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Ensiling Wet Distillers Grains with Other Feeds

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During the last century, livestock producers have relied heavily on highly valued crops to feed their cattle. Corn grain and silage, alfalfa hay and silage as well as other highly productive crops have been used extensively. Changes in oil prices have sparked interest into renewable energy alternatives. Ethanol production from corn has gained popularity in the Midwest resulting in increased availability of corn distillers grains.

Corn distillers grains are an excellent feed for ruminants. They can usually be purchased as wet (40-70% moisture) or dry. They supply approximately 10% more energy than corn grain, and approximately 30% protein, 10% fat and 1% phosphorus. These are highly priced nutrients and thus desirable in a feed, although they might pose a challenge when formulating diets. When distillers grains are fed with other feeds that also supply these nutrients, dietary excesses of nitrogen and phosphorus may result in increased nutrient excretion and thus environmental concerns. Therefore, it is recommended that distillers grains be used to supplement feeds with a complementary nutrient profile such as low protein, energy, fat, and phosphorus.

Preserving Wet Distillers Grains

The nutrient content of some agricultural byproducts available in the Midwest is listed in Table 1. One of the things that can be noted immediately is that except for ADF, NDF, and calcium, distillers grains supply more nutrients relative to the requirements of cattle than the other feeds. When comparing with straw, protein in distillers grains is six times greater, whereas phosphorus is eight times greater. The high sulfur concentration in distillers grains also may pose a constraint, particularly when fed to young ruminants. Excess sulfur in the diet induces a vitamin B1 (thiamin) deficiency resulting in neurological disorders. Most of the rest of the feeds shown in Table 1 have significantly lower concentrations of P and S. Combining them with distillers grains will create a dilution effect, making the blend more appropriate to be fed to ruminants both from health and environmental perspectives.

One possibility is to pellet dried distillers grains (DDG) with dry beet pulp and/or soy hulls. Dry soy hulls alone present a problem as they are very light, resulting in potential losses during mixing and feeding. Although DDG alone does not pellet well because of its high fat content, mixing with either soy hulls or beet pulp in a 50:50 ratio is a good alternative as the blend has about half the fat content resulting in good pellet hardness.

Wet DG (WDG) is another alternative to consider where availability, price, and distance from the ethanol plant do

Table 1. Nutrient content of selected feeds[1]

Feed	Nutrient content (% DM)							
	CP	ADF	NDF	Fat	TDN	Ca	P	S
Distillers grains	29.7	19.7	38.8	10	79.5	0.22	0.83	0.44
Soy hulls	13.9	44.6	60.3	2.7	67.3	0.63	0.17	0.12
Beet pulp	10.0	23.1	45.8	1.1	69.1	0.91	0.09	0.30
Corn silage	8.8	28.1	45.0	3.2	68.8	0.28	0.26	0.14
Corn stalks	5.4	46.5	77.0	1.1	54.1	0.35	0.16	0.10
Oat straw	4.4	47.0	70.0	2.2	50.0	0.24	0.06	0.23
Wheat straw	4.8	49.4	73.0	1.6	47.5	0.31	0.10	0.11

[1]*NRC (2001). Values can vary. Analysis of byproducts is recommended prior to incorporating into diets.*

not pose an economic constraint to its use. The wet product can be used fresh, but it should be consumed within three to four days in the summer or within one week in the winter to minimize spoilage. One of the advantages of WDG is that it sticks well to dry particles of other feeds, increasing the palatability and homogeneity of the diet. Wet DG should be ensiled if it is not going to be used within the time limits suggested.

Wet distillers grains can be adequately preserved when ensiled alone or in combination with other feeds. The conditions required are similar to those needed for any ensiled crop: air exclusion, adequate compaction, and low pH. Ensiling in silo bags is probably the method of choice as air exclusion is high, resulting in low spoilage and dry matter losses. One of the advantages of WDG is that it already comes from the processing plant with a pH near 3. Fermentation experiments of straight WDG (70% moisture) conducted by the SDSU Dairy Science Department showed very little change when preserved in silo bags for 14 days (Table 2).

Table 2. Fermentation Changes Over Time in Ensiled WDG

Item	Day			
	0	3	7	14
pH	3.1	3.1	3.2	3.2
Acetic acid	0	0	0.11	0.30
Propionic acid	0.30	0.30	0.32	0.30
Lactic acid	0.90	0.95	0.97	1.02

Preservation of WDG is excellent if bagged immediately, most likely due to initial low pH of the feed rather than due to fermentation (very little changes in pH and volatile fatty acids). This can be used advantageously by mixing WDG with other feeds, resulting in an initial drop in the pH of the blend (Table 3).

Table 3. Blends of Wet DG with Other Feeds

Item	pH at Day 0
Corn silage:WDG (75:25 as fed)	4.0
Soy hulls:WDG (70:30 as fed)	4.3
Beet pulp:WDG (66:34 as fed)	3.9

Ensiling wet distillers grains with corn silage

Blending WDG with other feeds has resulted in fermentation patterns that differ from the "traditional" lactic acid fermentation towards more production of acetic acid. In the past, acetic acid fermentation has been associated with decreased feed intake in ruminants. Recent research at the University of Delaware has shown that bacterial inoculants (Lactobacillus buchneri) that promote acetic acid fermentation in the silo not only do not adversely affect feed intake in lactating dairy cows, but also improve feed preservation.

Researchers at the SDSU Dairy Science Department have reported similar findings. Blends of WDG and corn silage ensiled on an as-fed basis in 50:50 and 75:25 corn silage to WDG ratios respectively showed increased aerobic stability upon exposure to air. When compared to straight corn silage, acetic acid had increased by 70% and 286% in the 75:25 and the 50:50 blends respectively by day 3 post-ensiling. This represented acetic acid concentrations of 1.4 and 2.8% for the 75:25 and 50:50 blends, respectively. One week after ensiling, acetic acid concentration exceeded 4% in the 50:50 blend.

Aerobic stability of the corn silage, WDG, and corn silage/WDG blends was tested by measuring the number of hours the feed remained stable before rising more than 4°F above ambient temperature. It took only 42 hours for the straight corn silage to increase 4°F above ambient temperature, whereas 312 and 648 hours were required for the 75:25 and 50:50 blends, respectively. Increased feed stability at feed out is thus one advantage of ensiling corn silage with WDG. One other advantage is the larger particle size of the blend, which makes it easier to remove for feeding during the winter months when straight WDG usually freezes.

Ensiling wet distillers grains with soy hulls or wet beet pulp.

Other byproduct feeds that are good alternatives for blends with WDG include soy hulls and beet pulp. Both are low in protein, fat, and phosphorus, although they both provide fermentable energy due to the presence of highly digestible carbohydrates. Both offer the additional advantage of increasing acetate production in the rumen, thus reducing the risk of acidosis. There is also well-documented research on their effect of increasing milk fat concentration. Blends with WDG are high in energy, making them an ideal substitute for part of the grain in diets. Use in high forage diets is also recommended as they provide readily available energy without decreasing rumen pH excessively, which is known to be detrimental to fiber digestion. Ensiling either feed with WDG has been proven effective with very good preservation and palatability.

Research at the SDSU Dairy Science Department evaluated the anaerobic fermentation characteristics of ensiling wet corn distillers grains (WDG) alone or mixed with soy hulls (SH). The treatments, by weight, were the following: 1) 100% WDG; 2) 85% WDG + 15% SH; and 3) 70% WDG + 30% SH. The pH of the straight WDG was the lowest at 3.2 and increased as WDG concentration in the blend decreased (4.0 and 4.3 for 85% and 70% WDG, respectively). Lactic acid (% of DM) was highest for 100% WDG and tended to decline as SH was included in the treatments, whereas acetic acid increased for the 85% and 70% WDG treatment after 21 days of fermentation.

Combining WDG with SH resulted in immediate acidic conditions in the silage mass as a result of the initial low pH of the WDG rather than from fermentation. Experiments with this blend in growing heifer diets have shown that the WDG/SH blend can substitute for the grain fraction in forage-based diets. Because of high-energy content and palatability, combined with potential for increased intake, it is recommended that feed intakes be restricted to avoid excessive weight gains. Alternatively, distillers grains may be included in the diet together with less digestible forages.

In a similar experiment the SDSU Dairy Science Department also evaluated the fermentation and preservation characteristics of ensiled WDG with wet beet pulp (WBP). The treatments by weight were as follows: 1) 100% WBP; 2) 66% WBP + 33% WDG; 3) 33% WBP + 66% WDG; and 4) 100% WDG. The initial pH was the greatest for 100% WBP (4.2) and decreased as concentration of WDG increased (3.9, 3.6, and 3.3 for 66%, 33%, and 0% WBP, respectively). By day 4, the pH of all feeds was below 4.0 and did not change throughout the experiment.

This suggests that preservation can be adequately achieved in both feeds ensiled alone, as well as in any of the two combinations tested. Acetic acid increased over time in all treatments, and was highest for the 100% WBP, where it reached 5.17% of DM. It was thus concluded that ensiling WBP and WDG is an effective method of preserving both wet co-products. The blend was tested in a lactating dairy cow experiment. Both preservation of the WDG:WBP blend and palatability at feed out were excellent.

Ensiling wet distillers grains with crop residues

Another area that holds promise is the use of crop residues such as corn stalks or other high fiber roughages blended with WDG. Crop residues have complementary characteristics to WDG as they are low in energy, protein, fat, phosphorus and sulfur, and the digestibility of the fiber in these feeds is also low. The deficiencies and excesses of each feed thus cancel out when they are blended together in the diet (see Table 1). This can be accomplished by preserving either feed individually (baled roughage; fresh and/or ensiled WDG) or by mixing and ensiling them together. This last approach poses challenges, as the particle size in the roughage fraction needs to be reduced sufficiently to exclude air as much as possible during ensiling.

The ratio at which both feeds are added needs to be such that enough moisture is provided to assist in compaction and fermentation. Actual fermentation of these blends is limited due to minimal water soluble carbohydrates. It is important to realize that because of this limited fermentation, we rely on the initial pH of the WDG to enhance preservation of the blends. Consequently, it is important to verify that the initial pH of the WDG is 3.5 or less. Previous research suggests that a moisture content of the ensiled blend should be at least 50%. Drier blends will not preserve as well due to difficulty in achieving adequate compaction. Taking this into consideration, the use of WDG with 65% moisture is preferred over the so-called “modified” WDG, which contains approximately 40-50%. For example, mixing 1 ton of WDG (65% moisture) with 790 lbs of corn stalks (10% moisture) resulted in a blend of approximately 50% dry matter, 18% protein, 65% TDN, 6% lipids, 0.15%Ca, 0.5% P, and 0.5% sulfur.

Final recommendations

Agricultural byproducts present challenges in diet formulation due to excessive or deficient nutrients compared with nutrient requirements of cattle. Combination of these feeds seems to be a logical approach to improve the efficiency of their utilization in ruminant diets. It is important to consider individual feed characteristics as well as the ease of handling at the farm before choosing a preservation method. Wet DG and beet pulp preserve very well when bagged individually or blended together. Combinations of WDG with soy hulls or wet beet pulp as well as combinations of WDG with corn silage have been tested with success. One of the benefits of the WDG/corn silage mix is the improved aerobic stability at feed out as the proportion of WDG in the blend increased. Blending corn distillers grains with alternative and byproduct feedstuffs is an innovative approach to stretch forage supplies during feed shortages as well as to reduce feed costs.

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