

2022 USAFRI Research Project Objectives

The Relationship Between Passage Rate and Degradation Rate of Alfalfa and Its Effect on Digestibility Virginia Polytechnic Institute and State University - Ferreira

Project Award: \$66,208

Justification:

- Kammes and Allen (2012) determined that the passage rate of alfalfa silage was approximately 50% faster than that of orchard grass silage (3.80 %/h vs. 2.50 %/h), which implies that alfalfa provides less physically effective fiber for dairy cattle than grasses. This assumption means that alfalfa does not effectively increase the retention time of ingesta in the rumen and decreases the digestion of nutrients compared to orchard grass. This outcome is one reason why many producers steer away from utilizing alfalfa in their diets to their full capacity. However, this may not be entirely true. Before discussing how we may elucidate alfalfa's capacity to increase feed residency time and improve dietary digestibility, we invite you to consider the following:

What if we could show that the passage rate of alfalfa is more comparable to that of cool-season grasses? That the forage is composed of effective fiber, promotes dietary digestibility, and provides substantive energy? Would that change the producer perspective to be more favorable to the use of alfalfa in the dairy cow diet? If we can disseminate to producers that alfalfa can sufficiently increase feed residency time while maintaining high digestibility and energy availability to support high-producing dairy cows, we believe alfalfa usage in dairy cow rations may increase by at least 2.5% and increase alfalfa sales in the forms of hay or haylage by half a billion per year in the US.

Let us first review the importance of passage rate. Nutrient supply to the animal and nutrient utilization by the animal directly affect productivity and therefore needs to be maximized with little cost to the producer. This is largely modulated by the rate at which a feed is broken down by the microbial community (degradation rate) and the speed at which it escapes the rumen (passage rate). It is the delicate balance between these two parameters that determines the effectiveness of a forage to provide effective fiber and nutrients to cattle. In terms of digestibility, you cannot only look at one of these parameters. Therefore, for extensive digestion and better utilization of structural carbohydrates by the animal, it is necessary for the degradation rate to considerably exceed the passage rate.

Results in our laboratory demonstrate that the degradation rate of alfalfa is markedly increased by 80% at 7.82%/h compared to cool-season grasses at 4.32%/h (Ferreira and Teets, 2020). A faster degradation rate means the animal is utilizing the nutrients faster and is more likely to receive the full benefits of the forage before its escape from the rumen. As we mentioned before, the relationship between degradation rate and passage rate is vital in understanding the true benefits and quality of a particular forage. Thus, in comparison of Kammes' and Allen's results to our own, we think that alfalfa is a more efficient forage source due to its high digestibility and its retention in the rumen to promote further digestion of other components of the diet. Even further, the estimated passage rate of alfalfa by Kammes and Allen may be overestimated, and this relationship between degradation rate and passage rate may be even greater for alfalfa.

However, using duodenal flow of forage components in relation to ruminal pools likely overestimates passage rates of forages and undermines their effectiveness in increasing the residency time of feeds needed to maximize digestibility. Rumen digesta must pass through the omasum and abomasum, which

may markedly alter pool ratios of components between the rumen and the duodenum. This could be due to further digestion of feedstuffs or entrapment of components in these intermittent organs. By this estimation method, the escape of components from the rumen is likely overestimated. Using the appearance of components into the duodenum may not be a good indicator of the passage rate from the rumen.

We hypothesize that by this method we will show that alfalfa passage rate is slower than previously described and more comparable to grass hays. Thus, by demonstrating the relationship between degradation rate and passage rate of alfalfa hay and orchard grass, we may be able to demonstrate that alfalfa can be included in the dairy cow diet to sufficiently increase feed residency time and rumen fill and improve dietary digestibility while providing high energy.

Objectives:

- The objectives of this study are to demonstrate the relationship between the degradation rate and passage rate of alfalfa compared to orchard grass and these forages' effects on rumen fill and total-tract digestibility. This will be achieved by two projects: 1) Determining the degradation rate of alfalfa, orchard grass, and a 50:50 mix; and 2) Feeding three different diets composed of alfalfa, orchard grass, or a 50:50 mix to lactating cows, providing pulse doses of externally marked forage, and determining forage passage rate, rumen fill, and total tract digestibility.