LIPID METABOLOMIC CHANGES IN TWO MUSCLES FROM BEEF AT 2 HOURS AND 24 HOURS POSTMORTEM

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I. OBJECTIVES

The *longissimus* and the *semitendinosus* muscles are economically important muscles that vary in meat quality attributes. Study of postmortem metabolism is often focused on glucose metabolism and biochemical changes associated with exhaustion of adenosine triphosphate. However, little is known about postmortem changes in lipid metabolites. The use of metabolomic analysis can provide insight into metabolic processes that have not been evaluated during the early postmortem period. Therefore, the study objective was to evaluate changes in lipid metabolites that occur in 2 muscles from beef between 2 h and 24 h postmortem.

II. MATERIALS AND METHODS

Steers (body weight = 365 ± 3.9 kg) of predominately Angus and Simmental breeding were subjected to a 126-d ($n = 46$) or 154-d ($n = 23$) feeding period as part of a study evaluating supplemental ractopamine hydrochloride. The total mixed rations were delivered once daily at 0800 hours. Steers had *ad libitum* access to feed and water. Twelve steers (6 from each feeding period) were selected at random to be slaughtered at the North Dakota State University Meat Science Laboratory for tissue collection. Muscle samples (~50 g) were collected from the *longissimus* (11th rib) and *semitendinosus* (midpoint between origin and insertion) at 2 h and 24 h after stunning. Samples were frozen at −80°C and stored until further analysis. Samples were submitted to a commercial laboratory for metabolic profile analysis. Samples were prepared and extracted for analysis by ultrahigh performance liquid chromatography-tandem mass spectrometry. Identified compounds were subjected to analysis by analysis of variance. A summary of the differences in metabolites between 2 h and 24 h that achieved statistical significance ($P \leq 0.05$) was provided by the analytical company.

III. RESULTS

In the *longissimus* and *semitendinosus*, there were 56 and 58 compounds related to lipid metabolism that changed ($P < 0.05$) between 2 h and 24 h, respectively. Oleoyl CoA decreased in both muscle types from 2 h to 24 h. Malonate and palmitoyl CoA decreased over time in the *longissimus* but not in the *semitendinosus*. Long chain polyunsaturated fatty acids (docosapenteaenoate [22:5n3], mead acid [20:3n9], and arachidonate [20:4n6]) increased over time in both muscle tissues. Multiple acyl carnitine species were also elevated in both muscle types; a few decreased over time in the *longissimus*, which was not observed in the *semitendinosus*. Many lysophospholipids were increased over time in the *semitendinosus* ($P < 0.05$) that were not changed in the *longissimus*.

IV. CONCLUSION

Overall, these results indicate that lipolysis and release of free fatty acids increased between 2 h and 24 h in both muscle types. However, there were marked differences between the muscle types in metabolites from fatty acid and lysophospholipid metabolism. The observed

differences in these metabolites could have impacts on mitochondrial membrane integrity, calcium regulation, and apoptosis resulting in differences in aging and meat quality outcomes.

Keywords: beef, lipid, metabolomics, postmortem time