The Relationship of Feed Efficiency and Visceral Organ Size in Growing Lambs Fed a Concentrate or Forage-Based Diet

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Introduction

Rising costs of limited-feed resources within the sheep and beef cattle industries have increased feed costs, decreasing producer profitability. One way to reduce feed costs is to select for animals within the flock or herd with reduced intake and improved feed efficiency. Residual feed intake (RFI) is a measure of feed efficiency that is moderately heritable and genetically independent of mature size.

Although interest in RFI and feed efficiency is increasing in both research and industry settings, physiological mechanisms underlying differences in individual feed efficiency remain largely unknown. The gastrointestinal tract (GIT) is not only essential for nutrient digestion and absorption, but it is also a major energy and nutrient user in the animal. Despite recent research in our lab and others, the role of the GIT in feed efficiency is still unclear.

Objectives

We hypothesized that a portion of individual differences observed for feed efficiency can be attributed to GIT size and function, which would vary based on diet. The objective of this study was to determine GIT and visceral organ size in high- and low-efficiency growing lambs fed either a concentrate- or forage-based diet.

Materials and Methods

Eighty-two growing wethers of Rambouillet, Hampshire, and Suffolk breed types were randomly allocated by body weight to receive either a pelleted concentrate-based diet (CONC; 50.2% corn and 31% wheat middlings) or pelleted forage-based diet (FOR; 67.7% alfalfa pellets and 27.5% wheat middlings). Individual feed intake was measured by the GrowSafe feed intake system for a 49-day trial period, and RFI was calculated for each lamb.

Based on their RFI, the 20% most efficient (low RFI; n=8) and 20% least efficient (high RFI; n=8) wethers from each diet type were slaughtered at the University of Wyoming Meat Lab. At this time, the GIT and visceral organs were dissected and measured. All animal procedures were approved by the UW Institutional Animal Care and Use Committee.

Results and Discussion

Body weight at slaughter was not affected by diet type or RFI class (average=146.7 lb). High-efficiency (low RFI) lambs tended to have greater (P=0.09) pancreas (0.21 vs. 0.18 lb) and spleen (0.24 vs. 0.21 lb) mass.
than low-efficiency lambs, although RFI class did not affect empty GIT, stomach complex, small intestinal, large intestinal, omental (belly) fat, mesenteric fat (the protective fat layer that covers the intestines), liver, lung, heart, or kidney mass. Organ mass per unit of body weight of all visceral organs was unaffected by RFI class. Additionally, small intestinal length was not influenced by RFI class in this study. As expected, diet type impacted \((P<0.05)\) mass and mass per unit of body weight for several visceral and GIT organs.

To the authors’ knowledge, this is the first study investigating a relationship between visceral organ size and RFI in growing lambs. Results indicate that pancreas and spleen size may be greater in more-efficient lambs. Given the many digestive and metabolic functions of the pancreas, increased pancreas function could improve feed efficiency. A companion study, however, found no differences in two digestive enzymes produced by the pancreas (α-amylase or trypsin) between high- and low-efficiency lambs. Increased spleen mass may suggest greater blood volume or altered red blood cell dynamics or immune response in more-efficient lambs.

Recent data from our lab in feedlot cattle demonstrate a possible relationship of small intestinal mass and growth with RFI in feedlot cattle. Differences between the current study in lambs and work in cattle may be due to species, or multiple breeds in the current study may have diminished differences due to RFI class.

In summary, visceral organ size in growing lambs was more affected by diet type than individual feed efficiency status, as measured by RFI, in the current study. Despite this, pancreas and spleen size and function differences may exist between high- and low-efficiency lambs.

Further research is necessary to determine the role of the visceral organs, and especially the GIT, in ruminant animal metabolic efficiency. Better understanding of this relationship will allow for creation of management strategies to improve efficiency at the gut level.

**Acknowledgments**

This project was partially funded by the Wyoming Agricultural Experiment Station’s Competitive Grants Program. Thank you to the UW Meat Lab, Laramie Research and Extension Center’s Sheep Unit, and UW ruminant nutrition and genetics laboratories for assistance with this project.

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**Key words:** feed efficiency, residual feed intake, sheep