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The Digestibility of Dried Sweet Potatoes by Steers and Lambs

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CONTENTS

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All parts of the United States except the Corn Belt need a source of concentrate feed for livestock. There is certainly no exception to this need in the South and Southwest; thousands of cattle produced in these areas must be shipped north each year to be fattened in the Corn Belt. Many Southern owners or prospective purchasers would prefer to complete the production of finished beef at or near the point of origin. Southern beef-cattle feeders as well as dairymen often must have concentrates shipped in to supply their minimum current needs.

Sweet potatoes have recently attracted attention as a possible source of carbohydrate feed for the South and Southwest. It appears entirely possible that large areas of sandy-type soils in these regions could be used to grow this crop. Preliminary research at several experiment stations indicates that sweet potatoes, when properly dried and fed, are very acceptable livestock feed, especially for cattle. However, no data were available on the digestibility of dried sweet potatoes as compared to other commonly used concentrates; nor had their total digestible nutrient content, or over all feeding value, been studied previously. Therefore the study of the digestibility of dried sweet potatoes reported in this bulletin was undertaken.

At the present time, cull sweet potatoes ("jumbos" and "strings") are largely unmarketable. Turning these culls into stock feed shows promise of increasing the per acre return from sweet potatoes grown primarily for table use. Whether, in the future, sweet potatoes can be profitably grown solely for use as livestock feed depends on working out economical methods of production. However, research now under way at this and other Stations suggests that yields considerably above those usually made when sweet potatoes are grown primarily for human consumption can be achieved through breeding of new varieties especially for livestock feed, and development of cultural methods adapted to their production.

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REVIEW OF LITERATURE

Grimes (1941) found sweet potato meal to be 91 percent as efficient per unit of gain as corn meal when fed with cottonseed meal and peanut hay. In a second experiment he (1942) found sweet potato meal to be worth 90 percent as much as corn when both feeds were fed in addition to cottonseed meal and hay, or silage. Darlow *et al.* (1945) found dried sweet potatoes to be worth approximately 82 percent as much as corn in fattening steer calves, when the sweet potatoes were used to replace the corn in a ration consisting of cottonseed meal, sorgo silage, corn, and one pound of alfalfa hay, daily. In a second experiment conducted the following year with the same ration, Darlow and coworkers (1946) secured almost idenical gains with steer calves fed the dried sweet potato ration as those fed the corn ration. The calves fed sweet potatoes sold for 50 cents per hundredweight less than the corn-fed calves in the second experiment, whereas they sold for the same price in the first experiment. In the second experiment, the dried sweet potaotes proved to be worth 95 percent as much as corn from the standpoint of gain alone and 90 percent as much as corn when the difference in selling price was considered.

Cullison (1944), working at the Mississippi Station, secured gains of 1.84 pounds daily with four steers self-fed dried sweet potatoes with cottonseed meal, Dallis grass hay, sorghum silage and oyster shell as compared to gains of 1.80 pounds secured with ten steers that received corn in place of dried sweet potatoes. In a previous experiment at the same station (1942), dried sweet potatoes replaced corn nearly pound for pound in fattening six steer calves. Similar results were secured when dried sweet potatoes replaced corn in steer fattening experiments at the Tennessee Station (1940).

Copeland (1941) used dried sweet potatoes to replace corn in a dairy ration and found the potatoes to have a value of about 90 percent the productive value of corn. The cows produced 3 percent more milk when corn was fed than when sweet potatoes replaced it.

Grimes (1941) observed that mules did not care for dried sweet potato meal fed alone and that they used it to best advantage when it made up no more than 50 percent of the grain ration. This worker also reports that dried sweet potatoes

were unsatisfactory for pigs weighing 50 lbs. The pigs consumed only about one-half as much potato meal as they did corn when each concentrate was fed in addition to tankage, and the pigs scoured considerably more on the sweet potato ration. Larger pigs made more satisfactory use of the potatoes when the potatoes replaced no more than one-half the corn in the ration.

Godbey and Starkey (1942) found that sweet potato meal increased the feed required per unit of gain 8 percent when it was used to replace alfalfa meal in a trio mix for fattening hogs in dry lot. The potato meal was a very satisfactory replacement for corn in fattening weanling pigs. The pigs ate insufficient meal to gain at a satisfactory rate even after the meal had been moistened and heated at 15 pounds pressure for 30 minutes. The trial was discontinued after 42 days.

PROCEDURE

Four steers and eight lambs were used as experimental subjects to determine the digestibility of dried sweet potatoes when the potatoes were added to a basal ration of alfalfa hay and when they were added to a basal ration of prairie hay supplemented with cottonseed meal. The two basal rations contained the same weight of air-dry feed. The same basal rations were used to determine the digestibility of coarsely ground yellow corn in order that the digestibility of the dried sweet potatoes might be compared to this more widely used concentrate when both were fed under identical experimental conditions.

The dried sweet potatoes were grown on the Oklahoma Vegetable Research Station near Bixby. The potatoes were largely "strings" and "jumbos" of the Porto Rico variety, dug in October and November. They were run through a slicer and spread to sun-dry in layers varying from one to two inches in depth on an abandoned concrete highway pavement. They were turned two or three times and were sacked within 24 to 48 hours after spreading. When sacked they were leathery but would crackle when broken. Approximately three pounds of harvested potatoes were required to produce one pound of the dried product containing about 10 percent moisture. The average yield of sweet potatoes was over 250 bushels per acre, which is equivalent to over two tons of dried feed per acre on land unsuitable for corn.

The corn was No. 3 yellow corn which was coarsely cracked for both the steers and lambs. The alfalfa and prairie hays were of good quality, carried good color, and were quite free of heavy stems and foreign matter.

The steers were grade Herefords and weighed approximately 700 pounds at the start of the experiment. They were stanchioned in raised-bottom stalls and fed and watered twice daily. Block salt was always available. The feces were caught in gutter boxes and transferred to covered metal containers. A two percent aliquot was taken daily and preserved with the aid of thymol and refrigeration at 0° C. The urine was collected by means of a rubber funnel and hose which led to a container beneath the stall. A two percent daily aliquot was acidified with H^2SO^4, treated with thymol, and stored in the refrigerator. Collection periods were of 10 days duration following preliminary feeding periods also of 10 days duration.

The experimental rations fed the steers and the composition of the ration components are given in Table 1. Three experimental rations, designated as rations A, B, and C, were fed in the first series of digestion trials. Ration A was the basal ration composed of prairie hay and cottonseed meal. Ration B was the basal ration plus dried sweet potatoes, and ration C was the basal ration plus corn. Ration G, a maintenance ration of prairie hay and cottonseed meal, was fed at the same time to provide a fourth ration so all rations could be fed the four steers in rotation. The results obtained wtih ration G were used in another investigation. The same procedure was followed in the second series of trials with rations designated as rations AA, BB, and CC. The basal ration AA consisted of alfalfa hay and rations BB and CC contained, in addition, dried sweet potatoes and corn, respectively. The same steers were used in this second series of trials which followed immediately after the first series.

In the digestion trials with lambs, eight grade Rambouillet lambs of range origin were used. They weighed an average of 61 pounds at the start of the experiment. As in the trials with steers, the lambs were fed twice daily during 10-day preliminary and 10-day collection periods. The lambs in groups of four were in individual pens during preliminary periods and in individual false-bottom cages during collection periods. A screen beneath the heavy wire floor of the cages caught the

TABLE 1.—Ration Components and Chemical Composition of Feeds Used in Digestion Trials With Steers.

Feed	Ration Components—(Daily allowance in grams)						Percentage composition of dry matter				
	A	AA	B	BB	C	CC	Crude protein (N x 6.25)	Ether extract	Crude fiber	N-free extract	Organic matter
Prairie hay	2,722	-----	2,722	-----	2,722	-----	4.13	2.18	34.48	52.87	93.66
Cottonseed meal	908	-----	908	-----	908	-----	45.24	6.91	10.01	31.95	94.11
Dried sweet potatoes	-----	-----	3,632	3,632	-----	-----	7.15	1.42	3.65	81.53	93.75
Yellow corn	-----	-----	-----	-----	3,632	3,632	8.73	5.07	2.13	82.61	98.54
Alfalfa hay	-----	3,629	-----	3,629	-----	3,629	16.82	2.09	31.85	42.03	92.79

TABLE 2.—Ration Components and Chemical Composition of Feeds Used in Digestion Trials With Lambs.

Feed	Ration Components—(Daily allowance in grams)						Percentage composition of dry matter				
	D	DD	E	EE	F	FF	Crude protein (N x 6.25)	Ether extract	Crude fiber	N-free extract	Organic matter
Prairie hay	450	---	450	---	450	---	4.69	2.47	33.96	52.47	93.59
Cottonseed meal	150	---	150	---	150	---	44.56	6.22	10.17	33.33	94.28
Dried sweet potatoes	---	---	450	450	---	---	5.38	1.86	4.10	83.32	94.66
Yellow corn	---	---	---	---	450	450	9.72	4.83	2.28	81.50	98.33
Alfalfa hay	---	600	---	600	---	600	16.72	1.51	32.58	41.55	92.36

feces and a funnel shaped pan beneath the screen directed the urine into a collection bottle. Daily collections of feces were dried at 100° C. for 24 hours and stored in an air-tight container. At the end of each collection period the feces were weighed and a representative sample taken for analysis. Daily urine collections were acidified with sulfuric acid, treated with thymol and stored until the end of the collection period when they were measured and sampled for analysis.

The four lambs in each group received the same ration at the same time, one group being in collection cages while the other group was undergoing a preliminary feeding period. Salt was fed at the rate of 15 grams per lamb per day. The ration components and their composition are shown in Table 2. Rations D, E, and F correspond to rations A, B, and C, respectively, of the steer trials.

Proximate chemical analyses of feeds, feces and urine were made by usual methods (Gallup and Hobbs, 1944). In the trials with steers, nitrogen was determined in triplicate on 10-gram samples of wet feces and 5-ml. samples of urine. The hays were sampled daily during collection periods. The concentrate feeds were sampled at the beginning of the trials.

In the trials with lambs, nitrogen was determined on 2-gram samples of air-dry feces and 5-ml. samples of urine. The hays which had been chopped for feeding, and the concentrate feeds were sampled at the beginning of the trials.

The chemical compositions of the experimental rations are given in Table 3.

RESULTS AND DISCUSSION

The dried sweet potatoes were very palatable to both steers and lambs. There were no refusals of feed when the potatoes were included in the ration and only occasional refusals when corn was fed as the concentrate.

The average digestibility of nutrients in the supplemented rations fed to steers and lambs is given in Table 4. With steers, the dry matter of the sweet potato rations was more digestible than that of the corresponding corn rations. This was not true of lamb rations. The different response of these two species seems to be closely associated with the ability of the animals to digest N-free extract from the ration.

TABLE 3.—Composition of Rations Fed to Steers and Lambs in Digestion Trials.

	Ration Description*	Percentage composition of dry matter					
		Dry matter	Crude protein (N x 6.25)	Ether extract	Crude fiber	N-free extract	Organic matter
	Steers						
A	P. hay and C. S. M. (Basal)	92.96	14.22	3.34	28.36	47.74	93.66
AA	Alfalfa hay (Basal)	93.25	16.82	2.09	31.85	42.02	93.54
B	P. hay + C. S. M. +S. P.	91.49	10.74	2.39	16.20	64.37	93.71
C	P. hay + C. S. M. + corn	90.89	11.54	4.19	15.54	64.78	96.05
BB	Alfalfa + S. P.	91.63	12.07	1.76	18.00	61.43	93.26
CC	Alfalfa + corn	91.03	12.87	3.55	17.35	61.82	95.59
G	P. hay and C. S. M.	93.15	10.84	2.95	30.36	49.45	93.60
	Lambs						
D	P. hay and C. S. M. (Basal)	92.27	14.60	3.41	28.05	47.69	93.75
DD	Alfalfa hay (Basal)	88.92	16.72	1.51	32.58	41.55	92.36
E	P. hay + C. S. M. + S. P.	91.01	10.75	3.77	18.05	61.56	94.13
F	P. hay + C. S. M. + corn	90.99	12.56	4.00	17.31	61.79	95.66
EE	Alfalfa + S. P.	90.90	11.87	1.66	20.39	59.42	93.34
FF	Alfalfa + corn	86.41	13.84	2.88	20.10	58.00	94.82

* P. hay=Prairie hay.
C. S. M.=Cottonseed meal.
S. P.=Dried sweet potatoes.

TABLE 4.—Average Digestibility of Nutrients in Supplemented Rations Fed to Steers and Lambs.

	Ration Description	Apparent digestibility of dry matter (percent)					
		Dry matter	Crude protein (N x 6.25)	Ether extract	Crude fiber	N-free extract	Organic matter
		Steers					
B	P. hay + C. S. M. + S. P.	71.9	57.6	67.4	58.6	81.1	74.2
C	P. hay + C. S. M. + corn	66.9	60.2	76.3	58.7	72.8	69.2
BB	Alfalfa + S. P.	76.3	64.8	50.0	58.2	88.4	78.9
CC	Alfalfa + corn	75.5	67.4	67.8	57.2	84.5	76.7
		Lambs					
E	P. hay + C. S. M. + S. P.	65.1	59.8	70.4	48.9	75.8	68.7
F	P. hay + C. S. M. + corn	68.0	64.2	78.5	50.0	77.3	70.8
EE	Alfalfa + S. P.	70.0	58.9	43.0	50.2	83.9	72.6
FF	Alfalfa + corn	72.8	69.2	41.6	49.2	85.0	74.3

The steers digested the N-free extract of the sweet potato rations more efficiently than that of the corresponding corn rations but the reverse was true of the lambs.

Individual data for the digestibility of nutrients in the dried sweet potatoes alone and the corn alone, as determined in trials with steers, are given in Table 5. These values were calculated by difference from individual data secured when the supplemented ration were fed. The individual digestibility values for the basal rations used in these calculations were directly determined. Values secured in a similar manner in the trials with lambs are given in Table 6.

With steers, the digestibility of nitrogen-free extract of dried sweet potatoes was 93.4 percent when fed with a basal ration of prairie hay and cottonseed meal and 98.5 percent with a basal ration of alfalfa. The average of these two is 96.0 percent. Corresponding values for No. 3 yellow corn fed with the same basal rations were 80.1 percent and 92.6 percent, with an average of 86.4 percent.

With lambs, the digestibility of nitrogen-free extract of the sweet potatoes was 87.8 percent when the basal ration of prairie hay and cottonseed meal was fed and 92.4 percent when the alfalfa hay basal ration was fed. The average of these two is 90.1 percent. Corresponding values for corn fed with these two basal rations were 90.3 percent and 94.9 percent, with an average of 92.6 percent.

It appears from the combined results that the nitrogen-free extract (soluble carbohydrate fraction) of dried sweet potatoes is as highly digestible as that of No. 3 yellow corn. The steers, especially, were efficient in digesting nitrogen-free extract of sweet potatoes. Digestibility values obtained for dried sweet potatoes under other conditions are not available for comparison. Morrison's (1936) value of 94 percent for the digestibility of the nitrogen-free extract of corn is slightly higher than the average values obtained for corn in the present study.

Morrison (1936) gives a value of 76 percent for the apparent digestibility of protein in corn. In the present study, values of 60.2 percent and 61.2 percent were obtained with steers and lambs, respectively. Lower and inconsistent values, averaging 50.8 percent and 19.8 percent, were obtained for the protein of sweet potatoes with steers and lambs, respectively. Since in

TABLE 5.—Apparent Digestibility of Nutrients in the Basal Rations and of Dried Sweet Potatoes and Yellow Corn When Added to These Rations; Experiments With Steers.

(Percentages)

Nutrient	Steer No.	Basal rations		Dried sweet potatoes		Cracked yellow corn	
		A pr. hay + C. S. M.	AA Alfalfa hay	B Fed with pr. hay + C. S. M.	BB Fed with alfalfa	C Fed with pr. hay + C. S. M.	CC Fed with alfalfa
Protein	1	66.6	69.1	40.5	44.9	51.4	50.0
	2	68.1	65.4	61.0	52.3	63.1	61.0
	3	59.6	67.6	43.2	68.6	32.3	89.9
	4	65.4	67.3	26.0	70.4	61.7	72.2
	Av.	64.9±2.2	67.4±0.9	42.7±8.36	59.0±7.3	52.1±8.3	68.3±10.2
Ether extract	1	69.3	21.8	80.4	73.5	80.6	82.0
	2	69.5	.6	75.9	89.4	84.4	86.5
	3	63.1	1.0	78.9	102.4	79.0	89.1
	4	62.8	41.7	45.9	139.7	89.1	104.0
	Av.	66.2±2.2	16.3±11.3	70.3±9.6	101.3±16.5	83.3±2.6	90.4±5.6
Crude fiber	1	64.2	60.1	−27.4	178.7	−37.1	216.0
	2	68.8	48.6	58.2	119.7	−136.0	135.8
	3	61.4	42.2	21.5	135.3	−23.9	249.3
	4	66.3	44.9	−23.3	135.1	113.8	172.2
	Av.	65.2±1.8	49.0±4.6	7.3±23.7	142.2±15.2	−20.8±68.0	193.3±28.3
Nitrogen-free extract	1	62.4	72.6	92.3	98.0	78.6	87.3
	2	62.9	70.2	96.6	98.4	84.8	92.9
	3	57.7	67.3	93.1	98.9	71.9	95.9
	4	58.6	67.9	91.6	98.6	84.9	94.4
	Av.	60.4±1.6	69.5±1.4	93.4±1.3	98.5±.02	80.1±3.6	92.6±2.2
Organic dry matter	1	63.4	66.2	83.5	95.4	74.0	85.6
	2	65.8	60.7	92.1	95.4	78.0	90.5
	3	59.5	59.2	86.4	99.5	66.7	99.4
	4	62.0	59.1	81.7	98.0	83.4	94.0
	Av.	62.7±1.6	61.3±1.8	85.9±2.6	97.1±1.1	75.5±4.1	92.4±3.5
Total digestible nutrients							
Dry matter basis		57.4	55.6	81.7	91.4	80.2	94.9
88% dry matter basis		50.5	48.9	71.9	80.4	70.6	83.5

* In calculating these values a coefficient of over 100 was regarded as 100 and one less than 0 as 0.

both corn and sweet potatoes the protein, ether extract and crude fiber are present in relatively small amounts as compared to the amount of nitrogen-free extract, the determination of their respective digestibilities by difference is subject to greater variation and error. Likewise their determination probably is of less importance. It appears, however, that the steers were more efficient than the lambs in the digestion of protein from the sweet potatoes and that for both species the protein of sweet potatoes was less digestible than that of corn.

Interpretation of the results obtained in calculating the digestibility of the protein, ether extract and crude fiber must necessarily take into consideration the associative effect of one feed or nutrient upon another when mixed rations are fed. This effect, so frequently encountered in calculating the digestibility of nutrients in concentrates, will account for negative values and values of over 100 percent. Its significance has been discussed by Mitchell (1942) and Forbes (1943) in recent publications. In the present study, digestibility values of over 100 percent were consistently obtained for the crude fiber of sweet potatoes fed with a basal ration of alfalfa hay to steers. Such results are evidence that the digestibility of the fiber in the basal ration of alfalfa hay was enhanced by the presence of the additional concentrate feed. All other values indirectly calculated for the digestibility of crude fiber in sweet potatoes and corn were extremely variable; they have little significance other than to illustrate the magnitude of the error involved in the determination of digestibility coefficients of nutrients which are present in only small amounts in concentrate feeds.

The digestibility of ether extract was about the same for sweet potatoes as for corn. With steers, these average values for sweet potatoes and corn were 85.8 percent and 86.8 percent, respectively. With lambs, corresponding values averaged 73.4 percent and 78.4 percent.

The digestibility of organic matter in the two concentrates showed a trend similar to that of its major constituent, nitrogen-free extract. In the trials with steers, organic mater digestibility averaged 91.5 percent for sweet potatoes and 84.0 percent for corn. In the trials with lambs, corresponding values were 83.8 percent for sweet potatoes and 87.9 percent for corn.

TABLE 6.—Apparent Digestibility of Nutrients in Basal Rations and Dried Sweet Potatoes and Yellow Corn When Added to These Rations; Experiments With Lambs.

(Percentage)

Nutrient	Lamb No.	Basal rations		Dried sweet potatoes		Cracked yellow corn	
		D Pr. hay + C. S. M.	DD Alfalfa hay	E Fed with Pr. hay + C. S. M.	EE Fed with alfalfa	F Fed with Pr. hay + C. S. M.	FF Fed with alfalfa
Protein	442	66.9	70.0	35.4	— 6.5	55.0	56.2
	452	66.2	72.7	27.2	—18.0	41.0	57.8
	461	68.0	69.5	25.4	25.0	60.2	75.8
	471	64.2	69.8	33.0	14.7	83.9	69.1
	478	67.8	70.9	20.8	—22.8	29.6	49.6
	481	68.7	72.1	39.8	41.0	65.1	69.9
	483	66.3	70.4	33.9	16.6	57.8	64.4
	1322	68.1	71.4	27.8	24.0	64.6	79.3
	Av.	67.0±.9	70.9±.7	30.4±4.0	9.3±14.2	57.2±10.3	65.3±6.4
Ether extract	442	72.9	21.8	95.0	81.8	88.6	64.2
	452	70.9	29.2	93.9	78.2	84.0	69.7
	461	69.1	3.9	54.6	72.1	86.0	77.3
	471	67.3	1.5	46.9	75.1	95.3	72.9
	478	72.8	18.7	77.0	69.3	77.1	61.4
	481	71.4	6.2	69.3	81.1	90.6	72.6
	483	67.9	—9.8	52.0	77.1	85.0	69.9
	1322	73.0	20.8	68.6	81.3	81.5	78.7
	Av.	70.7±1.5	11.5±8.2	69.7±11.5	77.0±2.7	86.0±3.5	70.8±3.7
Crude fiber	442	54.2	48.9	— .6	62.7	—30.6	6.5
	452	48.3	50.6	—30.5	29.5	—52.9	—22.6
	461	51.7	47.0	51.8	85.9	26.3	126.8
	471	55.1	47.6	78.3	99.0	209.1	165.7
	478	47.7	46.4	— 3.7	—60.2	—113.9	—70.6
	481	51.9	50.9	88.0	108.9	88.9	69.9
	483	53.9	50.9	46.9	63.6	25.9	98.0
	1322	48.7	49.8	—34.7	114.0	43.8	51.5
	Av.	51.4±1.8	49.0±1.1	24.4±30.6	62.9±36.0	24.6±61.6	53.2±50.0

Table continued on next page.

TABLE 6.—(Continued)

Nitrogen-free extract	442	64.0	71.7	88.3	90.6	90.4	94.9
	452	56.8	71.4	86.9	89.3	86.3	91.5
	461	63.4	72.1	86.0	95.6	92.7	97.4
	471	63.1	71.5	88.1	96.2	99.4	96.6
	478	57.9	68.1	87.7	83.8	81.3	92.4
	481	61.7	73.3	89.8	95.6	92.6	94.8
	483	59.5	70.9	86.4	93.3	91.1	95.5
	1322	60.3	70.3	88.8	94.6	88.2	95.9
	Av.	60.8±1.7	71.2±.9	87.8±.8	92.4±2.7	90.3±3.3	94.9±1.3
Organic dry matter	442	61.8	62.5	81.6	83.8	84.2	88.2
	452	56.2	63.6	78.5	80.5	78.5	84.9
	461	60.8	61.6	81.5	90.8	87.7	95.6
	471	61.0	61.6	83.8	91.4	100.4	95.0
	478	56.9	60.1	79.7	71.3	72.2	83.5
	481	60.2	64.1	86.5	92.9	89.7	91.3
	483	59.2	62.4	81.0	87.4	86.0	91.9
	1322	58.6	62.4	79.7	91.3	84.7	92.9
	Av.	59.3±1.2	62.3±.8	81.5±1.6	86.2±4.7	85.4±5.2	90.4±2.8
Total dry matter basis		58.6	61.3	78.7	83.3	89.1	92.6
Digestible nutrients 88% dry matter basis		51.6	53.9	69.3	73.3	78.4	81.5

From the results of the digestion trials, the total digestible nutrient content of the basal rations and of the two concentrates was calculated on the dry-matter basis and converted to an air-dry basis (12 percent moisture). Thus the weighted average T. D. N. value of the basal ration of prairie hay and cottonseed meal on a 12 percent moisture basis was 51.2 percent, which is in close agreement with the value of 53.5 percent calculated on the same basis from average figures published in Morrison's (1936) tables. The weighted average T. D. N. value of the basal ration of alfalfa hay on the same basis was 52.2 percent; Morrison's (1936) value for alfalfa hay of similar crude fiber content when calculated to a 12 percent moisture basis is 48.5 percent.

In a comparison of the T. D. N. content of dried sweet potatoes with that of corn, it is perhaps significant that higher values were obtained for both concentrates when they were fed with alfalfa hay than when they were fed with prairie hay and cottonseed meal. Also, the average T. D. N. value obtained for sweet potatoes was about the same as that for corn when these values were calculated from the steer data alone. However, the weighted average T. D. N. value of all trials with both steers and lambs was 72.9 percent for dried sweet potatoes and 79.0 percent for the No. 3 cracked corn. On this basis, the sweet potatoes had a value of 92.3 percent of that of the corn with which it was compared. These comparative values agree closely with those obtained by Grimes (1941) and Darlow and coworkers (1946) when dried sweet potatoes replaced corn in the ration of fattening cattle. The T. D. N. value given by Morrison (1936) for No. 3 corn is 83.2 percent when recalculated to a comparable 12 percent moisture basis.

As a further comparison of dried sweet potatoes with corn, measurements were made of the amount of nitrogen retained by the steers and lambs during the digestion trials when the basal and supplemented rations were fed. The results (Table 7) show that the efficiency of nitrogen utilization by steers and lambs was greatly increased by the addition of either dried sweet potatoes or corn to the basal rations. The percentage of nitrogen intake retained was taken as a measure of nitrogen utilization. These differences in nitrogen retention which favored the supplemented rations were found to be highly significant when treated statistically by the analysis of variance

TABLE 7.—Average Daily Nitrogen Retention of Steers and Lambs Fed the Basal and Supplemented Ration.

Ration compounds		STEERS*			LAMBS**			
	Ration	Nitrogen intake daily (gm)	Nitrogen retained daily		Ration	Nitrogen intake daily (gm)	Nitrogen retained daily	
			Grams	Pct.			Grams	Pct.
P. hay + C. S. M. (Basal)	A	76.8	7.8	10.2	D	13.0	1.7	13.1
P. hay + C. S. M. +S. P.	B	113.8	30.9	27.2	E	16.4	3.8	23.2†
P. hay + C. S. M. + corn	C	120.7	35.6	29.5	F	19.0	4.4	23.2
Alfalfa hay (Basal)	AA	91.1	4.5	4.9	DD	14.3	1.6	11.2
Alfalfa hay + S. P.	BB	128.5	42.3	32.9	EE	17.7	5.0	28.2
Alfalfa hay + corn	CC	135.1	43.6	32.3	FF	20.2	6.7	33.2
Difference in mean required for 5% Pt.	----	----	----	12.3	----	----	----	7.2
Difference in mean required for 1% Pt.	----	----	----	16.7	----	----	----	9.6

* 4 steers.
** 8 lambs.
† Average of 7 lambs.

method (Snedecor 1940). Differences between sweet potatoes and corn in promoting nitrogen retention were not significant.

The lower retention of nitrogen when the basal rations were fed may be in part traced to inadequate energy intake, since higher nitrogen retention values were obtained when a ration containing twice as much prairie hay and the same amount of cottonseed meal was fed to steers. The latter ration, Ration G shown in Table 3, provided a daily intake of 88.0 grams of nitrogen, of which 14.1 grams or 16.0 percent was stored.

Some of the foregoing comparisons have been made between basal and supplemented rations which supplied different amounts of nitrogen (protein) as well as different amounts of energy nutrients and crude fiber. The conclusion that dried sweet potatoes and corn are of equal value in promoting nitrogen retention by ruminants, however, is based on comparisons between rations of similar proximate composition.

SUMMARY

Sweet potatoes prepared for feed by slicing and sun drying were compared with cracked No. 3 yellow corn in a series of digestion and nitrogen balance trials with steers and lambs. The dried sweet potatoes were found to be very palatable to both species of animals.

The apparent digestibility of nutrients in the sweet potatoes and corn was determined by difference when each concentrate was added in similar amounts to a basal ration of prairie hay and cottonseed meal and a basal ration of alfalfa hay.

The digestibility of nitrogen-free extract in the sweet potatoes average 96.0 percent in trials with steers and 90.1 percent in trials with lambs. Corresponding values obtained for corn in trials with steers and lambs averaged 86.4 percent and 92.6 percent, respectively. The apparent digestibility of protein in the sweet potatoes averaged 50.8 percent for steers and only 19.8 percent for lambs; corresponding values secured with corn were 60.2 percent and 61.2 percent, respectively. When fed with alfalfa hay, both concentrates increased the digestibility of crude fiber in the ration.

The weighted average total digestible nutrient content of the dried sweet potatoes calculated from combined data secured with steers and lambs was 72.9 percent on an air-dry basis (12 percent moisture); the value for corn similarly calculated was 79.0 percent. On the basis of total digestible nutrient content the dried sweet potatoes had 92.3 percent the value of No. 3 corn.

Nitrogen retention by steers and lambs was practically the same when the dried sweet potatoes were fed as when corn was fed. Both concentrates when added to the basal rations produced significant increases in the percentage of nitrogen retained by the animals.

LITERATURE CITED

(1) Copeland, O. C.
1941. *Dehydrated Sweet Potato Meal vs. Ground Shelled Corn for Lactating Cows.* An. Rpt. Tex. Exp. Sta.

(2) Cullison, A. E.
1944. *Dried Sweet Potatoes for Finishing Calves.* Miss. Farm Res. Bul. 8, pp. 1-8.

(3) Darlow, A. E., Campbell, W. D., Cross, Frank B., Heller, V. G., and Briggs, H. M.
1945. *Feeding and Grazing Experiments With Beef Cattle.* Okla. Mimeo. Cir. 136, pp. 19-21.

(4) Darlow, A. E., Campbell, W. D., Cross, Frank B., Heller V. G., and Briggs, H. M.
1945. *A Comparison of Dried Sweet Potatoes, Wheat, and Corn for Fattening Steer Calves.* Okla. Exp. Sta. Bul. 296, pp. 39-42.

(5) Forbes, E. B., and Swift, R. W.
1943. *Conditions Affecting the Digestibility and Metabolizable Energy of Feeds for Cattle.* Pa. Agr. Exp. Sta. Bul. 452.

(6) Gallup, W. D., and Hobbs, C. S.
1944. *The Desiccation and Analysis of Feces in Digestion Experiments With Steers.* Jour. Animal Sci., 3:326-332.

(7) Godbey, C. G., and Starkey, L. U.
1942. *Sweet Potato Meal for Fattening Hogs in Dry Lot.* 55th An. Rpt. So. Car. Exp. Sta.

(8) Grimes, J. C.
1941. *Sweet Potato Meal as a Substitute for Corn in Rations for Beef Cattle, Mules, and Hogs.* 52nd An. Rpt. Ala. Polytechnic Inst.

(9) Grimes, J. C.
1942. *Sweet Potatoes and Sweet Potato Products for Fattening Steers.* 53rd An. Rpt. Ala. Polytechnic Inst.

(10) Mississippi Station.
1942. *Dehydrated Sweet Potatoes for Fattening Calves.* 55th An. Rpt. Miss. Exp. Sta. p. 15.

(11) Mitchell, H. H.
1942. *The Evaluation of Feeds on the Basis of Digestible and Metabolizable Nutrients.* Jour. Animal Sci., 1:159-173.

(12) Morrison, F. B.
1936. *Feeds and Feeding; a Handbook for the Student and Stockman.* Ed. 20, unabridged, 1050 pp., illus. Ithaca, N. Y.

(13) Snedecor, George W.
1940. *Statistical Methods Applied to Experiments in Agriculture and Biology.* The Iowa State College Press, Ames, Iowa, pp. 422.

(14) Tennessee Station.
1940. An. Rpt. Tenn. Exp. Sta.