Volatile Components of Wet and Modified Corn Distillers Grains – A Survey

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Summary and Implications

Wet and modified distillers grain has been noted as to having a more net energy per unit than the dried equivalent. This difference seems to be due to the presence of volatile compounds present in the liquid fraction that are lost during drying.

Introduction

Distillers grains have become a popular feedstuff with the widespread increase of ethanol production. It has been noted that this feedstuff has a different feeding value in terms of net energy if the product is a wet or partially dried product rather than a dried product. Since moisture from water does not contribute any calories, it is proposed that a portion of this moisture is composed of soluble, volatile components that are lost when the product undergoes drying, thus making the "wet" product energetically advantageous in terms of a feed over the dry product.

Material and Methods

Fresh samples of wet and modified corn distillers grains were collected on the first Monday of each month from November 2014 through March 2015 from three ethanol plants in northwest Iowa. One half of each sample was submitted immediately to Dairyland Laboratories (Arcadia, WI) for evaluation of alcohol content (ethanol, methanol, 1-proprianol, 1-2-proprianol and butanol), volatile fatty acids (lactic acid, proprionic acid, acetic acid and butyric acid) along with some nutrient parameters (dry matter, pH, crude protein, fat and neutral detergent fiber) and ammonia.

The other half of the sample was allowed to sit in an open container in an unheated garage for two weeks before submitting for the same test in order to measure differences in these volatile components over time as would be the case with stockpiled product. The results from this survey were summarized in terms of average, standard deviation, minimum and maximum levels observed from the samples.

Results

Tables 1 through 3 provide a summary of the components found in the samples tested. The volatile components measured generally were present, but inconsistent from plant to plant and from one measurement time to the next measurement time. There did not seem to be any strong correlations or relationships between volatile components found and the plant or with other nutrients in the profile. The protocol followed by the Laboratory to provide these results measured the volatile items reported with the "as-provided" sample. The calculated dry matter was determined by taking the "wet" sample and oven drying it. The moisture fraction of the sample then ended up including the water but also these volatile components that evaporate during drying as well.

Not all of the volatile components possibly present were measured, but from those that were the finding of these volatile organic acids and alcohols indicate a substantial amount of feed energy is lost during drying since these components would be lost to evaporation upon the heating/drying process. Alcohol for instance contains approximately 6.9 Kcal / gram gross energy and organic acids contain about 3.1 Kcal / gram gross energy. The almost two percent volatile organic acid and additional two percent alcohol residuals that appear in our "wet" samples then provide about 20 Kcal per gram of "uncounted" gross energy per unit of feed. With many raw feed ingredients the conversion from gross to net energy is around 20-25%. On a net energy basis in this case the conversion from feed energy to tissue energy is probably considerably better with these two types of volatile components due to the refined nature of these nutrients since the digestibility and utilization of these components are nearly 100 percent in the animal. As for as the other volatile components not measured, there is no estimate yet of their quantity at this time, but it seems the next step would be to perform a toluene distillation to quantify the total true water and non water portions in the wet fraction of the feed and arrive at a better estimate of total nonwater composition in the wet fraction of the feed.

One troubling item is the potential for high levels of methanol in the feedstuff. Generally the recommendation is that this component be limited to 0.5% of the feed delivered to livestock. The average of 1.84% in these samples is considerably higher and potentially toxic if this feedstuff comprises more than a third of the ration as it often may.

The effect of allowing the feedstuff to sit exposed to the air for two weeks before analysis is shown in the following tables as well. Due to the volatile nature, as expected the quantity of these volatile components tend to decrease and the rate, I suspect, would be greater if the samples were stored under warmer conditions rather than the cooler conditions as we have done here. Methanol however,

tended to increase over the two week storage time. This may be the result of the longer carbon chain alcohols such as ethanol decomposing into this one carbon alcohol over time. Ammonia also shows a tendency to increase leading from a probable decomposition of protein over time.

Table 1. General Nutrients

	Dry Matter %	pH	Crude Protein %	NDF %	Fat %
Average	37.68	4.27	31.97	30.42	9.17
St.Deviation	5.76	0.55	1.35	3.23	0.80
Minimum	31.17	3.50	29.54	23.82	7.34
Maximum	50.15	5.10	34.12	34.80	10.85
Sample – Day 1 Avg.	37.10	4.26	31.74	30.51	9.17
2 Weeks Later Avg.	38.26	4.28	32.20	30.32	9.18

Table 2. Acids & Ammonia

	Lactic %	Acetic %	Proprionic %	Butyric %	Ammonia %
Average	1.87	0.12	0.02	0.01	0.31
St.Deviation	2.98	0.04	0.06	0.03	0.27
Minimum	0	0.06	0	0	0.03
Maximum	8.51	0.21	0.21	0.17	1.19
Sample – Day 1 Avg.	2.06	0.12	0.02	0.01	0.25
2 Weeks Later Avg.	1.69	0.12	0.02	0.00	0.36

Table 3. Alcohols

	Ethanol %	Methanol %	1-Proprionol %	1,2-Proprionol%	Butanol %
Average	0.05	1.84	0	0.05	0
St.Deviation	0.04	2.21	0	0.03	0
Minimum	0	0	0	0	0
Maximum	0.14	7.15	0	0.09	0
Sample – Day 1 Avg.	0.05	1.78	0	0.05	0
2 Weeks Later Avg.	0.04	1.90	0	0.05	0

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