Mitochondria delay proteolysis in an *in vitro* model simulating postmortem conditions

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Background

- Among all eating quality attributes, tenderness is often described as the most important factor dictating the overall acceptance of cooked beef, as well as future decision to repeat purchase.
- Aging of meats allows for the breaking down of proteins in the muscle by proteases, thus causing tenderness to accrue.
- The calpains are calcium dependent proteases that participate in the breakdown of essential cytoskeletal proteins during aging.
- Recent findings from our research group have suggested that mitochondria may have the ability to sequester large amounts of calcium during the postmortem period and therefore delay the activation of the calpain system and subsequently the rate and extent of proteolysis[1].
- To better understand the relationship between mitochondria, calcium homeostasis, and meat tenderness during the postmortem period, our objective is to use an *in vitro* model that simulates postmortem condition with the addition of isolated mitochondria.

Objective

Examine the role of mitochondria regulation of cytosolic calcium concentration and proteolysis in bovine muscle.

Methods

- Beef muscle samples were collected early postmortem and subsequently powderized and used for this study.
- The powder samples were incorporated into a buffer that contained all the components needed for postmortem metabolism.
- The mitochondria were then incorporated into the buffer at 0, 0.5, and 2 mg/ml.
- Aliquots were then taken at different time points to evaluate proteolysis and free calcium concentration.

Results

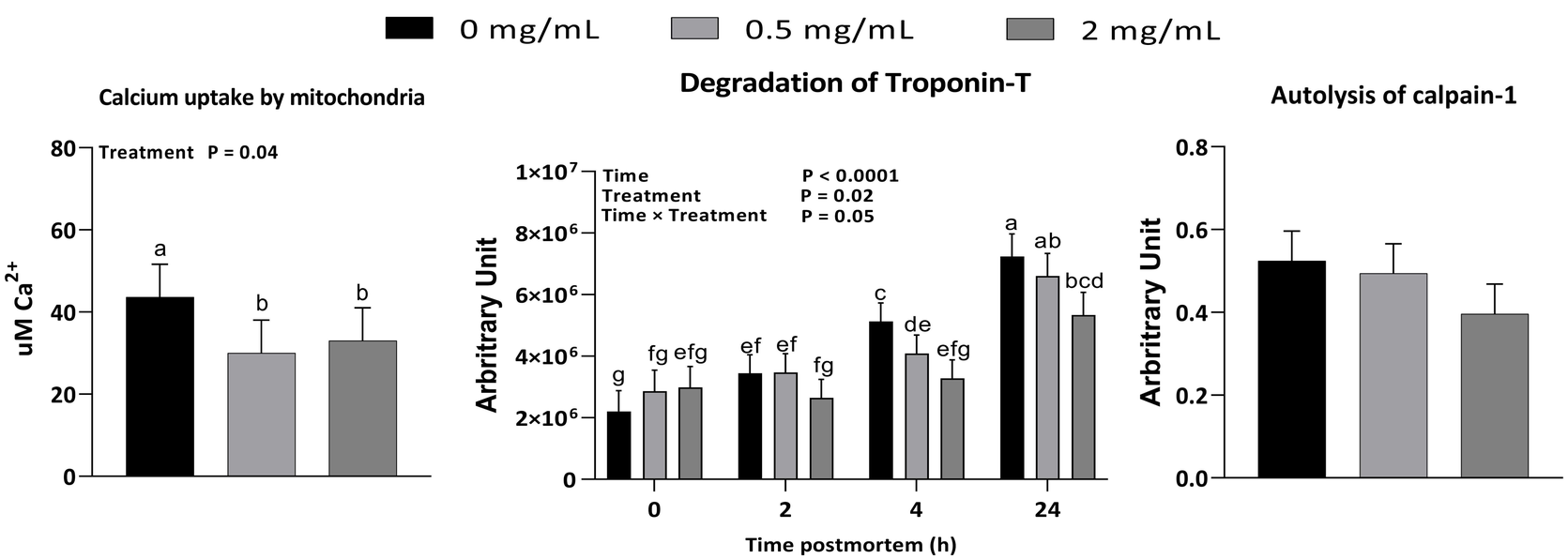

Figure 1. Results of calcium uptake by the mitochondria (A), degradation of Troponin-T (B), and autolysis of calpain-1 (C). A) Decreasing concentration of calcium was observed in buffer containing 0.5 and 2 mg/mL of mitochondria. B) The addition of mitochondria (2 mg/mL) reduced the degradation of Troponin-T. C) No difference was detected in the autolysis of calpain-1. Data are least-square means ± SE. Means lacking a common letter differ significantly ($P \leq 0.05$)

Conclusions

- Incorporating mitochondria in an *in vitro* system decreased free calcium concentration, proteolysis. However, only a trend was observed regarding calpain-1 autolysis
- Although this is only an *in vitro* model, the results thus far indicates that the abundance of mitochondria in skeletal muscle may influence the rate and extent of proteolysis during the postmortem period, mainly through a calcium dependent pathway.
- Further research into the relationship between mitochondria intactness and their calcium buffering capacity. Also, future work should evaluate the degradation of cytoskeletal proteins such as titin and desmin.

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Reference

1. *Dang, D. S., Buhler, J. F., Davis, H. T., Thornton, K. J., Scheffler, T. L., & Matarneh, S. K. (2020). Inhibition of mitochondrial calcium uniporter enhances postmortem proteolysis and tenderness in beef cattle. Meat Science, 162, 108039.*