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SOME CHEMICAL CHARACTER- ISTICS OF SOFT CORN

Agronomy Department

By

ALFRED BUSHEY

**AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE OF
AGRICULTURE AND MECHANIC ARTS**

Brookings, South Dakota

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SOME CHEMICAL CHARACTERISTICS OF SOFT CORN

Agronomy Department

By
ALFRED BUSHEY

The problem of soft corn is one which periodically demands attention and an early frost in the fall of 1923 provided a considerable quantity of soft corn in eastern South Dakota.

It seems, from inquiries received, and from the experience of a number of men who fed frosted corn during the past winter, that results obtained do not agree. Some farmers are of the opinion that in feeding their soft corn they lost almost the sale value of the corn, finding that hogs in particular made such slight gains that the feed consumed returned nothing. On the other hand, men whose corn was frosted on the same night seemed to have no trouble in securing gains in weight of livestock, to which they fed such corn.

The question of what constitutes soft corn, is one which is not easily answered. One station (Ia. Exp. Sta. Circ. 40, 1917) defines it as follows: "Generally speaking, soft corn is corn that runs anywhere from 25 to 65 per cent moisture. Sometimes, however, corn with a moisture content under 25 per cent may be considered as relatively soft corn, when compared to hard, mature corn." In the same publication the value of soft corn as feed is assumed to be equal to normal corn when fed in sufficient quantity to make up for the greater amount of water in soft corn. In other words, from the results, it would seem that when soft corn is dried to the normal water content of mature corn, which is about 12 per cent, the feeding value would be about equal.

In the above trials the ration was balanced with tankage and it is noted that the hogs on the soft corn ration consumed 50 per cent more tankage than on the mature corn ration, which leads one to wonder what would have been the result of feeding the corn without tankage. Not all feeders in South Dakota balance the ration with tankage. We

also have the practical experience of one man who found his frosted corn produced very unsatisfactory gains even when supplemented with tankage.

The frosted corn which we have seen in South Dakota this year does not present the characteristics noted above. In most cases it was examined in the crib, and very little mould was present. At the time it was being fed it really contained less moisture than the normal, as will be noted in Table I.

Purdue Experiment Station (Jr. Am. Chem. Soc. XLI, No. 8) describes some of the chemical characteristics of soft corn as compared to mature; "the amide or non-protein nitrogen content, and acidity in soft mouldy corn are quite high. From data presented it would appear that the amide nitrogen might be taken as a basis on which maturity may be determined."

On August 22, 1923, a frost occurred over small areas in eastern South Dakota. The damage to corn varied from very slight to killing as evidenced by the appearance of the foliage. For the following six weeks there was no frost in this region, which allowed corn ample time to mature.

On October 17, samples of corn, Nos. 1, 3, and 5, were secured from three fields which had been frosted, and No. 8 from one which had not.

Inquiries from farmers of South Dakota and varying results reported from feeding frosted corn during the past winter, prompted the Agronomy Department to attempt to get some insight into the composition and nature of this corn. Samples Nos. 6 and 7 were secured from crib in May.

Some of the physical appearances of a few representative ears of each sample may be noted in Figures 1, 2, and 3. The numbering of samples in the figures corresponds to the laboratory numbers, indicated above.

Composite samples of each were used for the following determinations:

TABLE I

Sample	Color		Physical characteristics	% Moisture (time of analysis)	% Protein	% Ash	% Oil (ether extract)	Total starch	Crude fibre	Germination
1	Yellow	Frosted	Shriveled, cob soft, kernels shriveled	7.89	11.68	1.97	4.37	74.00	4.00	None
3	Yellow	Frosted	Most ears shriveled, cobs, usually soft, very few discolored kernels	11.53	12.63	1.59	2.99			Weak 50%
5	White	Frosted	Most ears shriveled, cobs soft, very few discolored	9.71	12.62	1.55	1.96			Normal 90%
6	Yellow	Frosted	Very few ears shriveled	12.97	10.87	1.28	4.02			Normal 98%
7	Yellow	Not frosted	Normal	12.24	13.25	1.10	3.67	71.00	3.00	100%
8	Yellow	Not frosted	Normal	9.21	10.68					

It will be noted from the foregoing Table I that there is little difference in total crude protein between frosted and normal corn. Frosted corn contains a higher per cent of ash, similar starch, high crude fibre, and a varying oil (ether extract) content.

Corn is characterized as a feed for livestock and in noting its nutritive deficiencies which have been extensively studied, the lower per cent of protein than contained in most grains and lower ash content are most noteworthy.

The protein of corn is not a simple substance but is made up of a number of nitrogen bearing compounds which chemists usually classify according to their solubility in various solvents as, amide, albumens, globulins, glutelin, and zein.

Of these, glutelin and globulin are said to be complete proteins in that they furnish all the amino acids necessary for growth and maintenance, while in zein at least two amino acids, namely lysine and tryptophane, are said to be absent. Amide nitrogen is usually assumed to have no nutritive value.

In view of the importance of the various protein fractions, it is of interest to note their distribution in the samples examined.

TABLE II
Characteristic Proteins of Corn

Sample	Total protein	Percent total protein				
		Amides	Albumin	Globulin	Glutelin	Zein
1.....	11.68	10.42	11.24	11.02	48.28	18.03
3.....	12.62	3.60	8.15	9.28	55.07	23.89
5.....	12.62	2.24	6.06	9.48	59.98	22.20
6.....	10.87	5.10	7.88	8.52	50.50	28.00
7.....	13.25	2.50	5.80	6.13	62.27	23.30
8.....	10.86	2.21	6.70	6.55	58.36	26.17

From the above it is evident that soft corn is high in amide, albumin, and globulin nitrogen; low in glutelin, with a zein content which is variable.

In a feed which is normally low in desirable proteins the reduction by even a small amount of the glutelin and the increase of compounds of questionable value would apparently be noticeable in the results obtained in the feed lot.

The above data would indicate that the question of what is soft corn and what is its value as feed would not be easily answered from the physical appearance and also that the value of frosted corn will vary with each sample. The stage of maturity at which the injury occurs probably determines more than any other factor the value of the produce.

The question of the kind of corn which may be expected to fully mature under South Dakota conditions might be mentioned at this time. Quite often the increased yield of soft corn from large varieties is assumed to justify the use of large late corn when earlier corn would have matured. It is possible that smaller yields of mature corn would be more profitable in the feed lot than larger yields of soft product.

* * *

It is also of interest to note that corn with some of the characteristics of frosted corn may be produced by hail.

From a field of corn which had its leaves largely stripped by a hail storm in August, samples were secured in October. The corn had ample time to mature before frost and the portions of the field which were not damaged produced normal corn. Some analyses of samples from the hailed and unhailed portions are recorded in Table III.

TABLE III
The Characteristic Proteins of Corn

	Total protein %	Amide N %	Albumin	Globulin	Glutelin	Zein
Hailed (1)	9.62	4.33	8.96	12.98	49.33	24.4
(2)	8.81	5.40	8.77	13.89	57.40	20.59
Normal	10.86	2.21	6.70	11.55	53.36	26.07

Corn varies in chemical composition even when allowed to mature normally, but it would seem that anything which impedes the normal development produces a corn with less of the desirable proteins, which in turn might be expected to impair the feeding value.

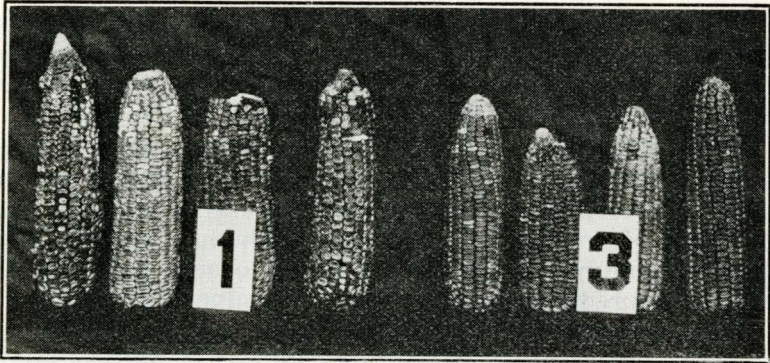


Figure 1. Frosted corn

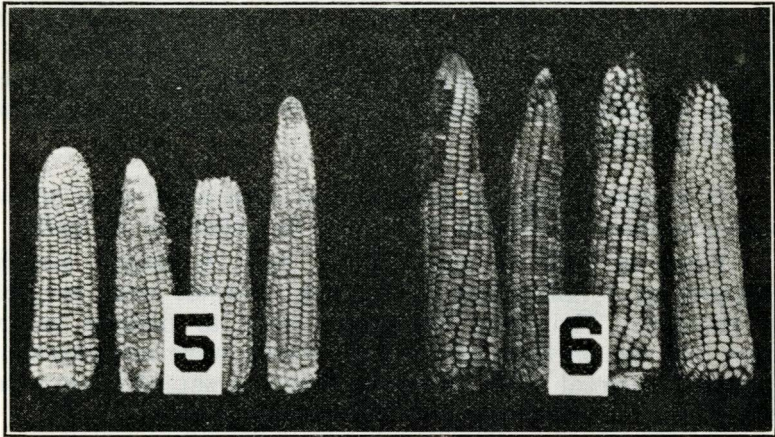


Figure 2. Frosted corn

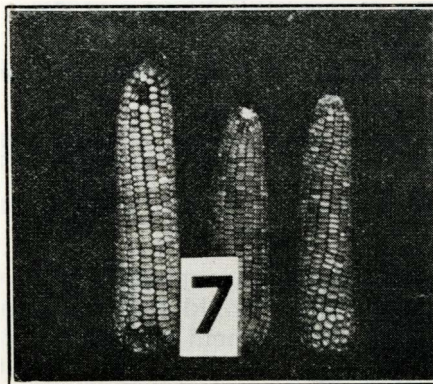


Figure 3. Corn matured without frost