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Economic Evaluation of Corn Processing for Finishing Cattle

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Economics of high-moisture corn are highly dependent on the discount at which it is purchased to dry corn. Economics of steam-flaked corn are attractive at corn prices common in Nebraska.

Summary

A finishing trial was conducted to determine performance of steers fed dry-rolled, high-moisture and steam-flaked corn-based diets. High-moisture corn and steam-flaked corn were determined to have 100% and 108% the value of dry-rolled corn, respectively. Estimated costs of corn processing ($/ton) ranged from $1.44 to $1.60 for dry-rolled corn, $1.98 to $2.34 for high-moisture corn, and $6.79 to $7.16 for steam-flaked corn. Economics of high-moisture corn are dependent on the discount at which it is purchased to dry corn. Economics of steam-flaked corn are dependent on corn price, but appear attractive at prices common in Nebraska.

Introduction

The cattle feeding industry in the United States commonly processes corn to some degree before it is incorporated into a ration and delivered to the animal. The goal of most processing methods is to increase starch availability of corn, thereby increasing its value to the animal. Corn processing can vary in methodology, cost and effectiveness in increasing value. Dry rolling, high moisture and steam flaking are the most common forms of corn processing in feedyards today. High moisture and steam flaking are more costly than dry rolling, but an increase in cattle performance may offset these costs. Objectives of this evaluation were to determine economic return of high-moisture and steam-flaked corn relative to dry-rolled corn in diets for finishing cattle.

Procedure

Performance

Ninety crossbred yearling steers (612 lb) were used in a completely randomized design with a 3 x 5 factorial treatment structure to evaluate effect of corn processing on performance of

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finishing cattle. Steers were randomly assigned to one of three finishing diets (Table 1) which were based on dry-rolled (DRC), high-moisture (HMC), or steam-flaked corn (SFC). Within each diet, steers were randomly assigned to one of five levels of urea (0, .5, 1.0, 1.5, or 2.0% of dietary DM).

Steers were individually fed using Calan electronic gates. Steers were offered their respective finishing diet on day 1 at 1.8% of body weight (DM basis). Feed offered then was increased .5 lb per day (DM basis) until steers were ad libitum (approximately 21 days).

Steers were weighed initially on three consecutive days after being limit-fed at 2.0% of body weight for five days in order to minimize differences in gut fill. Steers were implanted with Synovex C on day 1, reimplanted with Synovex Plus on day 67, and fed for a total of 167 days. Final weights were calculated using hot carcass weights adjusted to a common dress (63%). Data were analyzed using Mixed procedure of SAS. Least square means were separated using the Least Significance Difference method.

Table 1. Composition of finishing diets (% of DM).

	Diet[a]		
Ingredient	DRC	HMC	SFC
Dry rolled corn	82.0	—	—
High moisture corn[b]	—	82.0	—
Steam flaked corn[c]	—	—	82.0
Alfalfa hay	5.0	5.0	5.0
Cottonseed hulls	5.0	5.0	5.0
Molasses	3.0	3.0	3.0
Dry supplement[d]	5.0	5.0	5.0

[a]DRC = dry-rolled corn, HMC = high-moisture corn, SFC = steam-flaked corn.
[b]High-moisture was rolled at harvest and stored in covered concrete bunker and was 29% moisture and 46% soluble protein at time of trial.
[c]Steam-flaked corn was processed to 29 lb/bushel flake weight at a commercial feedyard facility and hauled to research feedlot on weekly basis.
[d]All diets supplemented to contain a minimum of .7% Ca, .28% P, .6% K, and .15% S (DM basis). All diets contained 27 g/ton Rumensin and 10 g/ton Tylan (DM basis).

Economics

Economics of corn processing are dependent on both value change in corn as well as cost of processing. Information regarding both of these factors is discussed below. It is important to note that many assumptions are made in this economic evaluation. Although assumptions are believed accurate given available information, readers are encouraged to substitute values that more accurately reflect their own situation.

Value of processing. The best indicator of value change due to corn processing is cattle performance. For this discussion, it will be assumed that a change in feed conversion is directly related to a change in value of corn. Therefore, if feed/gain is improved by 10% by a processing method, the corn has 10% more value. This approach has limitations, but seems conservative and straightforward. This approach is conservative because corn does not comprise 100% of the diet. All changes in value in this discussion are relative to DRC because it is the simplest form of processing in the performance data.

Costs of processing. There are four primary costs associated with corn processing: initial costs of equipment, electricity, natural gas and diesel fuel. Available literature was reviewed to estimate these costs.

Initial costs of equipment are difficult to estimate because they can be extremely variable depending on the type of system and available resources. Costs reported in literature (Schake et al. 1981. Energy and economic evaluation of corn and sorghum processing. Texas Agricultural Experiment Station, pp. 1-12) were used for this evaluation; however, readers should substitute costs which more accurately reflect their own situation. In the report mentioned above, initial equipment costs ($/head feedyard capacity) associated with DRC, HMC, and SFC for 5,000 and 20,000 head feedyards were estimated (Table 2). No attempt was made to update these costs for inflation because we were unsure how much costs on a $/head basis have changed. For this discussion, equipment was depreciated over a 10-year period, assuming no salvage value, and interest (10%) was charged on the average value of the investment.

Energy costs of corn processing are primarily composed of electricity, natural gas and diesel fuel usage (Table 2). Electrical usage was assumed to be

Table 2. Costs of corn processing for 5,000 and 20,000 head feedyards.

	Processing Method[a]					
	DRC		HMC		SFC	
Item	5,000	20,000	5,000	20,000	5,000	20,000
Equipment costs						
Initial investment, $/hd[b]	17.07	13.15	33.39	24.68	31.92	22.74
Initial investment, $	85,350	263,000	166,950	493,600	159,600	454,800
Annual depreciation, $[c]	8,535	26,300	16,695	49,360	15,960	45,480
Annual interest, $[d]	4,268	13,150	8,348	24,680	7,980	22,740
Annual costs, $[e]	12,803	39,450	25,043	74,040	23,940	68,220
Annual corn usage, ton[f]	18,250	73,000	18,250	73,000	18,250	73,000
Equipment costs, $/ton[g]	.70	.54	1.37	1.01	1.31	.94
Energy costs						
Electricity, kwh/ton	17.9	17.9	17.9	17.9	17.9	17.9
Natural gas, mcf/ton	—	—	—	—	1.1	1.1
Diesel, gal/ton	—	—	.05	.05	—	—
Electricity, $/ton[h]	.90	.90	.90	.90	.90	.90
Natural gas, $/ton[h]	—	—	—	—	4.95	4.95
Diesel, $/ton[h]	—	—	.07	.07	—	—
Energy costs, $/ton	.90	.90	.97	.97	5.85	5.85
Total processing costs, $/ton[i]	1.60	1.44	2.34	1.98	7.16	6.79

[a]DRC = dry-rolled corn, HMC = high-moisture corn, SFC = steam-flaked corn.
[b]Source: 1981 Texas Agricultural Experiment Station, pp. 1-12.
[c]Assumes 10-year depreciation period and no salvage value.
[d]Assumes 10% interest rate on average investment.
[e]Annual costs = annual depreciation + annual interest.
[f]Assumes 100% capacity and 20 lb/day corn intake (15% moisture basis).
[g]Equipment costs = annual equipment costs divided by annual corn usage.
[h]Electricity = $.05/kwh, natural gas = $4.50/mcf, diesel = $1.31/gal.
[i]Total processing costs = equipment costs + energy costs.

Table 3. Performance of finishing cattle fed dry-rolled, high-moisture, or steam-flaked corn.

	Processing Method[a]		
	DRC	HMC	SFC
Dry matter intake, lb/day	22.2[b]	21.6[b]	20.3[c]
Average daily gain, lb	3.61	3.55	3.60
Feed/gain	6.13[b]	6.10[b]	5.62[c]
Feed/gain, % of DRC	—	100	108

[a]DRC = dry-rolled corn diet, HMC = high-moisture corn diet, SFC = steam-flaked corn diet.
[bc]Means in same row with unlike superscripts differ (P < .001).

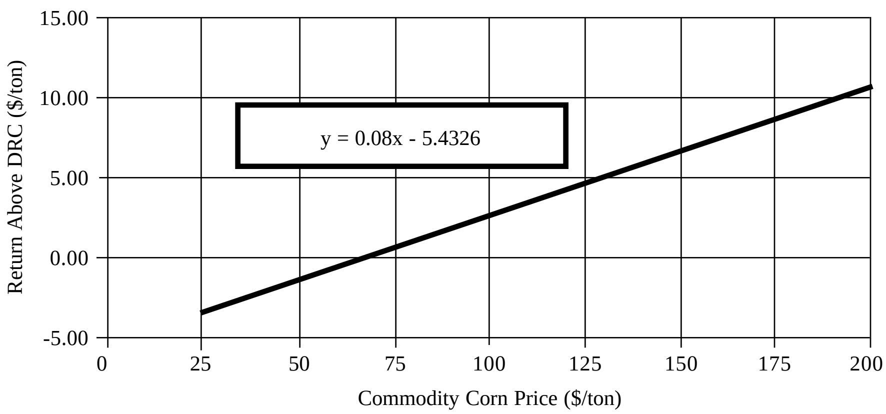

Figure 1. Economic return of steam-flaked corn above dry-rolled corn (DRC) for a 5,000 head feedyard.

similar among processing methods (17.9 kwh/ton) and priced at $.05/kwh. Natural gas usage for steam flaking was assumed to be 1.1 mcf/ton of corn processed and priced at $4.50/mcf which reflects current costs in Nebraska. Diesel fuel usage of .05 gal/ton of corn processed was assumed for high-moisture corn for packing in a bunker silo and use of a front-end loader while feeding. Diesel fuel was priced at $1.31/gal, which was the 12-month average price in Nebraska for 1999. Total estimated processing costs for DRC, HMC, and SFC in 5,000 and 20,000 head feedyards are shown in Table 2.

High-moisture corn and SFC were analyzed by their return above DRC, because DRC was the simplest form of processing in performance data. Return of either HMC or SFC above DRC was calculated by the equation: Return of processing above DRC ($/ton) = [((corn price, $/ton) + (cost of dry rolling, $/ton)) x (% improvement in feed/gain)] - [(corn price, $/ton) + (cost of respective processing, $/ton)].

Results

Results from the finishing trial are shown in Table 3. Corn processing method x urea level interactions were detected for DM intake (P < .05) and ADG (P < .05), but not for feed/gain (P > .10). Because feed/gain is the measurement of interest for this evaluation, only main effects of corn processing are shown in Table 4. Steers fed SFC consumed approximately 7.3% less DM (P < .01) than steers fed DRC and HMC diets. Daily gains were similar (P > .50) for all diets. As a result, steers consuming the SFC diet were 8% more efficient (P < .001) than steers consuming DRC or HMC diets.

Results from the performance trial are in close agreement with those reported in literature. A recent review of grain processing summarized performance from 353 research trials in which DRC, HMC, and/or SFC were fed. In this report, feed/gain was similar for steers consuming DRC and HMC, whereas steers consuming SFC were about 11% more efficient (1997 Journal of Animal Science, 55:868-879).

Based on results from the finishing trial and calculations described above, HMC has 100% the value of DRC, whereas SFC has 108% the value of DRC. Therefore, if DRC costs $2.00/bu, then HMC also is worth $2.00/bu, whereas SFC is worth $2.16/bu. It is important to note that these values are all on an equal DM basis. In addition, these values do not account for factors such as: buying high-moisture corn at a discount compared to dry corn, differences in shrink among the processing types and differences in interest on purchased corn.

High-moisture corn has 100% the value of DRC (equal DM basis). Given cost assumptions described above, HMC would result in a $.74/ton loss in a 5,000 hd feedyard compared to DRC. Whereas in a 20,000 hd feedyard, HMC would result in $.54/ton loss compared to DRC. These values are all on an equal DM basis and assume the same commodity corn price. Therefore, purchase of HMC would need to be discounted by these amounts, plus costs of any additional shrink and interest which may occur, in order to break even with DRC. There are several ways in which feedyards discount purchase price of HMC. One way might be a $.02/bu discount per point of moisture above 15%. Therefore, if a feedyard purchases corn at 28% moisture, commodity price would be discounted by $.26/bu. At the 10-year average Nebraska commodity corn price ($2.48/bu), HMC would be purchased at $2.22/bu (15% moisture basis). This would result in $8.55/ton return for HMC above DRC in a 5,000-head feedyard. Again, this value does not account for any additional shrink or interest which may occur with HMC.

Steam-flaked corn has 108% the value of DRC (equal DM basis). Figure 1 shows economic return above dry rolling for SFC in a 5,000-head feedyard at various price levels for commodity corn. Regression equation (y = mx - b) is given so that actual return above dry rolling can be calculated at any corn price, where: y = return above dry rolling ($/ton), m = slope of line, x = commodity corn price ($/ton), b = intercept). The regression line for a 20,000-head feedyard (y = .08x

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- 5.2293) was not displayed because it was not visually distinguishable from the 5,000-head feedyard line. Corn price at which SFC breaks even with DRC can be determined by setting y equal to zero and solving for x. For a 5,000-head feedyard, corn price would need to be at least $67.91/ton ($1.90/bu) in order for SFC to break even with DRC. For a 20,000-head feedyard, corn price would need to be at least $65.37/ton ($1.83/bu) for SFC to break even with DRC. At 10-year average commodity corn price for Nebraska ($2.48/bu; $88.57/ton), SFC would return $30,167 per year above DRC ($1.65/ton on 18,250 ton/year) in a 5,000-head feedyard. In a 20,000-head feedyard, SFC would return $135,510 per year above DRC ($1.86/ton on 73,000 ton/year). These calculations assume 100% capacity, 20 lb/day corn intake (15% moisture basis) and do not account for differences in shrink, moisture appreciation, or labor between DRC and SFC.

Economics of HMC are greatly dependent on the magnitude of discount at which it is purchased compared to dry corn. Clearly, the largest cost associated with HMC is the initial investment in a concrete bunker. High-moisture corn can be economically attractive to a feedyard if the discount at which it is purchased is greater than additional processing costs, shrink and interest above DRC. This probably varies somewhat from feedyard to feedyard. Economics of SFC appear to be more clearly defined given assumptions made in this report. Economics of SFC are highly dependent on commodity corn price, but appear to breakeven at a corn price well below the 10-year average, even in a relatively small 5,000-head feedyard.

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