheffler, Mauricio Elzo
Department of Animal Science, University of Florida, Gainesville, FL

Abstract ID #: 104

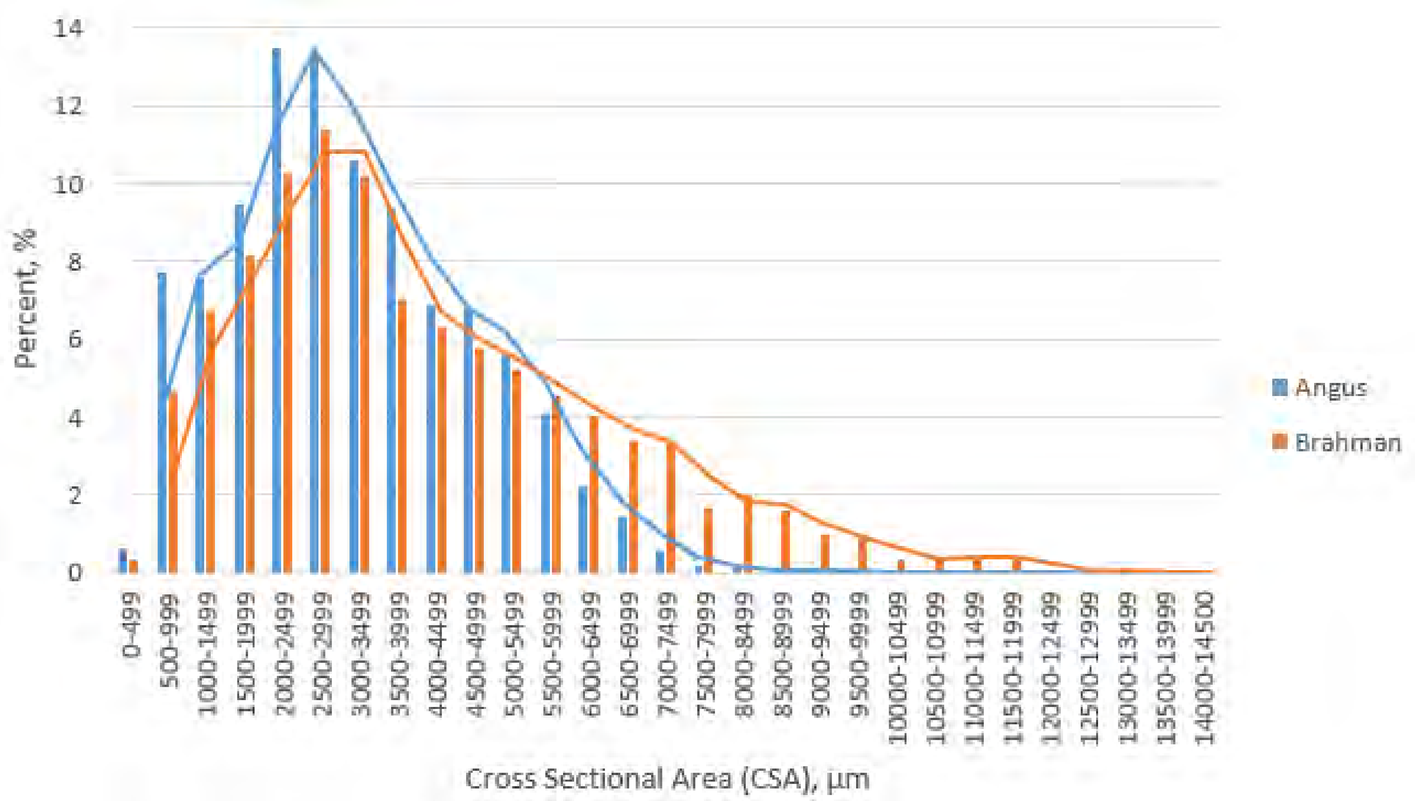


Fig. 4 Immunohistochemistry of MHC isoforms, scale bar = 400 µm. Distribution of CSA across all muscle fiber types