AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
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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 is to evaluate a novel ensiling strategy expected to enhance the nutritional value of 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 and neutral detergent fiber (NDF) digestibility was 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).

The four 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 cm² 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 was 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 am in the process of determining the extent to which beef cattle digest the respective silage treatments by measuring the ruminal degradation of dry matter, crude protein, ether extract, and NDF digestibility after eight time points—0, 2, 4, 6, 12, 24, 48, and 96 hrs.
SIGNIFICANT ACCOMPLISHMENTS TO DATE:
The organosulfide profile was performed for the onion slurry after steam distillation and the onion oil (Figure 1). The organosulfide, S-meth- and S-prop(en)ylcystein sulfoxide (SMCO), that induces beef toxicosis was identified in the onion oil and not in the onion slurry extraction. The fermentation and digestion results were received in October 2015 and are in the process of data analysis and statistics. Furthermore, the N and DM digestibility still need to be conducted at EOARC-Burns.

Figure 1: A) Onion slurry extraction after steam distillation and B) Onion Oil combined with L-Allin, S-meth- and S-prop(en)ylcystein sulfoxide, and di-n-propyl disulphide.
ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:
An entity in industry provided the primary investigator an additional $25,000 to conduct research related to onion slurry. The gift was processed through the Agricultural Research Foundation.

FUTURE FUNDING POSSIBILITIES:
Currently, there is no effort to find additional funding beyond what the $25,000 ARF gift and the $12,500 ARF competitive grant.

KEY REFERENCES

