Feedlot Animal Waste Compared with Cottonseed Meal as a Supplement for Pregnant Range Cows

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Highlight: *Three groups of pregnant beef cows grazing dry native annual range were either supplemented with pelleted cottonseed meal (0.90 kg/head daily), a pelleted mixture of 75% feedlot manure-25% barley (ad lib.), or received no supplementation for a period of 84 days. Cows were induced to consume the manure pellet on range by accustoming them to the manure-barley pellet in a preliminary period of feeding in a drylot. Individual cow variation in intake of manure supplement was similar to that found for the cottonseed meal supplement. A marked response occurred to both supplements as measured by cow weights at calving and weaning weight of the calf. Cows given the manure-barley pellet had a higher body weight than cows given the cottonseed meal supplement, but intake of supplement was much greater for those given the manure-barley pellet.*

The dry matter digestibility of the feedlot manure was 26.1%.

The disposal of manure from feedlots is a serious problem in animal agriculture in the United States (Clawson, 1970). Bunch (1972) recently reviewed studies which date from 1942 on the use of manure in cattle rations. Most of the work indicates that manure can be fed at 30-40% of the growing ration without deleterious effects. However, the feeding of manure to confined cattle as part of a growing ration, even though economical, does not solve the problem of feedlot manure disposal. The use of manure as a supplement to dry annual range which is low in protein and high in fiber (Hull et al., 1972) could offer a means of ultimate disposal whereby the manure is returned to the land, and in the process provide to the grazing animal nutrients deficient in dry annual range forage. The practicality of this approach was investigated.

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Preliminary Investigations

Observations during a preliminary trial indicated that cows could be induced to consume significant quantities of manure if barley and manure were pelleted together. For these pellets, the manure was sundried on concrete slabs, ground in a hammermill with 0.79 cm screen, mixed with ground barley, then pelleted in a "California" pellet mill with a 0.95 cm pellet die. The dried manure contained 18.8% crude protein. These preliminary feeding trials also indicated that when manure pellets were placed in a feed manger with good quality roughage cattle refused to eat the manure pellet. However, if a poor quality roughage, such as

rice straw, or a limited amount of oat hay was fed along with a decreasing amount of barley in a manure pelleted feed, by the end of a 2-3 week period cattle would readily accept a mixed pellet of 75% manure-25% barley. They would also eat, to a limited extent, a 100% manure pellet providing some roughage was available. Under drylot conditions, 10 heifers which followed this adjustment routine had a mean consumption of 4.1 kg/day of a 75% manure-25% barley pellet. The heifers were limited to 4.0 kg of ground oat hay/day and made an average daily body weight gain of 0.72 kg.

Experimental

A 84-day supplementary feeding trial under range conditions was undertaken at the University of California Sierra Foothill Range Field Station, Browns Valley, Calif. Twenty-four mature-grade Hereford cows, following weaning of their calves and pregnancy confirmation, were randomly allocated into three groups of eight cows each. Treatments included were: (1) supplementation with solvent extracted pelleted cottonseed meal (CSM) (41% crude protein); (2) supplementation with a 75% manure-25% barley pellet (16.1% crude protein); and (3) no supplementation. Manure-barley pellets were made as previously described. The manure was from cattle given a feedlot ration of the following composition: alfalfa hay, 32.5%; oat hay, 12.5%; beet pulp, 7.0%, rolled barley, 39.0%; cottonseed meal, 2.5%; molasses, 6%; salt, 1%; dicalcium phosphate, 0.25% and oystershell flour, 0.25%. Chromium sesquioxide (0.25% CP) was added to both the manure and CSM pellets to obtain a measure of individual variation in intake of the supplements. The method described in the preliminary trial was used to accustom the pregnant beef cows to their respective supplements. They were confined to a drylot and given 3.6 kg oat hay daily and the percent of manure in the pellet gradually increased over a 2-week period until it reached 75%. The cattle were moved to dry range on August 3, 1972. The CSM supplement was given to the cattle three times per week at 0.90 kg/head/day while the 75% manure pellet was fed ad lib. The experimental areas for the two supplemented groups consisted of two fields, one of 12.1 and the other of 16.2 hectares of rangeland that had previously been cleared of trees and brush, but not reseeded. The two groups of cows were alternated in the fields every two weeks after the start of the trial. Two adjacent fields of 43.7 and 30.4 hectares, cleared of brush and partially cleared of trees, were used by the unsupplemented cattle. The unsupplemented cows were rotated monthly between the two adjacent fields. The vegetation in all fields consisted of indigenous annual grasses and forbs.

Every second week samples of forage were taken along a permanent transect.

Table 1. Mean body weight changes of pregnant range cows grazing dry annual range and given supplements of cottonseed meal (CSM) and manure-barley pellets.

Item	Supplement		
	None	CSM	Manure-barley
Number of cows	8	8	8
Length of supplemental period, (days)	84	84	84
Cows' body weight (kg)			
At weaning, 7-6-72	439.1	445.4	447.7
At start of supplementation[1]	444.5[a]	440.1[a]	440.9[a]
At end of supplementation	408.7[a]	458.6[bc]	475.8[c]
Gain or loss during supplementation (kg)	−36.3[a]	+14.5[bc]	+34.9[c]
Supplement consumed (kg/head/day)	0	0.90	7.75

[1] a, b, c: treatments on the same line having the same superscript are not significantly different ($P < 0.05$).

Table 2. Post-supplemental performance of cows and calves.

Item	Supplement		
	None	CSM[1]	Manure-barley
Number of cows calving	8	8	8
Birth weight of calves (kg)[2]	34.5[a]	34.0[a]	33.5[a]
Cow weight at end of calving (kg)	384.2[a]	431.8[b]	434.1[b]
Percent cows pregnant	100	100	100
Weight of calves at weaning, 5-24-73	190.0[a]	197.8[ab]	205.5[bc]

[1] CSM = cottonseed meal.
[2] a, b, c: treatments on the same line having the same superscript are not significantly different ($P < 0.05$).

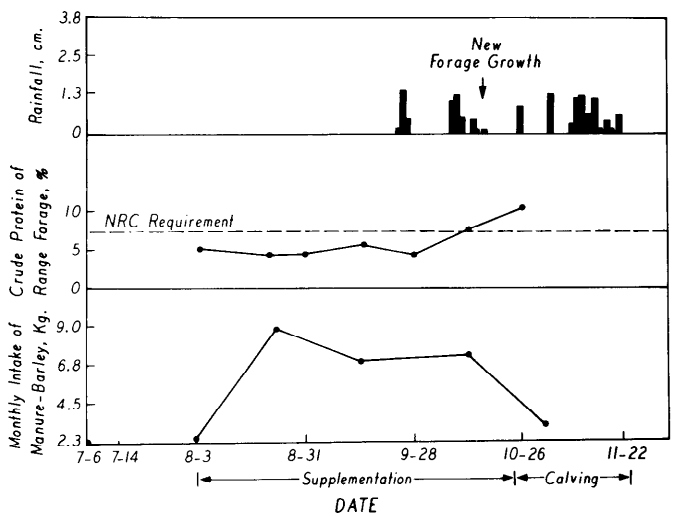

Fig. 1. *Rainfall and the start of new forage growth, crude protein content of the sampled forage indicating National Research Council (NRC) recommended level of protein for pregnant beef cows, and mean monthly intake of the manure (75%)-barley (25%) pellet.*

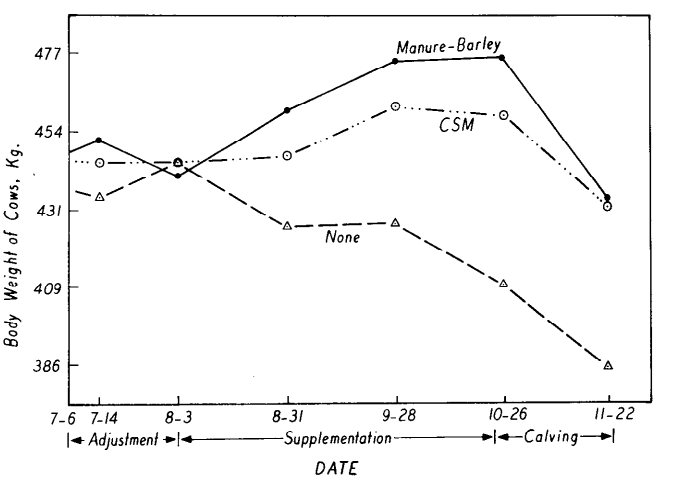

Fig. 2. *Changes in body weight of cows prior to, during, and following supplementation with a manure (75%)-barley (25%) or cottonseed meal (CSM) pellet and no supplementation.*

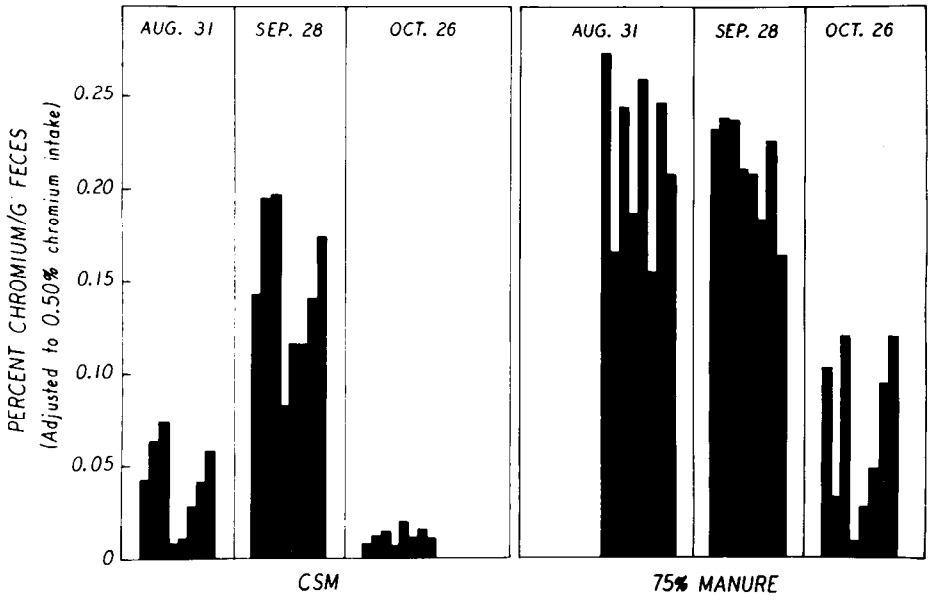

Fig. 3. *The fecal chromic oxide dry matter ratios of eight cows given supplements of either cottonseed meal (CSM) or manure (75%)-barley (25%) pellets at three weigh periods. For each period the values for individual cows are presented in the same sequence.*

Four 0.093-m^2 quadrats were randomly thrown and clipped to a height of 1.0 cm above ground. The four forage samples were composited for analysis. Samples of supplements were taken as fed and composited monthly for laboratory analysis. The cattle were weighed every 28 days after an overnight shrink without feed or water. Samples of feces were manually taken from the rectum of cows at these weighings for laboratory analysis.

A digestion trial using four dry beef cows and the chromic oxide techique (Lindahl, 1959) was conducted on the manure used as a range supplement. The cows would not consistently eat the 75% manure-25% barley pellet or the 100% manure pellet alone, so a limited amount of ground oat hay was fed twice daily with the manure pellets. After the cows became accustomed to this feeding schedule, they were maintained on a constant intake of chopped oat hay and either 75% or 100% manure pellets for 1 week prior to and during the 5 days of twice daily fecal collection. A dry matter digestibility of 63% and 83% for the oat hay and barley, respectively, was assumed (Garrett, personal communication).

The samples of forage were analyzed for nitrogen by the methods of the A.O.A.C. (1959). Chromium was determined by atomic absorption spectrophotometry by the method of Arthur (1970). Analysis of variance was used for the statistical analysis and the method of least significant difference was used to determine significance between treatments.

Results and Discussion

During most of the supplemental period, the samples of the annual range forage contained less than the 7.5% crude protein, the percentage recommended by the National Research Council (1970) for the pregnant cow (Fig. 1). This analysis of the forage followed very closely that found previously for this experimental area (Hull et al., 1972). A positive response in body weight was found to both supplements during this period (Table 1, Fig. 2). Cows in the manure supplemented group had gained 34.9 kg at the end of supplementation, whereas the unsupplemented cows had lost 36.3 kg. This difference in body weight was reduced to 40.5 kg at calving (Table 2), the supplemented cows losing more body weight than the unsupplemented cows in the period following the fall rains. The manure-supplemented cows consumed 5.4-8.2 kg/head daily of the pellets, which was more than had been anticipated at the start of the experiment, and made greater gains than the CSM-supplemented cows. The difference in response to the two supplements was probably largely due to the contribution from the barley in the manure pellet, which was equivalent to 1.95 kg/head/day. Thus, both more protein and energy was supplied to the manure- than the CSM-supplemented group.

Birth weight of the calves was not affected by the supplements, but the weaning weight of the calves from cows given the manure-barley pellet was significantly ($P<0.05$) greater than those not receiving a supplement. The computed digestibility coefficients of the dry matter of manure were similar whether they were calculated by difference (when fed with barley) or fed alone with the basal hay ration. The values were therefore combined, which gave a mean digestion coefficient of dry matter of 26.1% ± 0.65 (S.E.).

Figure 3 gives a comparison of individual cow fecal chromic oxide: dry matter ratios during the three summer months they were supplemented. The uniformity of the ratios indicates that the intake of supplements in respect to range was similar for all animals in each group.

Once the cows became accustomed to the manure-barley pellets, they readily consumed them; even following the onset of new growth when most cattle start to refuse supplementation, the cows ate a significant amount of the manure pellet (Fig. 2). All cows calved normally and rebred. There was no apparent beneficial or adverse effect of manure supplementation on calf birth weight or reproduction of the cows. Manure supplementation significantly ($P<0.05$) increased the weaning weight of the calves. Presumably, milk production of the supplemented cows was greater, as milk production is highly correlated with weaning weight of the calf (Warwick, 1958).

The experiment indicates that manure in combination with barley may be fed as a supplement to pregnant range cows and provides an alternative to the use of high quality protein supplements such as CSM. Using manure as a range supplement provides a method for its disposal and the recycling of the nutrients contained in the manure.

Literature Cited

Association of Official Agricultural Chemists. 1959. Official methods of analysis. Ass. Offic. Agr. Chem., Washington, D.C.

Arthur, D. 1970. The determination of chromium in animal feeds and excreta by atomic absorption spectrophotometry. Canadian Spectroscopy. 15:134.

Bunch, R. J. 1972. Feeding livestock wastes. American Feed Manufacturers Nutrition Council. Proc. 32nd Annual Meeting, p. 13.

Clawson, J. 1970. Economics of recovery and distribution of animal waste. Symposium on Animal Waste Management and Disposal, 62nd Annual Meeting of American Soc. Anim. Sci., University Park, Pennsylvania.

Hull, J. L., C. A. Raguse, and J. P. Guild. 1972. Supplementation of dry annual range by irrigated pasture. J. Range Manage. 2:96-99.

Lindahl, I. L. 1960. Methods employed in nutrition research. *In* Techniques and Procedures in Animal Production Research. Amer. Soc. Anim. Sci., p. 173-193.

National Academy of Science – National Research Council. 1970. Nutrient requirements of beef cattle. Nat. Academy of Sci.-Nat. Res. Council Publ. 1754. Washington, D. C.

Warwick, E. J. 1958. Fifty years of progress in breeding beef cattle. J. Anim. Sci. 17:922-943.