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TITLE

Enhancing the nutritive value of dry forages by ensiling with onion slurry: An unconventional strategy to create alternative feedstuffs for beef cattle

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SUMMARY

The Treasure Valley is a fertile region that extends from southwestern Idaho into southeastern Oregon. The Valley supports robust forage and crop production that contribute to Oregon's leading agricultural commodities. Two leading agricultural commodities include storage onion and cattle production. Historically, cow-calf producers have fed cull onions in winter feed rations to mitigate feed costs that account for 50-70% of annual operation costs. On a dry matter basis, the nutritional value of cull onions is similar to barley so it is common practice for cow-calf producers and feeders to offer cull onion (Lincoln et al. 1992). Interestingly, results are not consistent. On one hand, cull onions are highly palatable and easily digested while on the other hand they contain toxic compounds. Lincoln et al. (1992) demonstrated that cull onions contain organosulfides that have the ability to damage red blood cells. Steam distillation is one procedure that can accumulate the organosulfide compounds in onion oil and away from the byproduct. Fortunately, a local company in the Western Treasure Valley steam distills cull onions to produce onion oil. Their byproduct is 10-15 million gallons of onion slurry waste (5% dry matter) that is produced from November through May. The focus of the current project was to enhance the nutritional value of dry forages produced locally—corn stover, teff straw, onion hulls, wheat straw, alfalfa, alfalfa-grass—by ensiling them with onion slurry. Additionally, the project identified whether steam distillation separated the organosulfides from the onion slurry. Finally, it identified the nutritional profile and digestibility of ensiled forages from the original dry forage source.

OBJECTIVES:

The objective of the proposed study was to evaluate a novel ensiling strategy expected to enhance the nutritional value of low-quality dry forages by ensiling them with onion slurry for 60 days.

PROCEDURES:

The ensiling and fermentation study was conducted with colleagues at the Washington State University Irrigated Agricultural Research & Extension Center in Prosser, WA, while the nutritional value analyses, neutral detergent fiber (NDF) digestibility, dry matter digestibility, and nitrogen digestibility were conducted with colleagues at the Oregon State University-Eastern Oregon Agricultural Research Center (OSU-EOARC) in Burns, OR.

The molecular profiles of the onion oil and onion slurry were characterized. Specifically, samples were analyzed for organosulfides in the Department of Chemistry and Biochemistry at Boise State University (Boise, ID) using high-pressure liquid chromatography.

The six forage treatments for ensiling included: 1) alfalfa hay, 2) wheat straw, 3) alfalfa-grass hay, 4) corn stover, 5) teff straw, and 6) onion hulls. Each treatment contained approximately 10% moisture and was ground to a particle length of 1-1.5 inches using a chipper. Afterwards, the forages received 1 of 2 moisture treatments—either onion slurry or water—until the total moisture reached 65%. To ensure that the forage treatments absorbed the maximum amount of moisture, they were set-aside in separate barrels for 24 hours. Afterwards, treatments were randomly assigned to mini-silos measuring 101 mm (diameter) x 2 m (length) using a previously validated ensiling technique (Fransen and Strubi 1998). Each mini-silo tube contained 4.54 kg of wet forage, which was individually packed using a 2.5 cm^2 wooden stick. There were four replicates per treatment for a total of 48 mini-silos.

The forages were ensiled in the mini-silos for 60 days prior to opening. At that point, the silage was weighed and subsamples were immediately allocated to plastic bags and froze. Wet silage samples were then analyzed for their full fermentation profile, which will be characterized to draw conclusions about the ensiling process. In particular, we measured pH, ammonia N, lactic acid, and acetic acid levels. The experiment was replicated (96 mini-silos total) using the original forage and new batch of onion slurry. The onion slurry is known to have a consistent chemical composition from November through May.

After the ensiling process, the samples were sent to Dairy One to determine the nutritional value of the feedstuffs. The dry forage, wet pre-ensiled forage, and post-ensiled forage subsamples were dried at 50 C and ground through a Wiley Mill to determine dry matter recovery, crude protein, NDF, acid detergent fiber, ash, ether extract, calcium, potassium, sodium, phosphorous, lactic acid and total digestible nutrients to make comparisons between the treatments.

Furthermore, separate silage subsamples were placed in the rumen of steers to determine the extent to which beef cattle digest the ensiled treatments. Before ruminal incubation, the subsamples were placed in nylon bags before being heat-sealed. Three samples from each silage treatment were secured in a larger nylon net and then placed into the rumen of each of four ruminally-cannulated steers. Each steer was considered a replicate for a total of four replicates per treatment. I further determined the extent at which beef cattle digest the respective silage treatments by measuring the ruminal degradation of dry matter, nitrogen, and NDF digestibility after eight time points—0, 2, 4, 6, 12, 24, 48, and 96 hrs.

SIGNIFICANT ACCOMPLISHMENTS:

The current project was divided into to manuscripts that will be submitted to a refereed journal—*Animal Feed Science and Technology*. While the manuscripts are underway, preliminary information was disseminated through extension routes to provide information to the beef cattle industry. Specifically, information was disseminated through the Livestock & Rangeland Extension Newsletter in Malheur County—a newsletter received by nearly 600 livestock industry stakeholders—and the *Oregon Beef Producer*, the Oregon Cattlemen's Association magazine. Information was also disseminated in face-to-face extension & outreach activities. I was invited to share the information with 60 stakeholders and 19 fellow field faculty at four separate events.

BENEFITS & IMPACT:

The current project highlighted a key benefit that has potential impact based on additional research phases that will be pursued with funds that an allied-industry gifted my extension and research programs. That benefit includes using onion slurry waste to ensile dry, low-quality forages with favorable fermentation characteristics.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:

I used the ARF grant to leverage an allied-industry company to gift my extension and research programs $25,000. They complied and that gift was set up within ARF with the purpose of being used for research for onion byproduct.

FUTURE FUNDING POSSIBILITIES:

The next phase of action is to use allied-industry funds to conduct a study that incorporates onion slurry into a ration for cows fed in dry lots throughout the winter. The goal of that project will determine the extent to which cows can be fed onion slurry in combination with low-quality forages and the effects on cow performance.