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The Influence of Diet on Calcium Flux in Fresh Beef

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Objectives

Distillers grains (DG) contribute to cattle sarcoplasmic reticulum (SR) membrane instability by increasing poly-unsaturated fatty acid (PUFA) content in the SR membrane, possibly resulting in early postmortem calcium (Ca) leakage and improved tenderness. Mitochondria, the secondary Ca-sequestering organelles in the muscle, are relatively easy to isolate intact and provide the opportunity to study Ca release under carefully controlled and tightly defined conditions. Our objective was to isolate mitochondria from cattle fed DG and corn to determine the influence of diet and oxidation on Ca release.

Materials and Methods

Cattle (n = 48) were fed a corn-based finishing diet with or without deoiled, dried DG (50% DM basis). After harvest, strip loins were collected and steaks from each loin were aged for 2, 8, and 14 d, powdered, and stored at –80°C for analysis. Samples (n = 12) were randomly selected from each diet group for all aging periods. Mitochondria were isolated using high speed centrifuge from d 2, 8, and 14. The SR was isolated from each d 2 sample. Both mitochondria and SR samples were analyzed for PUFA content using gas chromatography, and phospholipid content using thin layer chromatography. Mitochondria from d 2 and 8 were artificially oxidized using an iron and ascorbic acid mixture.

Results

In both organelles, the DG diet samples had higher 18:2 and total PUFA content ($p < 0.0001$) compared to corn samples. Day 14 mitochondria had higher 18:2 ($p = 0.0009$) and total PUFA ($p = 0.028$) contents compared to d 2 and 8 mitochondria, as expected from aging of unsaturated fats. Phospholipid contents (phosphatidylethanolamine phosphatidylcholine, and phosphatidylinositol) of the mitochondria and SR were unaffected by diet. Oxidized mitochondria retained significantly less Ca than non-oxidized ($p = 0.001$) mitochondria. Day 2 mitochondria retained significantly less Ca than d 8 ($p = 0.009$) mitochondria. Overall, mitochondria from cattle finished on corn tended ($p = 0.08$) to retain more Ca than mitochondria from cattle finished on DG.

Conclusion

Results indicate that greater PUFA content deposited in organelles may affect Ca flux by increased susceptibility to oxidation. A DG diet may influence Ca flux and ultimate tenderness by this mechanism.