

Practical Winter Feeding and Utilizing By-Product Feeds

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Corn Co-Products

As the number of ethanol plants in Nebraska and South Dakota increases and the availability of corn co-products (esp. corn distiller's grains) continues to rise, more and more corn co-products are available to backgrounding yards as well as the cow-calf producer. Because corn co-products are relatively high in protein, energy and phosphorus, they are very well suited for range supplements. Corn co-products are also a high-fiber protein and energy source, with a majority of the starch removed during milling process. The removal of starch essentially eliminates the negative effects associated with feeding grains on low-quality forage digestion. Because of their increased protein level, greatly reduced starch content, and increased fiber component, distiller's grains, as well as other co-product feeds work very well with low-quality forages.

There are two primary types of corn milling processes. These two processes, although using the same grain source, produce quite different products. The Ethanol industry uses a "dry milling" process that in addition to ethanol, produces distillers grains or distillers grains plus solubles. The other less common process is referred to as "wet milling" and produces high fructose corn syrup (the main sweetener in colas), oil and starch. The main co-product produced from wet corn milling is corn gluten feed. The corn gluten feed usually contains the corn bran and the solubles or "steep" and sometimes some high protein gluten depending on the processing plant

Average analysis of the byproducts is shown in Table 1. In general, about 1/3 of the dry matter of corn remains as feed products after the starch and(or) oils are removed during milling. In other words, corn is approximately two thirds starch and nearly 100% of that is removed in the fermentation process. Because of the removal of starch, nutrients such as protein, fat and minerals are therefore concentrated (almost 3X) in the co-products that are produced. Keep in mind that in the wet corn milling process, corn oil is one of the products removed. Therefore, corn gluten feed is usually lower in energy than distiller's grains because of the reduction in fat content of the co-product. Also, the protein in the germ is extracted as corn gluten meal, a high protein feed that contains high quality protein that is high in bypass or undegradable intake protein (UIP). This product is usually marketed to swine, poultry or pet food industry so corn gluten feed that is available in range country is usually lower in UIP or bypass protein than corn distillers grains.

Table 1. Nutrient composition of selected corn milling byproducts.

Feedstuff: ^a	DRC ^b	WCGF-A	WCGF-B	DDGS ^c	WDGS ^c	CCDS ^c	MWDGS	Steep ^d
DM	90	44.7	60.0	90.4	34.9	35.5	45-50	49.4(49.0) ^e
CP, % of DM	9.8	19.5	24.0	33.9	31.0	23.8	NA	35.1
UIP, % of CP	60	20	20	65	65	65	NA	20
P, % of DM	0.32	0.66	0.99	0.51	0.84	1.72	NA	1.92
TDN, %	90.0	90.0	94.5	101	112	112	NA	113
NEg, Mcal/lb	0.70	0.70	0.74	0.78	0.87	0.87	NA	0.88

^aDRC=dry rolled corn with NRC (1996) values, WCGF=wet corn gluten feed from two plants, DDGS=dried distillers grains + solubles, WDGS=wet distillers grains + solubles, CCDS=condensed corn distillers solubles (corn syrup), MWDGS=modified wet distillers grains + solubles, steep is steep liquor from wet milling plants.

^bDRC values based on NRC (1996) values with approximately 3500 samples

^cValues are from spring, 2003 from only one plant in Nebraska that produces DDGS, WDGS, and CCDS with standard deviation based on weekly composites.

^dDM values represent variation from daily composites for a 60-d period. Other nutrients are based on monthly composites for 2002 and half of 2003.

^eValues in parentheses are monthly composites for 2003 from one plant in Nebraska, with assumptions that it is a mixture of steep and distillers solubles.

*Adapted from "Utilization of Corn Co-Products in the Beef Industry" produced by the University of Nebraska, Lincoln, and the Nebraska Corn Board.

Considerable research has been conducted by Nebraska, Kansas State, and South Dakota State concerning feeding distillers grains to growing and finishing cattle. A recent fact sheet produced by the University of Nebraska and the Nebraska Corn Board (website: http://beef.unl.edu/byprodfeeds/manual_01_00.shtml) suggests that the energy value of wet distiller's grains to be 120-150% the value of corn in finishing diets. These higher values are somewhat due to the increased energy value from the higher level of fat plus less rumen stress from acidosis, which may not be a factor in range cattle. Their summary found the energy value of distillers grain in forage rations would be 120-127% of that of dry rolled corn. Corn gluten feed appeared to have 100-108% the value of corn in finishing diets.

Corn co-products in high roughage diets and range supplements

Drs. Ivan Rush and Rick Rasby, UNL, have both summarized several studies evaluating the use of corn co-products in range and high forage diets. (Rasby, 2003 Range Beef Cow Symposium, Scottsbluff, NE <http://beef.unl.edu/beefreports/symp-2003-11-XVIII.shtml>) (Rush, 2005 Range Beef Cow Symposium, Rapid City SD., <http://beef.unl.edu/beefreports/symp-2005-00-XIX.shtml>). Both papers indicate that corn co-products work well in growing cattle, developing heifers and cow diets, providing excellent sources of protein, energy and phosphorus. As mentioned above, co-product feeds do not appear to lower digestibility of low-quality roughage diets, meaning that they may be a better source of energy when supplementing cattle on winter grass or lower quality forages. Because of this benefit, byproduct feeds can also be used as a major feed, or ingredient, in limit-fed, high concentrate wintering rations as a substitute for forage. This

will be important again this year, as continued drought has forced many producers to evaluate alternative wintering programs and diets.

Loy et al., (2003 Nebraska Beef Report) Conducted an experiment with 120 crossbred heifers to determine the value of dry distillers grains in high-forage diets and to evaluate the effect of supplementing daily compare to three times weekly. Heifers had free-choice grass hay and were supplemented with dry distillers grain, dry rolled corn, or dry rolled corn with corn gluten meal. Supplements were fed at two levels and offered either daily or three times per week in equal proportions. Heifers supplemented daily ate more hay, gained faster (1.37 vs. 1.24 lb/day), but were not more efficient than those supplemented on alternate days. The calculated net energy values for dry distillers grains were 27% greater than dry rolled corn.

Two additional experiments evaluated feeding dry distillers grains as an energy source in forage-based diets (Stalker et al., 2004 Nebraska Beef Report). Diets were formulated to be greater than 100 g/day deficient in DIP but with excess metabolizable protein. In both experiments, no response in performance was observed when urea was added to the diet. Sufficient urea was recycled to correct the DIP deficiency. These studies indicate adding urea to meet the DIP requirement is not necessary when dry distillers grains are fed as an energy source in forage based diets in an amount that metabolizable protein is in excess.

Although only 3 studies are reported here, continued studies consistently indicate that corn co-products work very well as a supplement in range and low quality forage situations. These supplements provide a good source of protein as well as energy, also having a positive effect on forage digestibility and feed intake.

Feeding Beet Pulp in Wintering Rations

With competitive prices for beet pulp and high hay prices, many beef operations have chosen to feed the pressed pulp not only to growing and finishing cattle, but to pregnant and lactating beef cows as well. In general, beet pulp is a valuable feed resource, and works very well in forage-based rations, such as growing rations and cow/calf diets. Beet pulp is relatively high in fiber (around 22%), and the fiber is highly digestible, resulting in a very safe supplemental energy source. Energy values for pressed beet pulp are equal to slightly higher than corn silage, and both can be used to provide needed energy and fiber as well as condition the ration.

Using pressed beet pulp in feeder rations. Several studies have evaluated the use of pressed beet pulp in step-up rations, grower rations, and finishing rations. Wyoming studies conducted during the early to mid 80's evaluated the use of beet pulp in growing and starter rations. Pressed beet pulp was fed at 20, 30, 40, and 50% of the growing ration. Although the wet nature of the beet pulp requires that animals must eat a large volume of feed, weight gains were similar across all levels of beet pulp, with 40% beet pulp producing the most efficient gains. Similar studies were conducted at the Panhandle Research Station in Scottsbluff during the 90's, with pressed beet pulp replacing the corn silage in growing diets at 0, 10, 20, and 30% of the ration. Gains increased slightly as beet pulp replaced silage in the ration, confirming that the energy value of beet pulp is similar to slightly better than corn silage. In all studies, additional protein was provided, either as alfalfa or commercial supplement. One feeding consideration is the low phosphorous level of pressed beet pulp. When feeding higher levels of pressed beet pulp, additional phosphorous may be required. Plant-derived protein supplements are typically high in phosphorous, so supplemental protein will also help to address ration phosphorous levels.

Quality of stored beet pulp. An additional feeding issue with pressed beet pulp is storage. Because of it's moisture level (typically 75% moisture), pressed beet pulp is too

wet to ensile properly, and by late spring, beet pulp piles can take on a whole new appearance. Although pressed beet pulp is an inexpensive feed source, utilizing these piles in late spring may not be as economical as once thought. There are certainly mold concerns with stored pulp, and while these molds may not be toxic, they could certainly be affecting feed consumption and feed efficiency. While I haven't found studies specifically addressing moldy beet pulp, a recent study conducted by K-State addresses the impacts of using moldy corn silage in growing diets. In this case, researchers skimmed the top 18 inches from a corn silage pit, and then included the spoiled feed at increasing levels into the growing diet. As the level of spoiled feed increased, feed intakes and overall ration digestibility decreased. This same scenario could also occur with "aged" beet pulp.

Effect of feeding spoiled silage on feed intake and digestibility (KSU, 2000)¹

	Test Rations			
	0	25	50	75
Spoiled corn silage, % of total silage fed	0	25	50	75
Spoiled corn silage, % of total ration	(0)	(5.4)	(10.7)	(16.0)
DM Intake, lb/day	17.5 ^a	16.2 ^b	15.3 ^{b,c}	14.7 ^c
DM Intake, % of body weight	2.36 ^a	2.22 ^{a,b}	2.10 ^{b,c}	2.04 ^c
Digestible dry matter, % (total ration)	74.4 ^a	68.9 ^b	67.2 ^b	66.0 ^b
Digestible protein, % (total ration)	74.6 ^a	70.5 ^b	68.0 ^{b,c}	62.8 ^c

¹Adapted from Whitlock et al., 2000 Cattleman's Day Report of Progress p. 22-24.

^{a,b,c}Means within a row with no common superscript differ (P<.05)

Pressed beet pulp in cow rations. While beet pulp can be used very successfully in growing diets, there is very limited data on feeding pressed beet pulp to pregnant and lactating cows. From a nutrient standpoint, pressed beet pulp could certainly be used to provide additional energy during late pregnancy, as well as after calving, when nutrient requirements are highest. Beet pulp is a safe, high fiber source of energy that complements forage-based rations very well. Some feeding considerations may include: **1) Pre-calving calcium levels, and the incidence of milk fever.** Milk fever is rare, especially in beef herds. It occurs when the cow is unable to mobilize enough calcium from body reserves to maintain blood calcium levels after calving. Dairies reduce the risk of milk tetany by feeding low calcium rations prior to calving, encouraging the mobilization of the cow's calcium reserves before lactation begins. Therefore, feeding high levels of calcium prior to calving (i.e. alfalfa and beet pulp combinations) may increase the incidence of milk tetany, even in beef herds. **2) Overall ration phosphorous levels.** Because the phosphorous level of pressed beet pulp is low, feeding high levels of beet pulp may also require additional phosphorous supplementation, especially as breeding season approaches. Protein supplements, which are generally high in phosphorous, will not only provide additional protein, but also help address the cow's phosphorous requirements as well. If there are any concerns or questions, feed tests and a simple ration analysis will help determine your overall ration phosphorous level. If necessary, phosphorous issues can also be addressed through the free choice mineral program. **3) Watching the quality of stored beet pulp.** As mentioned in the discussion of growing diets, feed quality is also important, especially with pregnant females. While commercial feed testing labs do have analyses for common feed toxins, the list is very short compared to the wide array of commonly occurring mold varieties and associated toxins that exist. If you are concerned about the quality of the feed, consider only feeding stored pulp to cows that have calved, limit the amount that is included in the ration, and selectively feed the pulp, avoiding heavily spoiled areas.

Animal requirements and nutrient composition beet pulp and selected feeds¹.

Item	TDN		Crude Protein		Calcium		Phosphorous	
	lb/d	%	lb/d	%	g/d	%	g/d	%
Nutrient requirements: 1,200lb dry cow during the last 1/3 of gestation	11.8	52.9	1.75	7.8	26	0.26	21	0.21
Nutrient requirements: 1,000 lb 2 yr old hfr 3-4 mo postpartum (nursing)	12.9	61.9	2.12	10.0	29	0.31	22	0.23
Nutrient requirements: 1,200 lb cow nursing calf (first 3-4 months)	12.8	55.5	2.18	9.3	28	0.27	23	0.22
Nutrient composition (dry matter basis) of typical feed ingredients used in winter rations ²								
Wet Beet Pulp (pressed), 25% DM		70.0		9.6		0.80		0.08
Alfalfa, mid-bloom		58.0		17.0		1.40		0.24
Brome Hay		55.0		10.0		0.40		0.23
Corn Silage, well-eared, 34% DM		70.0		8.0		0.28		0.23
Corn Grain, rolled		88.0		9.0		0.02		0.30

¹Nutrient Requirements of Beef Cattle, 1996

²Based on collected feed analyses, 1996 NRC, and R.L. Preston, 2005.

In order to remain competitive, it's important to utilize available feed resources. Pressed beet pulp, along with other byproduct feeds such as distiller's grains, wheat midds and corn gluten feed are all valuable feed resources. When considering these feeds, it's important to factor in all costs – not only the cost of the feed, but trucking to your operation, as well as any additional feed expenses, equipment, etc. Considering the benefits and limitations of these byproduct feeds and managing accordingly will help to maximize their economic value.

Managing Hay Loss During the Winter

when hay is expensive and difficult to find, reductions in hay losses may become very important. Several studies have attempted to measure the amount of hay loss using various methods of feeding. Keep in mind that the amount of hay waste depends on feeding management, as well as quality of the forage

Hay Loss Associated with Stationary Round Bale Feeders

For smaller producers, and small groups of cattle, large round bales create a problem. How do you deliver the correct amount of feed daily, while minimizing waste? Early methods of dropping an entire bale in the pen, without a feeder, resulted in considerable waste. Studies done in the 70's and 80's estimated that 35 to 45% of the bale was wasted. Round bale "ring"-type feeders reduced this amount considerably. These traditional ring feeders were more recently improved by adding an additional cone-shaped framework in the middle of the feeder that elevates the round bale. These "cone" feeders create a separation between the bale and the animal, so that less hay is pulled out of the bale and trampled, reducing waste compared with ring, trailer, and cradle feeders as shown in the table below.

Hay loss associated with various round bale feeders.

Buskirk et al., Michigan State, 1999	Round Bale Feeder Type			
	Ring	Cone	Cradle	Trailer
Estimated dry matter intake, lbs/cow/day	25.1	25.4	24.3	27.1
Hay dry matter waste, lbs/cow/day	1.6 ^a	.9 ^a	4.2 ^b	3.5 ^b
Waste, % dry matter basis	6.1 ^a	3.5 ^a	14.6 ^c	11.4 ^b

^{abc}Within a row, means lacking a common superscript letter differ (P < .05).

Hay Loss Associated with Delivering Feed Daily

For larger groups of cattle, where feed is delivered daily, bale processors have definitely made it easier to handle and uniformly deliver hay to cattle. If you are feeding round bales on the ground, round bale processors seem to reduce the amount of waste by 3 to 10% compared with rolling the bales out manually, as shown in the following table. Only two studies are reported here, and it is very difficult to estimate the amount of hay that is delivered and not consumed. Feeding cattle in bunks also reduced the amount of waste by 5%. Although feed bunks may reduce waste, they also create additional management issues such as having to feed in the same spot every day and providing adequate bunk space to allow all animals to eat at once. However, bunks also make it easier to deliver supplements, grains, and byproducts that may help to reduce overall feed costs.

Hay losses associated with different methods of delivering hay.

Study	Round Bale Feeding Method			Round bale cone feeder
	Rolled out on ground	Processed, fed on ground	Processed, fed in Bunk	
Blasi et al., K-State, 1993				
Wheat hay offered, lb DM/day	24.6	21.2	22.3	
Amount wasted, %	23 ^b	13 ^{a,b}	8 ^a	
Sudan hay offered, lb DM/day	19.9	20.8	20.1	
Amount wasted, %	22	16	11	
Landblom et al., NDSU, 2002				
Mixed hay offered, lb /day	30.9	29.9		26.3
% Decrease in feed used	- -	3.2%		14.9%

^{ab}Within a row, means lacking a common superscript letter differ (P < .05).

Does it Pay??

Attempting to determine whether or not the addition of bale processors or bunks actually pay for themselves becomes a tricky issue, depending on the size of the herd and the price of forage. Let's assume that the use of a bale processor and bunks both help to reduce waste, and the benefits from each can be added together. The following table tries to put dollar amounts on the benefits and expenses associated with bale processors and bunks, expressed as annual costs per cow.

Partial budget for feeding systems

Benefits and expenses, expressed as annual \$/cow	Herd size, No. of Cows			
	250	500	1000	
Benefit of 6.5% annual hay savings, processor ^a	4.88	to 4.88	to 4.88	to
	10.73	10.73	10.73	
Benefit of 5% annual hay savings, bunks ^a	3.75	to 3.75	to 3.75	to
	8.75	8.75	8.75	
Bale processor annual expenses ^b	10.38	5.19	2.59	
Annual feed bunk cost ^c ,	2.40	2.40	2.40	
Cost vs benefit of bale processor and bunks		1.04	to 3.64	to
	-4.15 to 6.7	11.89	14.49	

^aEstimates based on feeding 1.5 ton/cow, and using hay prices of \$50 to \$110/ton.

^bApproximate values based on \$12,500 purchase cost and 6% interest on investment, 20% salvage value, 10 years of use, and \$800 estimated annual repair/maintenance costs.

^cBunk costs were estimated at \$12/foot initial cost, 5 year life span, and bunk space of 1 ft/cow (assuming that cattle can eat from both sides of bunk, this would mean 2 ft of bunk space/cow)

Items that are not included in this estimate include any potential reductions in time and labor (may or may not be an issue, depending on whether the kids are away at college or

not). Another potential benefit, especially with bale processors that include an electronic scale, is the improved accuracy and consistency in delivering feed. As with nearly all purchases, investments made in equipment become easier to swallow when you can spread the expense over a greater number of cows. The success of bale processors is also related to the type of processor, and the quality of forage. Additional processing of coarse, low quality forages should improve utilization and reduce waste, while high quality grass hay and alfalfa may be less affected by processing.

An additional method of reducing hay waste with bale feeders is limiting the amount of time that cows have access to the bale feeder. The University of Illinois has conducted a series of studies looking at the effect of time restriction to bale feeders on winter dry and lactating cow performance. In these studies, the hay offered was a medium to high-quality hay, (57 to 63% TDN), and cows are primarily Simmental X Angus crossbred commercial cows.

Effect of limiting access to round bale feeders on dry cow performance.
(Adapted from Faulkner et al., (2006).

	Free-Choice	9 hours access	6 hours access	3 hours access
Gain, lbs	207	192	160	118
Intake, lb/hd/d	40.2	34.5	28.8	20.8
Waste, lb/hd/d	3.9	2.3	1.7	1.3
Manure, lb/hd/d	81.0	63.2	48.8	35.1
\$/hd/day*	1.52	1.21	.91	.69

*Hay used in this study was 57% TDN priced at \$70/ton.

Effect of limiting access to round bale feeders on lactating cow performance.
(Adapted from Faulkner et al., 2006)

	Free-Choice	8 hours access	4 hours access
Gain, lbs	-42	-60	-132
Intake, lb/hd/d	35.6	32.1	22.5
Waste, lb/hd/d	6.4	4.0	2.4
Manure, lb/hd/d	22.9	18.7	13.9
\$/hd/day*	1.42	1.28	.90

*Hay used in this study was 64% TDN priced at \$70/ton.

It's important to note that limiting access to bale feeders requires 1) A medium to high quality forage 2) Close observation of the cattle to make sure they are maintaining weight and condition, and 3) Adequate space for all cows to have access to the hay during the allotted periods, and 4) The potential for sorting the cows to remove the timid or poor performing cows. Not all cows are suited to time-restricted feeding programs.

When teamed with forage analysis, ration balancing, hay budgeting, and feeding management, managing hay waste is an additional tool to more efficiently manage winter nutrition, one of the largest expenses for cow/calf producers.

Summary

Reducing winter feed costs is a key component to sustainable and profitable livestock operations. During winters when hay costs continue to climb, it's important to review and evaluate management as well as diets, to make sure costs are minimized. The use of co-product feeds both as a supplement or forage substitute, combined with effective hay feeding and management can help to reduce winter feed costs while maintaining cow condition.