Nutritional Value of Cattle Feedlot Waste For Growing—Finishing Beef Cattle

R. C. Albin, L. B. Sherrod

INTRODUCTION

NUTRIENT recycling offers a possible approach to feedlot waste management. This concept involves the utilization of feedlot waste as a feedstuff, with reutilization of nutrients as in natural ecosystems (Albin, 1971). A recent review by Anthony (1971) summarized this area of research. One of the striking features of his paper was that no work had been reported in the literature concerning the recycling of waste from southwestern cattle feedlots, where new and improved grain processing techniques are employed. One report from Texas Tech University was included in Anthony's summary, but it involved feedlot waste in which dry-rolled grain sorghum had been used in the cattle rations (Durham et al. 1966). The Environmental Protection Agency has stressed that more information is needed on the practice of nutrient recycling with particular reference to its safety, practicability, and usefulness (Anonymous 1971). Johnson (1972) has reported digestibility values for beef cattle feedlot waste when included at 25 percent and 40 percent levels in high roughage rations.

This study was conducted to determine the nutritive value of feedlot waste from southwestern cattle feedlots where improved grain processing techniques and low levels of roughage are being used.

The specific objectives of this research were:

1 to determine the effect of feeding different levels of feedlot waste to beef cattle upon acceptability, consumption levels (or palatability) and digestibility; and

2 to determine the nutritive value for beef cattle of composted feedlot waste and dry, ground uncomposted feedlot waste.

EXPERIMENTAL PROCEDURE

Waste that had been scraped from the soil surface of a commercial beef cattle feedlot and stockpiled for approximately 1 month was ground through a hammer mill over a 0.25-in. screen. Rations containing feedlot waste were offered to feeder steers in three, 28-day total collection digestion trials. The steers were tied individually in stalls which sloped toward the feed trough. The animals were fed twice daily, allowed free access to water, and checked daily for health and stress symptoms. Fecal samples were collected daily and sampled for laboratory analyses during the last 7 days of each trial.

Trial I involved including ground, but otherwise unaltered, feedlot waste in four concentrations in a high-energy finishing ration containing adequate protein. The four mixed rations are shown in Table 1 and their chemical and energy composition are presented in Table 2. Each ration was offered to five steers.

Trial II involved composting the feedlot waste, then using similar percentages of this material as in Trial I (Table 1). The chemical and energy contents are shown in Table 2. For composting, 4000 pounds of ground feedlot waste were piled in a cone shape after mixing enough water to increase the moisture content to near 40 percent, and allowed to compost for five days with daily stirring and mixing. Each ration was offered to five steers.

TABLE 1. RATION COMPOSITION FOR TRIALS I AND II (PERCENT, AS FED BASIS)

Ingredients	Rations*			
	Control	20 percent waste	40 percent waste	60 percent waste
Sorghum grain, dry rolled	76.0	60.8	45.6	30.4
Cottonseed hulls	4.0	3.2	2.4	1.6
Alfalfa hay, chopped	4.0	3.2	2.4	1.6
Cottonseed meal	3.0	2.4	1.8	1.2
Molasses	4.0	3.2	2.4	1.6
Supplement (TTA-3)*	8.0	6.4	4.8	3.2
Ammonium sulfate	1.0	0.8	0.6	0.4
Feedlot waste, ground†	0.0	20.0	40.0	60.0
TOTAL	100.0	100.0	100.0	100.0

*Provided 45 mg chlortetracycline and 30,000 IU of vitamin A per pound, with 3.4 percent Ca, 1.1 percent P, 40 percent crude protein, 5 percent salt, 8.5 percent urea, 0.5 percent trace mineral premix, 10 percent dehy alfalfa and ground sorghum.
†Unaltered in Trial I; composted in Trial II.

TABLE 2. ANALYTICAL COMPONENTS OF RATIONS IN TRIALS I AND II (DM BASIS)

Item	Trial I		Trial II	
	Unaltered waste	Control ration	Composted waste	Control ration
Dry matter, percent	82.55	87.12	78.95	86.31
Crude protein, percent	21.6	16.5	20.3	15.2
Ash, percent	31.7	3.82	33.60	4.20
Gross energy, kcal/g	3.546	4.286	3.390	4.424
Ca, percent	2.35	0.52	2.55	0.50
P, percent	0.72	0.33	0.93	0.46
Cell soluble material, percent	49.79	76.28	44.88	78.18
Cell wall material, percent*	33.95	11.17	34.52	9.88

*Corrected for insoluble ash.

Trial III involved feeding unaltered and composted feedlot waste in a low-energy, low protein ration, resembling a high-roughage growing ration (Table 3). The chemical and energy compositions of the rations are shown in Table 4. Each ration was offered to five steers.

This research was supported in-part by the Houston Livestock Show and Rodeo.
Approved by the Dean as College of Agricultural Sciences Publication No. T-5-109.
The authors are: R. C. ALBIN and L. B. SHERROD, Animal Science Department, Texas Tech University, Lubbock and the Texas Tech University Center at Amarillo, Pantex.

Reprinted from Conference Proceedings of 3rd International Symposium on Livestock Wastes

TABLE 3. RATION COMPOSITION FOR TRIAL III USING LOW ENERGY — LOW PROTEIN RATIONS (PERCENT, AS FED)

Ingredient	Control ration	Unaltered waste	Composted waste
Sorghum grain, dry-rolled	17.1	6.7	7.0
Cottonseed hulls	60.0	48.8	47.0
Cottonseed meal	17.5	0.0	1.5
Salt	0.25	0.0	0.0
Limestone	0.3	0.0	0.0
Rock phosphate, defl.	0.3	0.0	0.0
Molasses	4.0	4.0	4.0
Aureomycin (50 g/lb)	0.025	0.025	0.025
Vitamin A (30,000 IU/g)	0.5	0.5	0.5
Unaltered feedlot waste	0.0	0.0	0.0
Composted feedlot waste	0.0	0.0	40.0
TOTAL	100.0	100.0	100.0

TABLE 4. ANALYTICAL COMPONENTS OF RATIONS IN TRIAL III (DRY BASIS FOR LOW ENERGY — LOW PROTEIN RATIONS

Item	Control ration	Unaltered waste	Composted waste
Dry matter, percent	87.59	87.67	85.10
Crude protein, percent	11.3	11.2	11.7
Ash, percent	3.76	13.46	13.85
Gross energy, kcal/g	4.584	4.217	4.102
Ca, percent	0.34	0.97	1.05
P, percent	0.33	0.39	0.34
Cell soluble material, percent	35.59	34.72	35.77
Cell wall material, percent*	44.95	43.44	43.87

*Corrected for insoluble ash.

TABLE 5. APPARENT DIGESTION COEFFICIENTS OF RATIONS FOR TRIAL I USING UNALTERED CATTLE FEEDLOT WASTE (PERCENT)

	Rations*			
Item	Control	20 percent waste	40 percent waste	60 percent waste
Dry matter	80.43	68.39	64.08	58.23
Organic matter	81.64	71.16	67.49	61.97
Gross energy	79.30	67.92	63.81	61.82
Crude protein, apparent	72.10	61.30	54.76	52.83
Crude protein, true	89.15	76.87	69.66	67.49
Cell soluble material	85.25	76.65	70.61	67.88
Cell wall material	55.01	51.84	44.52	41.26

*Treatment means on the same line are significantly different ($P<0.01$) in a linear pattern.

RESULTS AND DISCUSSION

Apparent digestion coefficients of rations in Trial I are presented in Table 5. As the percentage of feedlot waste increased in the ration at levels of 0, 20, 40 and 60 percent, the apparent digestibility of all ration nutrient and energy components decreased in a significant ($P<0.01$) linear pattern. The apparent digestibility of crude protein decreased from 72.1 percent in the control ration (0 percent feedlot waste) to 52.8 percent in the 60 percent feedlot waste ration, and gross energy apparent digestibility decreased from 79.3 percent to 61.8 percent. The same significant trends were observed in Trial II (Table 6), using composted feedlot waste, except for the apparent digestibility of cell wall material which increased significantly ($P<0.05$) from 31.0 percent and 29.8 percent in the control and 20 percent feedlot waste rations, respectively, to 41.7 percent and 39.6 percent in the 40 percent and 60 percent feedlot waste rations, respectively. One explanation for this unusual pattern is that when the feedlot waste was composted, apparent digestibility of the feedlot waste was improved from 29.3 percent in unaltered feedlot waste to 42.0 percent in the composted feedlot waste (Table 8).

TABLE 6. APPARENT DIGESTION COEFFICIENTS OF RATIONS FOR TRIAL II USING UNALTERED CATTLE FEEDLOT WASTE (PERCENT)

	Rations*			
Item	Control	20 percent waste	40 percent waste	60 percent waste
Dry matter	74.29	63.35	59.87	51.66
Organic matter	75.55	66.52	63.81	56.11
Gross energy	73.58	64.07	60.81	54.22
Crude protein, apparent	65.05	53.05	48.57	44.13
Crude protein, true	83.57	70.91	65.42	59.65
Cell soluble material	83.57	78.76	72.81	68.07
Cell wall material	31.03†	29.84†	41.72‡	39.60‡

*Treatment means on the same line are significantly different ($P<0.01$), except for cell wall material, in a linear pattern.
†,‡Means on the same line having different superscripts are significantly different ($P<0.05$).

Table 7 portrays apparent digestion coefficients for the rations used in Trial III. Little difference in digestibility of ration contents was observed between the rations containing unaltered or composted waste (low protein - low energy) for dry matter, gross energy, and cell soluble material; but these apparent digestion coefficients were significantly ($P<0.05$) lower than those for the control ration. Apparent digestion coefficients for organic matter and crude protein were significantly lower ($P<0.05$) for the composted feedlot waste ration than for the unaltered feedlot waste ration, and these apparent digestibilities were significantly lower ($P<0.05$) than those for the control ration. Cell wall material apparent digestibility was significantly lower ($P<0.05$) for the unaltered feedlot waste ration (38.0 percent) than for the control ration (41.4 percent) and the composted waste ration (42.0 percent). This observation would agree with data in Table 6 showing improved cell wall digestibility in the 40 percent composted waste ration.

TABLE 7. APPARENT DIGESTION COEFFICIENTS OF RATIONS FOR TRIAL III USING LOW — ENERGY LOW PROTEIN CATTLE RATIONS (PERCENT)

	Rations		
Item	Control	Unaltered 40 percent waste	Composted 40 percent waste
Dry matter	52.27*	44.36†	42.04†
Organic matter	53.99*	49.48†	44.93‡
Gross energy	52.47*	46.67†	43.95†
Crude protein, apparent	23.02*	17.87†	13.24‡
Crude protein, true	48.16*	41.98†	38.52†
Cell soluble material	61.59*	56.64*	57.11†
Cell wall material	41.40*	38.00†	41.98*

*, †, ‡ Means on the same line having different superscripts are significantly different ($P<0.05$).

By using the difference method for calculating the digestibility of ration components, an overall summary of the apparent digestibility of cattle feedlot waste when included at a level of 40 percent in either high grain or high roughage rations is presented in Table 8. These data suggest that when feedlot waste is composted and fed in high concentrate – adequate protein rations at a level of 40 percent, the apparent digestibility of energy-yielding components (dry matter, organic matter and gross energy) would be improved 10-15 percent; whereas crude protein, cell soluble material and cell wall material digestibilities would be improved 20-25 percent. The data in Table 8 also indicate that when feedlot waste is included in a low energy - low protein ration, the feedlot waste should be digested to a greater degree than when fed in a high energy - adequate protein ration. These data further suggest that when feedlot waste is composted and fed in low energy - low protein rations at a level of 40 percent, the apparent digestibility of dry matter and organic matter would be unchanged, gross energy would be decreased by about 10 percent, crude protein decreased by 25 percent, and cell soluble material should be decreased by about 8 percent. The apparent digestibility for cell wall material was increased by nearly 100 percent due to composting.

The apparent digestion coefficients reported in Table 8 for unaltered feedlot waste are higher than values reported by Lucas et al. (1974) using 20 percent cattle fecal waste in a 50 percent roughage ration. The difference can be explained by the lower level of fecal waste used by the latter researchers. In the present study, apparent digestion coefficients were calculated by the difference method for cattle feedlot waste when fed at 20 percent, 40 percent and 60 percent levels in cattle rations. Apparent digestion coefficients for feedlot waste at the 40 percent level are presented in Table 8. When compared at the 40 percent level of feeding, apparent digestion coefficients for feedlot waste were lower when fed at a 20 percent level, but higher when fed at a 60 percent level. This linear expression of increasing values for apparent digestibility was unexpected, but could indicate an associative effect of feedstuffs. This observation was reported by Anthony in waste feeding trials with cattle at Auburn University (personal communication).

TABLE 8. SUMMARY OF APPARENT DIGESTION COEFFICIENTS FOR CATTLE FEEDLOT WASTE WHEN FED AT A 40 PERCENT LEVEL IN CATTLE RATIONS (PERCENT)*

	Type of ration:	High energy Adequate protein		Low energy Low protein	
Item	Type of waste:	Unaltered	Composted	Unaltered	Composted
Dry matter		33.26	38.38	37.59	37.91
Organic matter		34.76	38.08	38.85	38.77
Gross energy		34.30	37.79	38.82	35.03
Crude protein, apparent		26.17	32.96	58.04	45.83
Crude protein, true		29.27	36.03	61.09	49.02
Cell soluble material		40.83	50.25	65.32	59.53
Cell wall material		29.31	42.00	16.53	33.19

*Calculated by the difference method.

Johnson (1972) used sheep to determine the digestibility of cattle feedlot waste when included at 25 percent and 40 percent levels in low energy rations with cottonseed hulls as the roughage. The rations he used for the 40 percent levels were comparable to the 40 percent ration of this study. Digestibility values for dry matter and organic matter from his study were about 10 percent higher than those in the present study (about 38 percent, Table 8). The cell wall material digestion coefficient for the waste in this study was near 17 percent. Johnson's crude protein values were higher than the coefficients for this study. In experiments to more closely evaluate beef cattle feedlot waste as a protein source for growing lambs, Johnson et al. (1973) found that the feedlot waste samples were much lower in crude protein values (<12 percent) than those reported by Johnson (1972) and that its digestibility was lower (<40 percent). Their data suggested that composting may decrease the crude protein value of beef cattle feedlot waste. Our data (Table 8) indicate a similar trend for low energy rations, but that little effect of composting might be detected in high energy rations with lower overall digestibility values.

Ferrell and Garrett (1973) studied the effect of continued recycling of cattle feedlot manure with special interest in the possible buildup of substances in the manure. Their results suggest that there is some nutritive value in cattle manure and that recycling would not create a buildup of minerals or lignin. They reported that only about 26 percent of the dry matter in manure disappeared during the recycling. With only one recycling, the data in Table 8 would suggest about 33-35 percent disappearance of dry matter.

There were no problems with feed consumption. The steers readily consumed all rations, regardless of the level of feedlot waste. No animal health problems were observed.

SUMMARY

This study was conducted to determine the nutritive value of feedlot waste from southwestern cattle feedlots where improved grain processing techniques and low levels of roughage are being used. Waste that had been scraped from the soil surface of a commercial beef cattle feedlot and stockpiled for approximately 1 month was ground through a hammer mill over a 0.25-in. screen. Rations containing feedlot waste were offered to feeder steers in three, 28-day total collection trials. Unaltered or composted feedlot waste was mixed into high energy - adequate protein and low energy - low protein rations at concentrations of 0, 20, 40 and 60 percent. As the percentage of unaltered feedlot waste increased in high energy - adequate protein rations, the apparent digestibility of nutrient and energy components decreased in a significant ($P<0.01$) linear pattern. The same trends were observed when composted waste was used except for the apparent digestibility of cell wall material which increased significantly ($P<0.05$). In low energy - low protein rations, apparent digestion coefficients were significantly lower ($P<0.05$) for rations containing feedlot waste.

Composting feedlot waste lowered the apparent digestibility of rations for organic matter and crude protein, but cell wall digestibility was lower for rations containing unaltered feedlot waste. Apparent digestion coefficients for feedlot waste were higher when the waste was included in low energy - low protein rations than for high energy - adequate protein rations. Composting decreased the apparent digestibility of feedlot waste for all components except cell wall material, which was significantly increased, when included in low energy - low protein rations. The apparent digestibilities for feedlot waste increased at each

(Continued on page 217)

Nutritional Value of Cattle Feedlot Waste

(Continued from page 213)

higher percentage of use.

References

1 Albin, Robert C. 1971. Handling and disposal of cattle feedlot waste. J. Anim. Sci. 32:803-810.

2 Anonymous. July 24, 1971. EPA takes "lenient" stand on feedlot waste disposal. Feedstuffs, p. 4.

3 Anthony, W. Brady. 1971. Animal waste value - nutrient recovery and utilization. J. Anim. Sci. 32:799-802.

4 Durham, R. M., G. W. Thomas, R. C. Albin, L. G. Howe, S. E. Curl and T. W. Box. 1966. Coprophagy and use of animal waste in livestock feeds. Proc. Natl. Symp. Animal Waste Mgt. ASAE Publ., SP-0366:112-114.

5 Ferrell, C. L. and W. N. Garrett. 1973. Observations concerning the use of cattle manures in drylot feeding. Proc. 12th Ann. Calif. Feeder's Day. p. 4.

6 Johnson, R. R. 1972. Digestibility of feedlot waste. Okla. State Univ. Agr. Exp. Sta. Misc. Publ. 87:62.

7 Johnson, R. R., J. R. Kropp and M. McGeehon. 1973. Animal wastes as protein sources for ruminants. Okla State Univ. Agr. Exp. Sta. Misc. Publ. 90:94.

8 Lucas, D. M., J. P Fontenot and K. E. Webb, Jr. 1974. Digestibility of cattle fecal waste. J. Anim. Sci. 38:231.