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EVALUATION OF TURKEY LITTER SILAGE AS A FEED SOURCE FOR REPLACEMENT DAIRY HEIFERS*

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Record high grain and protein supplement prices in the early 1970s provided the impetus for developing lower priced substitutes for grains and concentrates in livestock rations. One promising substitute is animal wastes, since these are often of considerable nutritive value [1, 3, 5, 7].

The purpose of this paper is to evaluate the technical and economic feasibility of feeding ensiled turkey litter to replacement dairy heifers. In addition, the implications to both dairy and poultry producers of using turkey litter as a feed are also discussed.

NUTRIENT COMPOSITION

An indication of the possibility of using ensiled turkey litter (TLS hereafter) as a feed can be obtained by comparing the nutrient composition of TLS to that of a forage, corn silage and to that of a supplement, soybean meal.[1] Comparison of TLS to corn silage reveals that TLS exceeds corn silage in dry matter and total digestible protein. Corn silage is higher than turkey litter in total digestible nutrients (Table 1). However, TLS is considerably lower than soybean meal in all nutrient categories. For further discussion of the nutritive value of turkey and other poultry litter, see [3, 5, 6].

Even though turkey litter silage is a source of nutrients for ruminants, it must be fed with other roughages (such as corn silage or hay) because of palatability problems. Consequently, its use as a feed will involve partial rather than complete substitution.

TABLE 1. NUTRIENT COMPOSITION OF CORN SILAGE, TURKEY LITTER SILAGE AND SOYBEAN MEAL

Feed	Dry Matter	Moisture Free Basis: Total Protein	Digestible Protein	Total Digestible Nutrients
		--Percent--		
Corn Silage[a]	26	8	5	71
Turkey Litter Silage[b]	52	18	13	45
Soybean Meal[a]	90	49	41	78

[a]Source: [9].
[b]Source: [4, 5].

EXPERIMENTAL DESIGN

Twenty-four Holstein heifers averaging 475 pounds were randomly assigned by weight to one of four treatments. The composition of the treatments were: Treatment 1 (T_1) was composed of 90 percent corn silage and ten percent supplement. This ration represented the control group, or conventional ration, since it contained no TLS. Treatment 2 (T_2) consisted of 15 percent TLS, 75 percent corn silage and ten percent supplement. Treatment 3 (T_3) was composed of 30 percent TLS, 60 percent corn silage and ten percent supplement. Treatment 4 (T_4) consisted of 45 percent TLS, 45 percent corn silage and ten percent supplement.

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[1]Turkey litter may be ensiled in either a trench or upright silo. For a discussion on the procedures for and problems associated with ensiling turkey litter, see [2, 4].

Heifers were given an adjustment period of ten days and were then fed, free choice, on a group basis, for 84 days. They were weighed individually at one-week intervals for the first two weeks and at two-week intervals thereafter. Average daily gain for each animal was estimated by simple linear regression.

RESULTS

Treatment effects were evaluated using the following model:

$$Y_{ij} = \beta_0+\beta_1 X_{1j}+\beta_2 X_{2j}+\beta_3 X_{3j}+\beta_4 X_{4ij}$$

$$+\beta_5 X_{5j}+\beta_6 X_{6j}+\beta_7 X_{7j}+\epsilon$$

where

Y_{ij} = the average daily gain for the i^{th} animal in the j^{th} group, for i=1, . . . , 6; j=1, . . . , 4

X_{1j}, X_{2j}, X_{3j} = dummy variables; if j=1, then X_1=1, and X_2, X_3=0, if j=2, then X_2=1, and X_1, X_3=0, etc.

X_{4ij} = the initial weight of the i^{th} animal in the j^{th} group, and

X_{5j}, X_{6j}, X_{7j} = are respectively $(X_{1j})(X_{4j})$, $(X_{2j})(X_{4j})$ and $(X_{3j})(X_{4j})$, i.e., "interaction" effects.

This model is an expanded version of an analysis of covariance model [8]. That is, in addition to adjusting treatment means for initial weight, changes in the slope of regression lines for each treatment are also accommodated by inclusion of variables X_{5j}, . . . , X_{7j}. The basic supposition here is that the relationship between average daily gain and initial weight differ according to ration.

Statistical results are presented in Table 2. Note that treatment effects, and interaction, were not significant at the 95 percent confidence level. Thus, the following conclusions appear warranted. (1) The regression coefficient of average and daily gain against initial weight did not differ among treatments. (2) There was no significant difference in average daily gain by treatment group. (3) Initial weight was the only variable to explain a statistically significant amount of variation.

LEAST-COST FEED RATIONS

Since nutritional requirements change as weight of the animal changes, least-cost ration for dairy heifers were developed for alternative weight levels. The weight categories were: W_1, 440-549 lbs.; W_2, 550-659 lbs.; W_3, 660-769 lbs.; W_4, 770-879 lbs.; W_5, 800-1,099 lbs.; W_6, 1,100 lbs. and greater.

Alternative feeds and their respective prices are presented in Table 3. These prices reflect those paid by farmers and include labor and storage costs. Transportation costs, however, were excluded.

Least-cost daily rations were computed for each of the weight categories for alternative constraints on TLS. Constraint 1, C1: The upper limit on TLS was zero. This ration will be referred to as "conventional ration." Constraints C2, C3, C4: The upper limit on TLS was 15, 30, and 45 percent of the ration, respectively, dry matter basis.

The composition of each least-cost ration and feed cost per pound of gain for alternative upper limits on TLS, by weight category, are presented in Table 4. Feed costs per pound of gain decreased for all weight levels as percentage of TLS in the ration was increased. Largest decreases were observed as the upper limit on TLS was raised from zero to 15 percent. This was because TLS was substituting for high-priced protein supplements. Subsequent

TABLE 2. EXPANDED ANALYSIS OF COVARIANCE OF TREATMENT EFFECTS

Source of Variation	DF	Sum of Squares	F
Treatments	3	.537	2.20
Initial Weight	1	.762	9.38[a]
Interaction	3	.074	.30
Residual	16	1.299	
Total	23	2.672	

[a]Significant at 95 percent confidence level.

TABLE 3. ALTERNATIVE FEEDS AND PRICES

Feed	Unit	Price
		--Dollars--
Alfalfa Hay	ton	$67.79
Barley	bu.	2.76
Corn	bu.	2.72
Corn Silage	ton	13.69
Cotton Seed Meal	cwt.	8.71
Mixed Hay	ton	57.75
Milo	cwt.	4.20
Oats	bu.	1.55
Straw	ton	30.24
TLS	ton	5.45
Soybean Oil Meal	cwt.	8.58

SOURCE: [2, 10].

TABLE 4. LEAST COST DAILY HEIFER RATIONS: COMPOSITION AND COST PER POUND OF GAIN

Weight Level[a]	C1 Feed	C1 Percent of Ration	C1 Cents/lb. Gain	C2 Feed	C2 Percent of Ration	C2 Cents/lb. Gain	C3 Feed	C3 Percent of Ration	C3 Cents/lb. Gain	C4 Feed	C4 Percent of Ration	C4 Cents/lb. Gain
W_1	CS	95.7	14.42	CS	84.7	11.21	CS	74.0	9.91	CS	74.0	9.91
	SBM	4.3		TLS	15.0		TLS	26.0		TLS	26.0	
				SBM	.3							
W_2	CS	97.8	16.45	CS	74.0	13.34	CS	60.0	11.84	CS	62.0	10.98
	SBM	2.2		TLS	15.0		TLS	30.0		TLS	26.0	
				Straw	11.0		Straw	10.0				
W_3	CS	98.7	18.25	CS	66.0	15.32	CS	35.0	13.56	CS	57.0	12.02
	SBM	1.3		TLS	15.0		TLS	30.0		TLS	43.0	
				Straw	19.0		Straw	15.0				
W_4	CS	98.8	20.13	CS	63.0	17.17	CS	47.0	15.21	CS	50.0	13.25
	SBM	1.2		TLS	15.0		TLS	30.0		TLS	45.0	
				Straw	22.0		Straw	23.0		Straw	17.0	
W_5	CS	98.7	22.43	CS	61.0	19.05	CS	36.0	16.82	CS	38.0	14.77
	SBM	1.3		TLS	15.0		TLS	30.0		TLS	45.0	
				Straw	24.0		Straw	34.0		Straw	17.0	
W_6	CS	95.7	26.00	CS	84.4	20.09	CS	41.0	17.16	CS	38.0	14.43
	SBM	4.3		TLS	15.0		TLS	30.2		TLS	45.0	
				SBM	.6		Straw	29.0		Straw	17.0	

[a] W_1=450-549 lbs.; W_2=550-659 lbs.; W_3=660-769 lbs.; W_4=770-879 lbs.; W_5=800-1,099 lbs.; W_6=1,100 lbs. and greater.

increases in TLS resulted in more modest decreases in cost, as TLS was substituting for corn silage. Results of sensitivity analysis indicated that if TLS were used as a substitute for protein supplements, dairy producers could afford to pay approximately $38 per ton for TLS. If TLS is used as a forage substitute, they could afford to pay approximately $18 per ton for it.

IMPLICATIONS FOR DAIRY AND POULTRY PRODUCERS

Dairy Producers

The use of TLS in rations for replacement dairy heifers can result in decreased feed costs for producing each animal. Total feed costs (minerals, etc. excluded) for growing a dairy heifer from 450 to 1100 pounds, with no TLS permitted, were estimated at $125. Total estimated feed costs when TLS had upper limits of 15, 30, and 45 percent of the ration were $104, $92, and $83, respectively. Thus, total feed costs were reduced by approximately 33 percent as the upper limit on TLS was increased from zero to 45 percent.

Poultry Producers

Use of turkey litter as a feed for dairy heifers also may have important implications for turkey producers. Traditionally, the primary use of turkey waste has been as a fertilizer. However, given former low price levels of conventional fertilizers, and handling costs associated with litter, many producers found it necessary to give the waste away. In some cases, they have paid to have it removed [2].

Implications to turkey producers of using turkey litter as a feed for dairy heifers can be ascertained by employing the following assumptions: (1) turkeys and litter are joint products produced in fixed proportions, for every pound of turkey produced 4.09 pounds of litter are produced [2]; (2) the price of turkey litter in its next best use, i.e., as a fertilizer, is zero; (3) costs of producing this joint product are the same whether the litter is sold or given away.

If turkey litter were used as a protein supplement and the price bid up accordingly, revenue and profit per bird would increase by 7.20 cents per pound. Clearly use of litter as a feed would have important revenue implications for turkey producers.

SUMMARY

Turkey litter silage represents a profitable alternative feed in rations for replacement dairy heifers. Its use as a feed by dairymen could reduce total feed costs of raising a dairy heifer by as much as 33 percent. If this joint product of the turkey enterprise is used as a protein supplement, revenue and profit to turkey producers would be increased.

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