Economic potential of using field peas in place of corn dried distillers grains in beef heifer growing diets

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The objective was to determine the economic potential of field peas relative to corn DDGS in diets of growing heifers. Regression results revealed that total gain was not influenced (P > 0.05) by dietary treatment, allowing for a comparative ration cost analysis. Base-case results indicate the ration with field peas costs $6.89/hd more than the ration with DDGS. The breakeven price of field peas is $254.8/t, 71% of the price of DDGS; the breakeven price of DDGS was $567.2/t, 141% of the price of field peas. Results will help pea processors and feed supply dealers develop a reliable supply chain for a beef cattle quality field pea source of feed.

Summary

The objectives were to determine economic potential of field peas relative to corn DDGS in diets of growing heifers and to determine price points for competitive utilization of field peas as an alternative to corn DDGS. Animal performance data from 324 heifers were generated from a completely randomized design feeding trial replicated over two years. Mixed effects regression models revealed total gain was not influenced ($P > 0.05$) by dietary treatment, allowing for a comparative ration cost analysis. Base-case ration costs were calculated using prices of $358/t and $403/t for corn DDGS and field peas, respectively. Base-case results indicate the ration with field peas costs $6.89/hd more than the ration with DDGS. The breakeven price of field peas is $254.8/t, 71% of the price of DDGS; the breakeven price of DDGS was $567.2/t, 141% of the price of field peas. Results will help pea processors and feed supply dealers develop a reliable supply chain for a beef cattle quality field pea source of feed.

Introduction

Feed costs account for 60% to 70% of the total costs of a beef operation (Kaliel and Kotowich, 2002). Thus, reducing feed costs while optimizing animal production is essential for maintaining a profitable operation. Feed costs can be reduced through the use of cost-effective ingredients in mixed rations fed to cattle. Corn dried distillers grains with solubles (DDGS) is one of the most common supplements used across the Great Plains region of the U.S. (Swanson et al., 2014; Lardy et al., 2009). Continued utilization of corn DDGS in cattle rations will likely be affected by availability and pricing. Factors such as an increase in corn oil price can result in a drastic reduction in DDGS production and an increase in the price of DDGS. Thus, there is a need to investigate and evaluate protein and energy sources that can cost-effectively replace corn DDGS in cattle rations.

The energy content of field peas is similar to cereal grains such as corn and barley when included in high-concentrate finishing diets (Lardy et al., 2009). Field peas are primarily grown for human consumption and for the pet food industry. However, the livestock industry is a potential market for field peas in situations where there is excessive field pea production, thus saturating the pet food market or production of field peas that do not meet specifications for human consumption. Major field pea growing areas include North Dakota and Montana in the U.S. and Manitoba, Saskatchewan and Alberta in western Canada. In such areas, feeding peas to livestock presents a realistic, on-farm value-adding opportunity for pea growers.

Field peas have been successfully included in cattle finishing diets (Gilbery et al., 2007; Lardy et al., 2009). Compared to other feedstuffs, the price of field peas is likely to be a major factor in determining utilization of field peas in cattle rations. However, identifying a price for field peas as livestock feed presents a challenge since field peas for livestock do not have a formal market compared to other feeds. This provides a need for data on which to base reliable recommendations on the

economic viability of utilizing field peas as a replacement of supplements such as corn DDGS in growing heifer diets. This study was conducted to determine the economic potential of feeding diets containing field peas vs. DDGS in diets of growing heifers and to identify relative price points for competitive utilization of field peas as an alternative to corn DDGS in diets of growing heifers.

Materials and Methods

This study was conducted at the Central Grasslands Research Extension Center located in Kidder and Stutsman counties in North Dakota. The two-year study was from Nov. 24, 2020, to Feb. 17, 2021 (year 1), and Nov. 8, 2021, through Feb. 24, 2022 (year 2). In the fall of each year, 162 growing Angus heifers (2020/2021, body weight [BW] = 688 ± 84 lb; 2021/2022, 624 ± 71 lb) were divided into two groups of similar average body weight and the groups were randomly assigned to six dry lot pens. Dry lot pens were surrounded by 8-foot-high wooden windbreaks on three sides of the pen. Each pen contained a 52-foot-long feed bunk and a winterized water bowl (Richie Industries Inc., Conrad, IA, USA). Three groups of heifers (27 heifers/pen) were assigned randomly to total mixed ration (TMR) diets containing either field peas or corn DDGS. Feed ingredients fed to heifers by diet and feeding period are reported in Table 1.

Heifer feeding was accomplished using a "clean bunk" feeding management. The goal of clean bunk management is for all feed delivered to a pen to be consumed daily, with bunks being empty for a certain period of time prior to the next feeding, without restricting feed intake (Erickson et al., 2003). Heifers had *ad libitum* access to fresh water. Heifer performance was assessed from averages of two-day body weights taken at the start and end of the study.

Animal performance data were analyzed using the MIXED procedure of SAS with pen as the experimental unit. The fixed effects in the model were diet (DDGS or peas), season (fall and winter) and the diet × season interaction. Year within pen was considered a random effect. Least square means were calculated and, where appropriate, differences between treatment means were tested using the Bonferroni test at a significance level of $P \leq 0.05$. Initial and final BW were collected on individual animals, and a pen value was calculated by averaging the respective individual animal values within a pen. Animal performance measures evaluated included initial and final BW, average daily gain (ADG), dry matter intake (DMI) and total gain (TG).

Economic evaluation of the feed costs for each TMR treatment (DDGS and peas) was based on the two-year average measures of DMI (lb/hd/day), TG (lb/hd) and days on feed. Because growth performance measures were not influenced by dietary treatment, a comparative ration cost analysis was conducted without the need to account for differences in animal performance. Enterprise budgeting techniques were used to calculate the two-year average costs of individual ingredients for each diet treatment. On March 1, 2022, prices of corn grain, hay and DDGS were obtained from a local farm input supplier (Farmers Coop Elevator Company, Streeter, ND) and were priced at $303, $100 and $358/t, respectively. In addition, a price of $37/t for corn silage was used and based on local production and estimated from corn production. Also, in March of 2022, based on conversations with field pea producers, the price of field peas was concluded to be in a range between $325 and $445/t ($8 to $11/bushel). For the analysis, we used the average base-case price of $403/t for field peas.

Ration costs ($\$ hd^{-1}$) were calculated as the product of DMI (lb/hd/day) for each ingredient (DDGS vs. peas), days on feed and individual ingredient price. Individual DMI for each ingredient was calculated from feed delivered (lb/hd/day) and diet composition. Over a two-year period, an average of 4.2% DDGS and 6% field peas were used in the corn DDGS-based and field peas-based diets, respectively. At a feed intake of approximately 18 lb/hd/day for both diets, 0.73 and 1.05 lb/hd/day of corn DDGS and field peas were included in the respective diets.

Because the price of field peas as a feed source for animal production is not likely to be directly affected by the price of corn or DDGS, sensitivity analysis was conducted to calculate relative total cost of feeding peas vs. DDGS for combinations of prices ranging from ±50% of the base-case prices of $358 and $403/t for DDGS and field peas, respectively.

Table 1. Feed ingredients fed on a dry matter basis to heifers by diet and feeding period (lb/hd/day).

	DDGS			Peas		
Variable	Fall	Winter	Average	Fall	Winter	Average
Hay	6.53	7.51	7.02	6.59	7.20	6.89
Silage	6.77	7.71	7.24	6.62	7.63	7.13
Corn	2.06	2.25	2.16	1.82	2.38	2.10
Supplement	0.49	0.56	0.53	0.49	0.57	0.53
DDGS	0.68	0.79	0.73	0.00	0.00	0.00
PEAS	0.00	0.00	0.00	0.99	1.11	1.05
Total	16.54	18.81	17.67	16.51	18.90	17.70

Results and Discussion

Initial BW, final BW, DMI, ADG and TG were not influenced ($P > 0.05$) by diet, but there were seasonal differences for each ($P < 0.001$; Table 2). Initial and final BW was greater ($P < 0.001$) in winter relative to fall, which was expected since the same heifers were utilized in winter. Average DMI was greater ($P < 0.001$) in the winter relative to fall, which follows logic that animals tend to eat more when colder. Conversely, TG and ADG were greater in the fall relative to winter, which reflects the typical observation that animals do not perform as well in the extreme cold that is common to North Dakota in the winter.

Two-year average cost of feed for each ingredient on a ($/hd/day) and ($/hd) basis is reported in Table 3. The cost of hay, silage, corn grain and supplements equaled $82.09/hd (or $1.84/hd/day) over the total feeding period, accounting for 87% and 81% of the total cost of the corn DDGS-based ration and dry field peas-based ration, respectively. The total cost of feed for a representative heifer for the total (fall plus winter) feeding period for the corn DDGS-based ration is $93.89/hd (or $2.10/hd/day) and is $6.88/hd (7.3%) less than the dry peas-based ration cost of $100.77/hd (or $2.26/hd/day) for base-case prices of $358/t and $403/t for corn DDGS and field peas, respectively. For perspective, at the base-case prices, a producer interested in feeding a group of 100 heifers similar to those fed in the study, the cost of feeding field peas instead of DDGS in the TMR would cost an extra $688 over the total feeding period.

Table 4 reports differences in the total cost of field peas relative to the total cost of DDGS for alternative combinations of prices of field peas and DDGS. Price combinations that have a negative total cost indicate market situations where field pea-based rations have an economic advantage over DDGS-based rations. For a market scenario where peas can be purchased at a price that is 50% less than the base-case price of peas and the price of DDGS is priced 50% higher than the base-case price, a producer would benefit economically from buying peas and saving $8.37 head^{-1} of feed cost, holding all other feed ingredient prices constant. Overall, for a base-case average price of $358 t^{-1} for DDGS, the breakeven price for field peas was equal to $255

Table 2. Performance of growing heifers consuming field peas-based or corn DDGS-based total mixed rations.

	TMR diet			Season			*P*-values		
	DDGS	Peas	SE	Fall	Winter	SE	Diet	Season	Diet x Season
DMI, lb/d	17.4	17.6	0.20	16.8[b]	18.1[a]	0.07	0.55	<0.001	0.72
DMI, %BW	5.7	5.5	0.13	5.7[a]	5.5[b]	0.07	0.77	0.001	0.75
Initial BW, lb	655	662	21.2	617[b]	697[a]	6.4	0.71	<0.001	0.66
Final BW, lb	730	741	19.6	699[b]	770[a]	6.6	0.60	<0.001	0.69
Total gain, lb	76.5	78.7	2.7	82.5[a]	72.5[b]	1.5	0.44	<0.001	0.53
ADG, lb/d	1.70	1.65	0.11	1.85[a]	1.48[b]	0.04	0.70	<0.001	0.66

[a-b]Means with a different letter within column for diet or season differ significantly ($P \leq 0.05$).

Table 3. Two-year average cost of feed for individual feed ingredients for two total mixed rations for fall, winter and total grazing periods

	Fall		Winter		Total	
Feed ingredient	$/hd/d	$/hd	$/hd/d	$/hd	$/hd/d	$/hd
Hay	0.32	14.61	0.36	16.80	0.66	29.91
Silage	0.13	5.68	0.14	6.76	0.27	12.07
Corn grain	0.29	12.78	0.35	16.41	0.68	29.92
Supplement	0.10	4.71	0.12	5.68	0.23	10.20
Dry distiller grains (DDGS)	0.12	5.46	0.14	6.68	0.26	11.79
Total cost with DDGS included	0.96	43.24	1.11	52.32	2.10	93.89
Field peas	0.20	9.35	0.22	10.48	0.42	18.68
Total cost with field peas included	1.04	47.13	1.20	56.12	2.26	100.77
Difference in cost between rations	0.08	3.89	0.08	3.80	0.16	6.88

Table 4. Difference in total cost of field peas relative to total cost of dry distiller grains (DDGS) ($/hd) for alternative price ($/MT) combinations

		PEAS							
	%	-	-50%	-30%	-10%	Base*	10%	30%	50%
	-	$/t	202	282	363	403	444	525	605
DDGS	-50%	180	3.42	7.15	10.88	12.76	14.65	18.38	22.10
	-30%	251	1.07	4.79	8.52	10.41	12.29	16.02	19.75
	-10%	323	-1.29	2.43	6.16	8.05	9.94	13.66	17.39
	Base*	358	-2.45	1.27	5.00	6.88	8.77	11.76	16.23
	10%	395	-3.64	0.07	3.80	5.69	7.58	11.30	15.03
	30%	466	-6.01	-2.28	1.44	3.33	5.22	8.94	12.67
	50%	538	-8.37	-4.64	0.53	2.42	2.86	6.59	10.31

*Base-case net return assuming a price of $358 and $403 per MT for DDGS and field peas, respectively.

t^{-1}, which was 36.8% less than the base-case price of $403 t^{-1} for peas and 71% of the base-case price of DDGS. Conversely, for the base-case price of field peas of $403 t^{-1}, the breakeven price of DDGS was equal to $567.3 t^{-1}, which was 58.3% more than the base-case price of $358 t^{-1} for DDGS and 141% more than the base-case price for field peas. At the respective breakeven prices, producers would be indifferent between using field peas or corn-based DDGS in their TMR.

Conclusions

Compared to a diet containing DDGS, a field peas-based diet that met nutrient requirements of growing heifers required 43% more field peas. At this level of incorporation, field peas would be an economically feasible replacement for corn DDGS in growing heifer diets when the price of the field peas is less than or equal to 71% of the price of corn DDGS. Our results offer the field pea processing industry useful economic information about the range of prices that beef cattle producers can afford to pay for peas relative to DDGS. This information will help pea processors and feed supply dealers develop a reliable supply chain for a beef cattle quality pea feed.

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Literature Cited

Erickson, G. E., Milton C. T., Fanning K. C., Cooper R. J., Swingle R. S., Parrott J. C., Vogel G., and Klopfenstein T. J. 2003. Interaction between bunk management and monensin concentration on finishing performance, feeding behavior, and ruminal metabolism during an acidosis challenge with feedlot cattle. J. Anim. Sci. 81:2869-2879.

Gilbery, T. C., Lardy, G. P. Soto-Navarro, S. A., Bauer, M. L. and Anderson, V. L. 2007. Effect of field peas, chickpeas, and lentils on rumen fermentation, digestion, microbial protein synthesis, and feedlot performance in receiving diets for beef cattle. J. Anim. Sci. 85: 3045-3053.

Kaliel, D. and Kotowich, J. 2002. Economic evaluation of cow wintering systems. Provincial swath grazing survey analysis. Alberta Production Economics Branch, Alberta Agriculture Food and Rural Development, Edmonton, AB.

Lardy, G. P., Loken, B. A., Anderson, V. L., Larson, D. M., Maddock-Carlin, K. R., Ilse, B. R., Maddock, R., Leupp, J. L., Clark, R., Paterson, J. A. and Bauer, M. L. 2009. Effects of increasing field pea (*Pisum sativum*) level in high-concentrate diets on growth performance and carcass traits in finishing steers and heifers. J. Anim. Sci. 87: 3335-2341.

Swanson, K. C., Islas, A., Carlson, Z. E., Goulart, R.S., Gilbery, T. C. and Bauer, M. L. 2014. Influence of dry-rolled corn processing and increasing dried corn distillers grains plus solubles inclusion for finishing cattle on growth performance and feeding behavior. J. Anim. Sci. 92: 2531-2537.