CHAMPION Feed Services Ltd.

Grain and Canola Screening Pellets for Feedlot Cattle

Tennis Marx and Steven Pylot

Take Home Message

- ✓ Grind and pellet grain and canola screenings to improve nutrient digestibility and reduce weed seed viability.
- ✓ Energy values on a dry matter (DM) basis for grain screening pellets based on cattle and sheep trials are: 1.5 Mcal Digestible Energy (DE)/lb DM or 75% Total Digestible Nutrients (TDN).
- ✓ Energy values on a dry matter (DM) basis for canola screening pellets based on cattle trails are:1.4 Mcal DE/lb DM; 70% TDN.
- ✓ Grain screening-based diets when formulated to similar energy and similar protein levels as barley grain-based diets result in similar cattle performance and can result in considerable cost savings, if competitively priced.
- ✓ Canola screenings have shown to be a viable feed ingredient in feedlot diets with reductions in cost of gain by up to 7%.

Cautions:

- ✓ Screening pellets should be sufficiently durable to minimize fines and digestive disturbances.
- ✓ Cattle fed a high proportion of screenings should be placed on a recommended ionophore program to minimize bloat problems.
- ✓ Finishing diets should not contain more than 50% canola screenings and contain some source (5% of diet DM) of coarsely chopped forage to minimize digestion disturbances.

Introduction

Grain and oilseed screenings can serve as a protein/energy source for growing calves and finishing cattle. The incorporation of screening products into livestock rations can open an economic window to lower cost of gains and extension of existing on-farm commodities. Historically, these commodities were of limited selection and could at times

contain unfavourable levels of low quality or unpalatable ingredients. Due to these perceptions, their utilization in livestock rations has historically been limited or managed as a low inclusion commodity in the total diet.

Restructuring of the grain handling system on the prairies has allowed the development of larger volumes of single raw source by-products leading to greater availability of commodity. Larger available volumes of screenings from pulse crops, cereal grains, oil seeds and legumes has allowed the feed industry to contract large volumes of more consistent product, and more flexibility when processing and blending to target specific products, leading to less variation in products used in cattle diets. Forward contracting of screenings can be a method of securing a producer's position on feeding inventories. Increased availability of screenings across the prairies has spurred renewed interest in processed screenings as an economical feed source that can be priced competitively with traditional energy sources such as barley grain.

What are Screenings?

Screenings are defined by the Canada Grain Act to mean dockage that has been removed from grain that does not qualify for any other grain grades. Depending upon their quality, screenings vary in level of parent and volunteer grain material, broken or shrunken kernels, hulls, weed seeds, chaff, dust and other plant material. Based upon their ingredient combinations, screenings are graded into various classes. Number (No.) 1 feed screenings, contain greater than 35% of the parent grain material that is broken and/or shrunken. This product has a high feeding value and is used primarily by the poultry and swine industries. No. 2 feed screenings have higher levels of weed seeds, particularly wild oats. Uncleaned screenings do not qualify for the preceding two grades, but if cleaned they would contain at least 35%, of the parent material by weight. Refuse screenings are dockage material that fails to qualify for any of the above grades and consist primarily of broken kernels of grain, chaff, small weed seeds, and dust. Canola screenings are a generated by either the canola seed processing or cleaning industry and consist of similar material to grain screenings except the parent material is canola. Canola screenings have the same grading protocol as grain screenings.

Grain screenings contain variable amounts of whole grain and oilseeds, whole weed seeds, hulls, and chaff which, can present physical handling problems. Grain screenings consist of material which is 45 to 80% of the density of the parent material (**6**). Due to the light bulky nature of hulls and chaff, unprocessed screenings are difficult to handle as they require specialized storage facilities, such as flat storage or drag legs to avoid bridging and plugging of equipment. Unprocessed screenings are also more difficult to transport as fewer tonnes of raw material (17 to 19 tonnes per 'Super B') can be hauled compared to 38 to 42 tonnes of pelleted screenings (**6**).

In addition to handling problems, unprocessed screenings present a potential problem of spreading weed seeds onto a farmer's property. Many weed seeds have hard seed coats that are resistant to digestion unless processed in some manner. Work conducted by Janzen (**3**) showed that numerous weed seeds germinated from fresh and previously frozen manure samples that were collected from sheep and steers fed unprocessed grain screenings. Janzen (**3**) also evaluated the viability of weed seeds in grain screenings that had been ground and steam pelleted, and/or treated with ammonia or urea. Very few seeds germinated from either the pelleted or ammoniated screenings, indicating that weed seed viability had been almost completely destroyed.

The most common form of processing is to grind screenings through a 1/8" screen or smaller, to ensure destruction of weed seeds and pelleting to reduce handling and feeding problems. Pelleting greatly improves animal acceptability as finely ground screenings can lead to bloat and other problems. Processing of screenings are commonly carried out by a feed manufacturing facility where blending of various screening products (i.e. canola, grain and specialty crop screenings) provides more consistent products at specific protein levels.

Similar to feeding whole barley or wheat, the digestibility of whole screenings will be reduced if not processed. Janzen (**3**) and Beames et al. (**1**) have shown that the processing of raw refuse grain screenings into pellets improves protein and energy digestibilities by 12% and 19%, respectively. Consistent with this, processing of canola screenings into pellets improved overall nutrient digestion by cattle by about 15 - 20% (**7**). It should also be note that processing of screenings also allows for a more consistent product by particle reduction

and minimizes separation in handling and transportation. Screenings should be processed to reduce transportation costs, increase ease of handling, reduce the spread of weed seeds and to improve animal utilization.

Cautions When Feeding Processed Grain Screenings to Cattle.

Processed grain screenings have been ground and pelleted. Excessive handling and/or poor pelleting can result in a high proportion of fines. These fines may predispose cattle to bloat or fines may separate from the ration when fed at high levels. Cattle fed a high proportion of screenings should be placed on a recommended ionophore program and undergo sound bunk management to minimize such problems.

Target Markets and Economics

Pricing of the various types of screenings may present challenges for producers. Nutritionally, screenings are as good as their level of fibre and protein when implemented into ruminant diets. Screenings can serve to replace roughage and energy sources in the total mixed ration based upon the required performance of the class of cattle fed. It is important to compare screening products to their proper competitor in least cost rations. Grain screenings by nature contain energy via starch and digestible protein and oils. It is the level of chaff, dust and hulls that can lower their energy level. Screenings are valued for their protein and energy content.

When the cost of protein is high relative to energy, the competitors are barley and canola meal. When the cost of energy is high the main competitor of grain screenings is barley grain. Table 1 shows the influence of varying nutrient composition on the value of processed screenings relative to the price of rolled barley. The table was developed assuming that barley had 12% protein, 82% TDN or 1.64 Mcal DE per

Table 1. Influence of Nutrient Composition on the Value of processed Grain Screenings Relative to Rolled Barley.

Grain Screening Pellets Nutrient Content (as fed basis)		Value of Rolled Barley $ per tonne (as fed basis)			
TDN%	Protein %	80	100	120	140
		$ Value of Grain Screening Pellets as a Percentage of Rolled Barley Value			
65.0	11.0	95.0	93.5	92.0	91.0
68.0	11.0	96.0	95.0	94.0	93.0
62.0	11.0	93.5	92.0	91.0	90.0
65.0	13.0	108.0	102.5	97.5	93.5
68.0	13.0	111.0	104.0	100.0	97.0

Above values have been determined in a steer backgrounding diet using average values for barley silage, straw, canola meal and barley grain. Values are to be used only as guidelines, feed test to be sure and determine relative worth to each farm situation. Values will change with type of cattle fed (cows vs. calves) and type of feed fed (barley silage vs. alfalfa hay). Table used with permission of V. J. Racz, Department of Animal and Poultry Science, University of Saskatchewan.

lb (Dry Matter (DM) basis) and ranged in price from $80 to $140 per tonne, and canola meal had 32% protein, and ranged in price from $235 to $250. The prices in **Table 1** will vary with specific farm situations and class of cattle to be fed. The **table** shows that as barley or energy prices increase, the value of screenings relative to barley proportionately decreases. When barley or energy costs are low the protein content, of screenings have a larger influence on screening value and the value of screenings increases.

Screenings in Backgrounding and Finishing Diets

The major feed grain fed to beef cattle in western Canada is barley grain. The cost of feed is the single largest cost that a producer can control in cattle feeding. The use of screenings in feedlot diets depends on the savings in cost and predictability of animal performance. Research conducted at the University of Saskatchewan and Agriculture and Agri-Food Canada Lethbridge Research Centre, measured the effects of several factors which might affect performance of screenings in the feedlot.

Nutrient Composition

Over two years of research conducted at the University of Saskatchewan has characterized grain screenings and canola screenings as having higher levels of protein (13-18%) and fat (5-17%) than barley grain. As seen in Table 2, grain and canola screening pellets crude protein content averaged 15.1% and 15.7% (DM basis), respectively. Fibre (acid and neutral detergent fibre; ADF & NDF) levels were higher in canola screenings (26.8% ADF and 39.0% NDF) than grain screenings (20.9% ADF and 33.7% NDF) and both contain more fibre than barley grain, but less fibre than alfalfa hay. Between batch

Table 2. Nutrient Composition of Barley Grain, Grain Screening Pellets and Canola Screening Pellets.

Nutrient	Barley[1]	Grain Screenings Pellets[1]	Canola Screenings[2]	Alfalfa Hay[2]
Crude protein	12.5	15.1	15.7	18.6
Acid Detergent Fibre	7.5	20.9	26.8	33.8
Neutral Detergent Fibre	24.1	33.7	39.0	47.0
Fat	2.4	9.9	10.0	5.2
Ash	2.9	7.0	10.6	3.3
Total Digestible Nutrients	83.0	75.0	70.4	62.7
Digestible energy (Mcal/lb)	1.66	1.49	1.37	1.24

[1]Marx (4), [2]Pylot(7)

standard deviations for most nutrients were relatively low (less than 4.0%) indicating minimal variability in nutrient make-up. The safest approach to avoiding unwanted surprises in the composition of screening pellets is to conduct a feed analysis on protein, ADF, NDF, calcium and phosphorus prior to any purchase.

The energy value of grain and canola screenings where established by conducting feeding experiments where these products were fed as the sole feed source to steers and sheep. Grain screenings were consumed readily by both cattle and sheep and the energy value of screenings was 75% total digestible nutrients (TDN) (1.5 Mcal DE/lb DM basis) for both the cattle and sheep. The energy value for canola screenings fed to growing steers was 70.0% TDN (1.4 Mcal DE/lb DM basis).

Feedlot Performance of Cattle Fed Grain Screenings in Backgrounding Programs

Two trials were conducted over 1995/96 and 1996/97 to examine the growth of cattle fed barley grain and/or grain screening-based backgrounding diets (**Table 3**). All cattle were supplied by Heartland Livestock Services, and were fed at the University of Saskatchewan Beef Cattle Research Station (**4**).

In year one (1995/96) 150 Hereford (medium frame) and 150 Charolais crossbred (large frame) calves were fed one of two diets formulated to 67% TDN and 12.5% CP. Diet 1 consisted of 41% barley concentrate mixture, 35% barley silage, 13% brome hay and 11% straw (DM basis). Diet 2 consisted of 60% grain screening pellets, 25% barley concentrate, 7% brome hay and 8% barley straw (DM basis). Canola meal was used as a protein supplement in the barley-based diet at 9.5% of concentrate mix. Grain screenings were obtained from a commercial source (New-Life Feeds Ltd.) over the course of the trial. The rations were priced using feed and ration processing costs relevant for the 1995/96 winter feeding period, in the Saskatoon area.

In year 2 (1996/97) 340 Charolais crossbred calves were fed one of four diets formulated to 65.5% TDN and 12.5% CP, based on grain screenings pellets or barley grain in combination with two forage sources barley silage and straw or brome hay and straw. The diets included (DM basis): Diet 1(BG:BS):48% barley silage, 36% barley grain concentrate and 16% straw; Diet 2 (GSP:BS): 36% barley silage, 52% grain screenings and 12% straw; Diet3(BG:BH): 50% Brome hay, 44% barley concentrate and 6% straw; and Diet 4 (GSP:BH): 70% grain screenings, 19% brome hay and 11.0% straw.

The performance of the backgrounding cattle is provided in Tables 3 & **4**. In year 1, the medium frame cattle averaged 562 lb, while the large frame steers averaged 572 lb at the start of test (Table 3). The cattle were backgrounded for 152 days at which time the average weight was 930 lb for the medium and 927 lb (unshrunk) for the large frame steers. The cattle were targeted for an average daily gain (ADG) of 2.0 to 2.2 lb per day as per a typical backgrounding program. Actual gains for the 152 day period were 2.4 lb per day across both frame sizes and were not influenced by diet. No significant differences in feed intake were observed between frame size and diet. Both the medium and large frame cattle fed the grain screening-based diet were more efficient ($P<0.05$) at converting feed to gain. Feed costs per pound of gain averaged $0.53 and $0.49 for the barley grain-based and grain screening-based diets, respectively and were not influenced by frame size of the cattle. The grain screening-based diets cost of gain was $0.04 lower per day than the cost of gain for barley-based diets and resulted in a savings of $13.68 for the grain screening-based diets over the 152 day feeding period.

Table 3. Effects of Feeding Grain Screening Pellets or Barley Grain on the Performance of Medium and Large Frame Steers (1995/96).

	Medium Frame		Large Frame	
Parameter	BG:BS[1]	GSP:BH	BG:BS	GSP:BH
Weight (lbs)				
Initial	564.0	561.0	571.0	573.2
Final	934.0	926.1	925.0	929.2
Days on Feed	152	152	152	152
Average Daily Gain (lb/day)	2.4	2.4	2.4	2.4
Feed Intake (DM basis lbs/day)	16.6	15.4	16.2	15.4
Feed : Gain	6.8[a]	6.4[b]	7.0[a]	6.5[b]
Feed Costs[2]				
Diet ($/Head/day)	1.17	1.07	1.14	1.07
Total $/Head	177.84	162.64	173.28	162.64
Gain ($/lb)	0.52[a]	0.48[b]	0.53[a]	0.50[b]

[1]Diet 1 consisted of: barley silage, brome hay, wheat straw and barley grain concentrate; Diet 2 consisted of: grain screening pellets, barley grain concentrate, brome hay and straw (as fed basis).
[2]Calculated assuming $142/tonne for barley grain, $37/tonne for barley silage, $120/tonne for grain screening pellets, $94/tonne for brome hay, $45/tonne wheat straw (including $21/tonne processing charges for dry forages) and $235/tonne for canola meal. All costs FOB University of Saskatchewan feedlot and include processing costs.
[a,b]means with different letters differ ($P<0.05$).

In year 2, the steers were backgrounded for 140 days (Table 4). Start of test weights averaged 625 lb, while end of test weights ranged from 930 to 950 lb (unshrunk). In keeping with the goals of a backgrounding program, average daily gains were limited to 2.2 lb per day through the regulation of dry matter intake. While differences were minimal, cattle fed the grain screening pellets gained faster than those fed the barley-based diets, regardless of forage source. Feed intakes were lowest ($P<0.05$) for the cattle fed the barley silage/barley grain-based diet (diet 1). No differences in feed intake were observed between the cattle fed the grain screening-based diets or with those fed the brome hay and barley grain diet. Feed conversions were lowest for the cattle fed the barley silage and barley grain diet and those fed the grain screening-based diets. Feed costs per pound of gain averaged $0.38/lb of gain for steers fed the grain screening/barley silage diet. Feed costs per pound of gain for the steers fed the barley silage/barley grain diet averaged $0.49/lb of gain. This difference of $0.11 per lb of gain amounted to a savings of $24 per head over the 140 day feeding period for steers fed the grain screening pellets. Similar results were observed for cattle fed the dry forage. Steers fed brome hay and grain screening pellets averaged $30 less in feed costs than those fed barley grain and brome hay.

Table 4: Effects of Grain Screening Pellets or Barley in Forage Based Backgrounding Diets (1996/97).

Parameter	BG:BS [1]	GSP:BS	BG:BH	GSP:BH
Weight (lbs.)				
Initial	628.0	625.0	630.0	626.0
Final	931.0	946.6	935.6	953.0
Days on Feed	140	140	140	140
Average Daily Gain (lb/day)	2.2[b]	2.3[a]	2.2[b]	2.3[a]
Feed Intake (DM basis lbs/day)	15.52[b]	16.45[a]	16.90[a]	16.98[a]
Feed : Gain	7.2[b]	7.2[b]	7.8[a]	7.3[b]
Feed Costs[2]				
Diet ($/Head/day)	0.96b	0.79	1.07	0.89
Total $/Head	134.4	162.64	149.8	124.6
Gain ($/lb)	0.49[b]	0.38[d]	0.54[a]	0.42[c]

[1]Diets: BG:BS – Barley Concentrate/Silage/Straw; GSP:BS – Grain Screening Pellets/Silage/Straw; BG:BH – Barley Concentrate/Brome Hay/Straw; GSP:BH – Grain Screening Pellets/Brome Hay/Straw.
[2]Calculated assuming $101/tonne for barley grain, $30/tonne for barley silage, $95/tonne for grain screening pellets, $85/tonne for brome hay, $45/tonne wheat straw (including $21/tonne processing charges for dry forages) and $268/tonne for canola meal. All costs FOB University of Saskatchewan feedlot and include processing costs.
[a,b]means with different letters differ ($P<0.05$).

These results confirm that grain screening-based diets when formulated to similar energy and similar protein levels as barley grain-based diets, result in similar cattle performance and considerable cost savings, if competitively priced.

Feedlot Performance of Cattle Fed Canola Screenings in Finishing Trial

A finishing trial was conducted at the Agriculture and Agri-Food Canada, Lethbridge Research Centre, in conjunction with the University of Saskatchewan to examine inclusion of canola screenings in finishing diets on performance and carcass characteristics of feedlot steers (Table 5). Eighty Charolais crossbred steers (430 kg) were randomly assigned to one of five diets consisting of a typical barley grain/barley silage diet, or diets consisting of canola screenings and barley silage. Canola screening inclusion levels varied from 25% to 95%.

Table 5. Effect of Replacing Barley Silage with Canola Screenings on Performance of Feedlot Cattle During an 83-day Finishing Period.

	Percentage of Canola Screenings in the Diet				
Parameter	0[1]	25	50	75	95
Number of cattle	14	13	13	13	13
Initial weight (lb)	957	935	937	968	948
ADG[2] (lb/d)					
Day 0 to 42	2.67[a]	3.22[a]	2.80[a]	1.65[b]	0.97[c]
Overall	2.71[a]	3.15[b]	3.04[ab]	2.18[c]	1.65[d]
Feed intake (lb/d)					
Day 0 to 42	20.15[a]	23.46[bc]	23.96[b]	21.54[ac]	20.90[a]
Overall	20.22[a]	22.97[bc]	23.96[b]	22.24[ab]	21.05[ac]
Bloat incidents	0	0	0	6	15
Cost of diet ($/tonne DM) [3]	159.5	154	152	139	133
Cost of gain ($/lb)	0.544	0.510	0.544	0.640	0.766

[1]The diet with no canola screenings consisted of 75% barley grain and 20% barley silage (as-fed basis). In each of the other diets, canola screenings replaced the barley silage and some or all of the barley grain. All diets contained 5% of a canola screenings-based supplement that provided vitamins and minerals.
[2]ADG: average daily gain.
[3]Calculated assuming $140/tonne for barley grain, $40/tonne for barley silage, $115/tonne for canola screening, and $210/tonne for supplement.
[a,b,c,d] means with different letters differ ($P<0.05$).
Sources: Pylot (7), McAllister et al. (5).

Including 25% canola screenings in place of the barley silage in the finishing diet resulted in a 16% improvement in ADG (Table 5) of feedlot cattle. Cattle fed diets containing 50% canola screenings exhibited ADG similar to those fed the typical feedlot diet, but when the level of screenings in the diet exceeded 50%, the rate of gain of the cattle declined. Intakes of the 25% and 50% canola screenings diets were higher than intake of the barley silage diet; with more than 50% screenings, intake was similar to that of the typical feedlot diet. Among the typical (barley silage) diet, 25% screenings diets, feed conversion efficiencies were similar, but they declined dramatically with the diets containing 75% and 95% canola screenings.

High (75% and above) levels of canola screenings were also associated with the occurrence of bloat (**Table 5**). Canola screenings were fed as pellets, and near the end of the trial there was a considerable increase in the amount of fines. Fine particles can increase the incidence of bloat, a problem that may be avoided by increasing the durability of the pellets through use of a pellet binder. As a precaution, when feedlot diets contain pelleted energy by-products, diets should contain at least 5% coarsely chopped roughage to aid in rumen function.

Incorporation of canola screenings reduced the cost of the diet from $159.50 to $133.00 per tonne (**Table 5**). Cost of gain was identical between the barley grain/barley silage diet and the 50% canola screenings diet. Including canola screenings at levels of 75% and 100% increased the cost of gain, whereas the diet containing 25% canola screenings reduced the cost of

Table 6. Effect of Canola Screenings on the Carcass Traits of Feedlot Cattle.

	Percentage of Canola Screening Pellets in the Diet				
Parameter	0	25	50	75	95
Number of cattle	14	13	13	13	13
Carcass weight (lb)	666.7^{ab}	663.1^{b}	687.6^{a}	642.0^{bc}	616.4^{c}
Average fat depth (mm)	12.2^{a}	11.5^{a}	11.5^{a}	8.5^{b}	7.3^{b}
Ribeye area (cm^2)	75.4	78.7	81.4	48.5	77.0
Yield (%)	56.5	57.7	57.9	58.6	60.5
Grade					
AAA	1	2	1	1	1
AA	7	7	4	5	4
A	5	4	6	7	7
B4	-	-	1	-	1
$ per carcass	997	993	1023	961	917

^{a,b,c}means with different letters differ ($P<0.05$).
Sources: Pylot (7), McAllister et al. (5).

gain by 7.0%, compared to the typical feedlot diet. Carcass weight and fat depth were reduced when the diet contained 75% and 95% canola screenings, and the steers on these diets were obviously under finished (**Table 6**). Return per carcass was highest for steers fed 50% canola screenings; followed by those fed the typical diet and those fed 25% canola screenings diet, which were similar, and were lowest for those fed 75% and 95% canola screenings. Carcass grades were similar among all diets.

Conclusions

Grain screening pellets are alternate feed sources for beef cattle that can provide a good source of energy and protein. Grain screening pellet-based diets can result in consistent rates of gain at lower costs than barley grain-based diets for backgrounding steers fed under winter conditions. Inclusion rates of up to 50% grain screening by-products are very manageable in feedlot diets. However, when greater percentages of grain screenings are fed, sound bunk management is necessary due to increased risk of digestive upset from reduced particle size in the diet. Canola screenings are high in protein, fat and fiber and can be used as an economical alternative feed source. Levels of canola screenings in backgrounding or finishing diets should be restricted to no more than 50% of the complete diet dry matter basis. Screenings could prove especially valuable when silage or hay supplies are low due to poor yields or insufficient land base for production.

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