MITOCHONDRIAL FUNCTION AND INTEGRITY IN POSTMORTEM MUSCLE OF BRAHMAN AND ANGUS STEERS

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I. OBJECTIVES

Mitochondria contribute to energy and heat production in muscle. Heat-tolerant Brahman may exhibit distinct mitochondria functional characteristics that subsequently impact postmortem energy metabolism and rate of beef tenderization. Our objective was to assess mitochondrial function in Angus and Brahman cattle during 24 h postmortem.

II. MATERIALS AND METHODS

Steers ($n = 26$) of primarily (80% to 100%) Angus or Brahman genetics were harvested at approximately 19 mo and 570 kg live weight. Samples from the *longissimus lumborum* were collected at 1, 3, 6, and 24 h postmortem. Fresh-preserved muscle samples were permeabilized using saponin, and muscle bundles (2–4 mg) were transferred to a high-resolution oxygraphy for oxygen consumption rate (pmol/s/mg tissue) measurement. A step-wise protocol was initiated by addition of pyruvate, malate, and glutamate to support the TCA cycle and assess leak respiration. The second step was injection of ADP to support electron flow through complex I (PCI), followed by succinate to stimulate complex II (PCI + II). Integrity of outer mitochondrial membrane was tested by cytochrome *c* (cyt_c) addition, using 15% as threshold for integrity. Next, titration with uncoupler (FCCP) was performed to force electron transport system to maximum capacity (ECI + II), followed by rotenone to inhibit complex I (ECII). Antimycin A was used to terminate experiment. Data were analyzed in a randomized block design, with slaughter date as block and fixed effects of breed, time, and the interaction. Random effect considered animal within slaughter date and time used as repeated measure, with covariance structure considering heterogeneous compound symmetry. Least-squares means were separated by Bonferroni test with alpha at 10%.

III. RESULTS

Breed and time differentially affected leak respiration (breed*time: $P = 0.020$) with 24-h Brahman showing a greater rate than Angus. Breed and time influenced PCI (breed: $P = 0.002$; time: $P < 0.001$), with higher rates related to Brahman *longissimus lumborum*. Similarly, PCI + II differed between breeds (breed: $P = 0.003$) and time (time: $P < 0.001$). For electron transport system capacity, ECI + II was affected by breed (breed: $P = 0.042$) and time (time: $P < 0.001$), and pattern for ECII was similar (breed: $P = 0.052$ and time: $P = 0.058$). Based on cyt_c, mitochondria from both breeds were intact at 1 h (breed: $P = 0.595$ and breed*time: $P = 0.368$). However, at 3 h postmortem, 46% of Brahman samples showed cyt_c response lower than 15%, whereas for Angus it occurred in 23% of samples.

IV. CONCLUSION

Mitochondria were intact and functioning for both breeds at 1 h postmortem. Greater respiration rates related to the tropically adapted Brahman during earlier times postmortem

revealed greater capacity to maintain aerobic energy production. Time postmortem consistently reduced mitochondria respiration.

Keywords: beef, energy, metabolism, respirometry