AGRI-FACTS
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Increasing Cow/Calf Profitability Using Chaff and Chaff/Straw Feedstuffs

Over the years, many cost-conscious cow/calf producers across western Canada have recognized the potential for chaff residues to help reduce the winter feeding costs in mixed farm operations.

Chaff that has often been considered a nuisance on the grain side of a mixed farm can prove to be a valuable low cost feed alternative on the cattle side. In fact, chaff may prove to work as a win-win solution for both operations, if some basic steps are followed. And nothing is more important than to first recognize that chaff is a low quality feed, suitable only for mature beef cows.

Chaff is a low quality feed, suitable only for mature beef cows

What is chaff?

Chaff is made up of glumes, hulls, unthreshed heads, short straw, leaf material, weed seeds and whole or cracked kernels from the harvested crop. As a result, chaff has a higher nutritive value than straw.

Background

Collection, handling and feeding

Chaff can be handled and collected in either of two ways. It can be collected and dropped on top of the straw swath, where it can then be baled using a cyclone type of attachment, or it can be collected and blown into a chaff wagon using a chaff collector. The wagon then dumps piles of chaff in the field for later collection or field feeding.

The first method of collection and handling is easy and requires a minimum of equipment purchases or modifications. Once baled, the chaff can be fed in round bale feeders, rolled out in the field, or tub ground and mixed with other feeds.

Chaff piles left in the field may be grazed or moved to a central feed pile and fed. Field grazing of chaff is relatively inexpensive, efficient and effective. Electric fencing may be used to limit access to chaff piles.

Field feeding is preferable to corral feeding because little if any yardage is taken up with the field-feeding scenario. Corral feeding may also prove more expensive simply because there is a transportation cost associated with removing the chaff from the field. One issue with field feeding is the potential for the development of small thick mats of straw around field feeding sites. These areas may suffer from poor germination and weed infestations in the following year.

If yard feeding is preferred, most chaff piles can be collected using a forage harvester or a hay sweep on a front end loader. (This feeding method also removes weed seeds from the field.) Once in the feed yard, the chaff can be mixed with other feeds, or it can be piled and fed free-choice. An electric wire may be used to limit access to the chaff pile.

The advantages of mixing chaff with silage are that producers are better able to stretch their feed resources and better match the feed to animal requirements. Transportation is the biggest issue concerning the economics of chaff. Chaff is very light but very bulky, which makes it costly to move long distances.

Feed testing

Why feed test?

As shown in Table 1, chaff quality can vary. The major factors that influence quality are crop type, stage of maturity, weed content, method of harvest, combine settings and crop and field variability. Chaff from oats and barley generally has a higher nutritive value than wheat, pea or canola chaff. As a result, it is important to use feed testing to determine feed value.

Feed sampling procedures

Use a core sampler to get samples from baled straw with chaff. For round bales, take about 20 samples from different bales. Sample from the round surfaces of the bales at a variety of locations. For rectangular bales, take 1 sample per bale from at least 20 bales. Take the samples from the middle of each bale end. Place the samples directly into a plastic sample bag.

Chaff piles can most easily be sampled by hand (Figure 1). Take at least 20 samples from a variety of different piles at different locations and depths to obtain a representative sample. Place these samples on a smooth surface and mix. Divide the sample to obtain a sub-sample sufficient to fill a standard forage sample bag (about 2 liters).

Photo courtesy of Duane McCartney

Figure 1. Chaff pile

Special care should be taken to ensure the sample is representative; heavier and lighter chaff components must be adequately represented. Ask that the feed testing laboratory grind the entire sample to ensure that the sample is representative of the original chaff.

What to test for

Feed laboratories offer many different analysis packages. The test or tests you choose will depend on your own needs and budget. Most packages of analyses include levels of crude protein, acid detergent fibre (ADF), neutral detergent fibre (NDF), calcium and phosphorus. The laboratory will use this information to estimate energy levels for you. You may also wish to test for trace minerals levels at least once every two or three years to assess the adequacy of your trace mineral supplement program.

Two methods of feed testing are available to beef producers. The wet chemistry test consists of simple chemical analysis. Near Infrared Spectrometry or NIRA method uses light wave analysis. Unfortunately, the NIRA test uses localized databases (different growing conditions than your own). In addition, most of the feeds tested are of high quality, so feed quality estimations of low quality feeds are often inaccurate. Although the wet chemistry analysis is more costly, it is considered to be the more accurate method of testing chaff.

Using feed test results

To meet livestock nutrient requirements, chaff/straw rations will generally require some supplementation for protein, energy, minerals and vitamins. Software such as Cowbytes provides a quick method to properly balance nutrients in chaff/straw feeding systems. Further information on Cowbytes can be located on Alberta Agriculture's website Ropin' the Web (http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/hst875)

Feeding chaff

Quality variability in chaff

Several variables can affect chaff feed quality:

- Combine settings: The more grain in the chaff, the better its feeding quality. If there are a large number of small kernels in the sample, the combine can be set to throw the light kernels over to the chaff, thereby improving the quality of the chaff. If the sample contains more broken straw than bits of grain and leaf material, it will have a lower feed value.
- Combine efficiency: The poorer the efficiency, the more cracked grain and unthreshed heads that will pass over the sieves and into the chaff.
- Underseeding: Underseeded crops such as alfalfa add green leaf material to the chaff, increasing crude protein levels.
- Stubble height: Higher cutting heights such as with direct combining can produce straw with higher nutritive values than when cut at ground level. Although this approach will reduce total straw yield, it will help in improving the overall quality of the chaff sample.

Table 1 provides a summary of the nutrient values for chaff and straw residues. Data represents more than 200 field samples taken during 1996 to 1998 in northeastern Alberta.

Table 1. Average feed values for all chaff and chaff/straw combinations

Sample	#	Dry matter (%)	Protein (%)	Energy Mcal/lb	Calcium (%)	Phosphorus (%)	Magnesium (%)	ADF* (%)	TDN** (%)
Wheat chaff	53	91.1 (86.5-95.7)	4.6 (2.9-6.3)	0.9 (0.73-0.97)	0.24 (0.13-0.35)	0.08 (0.04-0.12)	0.12 (0.07-0.12)	51.5 (46.5-56.5)	43.6 (37.8-49.4)
Wheat chaff and straw	21	86.1 (81.7-90.5)	4 (2.5-5.5)	0.8 (0.70-0.88)	0.25 (0.11-0.39)	0.12 (0.08-0.16)	0.09 (0.06-0.12)	51.3 (47.1-55.5)	39.7 (35.3-44.1)
Barley chaff	51	88.8 (84.8-92.8)	6.5 (4.2-8.8)	1 (0.91-1.17)	0.52 (0.25-0.79)	0.13 (0.07-0.19)	0.17 (0.12-0.23)	42.8 (37.3-48.3)	53 (47.2-58.8)
Barley chaff and straw	28	88.5 (84.9-92.1)	5 (3.2-6.8)	0.9 (0.80-1.00)	0.45 (0.27-0.63)	0.11 (0.06-0.16)	0.15 (0.09-0.21)	49.6 (44.0-54.7)	45.6 (40.2-51.0)
Oat chaff	17	87.4 (80.2-94.6)	7.2 (5.0-9.4)	1.1 (0.95-1.15)	0.71 (0.25-1.16)	0.14 (0.08-0.20)	0.23 (0.17-0.28)	42.6 (38.0-47.2)	53.1 (48.2-58.0)
Oat chaff and straw	5	84.4 (76.9-91.9)	5.1 (2.8-7.4)	0.9 (0.78-1.02)	0.39 (0.25-0.53)	0.1 (0.05-0.10)	0.15 (0.09-0.21)	50.1 (44.3-55.9)	45.1 (38.9-51.3)
Canola chaff	18	88.6 (83.9-93.3)	5.9 (4.0-7.8)	0.8 (0.63-0.91)	1.45 (1.08-1.82)	0.12 (0.06-0.18)	0.33 (0.20-0.44)	56 (48.8-63.2)	38.5 (31.2-45.8)
Pea chaff	11	79.4 (74.2-84.6)	9.2 (4.5-13.9)	0.8 (0.74-0.92)	1.76 (1.28-2.24)	0.13 (0.04-0.22)	0.35 (0.25-0.45)	46.1 (42.0-50.2)	42 (37.6-46.4)
Pea chaff and straw	4	89.1 (85.9-92.3)	7 (4.6-9.4)	0.8 (0.69-0.89)	1.56 (1.47-1.65)	0.11 (0.05-0.17)	0.27 (0.18-0.36)	54.8 (50.0-59.6)	40.1 (35.0-45.2)

Source: Alberta Agriculture, Northeast Conservation Connection and Agricultural Service Boards, 1996-1998 Northeast Alberta Chaff and Chaff/Straw survey

* ADF – acid detergent fibre

** TDN – total digestible nutrients

General recommendations for chaff or chaff/straw feeding

As indicated in Table 1, the nutrient values for chaff or chaff/straw combinations are generally too low for growing livestock. As a result, chaff or chaff/straw roughages are best suited for mature animals in good body condition (Body Condition Score (BSC) 3.5 Canadian scale). Animals in poorer condition or still growing should be segregated and fed a separate ration that will meet their nutritional requirements.

Key facts:

- Use protein supplements in chaff/straw combinations when chaff crude contains less than 6 per cent crude protein. Protein supplementation will enhance the digestion of low quality roughage.
- Adjust ration supplementation during winter feeding. For mature pregnant animals both protein and energy requirements increase during the second and third trimester.
- Protein sources such as lick tanks that contain high quantities of non-protein nitrogen are not as effective as natural protein sources when supplementing low quality forages.
- Plant-based supplements such as canola meal or alfalfa hay are a more effective form of protein supplementation. However, supplements such as canola meal require mixing with other feeds to achieve adequate feed intake.
- Concentrate supplements can be used to supply protein (15% crude protein or greater) and energy (75% TDN or greater). Mixing with other feeds may be required to achieve required feed intake.
- Supplemental minerals, salt and vitamins need to be provided when chaff/straw rations are fed.

To identify the appropriate supplement and mineral mix for your operation, contact your local ruminant nutritionist.

Table 2. Example rations: Winter feeding 1,300 pound mature cow in mid-gestation, BSC* of 3.5

	Ration #1 lbs	Ration #2 lbs	Ration #3 lbs	Ration #4 lbs
Barley chaff (In field)	25	22	25	25
Alfalfa hay	8	–	–	–
Barley silage	–	–	20	–
Barley grain	–	9	–	–
20% protein pellet **	–	–	–	5
Mineral/vitamin/salt	0.1	0.1	0.1	0.05

* Body condition score

** Pellets are plant protein source with mineral mix

Crop acre requirements

As shown in Table 3, chaff and straw yield will vary by crop type and soil zone. Harvesting systems will also affect the quantity of chaff or straw produced. As result, the number of crop acres required for a feeding program will vary with chaff yield, feed waste and animal intake.

For example, a chaff yield of 600 lbs/acre with 20 per cent waste and estimated daily intake of 30 lbs of chaff for a 30-day feeding period will require approximately 2.0 acres per cow.

$$\text{Acres/Cow/Month} = \frac{\text{30 lbs chaff/day x 30 days}}{\text{600lbs chaff x 80\% (20\% waste)}}$$

$$= 1.9 \text{ acres/cow}$$

Table 3: Typical amounts of harvestable straw and chaff per bushel of grain

Crop	Soil zone	Pounds of straw per bushel of grain*	Pounds of chaff per bushel of grain**
HRS Wheat	Brown	50	20 - 25
	Dark Brown	65	
	Black	80	
CPS Wheat	Brown	40	20 - 25
	Dark Brown	50	
	Black	60	
Barley	Brown	30	5 - 10
	Dark Brown	35	
	Black	45	
Oats	Brown	30	5 - 10
	Dark Brown	35	
	Black	45	
Canola	Brown	40	15 - 20
	Dark Brown	50	
	Black	60	
Peas	Brown	40	20 - 25
	Dark Brown	50	
	Black	60	

* Amount of harvestable straw, assuming about 80 per cent recovery in cereals, and 50 per cent in peas and canola, with 2 to 4 inch stubble left

** Amount of harvestable chaff, assuming no weed chaff

Source: *Estimating the Value of Crop Residues*, Agdex 519-25. March 1999.

Economic Assessment:

Chaff can be a dependable and economical feed source for winter feeding programs. However, it is important to know the costs associated with feeding chaff such as the costs for chaff collection, supplementation and feeding management. As shown in Table 4, the operational costs to collect chaff on per ton basis are relatively low. Because chaff is a low density product, moving it to a central feeding area can result in a significant increase in feeding costs (Table 5).

Table 4. Examples of in-field chaff collection costs per ton

Chaff collection equipment cost	100 tons	200 tons	300 tons	400 tons
$3,500	$5.70	$4.10	$3.50	$3.20
$7,500	$9.80	$6.10	$4.80	$4.20

Assumptions: Chaff yield of 600 lbs/acre; inputs for fuel, labor and repairs based on 2% increase in combining time, depreciation and maintenance costs for chaff collector.

Table 5. Estimated delivery costs for 100 tons of chaff

Equipment requirements	Cost per ton
Tractor with loader 25 hrs x $40/hr = $1,000/100 tons	$10.00/ton
Truck Hauling 5 miles at $90/hour at 4 tons/hour 25 hrs x $90 = $2,250/100 tons	$22.00/ton
Chaff delivery cost	$32.00/ton

Assumptions: 2006 custom rates for tractor and truck.

As shown in Table 6, chaff feeding provides an opportunity for livestock producers to reduce their winter feeding costs in comparison to drylot feeding. A market value for chaff is hard to define, so in this assessment, chaff has been valued at cost while other feeds are at market value. The economic advantage of chaff feeding depends on low production costs and in-field feeding systems that help reduce yardage costs. Cost's associated with feed supplementation, water provision or electric fencing may affect the net economic advantage of chaff feeding.

Table 6. Example in-field chaff grazing expenses versus drylot

	$/cow/day	
	In-field chaff	Drylot
Chaff ($5.70/ton)	0.09	–
Grass/legume hay ($60/ton)	–	0.90
20 % protein pellet ($170/ton)	0.42	–
Feed delivery/yardage *	0.10	0.67
Feeding management (electric fence/labor)	0.15	–
Total	0.76	1.57
Net advantage	0.81	

* D. Kaliel, *Yardage – The Cost Beyond Feed*.

Assumptions: 1,300 lb cow mid pregnancy, 30 lbs/day chaff or hay, 5 lbs protein supplement provided daily for chaff, feed delivery includes labor and equipment.

Summary

Chaff or chaff/straw blends can serve as a source of feed for winter rations; however, it is important that the rations be well balanced to ensure the cow's nutritional needs are being met. The economic advantages of in-field feeding would suggest that livestock producers should consider utilizing chaff in winter feeding programs. Consult your local ruminant nutritionist for assistance with ration formulation and costing chaff-based rations.

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For more information, contact
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