

# Wheat Middlings

## A Useful Feed for Cattle

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## Description and Composition

In recent years, additional grain milling and processing operations have come on the scene in North Dakota. A co-product of milling durum for semolina or wheat for flour is mill feed or mill run commonly marketed as wheat middlings. Expanded milling and increased availability has created interest in the state in the use of wheat midds in rations among livestock producers. (Milling companies currently producing and marketing wheat middlings in North Dakota are listed in Table 1.)

**Table 1. Sources of wheat midds in North Dakota.**

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**North Dakota Mill and Elevator**

Grand Forks, ND  
Hard Red Spring Wheat Midds - loose meal  
Operations began 1916

**Noodles by Leonardo**

Cando, ND  
Durum Midds - loose meal  
Operations began 1980

**Dakota Growers Pasta Company**

Carrington, ND  
Durum Midds - pelleted  
Operations began 1994

**Minot Milling**

Minot, ND  
Durum Midds - pelleted  
Operations began 1998

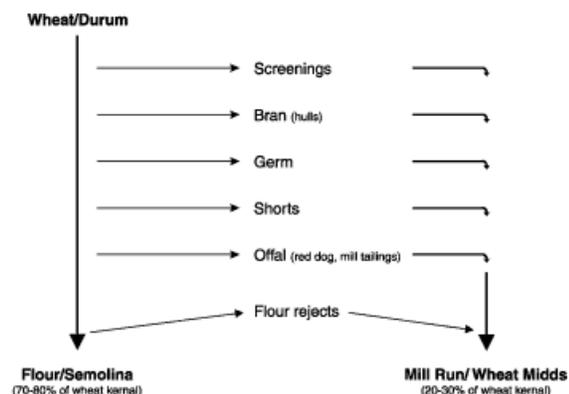
**Dakota Valley Mills**

Fairmount, ND  
Hard Red Spring Wheat Midds - pelleted  
Operations began 1998  
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The feed, livestock, and milling industries routinely use the term wheat midds or middlings to refer to the coproduct remaining after flour or semolina is extracted from wheat and durum during milling. Wheat midds generally include ground screenings from cleaning, particles of bran, germ, flour remnants, and the offal from the milling process as identified in

Figure 1.

Figure 1. Milling components.



Wheat midds vary due to differing qualities of parent grains, the specific milling operation, and the end products desired. Mills label and market wheat midds at conservative protein and fiber levels to allow for variations that might occur. Wheat midds are commonly guaranteed to have a minimum of 14 percent crude protein but are typically higher.

Wheat midd samples collected from North Dakota mills processing durum and hard red spring wheat reflect a fairly consistent product and slightly higher nutrient levels than samples collected from Kansas mills processing winter wheat. Average nutrient composition of 18 samples taken from four mills in North Dakota and 31 samples from three mills in Kansas are presented in Table 2 along with comparative values for common feed grains.

Table 2. Nutritional composition of wheat midds.

Nutrient DM Basis	North Dakota Midds <sup>1</sup>	Kansas Midds <sup>2</sup>	Cracked Corn <sup>3</sup>	Heavy Barley <sup>3</sup>	38 lb/bu Oats <sup>3</sup>
Crude Protein, %	18.70	18.10	9.80	13.20	13.60
ADF, %	11.10	13.50	3.30	5.77	14.00
NE <sub>m</sub> , Mcal/lb	.91	.83	1.02	.94	.84
NE <sub>g</sub> , Mcal/lb	.59	.50	.70	.64	.55
TDN, %	80.00	73.00	90.00	84.00	77.00
Starch, %	38.00	26.00	64.00	75.00	50.00
Calcium, %	.09	.13	.03	.05	.01
Phosphorous, %	.92	1.07	.32	.35	.41
Potassium, %	1.16	1.34	.44	.57	.47
Magnesium, %	.74	.50	.12	.12	.16
Sulfur, %	.18	.21	.11	.15	.22
Cobalt, ppm	.02	.21	.31	.35	.06
Copper, ppm	6.90	12.90	2.50	5.30	8.60
Selenium, ppm	1.00	.37	.14	.18	.24
Zinc, ppm	74.80	82.60	24.20	13.00	40.80

<sup>1</sup>4 locations, 18 samples

<sup>2</sup>3 locations, 31 samples

<sup>3</sup>1996 Nutrient Requirements of Beef Cattle

Wheat midds contain higher levels of fiber, protein, and minerals than the parent grain with reduced amounts of starch and energy.

Wheat midds will typically contain 17 to 18 percent crude protein (dry matter basis), which is intermediate between most feed grains and high protein oil seed meal co-products. The protein in wheat midds is considered to be fairly high in rumen

degradability with a bypass value of only 23 percent.

Although high fiber levels are typically associated with low energy values, the fiber in wheat midds is highly digestible by ruminants. The energy value of wheat midds is intermediate to feed oats and barley for cattle. However, since the particle size of the fiber is extremely small, the fiber in wheat midds is less effective in rumen stimulation and buffering as compared to long fiber from forages.

Wheat midds are high in macro and microminerals and a particularly good source of phosphorous and potassium. In addition, they are a good source of several trace minerals that are often marginal in forages, including copper, zinc, magnesium and selenium. Wheat midds typically have phosphorous levels reaching 1 percent; however, like most grains, wheat midds are low in calcium. When wheat midds are fed as a supplement to high roughage rations adequate in calcium but marginal in phosphorous, they may reduce or eliminate the need for additional phosphorous-containing supplements. However, calcium will be deficient or improperly balanced with phosphorous when wheat midds are fed in high amounts, in grain based rations, or to supplement very low quality crop residues.

## Characteristics and Handling

Depending on source, wheat midds are available as loose meal or pellets. The meal is fine, dusty, and light with a low bulk density, which makes it inconvenient and difficult to handle. Pelleting offers advantages to both the mill and user. Pelleting wheat midds greatly increases the density, which improves flowability, storage, and transportation and allows handling with conventional grain handling equipment. Dust and wind losses are also reduced, and livestock acceptability and performance are generally improved.

Die sizes used in pelleting vary among mills. Pelleted wheat midds are generally either  $\frac{1}{4}$  or  $\frac{1}{2}$  inch in diameter. Little difference has been seen in pellet quality between different sizes. Bulk density is generally doubled with pelleting to about 40 pounds per cubic foot. In most cases, proteins in the mill feed adequately bind the pellet and no additional binders or supplemental nutrients are added. Some crumbling and breakdown of pellets occurs with augering and moving, so handling should be minimized to prevent the accumulation of fines. Pelleted wheat midds are marketed at higher prices, \$7 to \$15 per ton, than nonpelleted wheat midds due to the added cost of pelleting and the increased consumer demand.

Pricing of wheat midds often reflects seasonal demand and may be lower in spring and summer months. Wheat midds purchased during market lows may be stored onfarm until needed; however, extended onfarm storage of wheat midds during the summer months is associated with spoilage and bridging.

The moisture content of pelleted wheat midds is typically about 13 to 14 percent. Wheat midd pellets readily take on moisture, swell, soften, and lose their integrity and ability to flow if exposed to high humidity. Binstored wheat midd pellets placed in storage at 14 percent moisture at 85 degrees F have been shown to lose flowability after a period of several weeks. Aerating the bin with cool evening, high humidity air hastened the deterioration. In contrast, using an aeration fan to move low relative humidity dry air through the bin and dry to a desired 11 percent moisture reduced deterioration.

In addition to pellet deterioration, mold growth and insect activity are common under higher temperature and moisture conditions.

Summer storage recommendations include: Store away from contact with concrete floors or soil. Make sure bins have no leaks and are thoroughly sealed. Level the surface, because a steep peak will contain fines which interfere with moisture movement. Aerate the bin to dry, not just cool, the pellets. Air should have a low relative humidity and the drying should be done within the first month of storage. Pelleted wheat midds do not behave like stored grain, so it is best to gain experience with small quantities before stockpiling large amounts.

## Use for Cattle

Wheat midds can be easily incorporated into cattle diets and are often an economically competitive source of protein or energy. Feed manufacturers often include wheat midds as an ingredient in commercial feeds and supplements.

Wheat midds are generally very palatable and readily consumed by all classes of cattle.

Wheat midds require no additional processing in comparison to feed grains, and pelleted midds can be fed on dry sod or frozen ground with lower losses than processed grain mixes. Waste is further reduced with larger pellets, cake, or cubes.

Since wheat midds contain higher levels of fiber and reduced levels of starch when compared to the wheat kernel, digestive disturbances are less of a concern. However, the finely processed starch that remains (ranging from 17 to 45 percent by weight) and the small particle size of fiber would indicate small incremental ration changes for adapting ruminants to wheat midds. Do not give unadapted cattle free access to wheat midds. Generally, feeding up to 1 percent of body weight as wheat midds will not cause digestive problems if adequate roughage is available.

Care should be taken to balance diets containing wheat midds to include appropriate calcium levels and maintain a desirable ratio of calcium to phosphorous. A calcium to phosphorous ratio of at least 1:1 is considered essential and a ratio of 2:1 is considered ideal. Calcium can be supplemented with the addition of ground limestone (34% calcium) or a high calcium feedlot mineral supplement. As a guide, the addition of 1 ounce of limestone for every 2 to 3 pounds of wheat midds fed to calves on backgrounding rations and 1 ounce of limestone for every 4 to 5 pounds of wheat midds fed to cows on wintering rations will supply needed supplemental calcium.

## Supplementing Cows

Wheat midds can be an effective supplement for beef cows grazing low quality winter range or being fed low quality forages. The moderate level of crude protein in wheat midds is highly degraded in the rumen and well utilized by cattle on low quality forages that are typically low in rumen degradable protein. Likewise, mature forages are typically low in phosphorus while wheat midds are a good source of phosphorous and other trace minerals. The low starch characteristics of wheat midds along with fairly high levels of digestible fiber minimize the antagonistic impact on fiber digestibility often seen with feeding grains.

A series of trials conducted at Oklahoma State University specifically evaluated the use of wheat midds as a source of supplemental protein and/or energy for cows grazing dormant native range. When recommended levels of supplemental protein were fed (1.18 lbs. CP/hd daily), cows fed wheat midds (7.6 lbs./hd daily) or a cornsoybean meal mixture (7.9 lbs./hd daily) gained more weight precalving than those supplemented with soybean meal only (3 lbs./hd daily). Cows benefited from the additional energy since adequate protein was available and the wheat midds appeared to be equal to a mixture of corn and soybean meal equivalent in protein content.

When the cost per pound of protein is favorable compared to that from oil seed meals, wheat midds can be used effectively as a replacement for supplementing protein to cows. When forage is limited or cow energy needs exceed energy levels in forage, the additional energy provided by wheat midds will be beneficial.

A South Dakota State University digestibility trial specifically evaluated the impact of wheat midds as a supplement for low protein forage on forage digestibility and intake. They determined hay and total diet intake and digestibility to be similar with both soybean meal supplemented at 2.5 pounds per head daily or wheat midds at 5 pounds per head daily. There was a slight increase in forage utilization with soybean meal compared to wheat midds, but total ration digestible dry matter was slightly increased by supplementing with wheat midds. However, wheat midds fed at high levels (11 lbs./hd daily) decreased forage intake as wheat midds are being substituted for hay, but also resulted in significantly lower hay digestibility (44.4% vs. 32.5%), lower total ration intake (23.2 lbs. vs. 21.8 lbs.) and decreased utilization of the low quality forage.

Results of an NDSU Carrington Research Extension Center trial indicate that cows can be fed a variety of feedstuffs, including rations comprised primarily of wheat midds and straw, and perform to their genetic potential if the ration is balanced for the cow's dietary requirements. Lactating first calf heifers fed a ration of primarily wheat midds and straw produced calves of similar weight and had similar weight change and reproductive performance to lactating first calf heifers fed a conventional corn silage, alfalfa based ration. Cows on the alternative ration consumed an average of 16.7 pounds of wheat midds, 10.5 pounds of straw and 5.5 pounds of alfalfa/grass hay daily along with a vitamin/mineral supplement.

## Backgrounding Calves

There is considerable interest in using wheat midds as a concentrate to replace grain in growing/backgrounding rations. Pelleted wheat midds compare favorably with grains due to higher protein, comparable energy values, and ease in feeding. Also, pelleted wheat midds are often priced as a cost-effective alternative. Wheat midds are particularly attractive in comparison to rations that use grains requiring processing, that are prone to cause digestive problems, or that require supplemental protein from an additional source.

Wheat midds in the loose meal form are associated with some acceptance problems by calves and should be limited to mixtures with more palatable feeds for starting calves on concentrate feed. Pelleted wheat midds are generally more readily consumed; however, in receiving diets, mixtures with other feeds may improve feed intake. Wheat midds by themselves are not safe for free choice feeding to calves unadapted to concentrate feeding and should be limit fed or mixed with roughages when starting calves on feed to prevent over consumption and acidosis.

Several studies have shown calves respond very well to wheat midds as a replacement for grain and soybean meal in backgrounding rations.

In growing calf diets, feeding wheat midds resulted in similar performance to a corn and soybean meal mix when fed at about 1 percent of body weight to calves with free choice forage as either grazed wheat, hay, or silage. At higher concentrate feeding levels or when stockers are being limit fed, a linear decline in average daily gain was observed as the concentration of wheat midds increasingly replaced corn and soybean meal in the ration. For backgrounded calves limit fed a wheat midds based ration, average daily gain can be improved with increasing levels of undegradable intake protein (UIP) from a protein source like heat treated soybean meal.

Wheat midds would also make a good supplement for yearlings on grass late in the grazing season when nutrient deficiencies occur in maturing grasses. The protein, phosphorous, and energy provided in wheat midds would help maintain gains late in the grazing season.

## Finishing Cattle

Wheat midds have a lower energy value than grains used in typical high concentrate finishing rations. Consequently, feeding wheat midds at increasing proportions in the ration can decrease cattle performance. Wheat midds are often priced to favor their use in finishing rations at levels that provide more economical cost of gain but with slightly reduced daily gains and feed conversions. Including wheat midds at modest levels in finishing diets will also minimize supplemental protein needs.

Several studies have evaluated replacing cracked corn with wheat midds in finishing diets. Kansas State University researchers concluded that pelleted wheat midds could replace 10 percent of the grain portion of a finishing ration without notably affecting performance. In general, a linear decrease in daily gains and feed efficiency were observed with increasing levels of wheat midds above this level. A similar study at the NDSU Carrington Research Extension Center found wheat midds included up to 20 percent of the grain portion of a cornbased finishing ration resulted in no effect on daily gains, feed conversion and intake.

*At 40 percent replacement of grain, wheat midds tended to decrease intake (3.5%) and gain (4%). Greater decreases in intake (9.25%) and gain (12%) were observed at 60 percent replacement of grain with wheat midds.*

Another study conducted at the Carrington REC compared wheat midds fed as pellets or meal in finishing rations. Pelleting was found to increase gains, especially when wheat midds are fed at higher levels (50% replacement for grain). Another Kansas study looked at mill feed replacing the roughage portion of the finishing diet. Researchers concluded that wheat midds could replace up to half of the roughage portion of cornbased finishing diets without reducing performance or increasing subclinical acidosis. Wheat midds should be used with caution as substitutes for hay and silage in feedlot rations since their fine particle size may have poor roughage characteristics.

## Creep Feeding

With the protein content of wheat midds meeting or exceeding creep feed recommendations (1516% crude protein) plus the easy handling of pellets, wheat midds are an attractive calf creep feed. Many commercial creep feeds contain a percentage of wheat midds. Producers who are set up to handle pelleted wheat midds can often use the bulk commodity alone or in combinations with other feeds as an acceptable and economical creep feed.

Wheat midds have been used extensively alone or in combinations with other feeds for creep feeding calves in drylot at the Carrington REC.

No major palatability problems or health challenges in the form of bloating calves or acidosis were observed. Calves tended to develop loose stools at the introduction of creep feed, but after a few weeks stools firmed up. Creep intake has been higher when pelleted wheat midds were fed in combination with field peas, corn gluten feed, or a commercial supplement than when fed alone.

Increased creep feed intakes, while associated with higher calf gains, are not necessarily more economical. Since the pounds of creep feed per pound of calf gain was increased with higher creep intake, the feed cost per pound of gain needs to be considered. Creep intake for spring born calves, creep fed for two months prior to October weaning, averaged about 7 pounds daily per calf.

## Example Rations

Wheat midds are a very versatile feed for cattle and may be useful in many feeding situations. Table 3 provides an estimate of gain for medium to large frame feeder cattle when fed differing levels of wheat midds in combination with either good or poor quality grass hay. The daily amounts of supplemental wheat midds needed to balance rations for gestating and lactating mature beef cows of a moderate size and condition are presented in Table 4.

**Table 3. Estimated gains for growing steers fed wheat midds and grass hay.**

Daily Consumption by 500 700 lbs <sup>1</sup> Feeder Steers	Approximate Winter ADG <sup>2</sup> with Free Choice Hay <sup>3</sup>	
	Good Grass Hay <sup>4</sup>	Poor Grass Hay <sup>5</sup>
Wheat Midds		
.5% of body weight (2.5 - 3.5 lbs.)	1.5	1.0
1.0% of body weight (5.0 - 7.0 lbs.)	2.0	1.5
1.5% of body weight (7.5 - 10.5 lbs.)	2.5	2.0

<sup>1</sup>Medium to large frame, implanted  
(assume .5 lb/day less gain from nonimplanted  
heifers).

<sup>2</sup>1984 Nutrient Requirements of Beef Cattle.

<sup>3</sup>Ration will require supplemental minerals and  
vitamins.

<sup>4</sup>Good grass hay assumed to have 10% crude  
protein and 56% TDN.

<sup>5</sup>Poor grass hay assumed to have 7% crude  
protein and 51% TDN.

**Table 4. Estimated daily feeding of wheat midds to supplement mature beef cows wintered on grass hay and straw.**

Daily Pounds of Supplemental Midds		
Gestating Cow	Lactating Cow <sup>2</sup>	Type of Forage Fed to Appetite <sup>1</sup>
0	6	100% Good Grass Hay <sup>3</sup>
4	12	100% Poor Grass Hay <sup>4</sup>
6	10	50% Good Grass Hay - 50% Straw <sup>5</sup>
10	15	100% Straw

<sup>1</sup>Ration will require supplemental minerals and vitamins.

<sup>2</sup>1200 lb mature beef cow in moderate body condition with moderate milk production.

<sup>3</sup>Good grass hay assumed to have 9% crude protein and 56% TDN.

<sup>4</sup>Poor grass hay assumed to have 6% crude protein and 51% TDN.

<sup>5</sup>Straw assumed to have 4.5% crude protein and 44% TDN.

## Pricing Considerations

Mills price wheat midds based on supply and demand relationships that are influenced by the current prices of feed grains, other coproducts, and seasonal patterns of use. Since most supplemental feeding occurs in the fall and winter, prices are typically lower in spring and summer months. In some instances, volume purchases or long term contracts for continual use may be negotiated at lower than spot market quotes. The cost of transporting wheat midds to the feedyard should be added to the purchase price. Estimated transportation costs per ton are illustrated in Table 5. Wheat midds are often priced to be an economical alternative feed, particularly for producers located near processing mills.

**Table 5. Freight cost should be added to mill price to determine feed yard price.**

Distance from Mill (miles)	Shipping Cost per Loaded Mile			
	\$1.80	\$2.00	\$2.20	\$2.40
	- Additional cost per ton for shipping - 40,000 lbs of wheat midds			
50	\$4.50	\$5.00	\$5.50	\$6.00
100	\$9.00	\$10.00	\$11.00	\$12.00
150	\$13.50	\$15.00	\$16.50	\$18.00
200	\$18.00	\$20.00	\$22.00	\$24.00
250	\$22.50	\$25.00	\$27.50	\$30.00
300	\$27.00	\$30.00	\$33.00	\$36.00

The decision to feed wheat midds is based on price as compared to other feeds and will depend on the particular feeding situation. Wheat midds are valuable in situations where: 1) both the protein and energy are needed in the ration, 2) when wheat midds are fed to animals with moderate energy requirements, or 3) moderate amounts are fed with higher energy feeds to animals with high requirements.

Due to differences in nutrient composition, comparing feeds on a price per ton is not very useful. Comparing feeds on a calculated cost per unit of protein or energy can determine the cheapest source for a particular nutrient. However, in many situations both additional energy and protein are needed. The value of wheat midds can be determined based on the most likely alternatives for providing energy and protein, such as a common feed grain and oil seed meal. Table 6 lists the cost per unit of protein and energy for selected common feeds as a comparison to wheat midds at several market prices. The relative value of wheat midds based on both protein and energy content is shown in Table 7.

**Table 6. Cost per unit of protein and TDN from wheat midds and other feeds at several market prices.**

	Cost	Cost/lb.	
		Crude Protein	TDN
Wheat Midds	\$50/T	.154	.036
	\$70/T	.215	.050
	\$90/T	.277	.065
	\$110/T	.338	.079
Corn	\$1.60/bu	.331	.036
	\$2.00/bu	.417	.045
	\$2.40/bu	.500	.055
	\$2.80/bu	.583	.064
	\$3.20/bu	.663	.072
Barley	\$1.20/bu	.218	.034
	\$1.50/bu	.272	.043
	\$1.80/bu	.326	.051
	\$2.10/bu	.380	.060
Oats	\$1.00/bu	.265	.047
	\$1.25/bu	.331	.058
	\$1.50/bu	.397	.070
Canola Meal	\$100/ton	.146	.079
	\$120/ton	.175	.095
	\$140/ton	.204	.111
	\$160/ton	.233	.127
Alfalfa Hay, mid bloom	\$40/ton	.121	.039
	\$60/ton	.182	.059
	\$80/ton	.243	.078

**Table 7. Relative value of wheat midds (\$/ton) based on protein and energy content at various prices for feed barley<sup>1</sup> and canola meal<sup>2</sup>.**

Canola Meal	Barley \$/bu					
	1.25	1.50	1.75	2.00	2.25	2.50
\$/ton						
80	54	62	70	78	86	94
100	57	65	73	81	89	97
120	61	69	77	85	93	101
140	66	74	82	90	98	106
160	71	80	88	96	104	112
180	79	87	95	103	111	119

<sup>1</sup>Barley assumed to have 13% CP and 83%TDN.

<sup>2</sup>Canola Meal assumed to have 40% CP and 70% TDN.

## Summary

The availability of wheat midds, a coproduct of durum and hard red wheat processing, has increased substantially as additional milling operations have been constructed in North Dakota. Cattle producers use this locally produced feedstuff primarily during the fall and winter feeding periods. Seasonal price variations provide opportunities for procuring wheat midds at reduced prices, but appropriate storage is required.

Pelleted wheat midds are a consistent convenient feed that are well accepted by cattle and are high in protein (18% crude protein) and energy (80% TDN). Wheat midds are also a good source of many minerals (0.9% phosphorous) with the exception of calcium, which often must be supplemented in rations containing a high percent of wheat midds. Cattle producers are finding wheat midds to be a useful feed alternative that can be used in many feeding situations including creep rations, backgrounding/growing rations, and cow herd supplements.

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