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OKLAHOMA
AGRICULTURAL EXPERIMENT STATION
CHEMISTRY DEPARTMENT
STILLWATER, OKLAHOMA

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A CHEMICAL STUDY OF BROOM CORN AND BROOM CORN SILAGE

BY C. T. DOWELL AND W. C. FRIEDEMANN

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A CHEMICAL STUDY OF BROOM CORN AND BROOM CORN SILAGE

BY C. T. DOWELL AND W. G. FRIEDEMANN

Oklahoma is the leading state in the production of broom corn. One hundred and seventy-five thousand acres were planted to broom corn in this State in 1917. The production for that year was 26,250 tons of brush. This represents over 50 per cent of the total quantity (Farmers' Bulletin No. 958) of brush produced in the five leading broom corn states. In spite of the importance of this crop to the State, nothing seems to have been done in the way of determining the value of the stalk and the seed for feeding purposes. The plant has been grown for the brush and the seed and stalk has been a more or less waste product.

It was our purpose in undertaking this study to determine the composition and digestibility of the broom corn seed; to prepare silage from the broom corn stalk, to determine its digestibility, and also to determine the composition of the ash of the stalk. In connection with these the main purposes of the study the sugar content of the stalk has been determined, the percentage of prussic acid in the plant, and the amount of tannin in the whole plant and in the seed.

It is stated on page 15 in Farmers' Bulletin No. 768 that broom corn may be used either as a silage or as dry ruffage, and that broom corn stover is thought to be worth as much as sorghum stover or corn stover. However, we have been unable to find that any experiments have been carried out whose purpose was to determine the relative feed value of these substances; nor have we been able to find any reference to experimental work on broom corn silage. The statement is made in Farmers' Bulletin 174, page 17, that, "In some sections, notably in California, the seed is allowed to ripen before the crop is harvested and about a ton of seed per acre thus being obtained which is used as a feed for hogs and poultry or it is ground into meal and used as a breadstuff for making "griddle cakes." It seems to be the practice in this state to pull the tops, to allow the stalk to stand, and to use the field later as a pasture. After the main top or head is pulled a number of small heads usually come out and reach maturity before the field is used as a pasture in the fall.

The heads are thrashed and since they are pulled before they are quite ripe the seeds undergo heating when left in a pile as is usually done and are rendered unfit for feeding purposes. In order to prevent this heating the seed have to be stirred from time to time in order to expose them to air and allow them to dry. We thought that there was no good reason why these immature seed could not be used with the stalk to produce silage and this we have shown to be true.

We filled one of our two-ton experimental silos with broom corn stalks just after the heads had been removed in order to determine whether or not this substance could be preserved in this way. Another two-ton experimental silo was filled with the stalks after the second small heads had come out and were practically mature. We found that in both cases the material was kept in good condition, that it had a pleasant odor, and that sheep ate it with as much or more relish than they did grain sorghum silage.

BROOM CORN SEED

The composition and digestibility of broom corn seed are shown in Table No. 1. For the purpose of comparison we include an analysis of darso in the table. (See Bulletin No. 132 of this Station).

TABLE NO. I

	Water	Ash	Protein	Fiber	N. Free Extract	Fat
Broom corn seed	10.06	4.27	13.37	9.04	59.62	3.64
Darso	11.72	1.93	11.76	3.82	57.47	3.30
Digestion coefficient of Darso			56.5		84.0	68.9
Digestion coefficients of broom corn seed			33.9		69.2	91.9

The composition of the stover from broom corn with second head, the composition of the silage made from the green plant, and the digestion co-efficients of this silage are shown in Table No. 2.

TABLE NO. II

	Water	Ash	Protein	Fiber	N. Ext.	Fat
Broom corn stover	11.7	6.82	8.60	38.99	36.96	1.46
Broom corn silage	80	1.85	1.30	6.82	9.77	0.23
Digestion coefficient of broom corn silage	*51.5	48.5	36.4	49.9	55.3	68.9

*Dry matter.

The only comment needed on this table is that the digestion coefficients for the silage are the result of a trial with one sheep. On account of a mistake made in the experiment the results obtained with the other two sheep were considered unreliable and were, therefore, not included. For a description of the crates in which the sheep were kept during this digestion trial, see Bulletin No. 132 of this Station.

PRUSSIC ACID

A sample of the broom corn was cut on July 6th when it was beginning to head and the prussic acid was determined. The method used was that of precipitating the acid as prussian blue and weighing the ferric oxide formed by burning the precipitate (C. T. Dowell, Journal of Agricultural Research, Vol. 16, page 175). The amount of prussic acid found, using the whole plant, was .0098 of one per cent. This shows that the amount of acid present is about the same as is found in the grain sorghums at the corresponding stage of growth. It would be expected that the young plant would contain a much larger amount.

ASH ANALYSIS

Analysis of the ash of the broom corn plant cut at the time of the beginning of heading and also the analysis of the ash of kafir cut at the corresponding stage of growth are shown in Table No. 3.

These analyses show that the ash from broom corn contains more silicon dioxide than does kafir and it contains decidedly less potash.

TABLE NO. III

	Broom Corn	Kafir
SiO_2	46.75	30.53
Fe & Al oxides	4.85	1.01
P_2O_5	4.12	6.02
$S\ O_3$	3.91	3.36
Mn_3O_4	.21	.17
CaO	7.83	4.75
MgO	3.83	4.59
K_2O	25.00	39.32
Na_2O	.79	1.56
Cl	3.96	4.90

SUGAR, AICOHOLS AND ACIDITY

The sugars, alcohols and acidity of the whole plant were determined according to well known methods and are shown in Table No. 4.

TABLE IV

Reducing sugars	1.60%
Total sugars	1.85%
Sucrose	.25%
Volatile Acidity, 1.0 cc. of N/10 NaOH per 100 g.	
Nonvolatile Acidity, 40.0 cc. N/10 NaOH per 100 g.	
Alcohols, none	
Soluble nitrogen (N × 6.25%)	= 1.84%
Total nitrogen ((N × 6.25%	= 5.28%

TANNINS

The determination of the tannins in broom corn plant and also in broom corn seed were made. The results are given in Table No. 5. We determined the tannins by two methods and found what would appear to be a large amount, both in the whole plant and in the seed. It is quite evident to one who has attempted to apply the known methods of tannin determination to determine tannins in feeds and plants, where there is only a small percentage present, that the probable error is very large and that the percentage of tannin found is undoubtedly too high. It is our purpose to try to work out a method that will be suitable for the determination of tannins in feeds and other substances where there is only a small amount present.

TABLE NO. V

	Lowenthal method	Lowenthal-Proctor
Broom corn plant	0.20%	0.19%
Broom corn seed	0.58%	0.86%

DISCUSSION

A comparison of the composition of broom corn seed with that of the grain sorghums shows that it is not quite so good a feedstuff from this standpoint as are the grain sorghums. The digestion co-efficients compare favorably with those of the grain sorghums. This same statement may be made with respect to broom corn silage and grain sorghum silage. The digestion co-efficients of the dry matter of broom corn silage and kafir silage are 51.6 and 55.5 respectively. The latter figure is taken from Henry & Morrison's book, "Feeds and Feeding." There has been objection raised to darso, broom corn and other feedstuff on account of the high percentage of tannin contained. We do not know, as already stated, the percentage of the tannin present in either of these feeds, but we know that broom corn contains more tannin than does either of the

common grain sorghums. We have made a search of the literature and have failed to find where any experiments have been carried out to determine the effect of tannin upon the digestibility and nutritive value of feedstuff. It might be expected that if they were present in large amounts that they would have a harmful effect, but it is doubtful whether or not any appreciable harm would be done when they are present in such small amounts as are found in nearly all feedstuffs.

It is our intention to carry out some experiments to determine the effect of tannins upon the digestibility and nutritive properties of feeds. The work we have done would suggest the desirability of some feeding experiments to determine the feeding value of broom corn feeds.