Effects of season and diet, including costs, on feedlot performance of bison

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Summary
Weaned bison bull calves were randomly assigned to four feedlot diets in a 4 treatment by 4 periods Latin square study. The feeding periods were 80 days long during spring, summer, fall, and winter. The four dietary treatments were identified based on major ingredients in each ration: 1) wheat screenings, 2) wheat middlings, 3) crambe meal, and 4) a commercial bison ration. Winter gains were lower than spring, summer or fall gains. Gains averaged 1.73 lbs. during spring, 1.38 lbs. during summer, 1.76 lbs during fall, and .38 lbs during winter. Average daily gains were 1.73 lbs for wheat screenings, 1.63 lbs for wheat midds, 1.53 lbs for crambe meal, and 1.61 lbs for the commercial diet during spring, summer and fall. Gains for wheat screenings were higher than for crambe meal with wheat midds and the commercial diet intermediate. There were no differences due to dietary treatment for dry matter intake, intake per unit weight, and dry matter per gain. **Feed costs per pound of gain were $.54 for wheat screenings, $.73 for wheat midds, $.73 for crambe meal, and $.89 for the commercial diet. Bison in this study gained less in the winter than other seasons, consumed a variety of feeds with similar performance that resulted in highly variable feed cost per pound of gain.**

Introduction:
The rapidly growing bison industry in the northern plains has producers looking for information on feeding bison in feedlot. In some intensively managed operations, bison calves are weaned in the fall, separated by sex, and started on feed. Bull calves are confined and fed until slaughter. The feeding period is often a year or more as bison eat less and gain slower than beef. Winter gains are of particular concern with very low and erratic gains. A natural trait of bison is to self-limit intake of concentrates. Self-feeders are frequently used without concern for overeating or acidosis but accumulation of fines may reduce intake. Many bison producers use a completely pelleted wheat screenings based-diet, which includes corn, molasses and mineral supplements. As bison numbers increase and the availability of wheat screenings varies from year to year, producers need information on other feeds. A number of alternative feeds are available in the northern plains. A yearlong feeding trial was conducted to compare four diets fed to bison.

Materials and Methods:
Seventy-eight fall weaned bison bull calves averaging 471 lbs were randomly allotted to one of four dietary treatments and assigned to identical 50 by 100 ft feedlot pens. Bison were fed during feeding periods started on February 15 (spring), May 5 (summer), July 25 (fall), and October 14 (winter). Dietary treatments were identified based on major or unique ingredients in the diet. They were 1) wheat screenings, 2) wheat midds, 3) crambe

meal, and 4) a commercial bison ration. Formulations are given in Table 1 for the first three diets. No formulation was available for the commercial bison feed.

Table 1. Formulations of bison feedlot dietary treatments
(Percent as fed)

Ingredient	Wheat Screenings	Crambe Meal	Wheat Midds
Wheat screenings	66.80	0	0
Corn grain	15.0	16.00	12.50
Crambe meal	0	14.00	0
Wheat middlings	0	30.00	66.20
Oat hulls	7.50	30.20	11.50
Molasses	5.00	5.00	5.00
TM salt	2.50	2.50	2.50
Vitamins/minerals	3.20	2.30	2.30
	100.00	100.00	100.00

The wheat screenings diet commonly used by many bison producers was the control. Wheat screenings are highly variable in composition but generally consist of green and yellow foxtail seed, commonly called pigeon grass (60-80%), cracked wheat (10-20%), and other weed seeds. Wheat middlings were from hard red wheat and durum. Crambe meal is an oil seed meal (35% protein) remaining after removal of the high erucic acid oil from crambe seed. Crambe is a close relative of rape and canola. It's a new crop in the northern plains with limited acreage. The commercial diet used a wheat midds base and contained a minimum of 12% crude protein, 2% crude fat and a maximum of 12% crude fiber. Nutrient analysis of the four diets on a dry matter basis is given in Table 2.

Table 2. Nutrient analysis of bison dietary treatments

	Screenings	Crambe Meal	Wheat Midds	Commercial	Hay
	----------Pelleted Diets----------				
Dry matter, %	90.03	89.68	90.01	91.58	87.66
	----------Dry matter basis----------				
Crude protein, %	14.89	15.11	14.35	14.24	8.29
ADF, %	12.34	16.60	11.10	17.91	50.31
NDF, %	21.94	29.53	22.91	35.06	74.10
Ash, %	6.70	10.52	9.11	9.61	11.24
Fat, %	3.37	3.20	3.39	3.93	1.02
Mcal/gram	4.30	4.19	4.17	4.24	4.07
Phosphorous, %	.75	.71	.52	.61	.09
Calcium, %	.77	1.10	.94	1.14	.59

The pelleted rations were offered in identical self-feeders in the center of each pen. Bison calves in all four pens were offered the same low quality grass hay free choice in large

round bale feeders. Water was available from heated fountains in the corner of each pen. Calves were weighed at the start of the study, and at the end of each feeding period. Bison in each pen were rotated to a different pen and a different feed after each period. Data were analyzed using general linear model procedures according to SAS (SAS, 1988). Pen was the experimental unit and period the replicate. Analyses were conducted for the main effects of diet, pen and season and diet x season interactions.

Results and Discussion:
Daily gains were lower during the winter feeding period than the other feeding periods. Gains were 1.73, 1.38, 1.76 and .38 lbs per day respectively for spring, summer, fall and winter (Table 3). Dry matter intake was higher during fall and winter than spring and summer probably due in part to heavier animals. Intake per unit weight was not different throughout the four periods. Table 3 presents feedlot performance information by season. Dry matter intake per gain appears to increase throughout the study suggesting decreased feed conversion as the bison grew. However, the low gains and tremendous variation during the winter contributed to a very high standard error in that period.

Table 3. Performance of bison in the feedlot by season of the year

Season	Spring	Summer	Fall	Winter	S.E.
BW, lb	540	665	795	876	12.33
ADG, lb	1.73a	1.38a	1.76a	0.38b	0.25
Pellet intake, lb.	13.70a	13.34a	19.62b	15.96ab	2.23
Hay intake, lb.	5.94a	7.20ab	8.30b	11.54c	0.97
DM intake, lb.	17.67a	18.50a	25.13b	24.75b	1.96
DM intake, % BW	3.27	2.78	3.17	2.82	0.27
DM intake/gain	10.24a	13.51a	14.41a	66.00b	19.85

a, b, c - values with different superscripts are significantly different, $P<.05$

Poor performance in the winter may be due to a photoperiod effect on intake by bison. Wild species are known to consume large amounts of feed if available during the late summer and fall to store up nutrients for winter. Lower intake and activity has been observed during colder darker months probably to conserve energy expenditure from activity.

More research is needed on photoperiod effects and possibly developing lighting strategies or feeding regimes to counter this phenomenon. An alternative feeding strategy would be to reduce diet energy content for a more natural feeding pattern. However, reduced winter gains could significantly decrease profitability in bison feeding. Artificial lighting has been shown to increase intake in cattle.

Because of the variation in gain during winter, dietary comparisons were made using only spring, summer, and fall data. Table 4 lists performance by dietary treatment. Gains on

wheat screenings were higher than crambe meal while gains from the other two diets were intermediate. Bison bulls gained 1.73, 1.53, 1.63 and 1.61 lbs/hd/day for wheat screenings, crambe meal, wheat midds, and commercial diet, respectively. Dry matter intake averaged 19, 20, 21, and 21 lbs/d. Dry matter intake, feed per pound gain, and intake as percent of body weight was similar for all treatments.

Table 4. Performance of bison in the feedlot by dietary treatment

	Wheat Screenings	Crambe Meal	Wheat Midds	Commercial Diet	S.E.
Initial wt. lbs	463	471	481	469	19.43
Final wt. lbs	883	870	852	840	25.63
Hay intake lbs/day	7.56	6.59	7.44	7.00	0.33
Pellet intake lbs/day	14.01	15.62	15.82	16.77	2.41
DM intake lbs/day	19.00	20.05	20.99	21.30	2.17
Avg. daily gain, lbs	1.73x	1.53y	1.63xy	1.61xy	0.05
DM intake/gain	11.62	13.21	12.86	13.19	1.70
DM intake, %BW	2.90	2.99	3.15	3.16	0.34

x,y values with different superscripts are significantly different P = .07

Feed costs per pound of gain were $.54 for wheat screenings, $.73 for both crambe meal and wheat midds and $.89 for the commercial feed. Yardage, interest rates, and death loss were not considered in determining feed cost per pound of gain. Keeping feed costs low without reducing gains is imperative for profitable bison feeding. Using alternative feeds from grain processing, especially wheat screenings, appears to produce the lowest feed costs. Feed costs can be highly variable depending on distance to co-product sources and processing facilities as well as labor, handling equipment, and storage facilities for ingredients and finished feeds.

Table 5. Economics of feeding bison by dietary treatment

	Wheat Screenings	Crambe Meal	Wheat Midds	Commercial
Pelleted feed $/ton[a]	112.03	125.70	132.36	155.00
Hay $/ton,	40.00	40.00	40.00	40.00
Daily costs $/hd/d	.94	1.11	1.20	1.44
Cost of gain $/lb gain	.54	.73	.73	.89

[a] Based on ingredient prices of $30/ton for wheat screenings, $2.25/bu for corn, $70/ton for crambe meal, $70/ton for wheat midds, $30/ton for oat hulls, $150/ton for molasses, $165/ton for TM salt and $34.00/cwt for vitamin-mineral mixture. Includes flat storage, trucking and pelleting costs of $45/ton.

Implications:
Results of this study indicate bison will consume rations with a variety of ingredients similar to cattle, provided the diet is palatable and nutritious. The wheat screenings based-diet provides the lowest feed cost per unit gain. Screenings, however, may be highly variable in nutrient content depending on the source, year, and several other factors. It is not known if co-product feeds are economically competitive with higher energy feed grains such as corn or barley.

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