

Nutritive Value of Dehydrated Sweet Potato Trimmings Fed to Beef Steers

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Two feeding trials and a metabolism trial were used to determine the nutritive value of sweet potato trimmings as a carbohydrate feed for beef steers. The experimental rations contained either 51% dehydrated sweet potato trimmings or 51% cracked corn. Average daily gains, carcass grades, marbling scores, ruminal pH values, and digestibilities of crude protein and dry matter were lower when steers consumed the trimmings ration. Tenderness scores, Warner-

Bratzler shear scores, taste panel over-all desirability scores, and nitrogen retention were similar for steers on both rations. The molar per cent of valeric acid and the total concentration of volatile fatty acids (VFA) were greater when steers consumed the trimmings ration. The results suggest that this waste product may have a place in cattle feeding, particularly under conditions when grain availability is limited.

Sweet potato meal is a satisfactory complete or partial replacement for corn in finishing rations for beef cattle (Grimes, 1941; Darlow *et al.*, 1946; Briggs *et al.*, 1947; Southwell and Black, 1948). With the increase in population and competition for food, sweet potatoes are now grown only for human consumption. In the processing of sweet potatoes for human consumption, however, certain raw products result which are shredded and dehydrated into a waste product called sweet potato trimmings. It contains the ends, defective portions which are trimmed from the potatoes, and occasionally whole potatoes which are not suited for human food. Although this waste product may vary in composition, it contains adequate amounts of protein and energy to be considered as an animal feed. The yearly production of these trimmings in Louisiana, Arkansas, and some Middle Atlantic States is about 6000 tons measured on a dry basis. Since information is lacking concerning the nutritive value of this product, experiments were conducted to determine its feed value for beef cattle.

Experimental Procedure

Trial 1a. Twenty yearling steers, averaging 289 kg., were allotted to two lots and group-fed rations based primarily on corn or sweet potato trimmings (Table I). Feed and water were available *ad libitum*. The steers were weighed individually at biweekly intervals during a 126-day experimental period and at the end of the feeding trial the steers were slaughtered and detailed carcass data were obtained. The rumens were examined at slaughter and scored for epithelial color and papillae size and clumping.

The chemical composition of both rations was similar except for ash. On a dry basis, the sweet potato trimmings were 5.5% crude protein, 13% ash, and 3788 calories per gram gross energy. The high ash content of the trimmings caused the trimmings ration to have a higher ash content than the corn ration.

Trial 1b. The nutritive value of ground sweet potato trimmings was tested in a short-term feeding

trial. Ten yearling steers averaging 366 kg. were divided into two groups and were fed the rations used in the other trials. Prior to slaughter, rumen samples were obtained by stomach tube 4 hours after the intensive morning feeding period (Putnam and Davis, 1963). The samples were strained through cheesecloth and determinations made for pH and volatile fatty acids (Baumgardt, 1964).

Trial 2. Four yearling beef steers were used in a conventional digestibility trial to determine the average digestion coefficients and nitrogen balance for the sweet potato trimmings and the corn rations. A 28-day adjustment period followed by a 7-day collection period was used for each of the two trials. The steer calves averaging 190 kg. were fed an amount of feed equal to 1.5% of each calf's body weight. Feed, feces, and urine were sampled and analyzed for dry matter (except urine), gross energy, and nitrogen by standard A.O.A.C. (Association of Official Agricultural

Table I. Composition and Analysis of Rations

Ingredient	Ration	
	Corn, %	Sweet potato trimmings, %
Timothy hay, ground	22.2	21.9
Cracked corn	51.4	...
Sweet potato trimmings	...	50.9
Molasses, blackstrap	13.3	13.2
Soybean meal	11.3	11.2
Urea	...	1.0
Trace mineral salt	0.9	0.9
Dicalcium phosphate	0.9	0.9
Vitamin A ^a	+	+
	100.0	100.0
Chemical analysis, dry basis, %		
Crude protein	13.4	13.2
Acid detergent fiber	12.9	14.4
Ash	5.7	10.9
Calories/gram	3890.0	3549.0

^a 2200 USP units supplied per kilogram of ration.

ARS, Animal Husbandry Research Division, U.S. Department of Agriculture, Beltsville, Md.

Chemists, 1960) methods. Feed and feces were analyzed for acid detergent fiber by the Van Soest (1963) method.

The feedlot, carcass, ruminal, and balance data from these studies were subjected to analysis of variance (Snedecor, 1956).

Results and Discussion

Trial 1a. The results are presented in Table II. Average daily gains were less ($P < 0.01$) for the steers fed the sweet potato trimmings. Based on gains alone, the sweet potato trimmings ration was worth about 80% as much as corn. This value does not compare favorably with the 90 to 95% value of dehydrated whole sweet potatoes when compared with corn (Grimes, 1941; Darlow *et al.*, 1946; Southwell and Black, 1948). The sweet potato trimmings were coarse and hard and this was reflected in lower feed intake.

During the first 63 days, the average daily gains and feed consumption were 0.6, 9.3, 1.2, and 11.2 kg. for the steers fed trimmings and corn rations, respectively. Therefore, in an attempt to improve the palatability of the ration, the sweet potato trimmings were ground during the last 63 days of the trial. As the trial progressed, the steers on the corn ration leveled off in gain, while the steers on the ration containing the trimmings made what appeared to be a compensatory gain. The average daily gains were 0.94 and 0.90 kg., respectively, for the sweet potato trimmings and corn steers during the last 63 days of the trial. The interaction between 63-day periods and treatments was significant ($P < 0.05$). The 50% increase in gains by the steers fed the sweet potato trimmings, while perhaps not entirely due to grinding, suggests it would be desirable to grind this material. Efficiency of feed conversion was similar for steers on both rations. At different times during the trial, two steers on the sweet potato trimmings were found dead and were reported to have died of undetermined causes.

Carcass grades were different ($P < 0.01$) between treatments. The steers receiving the trimmings ration were graded low good and the steers fed the corn ration were graded low choice. Dressing percentage was higher for the steers receiving the corn ration but there was no statistically significant difference between the treatments. Although all carcasses were moderately abundant in marbling, the group scores were different ($P < 0.05$) with the steers fed trimmings showing less marbling. The Warner-Bratzler shear results, taste panel tenderness, and taste panel over-all desirability scores were similar for both groups.

The ruminal epithelium was lighter colored ($P < 0.05$) in the steers fed the sweet potato trimmings ration compared to those steers consuming the corn ration. Oltjen and Davis (1965) fed all-concentrate rations based upon ground corn, and found that the ruminal epithelium was lighter ($P < 0.01$) in the rumen of steers consuming the urea-supplemented rations compared with rumens of steers fed soybean meal-supplemented rations. The sweet potato trimmings ration was supplemented with urea. The rumens of six corn steers had some bare

Table II. Feedlot Performance, Carcass Data, and Ruminal Characteristics of Steers Fed Corn or Sweet Potato Trimmings Rations

	Trial 1		Trial 1b	
	Corn	Sweet potato trimmings	Corn	Sweet potato trimmings
Feedlot Data				
No. of steers	10	10 ^a	5	5
Days on feed	126	126	35	35
Initial wt., kg.	290	288	367	365
Daily gain, kg.	1.0 ^b	0.8	1.5	1.2
Daily feed intake, kg.	11.6	9.4	10.8	9.2
Feed per unit gain	11.6	11.8	7.2	7.7
Carcass Data				
Carcass grade ^c	12.0 ^b	18.0	14.0	14.0
Dressing, %	61.5	59.6	60.4	59.3
Marbling score ^d	14.0 ^e	18.0	16.0	16.0
Tenderness ^f	5.0	5.3	5.7	5.3
Warner-Bratzler shear, kg.	6.8	6.4	6.6	8.9 ^g
Over-all desirability ^h	5.7	5.9	6.2	6.0
Ruminal Data				
Rumen condition				
Epithelial color ⁱ	3.2 ^e	2.2		
Papillae size ^j	3.6	3.4		
Papillae clumping ^k	1.4	2.0		
Rumen pH			6.5	6.2
Volatile fatty acids				
Acetic, molar %			57.4	56.9
Propionic, molar %			21.0	26.0
Isobutyric, molar %			1.6	1.3
Butyric, molar %			16.5	12.9
Isovaleric, molar %			2.1	0.8
Valeric, molar %			1.5	2.2 ^e
Total concn., μmole/ml.			100.1	126.7

^a Two steers died of undetermined causes.

^b $P < 0.01$.

^c Low choice, 12; high good, 14; low good, 18.

^d Moderately abundant.

^e $P < 0.05$.

^f Taste panel ratings on scale of 1 (very tough) to 7 (very tender).

^g One animal had a shear of 37.2, the average of the other four was 6.9.

^h Taste panel ratings on scale of 1 (least desirable) to 9 (most desirable).

ⁱ Light, 1; very dark, 4.

^j Infantile, 1; large, 4.

^k None, 1; severe, 4.

spots, while there was some parakeratosis in the rumens of three of the steers fed the trimmings ration. Papillae size and clumping were similar.

Trial 1b. The average daily gains of steers fed sweet potato trimmings were 80% of those of the steers fed corn. Feed intake was comparable between the two trials when figured on per cent of body weight.

Table III. Metabolism Data of Steers Fed Corn or Sweet Potato Trimmings Rations (Trial 2)^a

	Ration		
	Corn	Sweet potato trimmings	Standard deviation
Digestibility, %			
Dry matter	77.0 ^b	72.3	2.07
Crude protein	74.9 ^b	71.1	2.95
Acid detergent fiber	35.0	40.5	8.10
Organic matter	78.0	76.1	1.74
Gross energy	74.1	70.7	2.41
Nitrogen balance			
Nitrogen retained, g./day	+23.8	+22.2	3.55

^a Four observations.

^b $P < 0.05$.

Carcass data were similar for the two groups of steers which could be expected for a short feeding period. The molar per cent of valeric acid ($P < 0.05$) and the concentration of volatile fatty acids (VFA) were greater when steers consumed the trimmings ration and this is reflected in the lowered (0.3 unit) ruminal pH values ($P < 0.10$). There were no significant differences in the other VFA molar per cent values.

Based on the results obtained in the two feeding trials, the sweet potato trimmings were not so palatable as the corn and should be ground for best results. The gains were considered satisfactory after the trimmings were ground, but sweet potato trimmings are not equal to corn in a finishing ration if they furnish 51% of the ration. Southwell and Black (1948) found that dehydrated sweet potato meal was not so palatable as corn, and dehydrated sweet potatoes were not equal to corn when they furnished all of the grain in the ration but were equal to corn if they replaced up to 50% of the corn in the ration.

Trial 2. Results of the metabolism trial are shown in Table III. Digestibilities of dry matter and crude protein of the sweet potato trimmings ration were lower ($P < 0.05$) than those of the corn ration. Digestibility coefficients for acid detergent fiber, organic matter, and gross energy were not different. Nitrogen balance was similar for both rations. Briggs *et al.* (1947) found that the apparent digestion of crude protein was lower for sweet potato meal than corn while nitrogen retention was practically the same for both.

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