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Comparison of
CANE AND KAFIR SILAGE
for
MILK PRODUCTION

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The sorghums are especially suitable crops for the uplands of Oklahoma. Frequently these crops yield larger quantities of green forage per acre than can be secured with corn. This is often true even when the sorghums are grown on soils suitable for corn. Since the several varieties of sorghums differ considerably in yields of green forage, it is important that investigations be made of their relative feeding value per ton and per acre. The question that is frequently asked is: How does silage made from the sweet sorghums compare with that from the grain sorghums for use in feeding dairy cattle? Since there is little information available for a comparison of the value of these feeds with cows in milk, Dr. C. T. Dowell, director of the Oklahoma Agricultural Experiment Station, suggested that feeding trials be conducted using these feeds.

Associated with the relative feeding value of the sorghums, is the problem of utilization of the grain of these plants. The observation has been made frequently that cattle consuming threshed sorghum grain, dry fodder, and silage, pass appreciable amounts of the whole grain into the manure apparently undigested. A comparison of the whole grain fed in these forms is of some importance in connection with an investigation of the silage.

REVIEW OF LIERATURE

Reed and Fitch (8) compared the value of cane and kafir silage in the rations of five dairy cows during a ninety-day period. The kafir silage proved slightly more efficient than the cane silage for milk production, but the cows receiving cane silage made a greater increase in body weight. From the limited data obtained, these investigators concluded that "cane silage would prove the equal of kafir silage if the grain ration were changed so that the animal would use the nutrients more economically." They called attention to the fact that the sorghums frequently outyield corn, and may have an advantage in milk production per acre of forage used.

At the Kansas sub-station (4, 6) steers were wintered for three consecutive winters on kafir and sweet sorghum silage with a protein supplement. The following average results were observed:

Silage	Yield Per Acre	Average Daily Ration		Beef Produced From Silage	
		Silage	Protein Supplement	Per Ton	Per Acre
Kafir	10.66	27.29	0.98	95.03	1013
Sweet sorghum	16.93	27.55	0.98	81.28	1376
Corn	12.11	27.39	0.98	85.80	1039

Under the Kansas conditions the sweet sorghum silage had the lower feeding value per ton, but yielded so heavily that it was perhaps the more profitable crop per acre.

Blizzard (3) compared the feeding value of amber cane and black hull white kafir silage when used with alfalfa hay and cottonseed meal for fattening steers. The ten steers used in this experiment, which lasted 185 days, made approximately equal gains in weight on the two kinds of silage.

Aicher and McCampbell (1) conducted a ninety-day feeding trial with ten aged steers, divided into two groups, investigating the relative feeding value of cane and kafir silage made from the whole plant and from the stover. Two pounds of cottonseed cake were fed daily per animal, in addition to a full feed of silage, or of dry sorghum hay. The results obtained are summarized in Table I.

Table I. Yields of Forage, and Gains Obtained with Steers at the Fort Hays Branch of the Kansas Agricultural Experiment Station.

Feed used with two pounds of cottonseed cake per steer daily	Yields Per Acre		Gains Per Ton of Sorghum Fed		Gains Per Acre of Sorghums Fed	
	Kafir Tons	Cane Tons	Kafir Pounds	Cane Pounds	Kafir Pounds	Cane Pounds
Fodder (heads on)	3.0	3.5	74.60	88.40	223.80	309.40
Stover (heads off)	2.2	2.9	48.90	84.00	107.58	243.60
Silage (heads on)	9.7	9.8	54.08	61.80	524.58	605.60
Silage (heads off)	7.2	9.2	33.80	53.60	243.36	493.10
Sorghum hay	4.5	4.5	79.00	62.60	355.50	281.70

From this experiment the investigators concluded that cane silage was worth more per ton and per acre than kafir silage, and that a pound of dry matter in either cane or kafir silage was worth between 2 and $2\frac{1}{3}$ pounds of dry matter in dry cane or kafir roughage for fattening mature cattle. This conclusion does not allow for the additional protein supplement consumed per pound of dry matter in silage.

PLAN OF EXPERIMENT

During each of three winters, eight cows were divided into two equal groups on the basis of breed, age, weight, stage of lactation, yield and richness of milk, and used in feeding trials to compare the relative feeding value of cane and kafir silage, as measured by milk production. During the day the cows were exercised in a separate lot where they had access to water, common salt, and special feeding bonemeal. At night they were in stanchions. High wooden partitions were built into the mangers to prevent any loss of feed, and special care was taken to milk, feed and care for the cows on scheduled time.

The feeding trials, which were ninety days in length, were divided into three thirty-day periods, ten days preliminary, and twenty days experimental. The cows were weighed on three consecutive days at the beginning and close of each thirty-day period. Complete records were kept of the feeds consumed or refused, and of milk produced. Records were also secured of the salt and bonemeal consumed by the entire group during each feeding trial. Five-day composite milk samples were secured from each cow in the middle of each twenty-day experimental period, and the butterfat content determined by applying the Babcock test.

The two varieties of sorghums used for comparison in these feeding trials were Early Sunrise kafir and Kansas Orange cane. They were harvested when the grain was turning hard, and ensiled in two hollow tile silos eight feet in diameter. These silages were fed in alternate thirty-day periods, with a basal ration of alfalfa hay, and a mixed grain ration consisting of 400 pounds of wheat bran, 300 pounds of ground oats, 200 pounds of cornmeal and 100 pounds of choice grade cottonseed meal. In calculating the rations for each cow, 10 pounds of alfalfa hay and 30 pounds of silage were fed for each 1,000 pounds liveweight. The roughages were supplemented with sufficient mixed grain to meet the Morrison feeding standard. It was intended that so far as possible, the cows should not lose weight during the experiment.

Samples of silage were secured in the middle of each twenty-day experimental period, and preserved with formaldehyde for the usual chemical analysis, including calcium and phosphorus.

In the course of this investigation, data were secured on the losses of whole grain which occurred when cane and kafir silage are fed to dairy cows. The detailed plans of this investigation (2) were published in Oklahoma Bulletin 164, "Utilization of the Grain in Kafir and Cane Silage by Dairy Cows."

PRESENTATION OF DATA

The silage crop was obtained from the Animal Husbandry department, and although no record of yields for the particular samples could be obtained, a record of yields for the same varieties grown under comparable conditions was secured from the Agronomy department, and from the outfield experimental fields (7) over the state. In 1925, the kafir silage contained little grain, and hence was of lower quality as shown by the chemical analyses in Table III.

Table II. Yields of Green Forage per Acre Obtained from Early Sunrise Kafir and Kansas Orange Cane

Variety and Source	1925 Tons	1926 Tons	1927 Tons	Average Tons
Early Sunrise kafir from experiment station farm .....	.....	4.18	6.42	5.30
Kansas Orange cane from experiment station farm .....	.....	7.37	12.51	9.94
Kansas Orange cane from outfield experimental plots	8.26	12.40	10.58	10.41

Note: Data relative to yields obtained on the outfield experimental plots over the state were secured from H. C. Pojts.

Table III. Chemical Analyses of Early Sunrise Kafir and Kansas Orange Cane, Used in Feeding Trials.

Year	Water %	Crude Protein %	Crude Fiber %	Crude Fat %	Nitrogen- free Extract %	Total Ash %	Calcium (CaO) %	Phosphorus (P ₂ O ₅) %
EARLY SUNRISE KAFIR								
1925*	77.40	1.20	6.56	0.60	12.82	1.43	0.080	0.089
1926	69.19	2.08	7.47	1.29	18.30	1.66	0.114	0.113
1927	70.49	2.00	6.47	1.08	18.10	1.86	0.087	0.099
Average	72.36	1.76	6.83	0.99	16.41	1.65	0.094	0.100
KANSAS ORANGE CANE								
1925	76.74	1.46	7.07	0.55	12.92	1.26	0.091	0.062
1926	69.17	1.96	7.71	1.24	18.32	1.60	0.120	0.093
1927	72.38	1.74	6.81	0.98	16.73	1.36	0.116	0.097
Average	72.76	1.72	7.20	0.92	15.99	1.41	0.109	0.094

*Early Sunrise kafir contained little grain in 1925. It will be noted that the crude fat and crude protein were low due to the small grain content in that year.

Individual records of the dairy cows used in the feeding trials were kept in detail, but it seemed unnecessary to present them separately. Data obtained from three cows which became ill, were discarded, and only those obtained from twenty-one animals were used. In order to offset the natural decline in milk yield caused by advancing lactation, the results obtained in the first and third experimental periods of each feeding trial were averaged, and considered equivalent to those obtained in the second* or middle experimental period of each trial. The use of two lots of cows, one lot receiving each of the two rations being compared, largely eliminated variations in production caused by climatic changes during the course of the investigation. The method of

conducting the feeding trial is shown graphically in Table VI, and the data computed from the records of the feeding trials are presented in Table V.

Table IV. Plan of Conducting a Feeding Trial According to the Standard Double-Reversal Method.

Experimental cows No.	Period I ten : twenty days days: experimental	Period II ten : twenty days days: experimental	Period III ten : twenty days days: experimental
1			
2	kafir silage	basal ration	basal ration
3	plus	plus	plus
4	basal ration	cane silage	kafir silage
5			
6	basal ration	basal ration	basal ration
7	plus	kafir silage	plus
8	cane silage	plus	cane silage

Detailed records were kept during the ten-day preliminary feeding periods, but were not used in computations. The formula used in the computation of results was as follows:

$$\frac{\text{Period I} + \text{Period III} + \text{Period II}}{2} = \text{Summary of results.}$$

This method of computation was applied to the figures obtained with each of the two kinds of silage, and the results obtained are shown in Table V.

Table V. Summary of Feed Consumption, Production of Milk, Butterfat and Changes in Body Weight.

Year	No. of Cows	Changes in Body Weight		Grain lbs.	Total Feed Consumption		Kafir Silage lbs.	Milk lbs.	Production Butterfat lbs.
		Gain lbs.	Loss lbs.		Alfalfa lbs.	Cane Silage lbs.			
1925	7	96	....	1255	1440	4924	.....	3018.1	128.5
1926	8	208	....	1360	1735	5254	.....	3321.5	139.9
1927	6	11	....	960	1109	3426	.....	2126.8	104.1
1925	7	....	3	1260	1452	.....	4939	3083.1	125.9
1926	8	260	....	1360	1700	.....	5232	3342.9	138.9
1927	6	81	....	960	1124	.....	3407	2192.1	98.3

During the three feeding trials, the consumption of common salt and of finely ground feeding bonemeal was observed to average 2.306 and 0.86 pounds per cow per month.

The changes in body weight as presented in Table V, are for thirty-day periods, while all other records are taken from the twenty-day experimental periods only. Since data on feed consumption, milk and butterfat production during each of the ten-day preliminary periods are omitted, one-third of the change in body weight is credited to this part of the feeding trial in the final computations, and is therefore omitted in Table VI.

Table VI. Relative Feeding Value of Early Sunrise Kafir and Kansas Orange Cane Silage, as Computed from Three Feeding Trials with Dairy Cows.

Year	Kafir Silage lbs.	Feed Consumption Pounds of Silage Cane Silage lbs.	Per 100 Pounds of Silage		Production Per 100 Pounds of Silage Consumed		
			Alfalfa Hay lbs.	Grain lbs.	Milk lbs.	Butterfat lbs.	Body Weight lbs.
1925	100	....	29.40	25.51	62.42	2.55	-0.04
	....	100	29.23	25.49	61.29	2.61	1.29
1926	100	....	32.49	25.99	63.88	2.65	3.31
	....	100	33.03	25.89	63.22	2.66	2.64
1927	100	....	32.99	28.18	64.34	2.89	1.59
	....	100	32.37	28.02	62.08	3.04	0.21
Weighted Average	100	....	31.49	26.29	63.47	2.67	1.55
	....	100	31.49	26.28	62.24	2.74	1.54

The cows in the first feeding trial were used to obtain data concerning the amount of whole grain in cane and kafir silage that is utilized. The losses of whole grain into the manure when these silages are fed have been compared to similar losses previously observed at this station (5) in feeding threshed kafir and kafir heads to cattle, and the results presented in Table VII.

Table VII. Losses of Sorghum Grain when Fed Whole to Cattle.

Kind of Feed	Type of Animal	Whole Grain Voids in Manure %
Early Sunrise kafir silage	Dairy cows	49.46
Kansas Orange cane silage	Dairy cows	33.91
Blackhull white kafir heads	Two-year-old steers	58.7
Threshed grain, dry	Two-year-old steers	58.3
Threshed grain, soaked	Two-year-old steers	62.0

Comparisons of the two varieties of sorghums on the acreage basis, as presented in Tables VIII and IX, show that the Kansas Orange cane yields considerably more nutrients and have a far greater feed value than Early Sunrise kafir per acre.

Table VIII. Yield of Nutrients Obtained per Acre with Early Sunrise Kafir and Kansas Orange Cane.

	Yield of Silage Per Acre	Crude Protein	Crude Fat	Nutrients Per Nitro-free Extract	Acre Calcium (CaO)	Phosphorus (P ₂ O ₅)
	tons	lbs.	lbs.	lbs.	lbs.	lbs.
Early Sunrise kafir	5.30	186.5	104.9	1,739.4	10.0	10.6
Kansas Orange cane	9.94	341.9	182.9	3,178.8	21.6	16.7

Table IX. Yield of Milk and Butterfat per Acre of Silage.

Silage Crop	Silage lbs.	Feed Required		Milk lbs.	Computed Production	
		Alfalfa Hay lbs.	Mixed Grain lbs.		Butterfat lbs.	Gains in Body Weight lbs.
Kafir	10,600	3,338	2,787	6,728	283.0	164.3
Cane	19,880	6,260	5,224	12,373	544.7	306.2

DISCUSSION OF RESULTS

The relative value of cane and kafir silage is shown in the results obtained in three feeding trials conducted with dairy cows at the Oklahoma Agricultural Experiment Station.

Chemical analyses (Table III) showed silage made from the two varieties of sorghums to be similar in content of feed nutrients. However, the Kansas Orange cane outyielded Early Sunrise kafir (Table II) and produced more digestible nutrients per acre (Table VIII). The importance of mineral matter in dairy rations was recognized in this investigation. The calcium and phosphorus content of these two silages are published (Table III) for the first time.

Although the rations employed in these feeding trials are commonly believed to supply adequate mineral matter for dairy cows of average producing ability, yet the cows used in this investigation were found to consume of their own free will, nearly nine-tenths of a pound of finely ground feeding bonemeal per cow per month. In addition to this, they were observed to consume an average of 2.3 pounds of common salt each per month.

While receiving kafir silage, the cows produced more milk and maintained their body weight better, though greater butterfat yields (Table VI) were obtained when the cows were receiving cane silage. The differences in each instance were very slight, within the range of experimental error, and are therefore probably not significant. However, on the basis of yield of feed nutrients per acre (Table VIII) Kansas Orange cane had a decided advantage over the variety of grain sorghum employed in this investigation.

The fact that whole sorghum grains are utilized more completely when fed as silage than when fed in the head, threshed or soaked, (Table V) is of importance in obtaining the greatest benefit from the crop.

SUMMARY AND CONCLUSIONS

1. Silage made from Early Sunrise kafir and from Kansas Orange cane were found to have approximately equal feeding value, pound for pound.
2. Chemical analysis of Early Sunrise kafir showed it to be slightly superior to the Kansas Orange cane.
3. Because of the greater yield per acre, the cane is to be preferred to kafir in the production of total feed nutrients.
4. The whole grain in sorghum silages, when fed in this form, is utilized more completely than the unground dry or soaked grain fed separately in the grain ration.
5. The calcium and phosphorus contents of these two kinds of silage were determined, and are reported for the first time.
6. The amount of common salt and of special feeding bonemeal consumed per cow per month on these rations, was 2.3 pounds and 0.86 pounds, respectively.

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