

2019 USAFRI Research Project Objectives

Improving Alfalfa Fiber Digestion Through Extreme Mechanical Processing University of Wisconsin-Madison - Shinnars

Project Award: \$78,068

Justification:

- As much as 50% of the fiber in alfalfa haylage (AH) passes through the dairy cow's digestive tract and is not utilized for milk production (Combs, 2013). Consequently, interest in improving alfalfa fiber digestibility is growing in the field of dairy nutrition because of its impact on feed efficiency. The objective of this research is to improve the utilization of alfalfa by dairy cattle by introducing a novel "extreme" mechanical processing (ExMP) method. This novel process could significantly improve alfalfa digestibility by shredding open the plant stems so there is greater rumen microbial attachment and improved fiber degradation in the rumen.

Fiber is the slowest digesting fraction of the dairy ruminant diet, both the amount consumed, and its digestibility can have a significant impact on overall feed efficiency. Increasing alfalfa fiber digestibility in diets of dairy cattle by five percentage units will provide enough additional energy to support an additional 3 lb. of milk per day per cow (Combs, 2013). When alfalfa fiber digestibility is low, dairy producers must replace this forage with expensive byproduct feeds with greater fiber digestibility and energy content. Therefore, even small improvements in alfalfa fiber digestion will significantly improve feed economics.

Unfortunately, the producer has limited ability to manage alfalfa fiber digestibility. The current practice is to manage digestibility with harvest maturity but there is a trade-off between maturity and yield. Previous research has demonstrated that a form of ExMP known as maceration can improve fiber digestibility, thereby reducing the effective maturity of alfalfa (Kraus et al., 1999). Consequently, the producer would no longer need to trade yield for digestibility. However, past maceration processes were conducted at cutting which limited harvest rate and made it difficult to manage harvest losses.

Here we propose a new concept: ExMP at the time of harvest (i.e. chopping). Based on Kraus et al. (1999), we believe that ExMP at harvest will result in at least a 5 percentage unit increase in AH fiber digestion. We are very aware of the need to maintain effective fiber length in the dairy cattle ration. That is why our approach to ExMP will emphasize extensive shredding because shredding increases crop surface area without creating excessive reduction in particle length (Shinnars et al., 1987). To maintain effective fiber, we will be increasing the chopping length prior to ExMP, thereby maintaining effective fiber length even after processing. Through novel approaches to improve alfalfa fiber digestion by ExMP, we propose to make AH a more cost-effective ruminant animal feed and consequently increase the total US acreage of AH by growing the amount of AH in the dairy cattle diet.

In the past, the extent of disruption of physical form of alfalfa was quantified by ion conductivity of leachate (Kraus et al., 1999). Greater processing levels create more cell rupture and cell wall disruption, which subsequently leads to greater escape of cell contents into a water solution. Using this concept Kraus et al. developed what is referred to here as a Processing Level Index (PLI) which quantified the severity of processing. A PLI of 100% would be complete cell rupture and cell wall disruption – similar to what might be expected if alfalfa was processed in blender. Kraus et al. suggested that a PLI goal of 60% is appropriate to increase alfalfa surface area to such an extent that there is greater microbial attachment in the rumen, and subsequent improvement in alfalfa fiber digestibility.

Objectives:

- The objectives of this project are to 1) conduct a lactation study using two AH diets to determine if the fiber digestion benefits of ExMP AH will improve lactating dairy cow milk production; and 2) disseminate the results through presentations at the MFA Symposium, the Tri-State Dairy Nutrition Conference, and publish a peer-reviewed article in an appropriate professional journal.