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# THE UTILIZATION OF SOFT CORN IN BEEF CATTLE FEEDING

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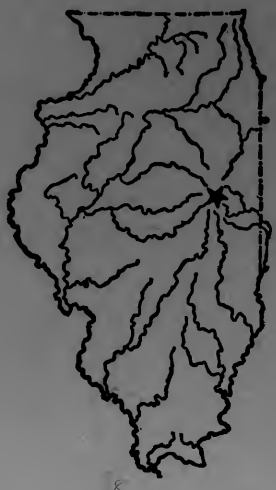

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# THE UTILIZATION OF SOFT CORN IN BEEF CATTLE FEEDING

By H. P. Rusk, Chief in Cattle Husbandry, and R. R. Snapp, Associate Chief in Beef Cattle Husbandry

The extent and importance of the soft-corn problem vary from year to year because of climatic conditions and differences in the time that corn is planted. The problem becomes serious and of national importance in occasional seasons when late planting is followed by a cool, wet summer terminated by an early frost. Since 1900 there have been six soft-corn years; namely, 1902, 1907, 1915, 1917, 1924, and 1927. The most serious losses occurred in 1917, when the U. S. Department of Agriculture estimated[1] that only 57 percent of the corn in the twelve principal corn-producing states was mature at the time of the first killing frost.

The importance of the soft-corn problem has long been recognized and numerous studies of its different phases have been made at the University of Illinois. The early studies pointed to the need for a comprehensive series of investigations that would correlate the results of previous studies and make systematic inquiry into other phases as rapidly as possible. The backward season of 1924, together with heavy frosts during October, was responsible for a large amount of soft corn in the vicinity of the Experiment Station and provided ample material for starting such studies. Accordingly the different phases of the problem were outlined and those having to do with the storing and drying of corn were undertaken by the Departments of Agronomy and Farm Mechanics working cooperatively, and those having to do with the chemical composition of soft corn and its feeding value were undertaken by the Department of Animal Husbandry. The work on the first part of the problem is still under way and only tentative recommendations concerning the relative value and practicability of the various methods of storing and drying can be made.[2]

The studies undertaken by the Animal Husbandry Department, pertaining to the composition and feeding value of soft corn, while in

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[1]National Stockman and Farmer, 41, 835. 1917.

[2]For brief statements of the results of these experiments, see the Thirty-Eighth Annual Report of this Station for 1924-25, page 141; the Fortieth Annual Report, page 217; and Circular 293, "Soft Corn, How to Store and Feed It," issued in 1924.

no wise complete, have led to five general conclusions which are discussed in this bulletin, namely:

1. The high moisture content of soft corn reduces the capacity of steers for total dry matter and retards the rate of gain as compared to that of cattle on a full feed of sound corn.

2. The belief that dry matter in well-preserved soft corn has fully as high a nutritive value, pound for pound, as the dry matter in sound, mature corn apparently is well founded.

3. The feeding value of an acre of soft corn should be judged by the amount of dry matter in the grain rather than by the stage of maturity.

4. The keeping qualities of ear-corn silage are comparable to those of normal silage.

5. The conversion of soft corn into ear-corn silage is suggested as probably the most effective method of storing such corn for cattle-feeding operations. This conclusion is based upon the physical appearance of such silage, its chemical composition, and the results of its use in feeding trials.

## FEEDING TESTS WITH MATURE STEERS

In the feeding tests started in the fall of 1924 by the Illinois Station four forms of soft corn were used; namely, shocked corn, standing corn pastured in the field, broken ear corn, and ear-corn silage.

*Cattle Used.*—Steers weighing approximately 1,000 pounds were chosen as best adapted to the tests because of their large capacity for a rather bulky ration and because of the possibility of putting them in market condition with a relatively short feed. Another reason for using mature steers rather than yearlings or calves was the lack of any shelter in the lots where the cattle were to be fed save the protection afforded by a large, untrimmed hedge along the west side of the lots. Mature cattle, it was felt, would suffer less from the unavoidable exposure than younger animals and would be ready for market before the heavy weather that usually prevails in February and early March.

The cattle were selected from a drove of 70 western-bred Hereford steers purchased on the Kansas City market October 13, 1924. They were all fed and handled alike from the time they arrived at the Station farm on October 15 until October 25, when the experimental feeding period began. These cattle graded from good to choice and cost on the Kansas City market $7.25 per hundredweight. Freight, feed consumed during the preliminary period, and a slight loss in weight brought their total cost to $8 a hundredweight in the lots at the beginning of the test.

FIG. 1.—THE STEERS AT THE BEGINNING OF THE TEST

This group is representative of the quality and condition of the steers in all the lots when started on experiment. They were selected from a drove of western-bred Herefords and weighed approximately 1,000 pounds.

*Rations Fed.*—Since methods of harvesting and storage are among the most important problems connected with feeding soft corn, the experiment was planned to yield information on the effects of various methods of handling the crop on its value as a feed for cattle. With this purpose in mind the following rations were fed to the six lots of cattle included in the experiment, each lot consisting of 10 steers:

| *Lot 1* | *Lot 2* |
|---|---|
| Shocked corn (soft) | Standing corn (soft) pastured in the field |
| Linseed meal | Linseed meal |
| Alfalfa hay | Alfalfa hay |
| *Lot 3* | *Lot 4* |
| Broken ear corn (soft) gathered from the field as needed | Old broken ear corn (mature) |
| Linseed meal | Linseed meal |
| Alfalfa hay | Alfalfa hay |
| *Lot 5* | *Lot 6* |
| Ear-corn silage (soft) | Ear-corn silage (soft) |
| Linseed meal | Oats |
| Alfalfa hay | Linseed meal |
| | Alfalfa hay |

*Field Selection of the Soft Corn.*—The soft corn fed as shocked corn and ear-corn silage and that pastured was grown in a field of 38.47 acres immediately adjoining the Station farm. Approximately one-fourth of the field was cut and set up in small, carefully constructed shocks for Lot 1. An equal area was fenced for pasturing by Lot 2. The remainder of the field was snapped and made into ear-corn silage for Lots 5 and 6. Considerable care was exercised to secure as fair a division of the field as possible. It was the opinion of those

who made the division that if there was any difference in prospective yield it was in favor of the areas to be shocked and pastured.

The broken ear corn used by Lot 3 was from another field of soft corn and appeared to be a little less mature than that used by the other soft-corn lots, altho moisture determinations did not indicate

FIG. 2.—FEED EQUIPMENT FURNISHED ALL LOTS

The only shelter for the steers was supplied by the high hedge fence shown here. The pastured lot did not have this to protect them.

any significant difference. It was a large, late-maturing variety that gave promise of a large yield before it was killed by the frost. Corn was taken from this field every few days as needed in the feeding operations.

A moderately heavy frost on the night of October 1 completely killed all corn in the low areas of both fields and caused more or less scattering damage to the corn on the higher ground. When harvesting operations began 15 days later, the husks, leaves, and stalks of the corn on the low ground were brown and dry while many of those on the high ground were still fresh and green. Since the field was divided in such a way as to include a proportionate share of high and low ground in the area set aside for each lot, no difficulty arose from the unequal ripening of the corn at the two ends of the field.

Harvesting of the area to be cut and shocked and of that to be made into ear-corn silage began on October 16 and was finished by October 20. Taken as a whole, the fodder was rather too dry to make first-class shock corn, while the ears gathered for ear-corn silage showed somewhat less maturity than that usually possessed by corn when made into ordinary silage.

The old corn fed to the steers in Lot 4 was sound corn from the previous season's crop. It contained on the average less than 14 percent of moisture and would have graded No. 2 or No. 3 if shelled.

*Condition of Soft Corn.*—The soft corn used in this experiment was too immature to husk and crib in the customary way. It is unsafe to crib corn with more than 25 percent moisture content, and this corn at the beginning of the feeding test ran from about 37 percent moisture for the ears in the shocked corn fed Lot 1 to 45 percent in the broken ear corn fed Lot 3. Thruout the test, at intervals of approximately two weeks, samples for dry-matter determinations were taken of all corn as it was fed. In the case of the corn that was being pastured, representative assortments of ears and nubbins were taken from different parts of the field. The results of these dry-matter determinations are shown in Table 1.

TABLE 1.—PERCENTAGE OF DRY MATTER IN CORN (EARS ONLY) FED TO STEERS DURING EXPERIMENT

| Principal kind of corn fed | Lot 1 Shock corn | Lot 2 Corn standing in field | Lot 3 Corn husked as needed | Lot 4 Old ear corn | Lots 5 and 6 Ear-corn silage[1] (ears and husks) |
|---|---|---|---|---|---|
| Date of sampling (1924) | | | | | |
| Oct. 30 | 62.87 | 55.52 | 54.64 | 87.11 | 42.5 |
| Nov. 14 | 69.42 | 72.37 | 71.05 | 92.73 | 46.76 |
| Nov. 29 | 58.40 | 67.56 | 56.48 | 80.55 | 34.77 |
| Dec. 13 | 71.76 | (Fed same | 63.16 | 86.80 | 41.96 |
| Dec. 26 | 72.24 | corn as | 62.89 | 86.50 | 39.76 |
| (1925) | | Lot 3 | | | |
| Jan. 3 | 69.78 | after Dec. | 70.95 | 87.52 | 39.92 |
| Jan. 10 | 72.86 | 10) | 69.23 | 83.42 | 36.81 |
| Jan. 17 | 68.66 | | 65.06 | 86.51 | .... |
| Weighted average | 67.52 | 68.90 | 65.30 | 86.37 | 40.32 |

[1]The dry-matter content of the husked ears as put into the silo was 44.77 percent; that of both husks and ears at the time of siloing was 39.47 percent. Of the total weight of material siloed, 78.66 percent represented the husked ears and 21.34 percent represented the husks and shanks.

There was some drying out of the corn during the course of the experiment. However, the moisture content of the last samples, which were taken on January 17, ran from a little more than 30 percent to approximately 35 percent. As has been stated, there was considerable variation in the maturity of the fields when caught by the frost, and it therefore is not surprising that the samples show considerable variation in moisture content. On the other hand, the variations are not large, and the data as a whole appear to add to the evidence that corn which is killed by frost will not dry out at anything like a normal

rate.[1] It is a matter of common observation that corn which has reached maturity and started to dry out normally will drop from 35 or 40 percent moisture to 20 percent in the course of a few weeks of normal fall weather. But in the case of both of the fields of standing corn used in this experiment, as well as in the case of the shocked corn, the moisture content remained abnormally high until the middle of January, when observations were discontinued.

Contrary to expectations there was very little spoilage in any of the forms of soft corn fed. Some heating and molding occurred in the first few loads of husked corn brought in for Lot 3, and it was necessary to follow the precaution of bringing in only two or three days' supply at one time until cold weather arrived, and even then it was found not to be safe to pile up more than a week's supply for the ten cattle. This of course necessitated husking and hauling the corn in from the field in some extremely bad weather, when sleet, snow, and ice in the fields and on the corn made the cost of gathering very high. While the corn left on the stalk in the field kept perfectly, and apparently was damaged by bad weather to no greater extent than sound corn under similar conditions, the difficulty experienced in always keeping a supply on hand renders this method of handling soft corn impractical after the arrival of winter weather unless there is other corn to feed during periods when it is difficult to obtain the soft corn from the field.

The fact that there was so little spoilage of ears in the shocked corn was especially surprising.[2] It was feared that this corn might start to rot before the experiment was well under way, but either the small, well-constructed shocks preserved it much better than was anticipated or the season was unusually favorable for this method of storage. The investigators are inclined to believe that they were unusually fortunate in the weather conditions encountered and hesitate to recommend shocking as a safe method of preserving immature corn which has so high a moisture content as this corn had.

*Other Feeds Used.*—The oats fed to the steers in Lot 6 were from the 1924 crop and were slightly discolored but otherwise sound. Oats were added to the ration of this lot because the climatic conditions which retard the spring and early summer growth of corn often are favorable to the production of heavy yields of oats. Continued wet weather thru oats harvest results in discoloration and consequent reduction of market value of the crop, making information on its utilization with soft corn very desirable.

Alfalfa hay and linseed meal were fed in approximately the same amounts to all lots, since it was desired to reduce variables to differ-

[1]See Table 6 also.

[2]Veterinarians attributed the death of three horses on an adjoining farm to the consumption of some soft corn that had molded in the shock.

ences in the grain ration. Previous experience with ear-corn silage led the investigators to suspect that some good legume roughage might have a greater physiological value when fed in conjunction with soft corn than its generally recognized feeding value would indicate. The alfalfa was chopped by running it thru a silage cutter, and this chopped hay and the linseed meal were mixed with the grain at the time it was fed. The chopping of the hay was done partly in order to facilitate weighing and sacking but principally to prevent waste and assure an equal consumption of hay and linseed meal by all cattle in each lot.

The steers in Lot 2 that were pastured were started in dry lot and fed snapped corn from the pasture area for the first nine days of the experiment, at the end of which time they were eating 28 pounds of soft corn daily. This was regarded as practically a full feed. On the tenth day of the experiment they were turned into the field and not removed except for weighing until the corn was practically gone. The acreages set aside for this lot and for Lot 1, which received shocked corn, were not sufficient to complete the test and were therefore supplemented with corn from the same field that furnished the corn for Lot 3.

### Cattle Make Satisfactory Gains on Soft Corn

All lots of cattle were started on feed October 25, 1924. The initial feed was at the rate of 10 pounds of alfalfa hay and 1 pound of linseed meal per head per day plus approximately one-fourth of a full feed of one of the various forms of corn.

The steers in Lots 2, 3, and 4 were started on 7 pounds of broken ear corn per head daily, while those in Lot 1 were fed an amount of fodder that contained approximately 7 pounds of corn. Lot 5 was given 30 pounds of ear-corn silage and Lot 6, 20 pounds of ear-corn silage plus 6 pounds of oats.

By the end of the first week of the feeding period the steers fed soft ear corn were consuming an average of 24 pounds per head daily, while those fed old corn had been "stuck" on 20 pounds and their ration therefore had been reduced in order to make them clean up their feed. After the first few feeds the steers receiving ear-corn silage refused to clean up until the hay was reduced from 10 pounds to 4 per head daily. There was no further difficulty in getting any of the lots on full feed, and all steers except one in Lot 3 showed keen appetites thruout the experiment.

Some difficulty was experienced with frozen corn and silage during the coldest weather but not enough to affect the results seriously. A summary of the results of this feeding trial is shown in Table 2.

All lots of cattle in the experiment made satisfactory gains. As was to be expected, the old corn produced the most rapid gains. This,

TABLE 2.—RESULTS OF FIVE METHODS OF FEEDING SOFT CORN TO MATURE STEERS
(October 25, 1924, to January 13, 1925, 80 days)

| 10 steers in each lot | Lot 1 Shock corn | Lot 2[1] Corn standing in field | Lot 3 Corn husked as needed (broken ear) | Lot 4 Old ear corn (broken) | Lot 5 Ear-corn silage | Lot 6 Ear-corn silage plus oats |
|---|---|---|---|---|---|---|
| | *lbs.* | *lbs.* | *lbs.* | *lbs.* | *lbs.* | *lbs.* |
| Average initial weight | 978.5 | 972.0 | 974.0 | 980.0 | 980.5 | 983.0 |
| Average final weight | 1 234.5 | 1 233.0 | 1 230.0 | 1 261.5 | 1 248.5 | 1 262.0 |
| Average gain | 256.0 | 261.0 | 256.0 | 281.5 | 268.0 | 279.0 |
| Average daily gain | 3.20 | 3.26 | 3.20 | 3.52 | 3.35 | 3.49 |
| Average daily feed | | | | | | |
| Ear corn | 26.40 | 40.68 | 31.48 | 25.59 | .... | .... |
| Linseed meal | 1.88 | 1.88 | 1.89 | 1.89 | 1.89 | 1.89 |
| Oats | .... | .... | .... | .... | .... | 6.00 |
| Normal silage | .... | .... | .... | .... | .... | .... |
| Ear-corn silage | .... | .... | .... | .... | 45.43 | 38.43 |
| Alfalfa hay | 2.46 | 2.60 | 2.70 | 2.70 | 2.35 | 2.43 |
| Feed per cwt. gain | | | | | | |
| Ear corn | 825 | 1 247 | 984 | 727 | .... | .... |
| Linseed meal | 59 | 58 | 59 | 54 | 56 | 54 |
| Oats | .... | .... | .... | .... | .... | 172 |
| Normal silage | .... | .... | .... | .... | .... | .... |
| Ear-corn silage | .... | .... | .... | .... | 1 356 | 1 102 |
| Alfalfa hay | 77 | 80 | 84 | 77 | 70 | 70 |
| Dry matter in corn and cob per cwt. gain | 555 | 859 | 642 | 628 | (534)[2] | (592)[2, 3] |
| Pork produced per steer | 35.0 | 22.2 | 12.2 | 22.0 | 6.0 | 5.8 |
| Pork produced per cwt. corn | 1.66 | .68 | .48 | 1.07 | 3.30 (per T.) | 3.77 (per T.) |
| Selling price per cwt. at Chicago, January 27[4] | ($9.65) | ($9.65) | ($9.35) | ($9.85) | ($10.00) | ($9.85) |
| Shrinkage between feed lots and market, percent | (4.55) | (5.44) | (4.50) | (4.96) | (4.91) | (5.19) |
| Dressing percentage | (60.46) | (60.80) | (60.02) | (60.56) | (60.66) | (60.73) |

[1]Figures for Lot 2 are for a 58-day period; see explanatory note in connection with Table 3. [2]Based on dry matter in husked ears when put into the silo. [3]In oats and ear-corn silage. [4]As the ear-corn silage was exhausted at the end of 80 days, the test is reported for that period. However, all lots were continued on feed 10 days longer, soft, broken ear corn being substituted for ear-corn silage in Lots 5 and 6.

however, appeared to be due to a larger consumption of dry matter rather than to a difference in the quality of the dry matter. Considered on the basis of the amount of dry matter consumed for 100 pounds of gain, the soft-corn lots, with the exception of Lot 2 which was pastured, made the best showing, tho the differences in favor of the soft-corn lots are not large except in the case of Lot 5 fed ear-corn silage.

The calculated consumption of 40.68 pounds of ear corn per head daily by the pasture lot is based on the assumption that there was as

FIG. 3.—LOT 1, FED SOFT CORN FROM THE SHOCK, AT END OF TRIAL

After 90 days on soft corn these cattle carried a good to choice finish and dressed 60.46 percent in Chicago.

much dry matter per acre in the ears in this field as in the area made into ear-corn silage. This amount of dry matter plus the weight of the moisture in the ears while the field was pastured was taken as the weight of the ear corn utilized by the cattle.

The high consumption of corn charged to the pastured lot undoubtedly represents considerable wastage. Theoretically the corn wasted by the cattle should have been utilized by the hogs which were kept in the field for this purpose. This was not the case, however, in spite of the fact that 20 thrifty pigs weighing approximately 125 pounds each occupied the field while the cattle were there and for 26 days thereafter. The failure of the hogs to make economical use of this down corn is explained partly by the fact that snow and sleet hindered its recovery and partly by the fact that the ground, after being trampled by the cattle and then frozen, was much of the time so rough that the hogs refused to forage for more than enough to maintain themselves. In fact, the pork production in all lots was probably considerably reduced by the alternate muddy and frozen condition of the ground.

TABLE 3.—COMPUTED AMOUNTS OF BEEF AND PORK SECURED PER ACRE WITH VARIOUS FORMS OF SOFT CORN FED TO MATURE STEERS

| | Lot 1 Shock corn | | Lot 2 Corn standing in field | | Lot 3 Corn husked as needed | | Lot 5 Ear-corn silage | |
|---|---|---|---|---|---|---|---|---|
| | Cattle | Hogs | Cattle | Hogs | Cattle | Hogs | Cattle | Hogs |
| Total gain, 80 days, pounds | 2 560 | 350 | 1 880[2] | 179[2] | 2 560 | 122 | 2 680 | 60 |
| Acreage of corn used from own area | 9.06 | .... | 9.46 | .... | .... | .... | 9.40 | .... |
| Additional corn fed, pounds | 3 050 | .... | 3 230 | .... | 25 180 | .... | .... | .... |
| Acreage equivalent of corn fed | 1.60 | .... | 1.27 | .... | 10.87 | .... | .... | .... |
| Total acreage of corn fed to cattle and hogs | 10.66[1] | .... | 10.73[2] | .... | 10.87[3] | .... | 9.40[4] | .... |
| Gain per acre, pounds | 240.2 | 32.8 | 175.2 | 16.7 | 235.5 | 11.2 | 285.1 | 6.4 |

[1]Beginning with December 27 ear corn from the same source as that fed Lot 3 was used to supplement the shock corn, the 9.46 acres of shock corn originally assigned to this lot proving insufficient to last the full 80 days. Altogether 3,050 pounds of this ear corn was fed, containing as much dry matter as the ears from 1.6 acres of shock corn. In converting these ears to a shock-corn basis, the feeding value of the corresponding stover is ignored. Since, however, cattle given a full feed of corn in the form of shock corn receive a great surplus of roughage, the resulting error is thought to be insignificant.

[2]These gains are figured for but 58 days. The area of standing corn in which Lot 2 was pastured was practically exhausted on December 10, 46 days after the experiment began. Beginning on that date this lot was fed additional corn from the same source as Lot 3. Twelve days later the cattle were removed to the dry lot for finishing. Before removal from the field, Lot 2 had been fed 3,230 pounds of soft ear corn having a calculated dry-matter content of 2,036 pounds. The dry matter in the ears of standing corn was assumed to be the same as in the ears gathered from an equal area for ear-corn silage, or 15,067 pounds of dry matter for the 9.46 acres pastured. Hence it was calculated that the total corn used by the cattle and hogs in this lot during the 58-day period was equivalent to 10.73 acres of standing corn.

[3]The corn eaten by Lot 3 was obtained from a field where the ears were larger and the yield higher than in the field furnishing the corn for the other soft-corn lots. The area charged against this lot is therefore calculated by dividing the total weight of dry matter in the corn eaten, by the amount of dry matter per acre in the ears made into ear-corn silage. While this method is not exact, it is believed to be satisfactory for this comparative study.

[4]This is actual area of silage fed. Of the silage harvested from 19.68 acres of soft corn, 48.1 percent was used for Lot 5 and 40.7 percent for Lot 6. Lot 6 is not brought into this table because the use of oats in that lot makes any comparison on an acre basis of doubtful value.

The gains made by the hogs in the lots fed ear-corn silage were smaller than expected, but the relation between the pork production in those lots and in the other lots was in line with expectations. With the exception of Lot 1, where the larger pork production was undoubtedly due to the cattle throwing fodder out of the bunks, the gains on the hogs were much lower in the five lots receiving soft corn than in the one lot receiving mature corn.

### Ear-Corn Silage Proves Most Economical Form

One of the most interesting and significant phases of this study is the comparison it affords of the gains on cattle and hogs produced from an acre of soft corn harvested in different ways (Table 3).

As measured by total gain per acre, pasturing soft corn in the field was by far the least efficient method of feeding used in this experiment. From the standpoint of labor saved in harvesting and feeding, it was the most effective method. However, when the extra labor involved in getting this badly trampled field into shape for planting the following spring is considered, the advantage in the labor saved is not so apparent. The results of this single test appear to be unfavorable to this method of using soft corn.

By far the largest gains produced per acre were made by the steers receiving ear-corn silage. Altho this lot involved the largest expenditure of labor in harvesting and entailed by far the greatest investment in machinery and equipment, the sum total of evidence from this test indicates that the use of ear-corn silage is the most economical method of utilizing soft corn. There was practically no more labor involved in the harvesting and feeding of the ear-corn silage than in the harvesting and feeding of the shock corn, but the investment in equipment was of course much larger when the corn was fed as silage.

Under the weather conditions that prevailed during this experiment, the shocked-corn method of feeding proved very satisfactory when the total beef and pork produced per acre are considered. This method, however, probably entails the greatest risk of spoilage of any of the methods used in this investigation. Hauling soft corn direct from field to feed lot is fairly satisfactory if the only consideration is the amount of meat produced, but it is not satisfactory from a labor standpoint after bad weather sets in.

### Sound Corn Made Better-Looking Beef

In order to observe the quality of beef produced by soft corn, the wholesale rib cut from one side of each steer in Lot 3, fed soft corn, and in Lot 4, fed sound corn, was shipped from Chicago to the University for study.

As stated in the Thirty-Eighth Annual Report of this Station, "based on appearance, the quality of beef from steers that were fed sound corn was superior to that from steers fed soft corn. The carcasses were passed on by a number of packing house men and retail meat dealers who knew nothing of the feed the cattle had eaten. All of them preferred the sound-corn cattle. The marbling and coloring of the beef in these carcasses were much better than in those produced on soft corn. In addition, the meat was firmer. However, chemical analysis of the ribs did not show any difference in water and fat content between the beef from the two groups. There was no difference in the palatability of the two kinds of beef."

## SOFT EAR-CORN SILAGE VS. SHELLED CORN FOR CALVES

Very satisfactory results were secured from the use of soft corn in the form of snapped ear-corn silage in a 200-day feeding trial with calves during the season of 1926-27. Good to choice, high-grade Hereford feeders from southwest Texas were used. They had not been accustomed to grain when started on experiment.

Twenty-five steer calves were selected and divided into two lots. Lot 7, including 15 calves, was fed a ration of ear-corn silage, cottonseed meal, and alfalfa hay. Lot 8, containing 10 calves, was fed a ration of No. 5 shelled corn, cottonseed meal, normal silage, and alfalfa hay.

Both lots were started on experimental feed December 25, 1926. Lot 7 was started on 10 pounds of ear-corn silage, 1 pound of cottonseed meal, and 2 pounds of alfalfa hay per head daily. Lot 8 received 2 pounds of shelled corn, 1 pound of cottonseed meal, 10 pounds of normal silage, and 2 pounds of alfalfa hay per head daily. The allowances of ear-corn silage and shelled corn were rapidly increased until the calves were on full feed.

Cottonseed meal was fed to both lots at the rate of 1 pound per head daily until the consumption of shelled corn in Lot 8 reached 7 pounds; thereafter the cottonseed meal was fed to both lots at the rate of 1 pound to 7 pounds of shelled corn consumed by Lot 8.

Alfalfa hay was fed in both lots at the rate of 2 pounds per head daily thruout the experiment.

### Calves on Ear-Corn Silage Made Slightly Cheaper Gains

The ear-corn silage was put up in the fall of 1925 and the silo had not been open in the intervening 15 months. It had kept perfectly and the calves relished it from the beginning.

During the first 140 days the calves in Lot 7 consumed an average of 18.08 pounds of ear-corn silage per head daily; this was equivalent to approximately 8 pounds of shelled corn. During the same period calves in Lot 8 consumed an average of 9.07 pounds of shelled corn

per head daily, not including the corn contained in the normal silage. The average daily gain in Lot 7 was 2.25 pounds for the first 140 days and 2.52 in Lot 8 for the same period. It appears, therefore, that the calves receiving soft corn in the form of ear-corn silage made slightly better use of the corn in the ration than the calves receiving shelled corn.

At the end of 140 days' feeding, Lot 7 was divided. Ten of the calves, designated as Lot 7a, were continued on the original ration. Five calves, designated as Lot 7b, were given shelled corn in addition

FIG. 4.—FEEDER CALVES USED IN 1926-27 EXPERIMENT

This is the shelled corn lot after 126 days. The ear-corn silage lot made somewhat more efficient, tho not quite so rapid, gains.

and the allowance of ear-corn silage was reduced about one-third. The addition of shelled corn to the ration increased the total consumption of corn for the entire period but failed to increase the rate of gain.

The estimated value placed on these cattle by a committee composed of commission men and packer buyers from the Union Stock Yards, Chicago, at the close of the experiment was $11.25 for the steers fed soft corn in the form of ear-corn silage thruout the test, Lot 7a, and $11.15 for the steers in Lot 7b that received shelled corn in addition to ear-corn silage during the last 60 days. However, the steers that received shelled corn for the last 60 days shipped better, outsold the straight ear-corn silage lot 25 cents per hundredweight, and outdressed them 1.7 percent (Table 4).

Two steers in Lot 7a became very sick about ten days before the close of the experiment. One of these steers was removed from the lot on July 5 and the other on July 9. One died a few days later and the other was killed for autopsy. The cause of their illness was not

TABLE 4.—SOFT EAR-CORN SILAGE VS. SHELLED CORN FOR FATTENING CALVES
(December 25, 1926, to July 13, 1927, 200 days)

| Cost of cattle in lots per cwt.. $9.90 | Lot 7<br>15 steers<br>140 days | Lot 7a<br>10 steers<br>200 days | Lot 7b<br>5 steers<br>200 days | Lot 8<br>10 steers<br>140 days | Lot 8a<br>7 steers<br>200 days |
|---|---|---|---|---|---|
| Average initial weight, pounds | 377.6 | 361.8 | 409.0 | 376.0 | 379.1 |
| Average final weight | 692.6 | 807.5[1] | 830.7 | 728.5 | 849.5 |
| Total gain per head | 315.0 | 443.6[1] | 421.7 | 352.5 | 470.4 |
| Average daily gain | 2.25 | 2.18 | 2.11 | 2.52 | 2.35 |
| Average daily ration, pounds | | | | | |
| Shelled corn | .... | .... | 5.38[8] | 9.07 | 10.08[3] |
| Cottonseed meal | 1.36 | 1.48 | 1.76[8] | 1.36 | 1.48 |
| Ear-corn silage | 18.08 | 20.16 | 16.93[8] | .... | .... |
| Normal corn silage | .... | .... | ....[8] | 8.14 | 8.08 |
| Alfalfa hay | 2.00 | 2.00 | 1.09[8] | 2.00 | 2.00 |
| Dry matter per head daily, pounds | 11.89 | 13.01 | 15.31[8] | 12.72 | 13.66 |
| Feed per cwt. gain, pounds | | | | | |
| Shelled corn | .... | .... | 77 | 360 | 428 |
| Cottonseed meal | 60 | 68 | 70 | 54 | 63 |
| Ear-corn silage | 804 | 920 | 841 | .... | .... |
| Normal corn silage | .... | .... | .... | 323 | 343 |
| Alfalfa hay | 89 | 92 | 82 | 79 | 85 |
| Total dry matter per cwt. gain, pounds | 527.9 | 594.6 | 612.4 | 504.4 | 579.7 |
| Feed cost per cwt. gain | $ 7.38 | $ 7.79 | $ 8.23 | $ 7.18 | $ 8.32 |
| Necessary selling price per cwt. in lot | $ 8.55 | $ 8.66 | $ 9.05 | $ 8.58 | $ 9.03 |
| Estimated value per cwt. in lot[2] | $ 9.05 | $11.25 | $11.15 | $ 9.65 | $11.85 |
| Estimated value per head in lot | $62.68 | $90.84 | $92.63 | $70.30 | $100.67 |
| Gain of hogs per steer, pounds | .... | .... | .... | 15.8 | 37.5 |
| Corn fed hogs per steer, pounds | .... | .... | .... | 15.50 | 42.37 |
| Income from hogs per steer (9c per pound) | .... | .... | .... | $ 1.23 | $ 2.85 |
| Return per head above initial cost of cattle and feed | | | | | |
| Excluding pork | $ 3.44 | $20.91 | $17.44 | $ 7.76 | $23.98 |
| Including pork | .... | .... | .... | $ 8.99 | $26.83 |
| Bushels of corn fed per head | 20.24 | 32.26[4] | 34.14 | 22.70 | 36.00 |
| Corn fed per cwt. gain, shelled basis, pounds | 359.8 | 407.3 | 453.4 | 360.6 | 428.6 |
| Return per bushel of corn | $ .92 | $ 1.39 | $ 1.25 | $ 1.07 | $ 1.36 |
| Market slaughter data, Chicago | | | | | |
| Weight per head (July 19), pounds | .... | 774.0[5] | 802.0 | .... | ([5]) |
| Shrinkage July 13-19, pounds | .... | 36.0 | 28.7 | .... | .... |
| Shrinkage July 13-19, percentage | .... | 4.44 | 3.45 | .... | .... |
| Selling price per cwt., Chicago | .... | $12.10 | $12.35 | .... | .... |
| Net proceeds per head[7] | .... | $90.24 | $95.64 | .... | .... |
| Net returns per cwt. on July 13 weight | .... | $11.14 | $11.51 | .... | .... |
| Dressing percentage | .... | 58.9 | 60.6 | .... | .... |

[1]Eight steers only; one steer removed July 5 and one July 9 owing to sickness. [2]The shelled corn was of only fair quality and would grade No. 4 or No. 5. [3]Estimated Chicago value less $1.00 per cwt. [4]On a dry-matter basis the ear-corn silage contained the equivalent of 16 bushels of No. 1 corn per ton of silage. [5]Five head only; 3 steers from Lot 7a were retained for futher feeding. [6]Lot 8a was slaughtered at Urbana. [7]Gross proceeds less $3.41 per head marketing expense. Feed prices used in calculation: shelled corn 70 cents a bushel, cottonseed meal $40 a ton, ear-corn silage $12 a ton, normal corn silage $5 a ton, alfalfa hay $20 a ton. [8]The average daily ration given for Lot 7b is for the last 60 days only; the feed consumed by these calves during the first 140 days is the same as for Lot 7.

definitely determined but symptoms were suggestive of *otitis media*.[1] No evidence involving any part of the ration was found. However, in order to eliminate the ration as a possible factor in this trouble, three of the calves were not shipped when the experiment was finished but were retained on the ration of ear-corn silage, cottonseed meal, and alfalfa hay until September 20, another 69 days. During this time these calves continued in perfect health and made slightly larger gains than three similar calves retained from Lot 8a fed shelled corn.

Three of the calves in Lot 8 receiving a ration of shelled corn, cottonseed meal, normal silage, and alfalfa hay were removed from the experiment at the end of 140 days for slaughter in connection with another phase of the investigation. The remaining 7 steers in this lot continued to make more rapid gains than the calves on ear-corn silage. At the end of 200 days these 7 steers in Lot 8a had put on a total gain of 470.4 pounds per head, or an average daily gain of 2.35 pounds, while the steers in Lot 7a had made a total gain of 443.5 pounds per head, or an average daily gain of 2.18 pounds.

While the rate of gain in both lots was satisfactory, the steers in Lot 8a that received shelled corn showed a noticeably higher finish and were valued 60 cents more per hundredweight than the calves that received ear-corn silage. It should be noted, however, that when the labor involved in feeding, interest charges and equipment charges are disregarded and all profits are credited to the corn fed, the returns per bushel in the two lots are practically the same. On the basis of 16 bushels of corn per ton of ear-corn silage, the steers in Lot 7a consumed an average of 32.26 bushels of corn in 200 days and returned $1.39 per bushel. The steers in Lot 8a consumed 36 bushels of corn per head, not counting the corn in the normal silage, and returned $1.36 per bushel. On the basis of a total consumption of 32.26 bushels of corn, Lot 7a required 407.3 pounds of corn (shelled basis) per hundredweight of gain and Lot 8a required 428.6. This difference, however, is not significant.

### Dry Matter in Grain of Ear-Corn Silage Proved Equal to Dry Matter in Shelled Corn

The grain fed the ear-corn silage lot was calculated on a No. 1, 14 percent moisture basis while that fed the shelled-corn lot graded No. 5 and contained an average of 17.4 percent moisture. When corn required per hundredweight gain is calculated on a water-free basis, the figures are 350.2 pounds for the ear-corn silage lot and 353.9 pounds for the shelled-corn lot. It is also significant that the difference in the consumption of total dry matter per hundredweight of gain in these

[1]An inflammation of the middle ear sometimes terminating in inflammation of the brain.

two lots is less than 2 percent, or well within the limits of experimental error.

These facts are further evidence in support of the belief that the dry matter of soft corn has practically as high feeding value pound for pound as the dry matter of mature corn. The sum total of the evidence from this experiment indicates that in calf-feeding operations soft corn, in the form of well-preserved ear-corn silage, when properly supplemented, may return as satisfactory results as No. 3 shelled corn fed under similar conditions.

## Shelled Corn Produced Higher Finish Carcass

The cattle from the ear-corn silage lot which were slaughtered at the end of the 200-day feeding period dressed 59.5 percent in Chicago. At the same time all but three of the shelled-corn lot were slaughtered at the Experiment Station. It is not possible to make a comparison of dressing percentages because of differences in shrinkage before slaughter. However, inspection of the carcasses by the grading committee of the U. S. Department of Agriculture indicated that the shelled-corn lot carried a higher finish and had a firmer eye of beef.

The remaining three steers from each lot that were continued on experiment until the ear-corn silage was exhausted on September 29 were slaughtered at the Experiment Station. Feed and water were withheld for 24 hours, and final weights were taken just before slaughter. On the basis of these weights and cold carcass weights, the dressing percentages were 62.0 percent for the shelled-corn lot and 60.2 percent for the ear-corn silage lot. While all of these carcasses graded choice, the shelled-corn lot showed the higher finish and a firmer lean as judged by the lean in the eye of beef.

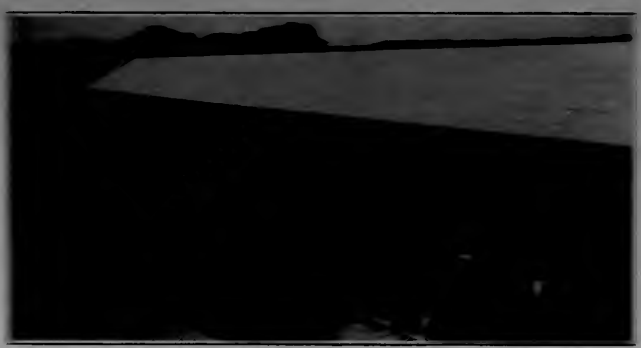

Fig. 5.—Experimental Unit in 1926–27 Cost Feeding Test.

Each shed unit is 26 by 20 feet, with an outside paved lot measuring 26 by 28 feet.

## EARLIER TESTS WITH EAR-CORN SILAGE

The results of the two feeding experiments reported in the preceding pages are, for the most part, in accord with the results of several preliminary investigations previously conducted. While the preliminary tests were too short to be conclusive, the results are nevertheless of interest and value because they add weight to the conclusions drawn from the main investigation.

### Good Results With Weanling Calves

The first feeding trial with ear-corn silage at the University of Illinois was conducted in the fall of 1906. A small amount of silage was made from green-snapped ears and used in a short preliminary feeding test beginning about two weeks after the ear corn was silved. During the week of October 14 to 20 one lot of 10 weanling calves was given a ration of shelled corn, linseed meal, and normal corn silage. The following week no shelled corn was fed, and normal silage was gradually replaced with snapped ear-corn silage. During the week when the transition from normal silage to ear-corn silage was made, the average daily gain of the calves was 2.5 pounds. These calves received, during the following 29½ days, an average daily ration of 20.1 pounds of ear-corn silage, 1.47 pounds cottonseed meal, and .36 pound of oat straw. Through this period they made an average daily gain of 2.59 pounds.

Considering the fact that 20 pounds of ear-corn silage containing 60 percent moisture is equivalent only to about 6.5 or 7 pounds of grain on a shelled-corn basis, the results were regarded as quite satisfactory.

Encouraged by the promising results obtained in this test in 1906, a more comprehensive study was planned for the following year. A concrete silo 12 by 40 feet was nearly half-filled with silved green ears during the first week of October.

The silo was opened the latter part of January, 1908, and the ear-corn silage was fed to 20 high-grade Shorthorn steer calves for the following 100 days. Except for a nitrogenous supplement (linseed meal, which was fed at the rate of approximately 1½ pounds a day) no other material was fed during this period.

As a check on this ration a lot of 10 similar calves was started at the same time on shelled corn, linseed meal, and normal corn silage, or what might be called a normal or standard corn-belt ration for fattening calves. A summary of the results of the two lots is shown in Table 5.

The calves receiving ear-corn silage made an average daily gain of 2.20 pounds for the 100 days, while those receiving shelled corn gained 2.95 pounds. The difference in the gains is accounted for by

TABLE 5.—SOFT EAR-CORN SILAGE VS. SHELLED CORN FOR FATTENING CALVES
(January 26 to May 16, 1918, 110 days)

| | Soft ear-corn silage 20 calves | No. 5 Shelled corn 10 calves |
|---|---|---|
| | *lbs.* | *lbs.* |
| Average initial weight | 490.5 | 490.0 |
| Average daily gain for 110 days | 2.20 | 2.95 |
| Average daily ration | | |
| Ear-corn silage | 28.32 | .... |
| Shelled corn | .... | 12.82 |
| Linseed meal | 1.51 | 2.56 |
| Normal silage | .... | 18.52 |
| Calculated dry matter per day | 13.09 | 18.23 |
| Feed per cwt. gain | | |
| Ear-corn silage | 1 289 | .... |
| Shelled corn | .... | 434 |
| Linseed meal | 69 | 87 |
| Normal silage | .... | 597 |
| Calculated dry matter per cwt. gain | 595 | 618 |

NOTE—The calves used in this experiment were high-grade Shorthorns.

the difference in the consumption of dry matter. The moisture content of the ear-corn silage averaged 58.6 percent. Hence the ration of 28.32 pounds of ear-corn silage and 1.51 pounds of linseed meal amounts to only 13.09 pounds when reduced to a dry-matter basis, while the dry matter in the ration of the other lot amounts to 18.23 pounds. The total dry matter per hundredweight gain was then almost identical for the two lots.

Unfortunately data on the percentage of husks and shanks were not secured on this silage, and it is therefore impossible to calculate the dry matter in the grain portion. It is obvious, however, that the husks, shanks, and cobs contained a considerable portion of the total dry matter and it appears certain that when reduced to equal moisture basis there was considerably less grain fed to the ear-corn silage lot than to the shelled-corn lot. If we assume that the percentage of husks and shanks in this silage corresponds to the percentage actually determined on another variety of corn used for ear-corn silage in 1924,[1] not only would the consumption of grain be much lower in the silage lot but the dry matter in the grain per hundredweight gain would also be lower.

### Unsatisfactory Results in One Experiment

During the fall and winter of 1919-20, 20 home-grown calves were fed a ration of snapped ear-corn silage and linseed meal. No other

[1]See Table 1.

feeds of any sort were supplied. These calves were well grown, averaging 457 pounds per head when started on this test November 6.

These calves did not relish their ration. In fact they were on feed almost two months before they consumed as much as 20 pounds of ear-corn silage per head per day. The calves fed in 1916 were eating that much by the end of the first week of the trial. Early in January several of the calves were clearly off feed. One died on the twenty-ninth of that month and another died on February 26. Because of the unthrifty condition of more than half of the animals the test was abandoned on March 6, and 6 of the sickest calves were taken to the Animal Pathology Laboratory for observation, where they were continued on the original experimental ration in the hope of ascertaining the cause of the trouble. No other calves died, and those that were in the poorest condition when they were taken to the laboratory made some improvement, but no marked change was noted until spring when grass came, then a marked improvement was noticed in all the animals.

Apparently the small amount of grass which grew in the lot where these calves were confined furnished something that was lacking in their previous ration. The evidence on this point, however, is too meager to warrant the drawing of any conclusions as to the actual cause of their unthrifty condition and subsequent improvement. Investigations under way at the present time (winter 1927-28) are designed to throw some light on the influence of vitamines as supplied by alfalfa hay and of minerals as supplied by bone meal in a ration composed of ear-corn silage and cottonseed meal.

On March 6, 10 of the remaining calves were put on a ration of shelled corn, linseed meal, alfalfa hay and normal silage. On this ration they made satisfactory gains. On August 4, 4 of the heifers were put into the College purebred herd, and 5 steers and 1 heifer were shipped to Chicago, where they averaged 955 pounds and sold for $17 per hundredweight, the top of the day.

The appearance of this ear-corn silage was good, and a bacteriological examination failed to reveal anything that might cause the unthrifty condition observed in the experimental calves.

### Good Results With Two-Year Olds

During the fall of 1918, 20 two-year-old steers averaging 812 pounds, were given an average daily ration of 23.86 pounds of snapped ear-corn silage, 2.46 pounds of linseed meal, and 1.95 pounds of oat straw for a period of 79 days. During that time they made an average daily gain of 1.67 pounds.

This gain is considered satisfactory in the light of the fact that not much more than half a full feed of ear-corn silage was fed. Subsequent experience leads to the belief that these steers would have made much larger gains if the feeder had not been so cautious in

getting them on full feed. In the 1924 experiment steers weighing 980 pounds were started on 30 pounds of ear-corn silage per head daily and for the 80-day feeding period their consumption of silage averaged 45.43 pounds per head daily (see Table 2, Lot 5).

## MOISTURE CONTENT OF SOFT CORN

The moisture content of soft corn was shown by early investigations to vary greatly with its stage of maturity at the time of the first killing frost and with subsequent handling and weather conditions. Immediately following the first killing frost it may vary from around 25 percent for corn that has reached its full growth and started to dry out normally, to 50 percent or even 65 percent for corn caught by frost while in the roasting-ear stage. Under favorable weather conditions corn with the smaller moisture content will dry out in the field and make fairly sound grain. Corn with the larger amounts of moisture, caught by frost while the stalk is still green and full of sap, will not dry out readily, and only the most favorable weather conditions, with continued dry, cool, and sunshiny days, can prevent it from spoiling in the field.

The percentage of moisture and total dry substance per acre in corn and cob at different stages of growth for the year 1917, already referred to as an especially serious soft-corn year, and for 1918, which was a normal corn year (Table 6), show how variations in the season affect the growth, maturity, and ultimate feeding value of the crop.

TABLE 6.—HOW VARIATIONS IN SEASON AFFECT AMOUNTS OF MOISTURE AND DRY MATTER PER ACRE IN CORN AND COB AT DIFFERENT STAGES OF GROWTH[1]

| 1917: Soft-corn year | | | 1918: Normal corn year | | |
|---|---|---|---|---|---|
| Date | Moisture | Dry substance per acre | Date | Moisture | Dry substance per acre |
| | *perct.* | *lbs.* | | *perct.* | *lbs.* |
| Aug. 15-16 | 90.53 | 238.5 | Aug. 16 | 77.11 | 1 156.3 |
| Aug. 24 | 82.67 | 968.3 | Aug. 23 | 66.39 | 2 088.5 |
| Aug. 31-Sept. 1 | 78.38 | 1 532.1 | Sept. 6 | 53.54 | 3 987.8 |
| Sept. 6 | 71.02 | 2 610.0 | Sept. 18 | 45.31 | 4 497.9 |
| Sept. 11 | 68.51 | 3 050.9 | Sept. 26 | 40.51 | 4 535.2 |
| Sept. 19-20 | 61.56 | 3 876.5 | Oct. 3 | 38.62 | 4 879.6 |
| Sept. 26-28 | 57.47 | 3 880.0 | Oct. 11 | 31.77 | 4 616.3 |
| Oct. 4-5 | 54.71 | 4 619.8 | Oct. 18 | 28.56 | 4 493.4 |
| Oct. 12 | 51.40 | 4 491.7 | Nov. 1 | 26.55 | 4 533.3 |
| Nov. 5 | 38.76 | 5 097.0 | Nov. 22 | 23.85 | 4 630.1 |
| Oct. 25[2] | 51.04 | 4 228.2 | Nov. 6[2] | 26.30 | 4 208.1 |
| | | | Dec. 11[2] | 22.60 | 3 953.6 |
| | | | Jan. 22[2] | 22.41 | 3 874.1 |
| | | | May 8[2] | 17.38 | 3 522.1 |

[1]From unpublished data by Grindley and Eckstein, University of Illinois.
[2]Shock corn.

There was a marked difference in the percentage of moisture and in the total dry substance in grain and cob per acre in the samples taken about the middle of August each year. The difference was fairly well maintained thruout the rest of the season, the moisture content running approximately 15 percent higher during 1917 than it did for corresponding dates in 1918. The total pounds of dry substance per acre reached an approximate maximum, indicating approaching maturity, much earlier in 1918 than in 1917.

While the difference in the moisture content of the ears during the abnormal year 1917 and the normal year 1918 persisted thruout the growing season, the differences in the total dry-matter content of corn and cob per acre gradually lessened. In fact the total dry matter on October 5, 1917, the day preceding the first killing frost, was practically equal to the total dry matter on October 3, 1918. This appears to indicate that even in a soft-corn year like that of 1917 some fields may produce practically the normal amount of dry matter but that it is greatly diluted with water.

Aside from the belief that soft corn is of low feeding value, this excess moisture is considered objectionable because it impairs both the storage and milling qualities of the grain. The storage and shipping of corn with more than 25 percent moisture are attended with so much risk that the market outlet is very limited. Hence the soft-corn problem is largely one of how best to preserve the feeding value of the dry matter in the immature ears and how to feed it most efficiently.

If, as the present investigations tend to show, a pound of *dry matter* in well-preserved soft corn is as efficient as a pound of dry matter in mature corn, then there was little difference in the feeding value per acre of these two fields.

## CHEMICAL COMPOSITION OF SOFT CORN

A study of the chemical composition of the dry substance reported in Table 6 is shown in Table 7.

During the later periods, when growth was most likely to be stopped by frost, there were no differences in the percentage composition of the dry matter in these two fields of corn which appear significant. While a chemical analysis of this nature does not give all the information necessary to form final judgment of the relative feeding value of the dry matter in soft and in mature corn, it does, so far as it goes, tend to confirm the results of feeding trials at this Station and at Iowa[1] which indicate that the dry matter in soft corn is about

[1]Kennedy and others at the Iowa Station (Bul. 75, Iowa Agr. Exp. Sta., 1902) as the result of their investigations, conclude that, "Soft corn . . . containing 35 percent of moisture at the beginning of the test, pound for pound, on a water-free, or dry matter basis was fully equal in feeding value to mature corn . . . when used for fattening cattle." Evvard (Circ. 40, Iowa Agr. Exp. Sta., 1917)

TABLE 7.—CHEMICAL COMPOSITION OF GRAIN AND COB AT DIFFERENT STAGES OF GROWTH[1] IN TWO DIFFERENT SEASONS: 1917, SOFT-CORN YEAR; 1918, NORMAL CORN YEAR
(Expressed in percentage of total dry matter)

| Date | Nitrogen-free extract | | Crude protein | | Ether extract | | Crude ash | | Crude fibre | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1917 | 1918 | 1917 | 1918 | 1917 | 1918 | 1917 | 1918 | 1917 | 1918 |
| Aug. 15-16 | 51.5 | 68.8 | 18.8 | 10.6 | 3.8 | 4.9 | 5.0 | 2.7 | 20.9 | 13.0 |
| Aug. 23 | .... | 71.3 | .... | 10.4 | ... | 6.1 | ... | 2.0 | .... | 10.1 |
| Aug. 24 | 64.8 | .... | 13.3 | .... | 2.3 | ... | 3.0 | ... | 16.8 | .... |
| Aug. 31 - Sept. 1 | 68.9 | .... | 11.8 | .... | 3.2 | ... | 2.6 | ... | 13.5 | .... |
| Sept. 6 | 77.8 | 73.4 | 10.5 | 9.9 | 3.7 | 6.8 | 2.2 | 1.8 | 11.0 | 8.2 |
| Sept. 11 | 74.0 | .... | 10.0 | .... | 3.6 | ... | 2.1 | ... | 10.3 | .... |
| Sept. 18 | .... | 77.0 | .... | 9.9 | ... | 4.4 | ... | 1.7 | .... | 7.1 |
| Sept. 19-20 | 76.0 | .... | 9.9 | .... | 3.7 | ... | 1.8 | ... | 8.6 | .... |
| Sept. 26-28 | 77.5 | 77.3 | 9.8 | 10.5 | 3.6 | 4.5 | 1.7 | 1.7 | 7.5 | 6.2 |
| Oct. 3 | .... | 74.9 | .... | 10.1 | ... | 5.8 | ... | 1.7 | .... | 7.5 |
| Oct. 4-5 | 76.5 | .... | 10.2 | .... | 4.0 | ... | 1.6 | ... | 7.7 | .... |
| Oct. 11 | .... | 78.9 | .... | 10.1 | ... | 3.9 | ... | 1.5 | .... | 5.6 |
| Oct. 12 | 77.4 | .... | 9.6 | .... | 3.5 | ... | 1.6 | ... | 7.9 | .... |
| Oct. 18 | .... | 76.1 | .... | 10.1 | ... | 5.9 | ... | 1.7 | .... | 6.3 |
| Nov. 1 | .... | 75.1 | .... | 10.4 | ... | 5.9 | ... | 1.7 | .... | 7.1 |
| Nov. 5 | 77.1 | .... | 9.4 | .... | 3.6 | ... | 1.6 | ... | 8.3 | .... |
| Nov. 22 | .... | 77.4 | .... | 10.2 | ... | 4.2 | ... | 1.3 | .... | 6.9 |
| Oct. 25 | 76.7 | .... | 9.5 | .... | 3.5 | ... | 1.6 | ... | 8.7 | .... |
| Nov. 6 | .... | 77.8 | .... | 10.0 | ... | 3.2 | ... | 1.7 | .... | 7.3 |
| Dec. 11 | .... | 77.6 | .... | 10.3 | ... | 4.2 | ... | 1.5 | .... | 6.5 |
| Jan. 22 | .... | 76.8 | .... | 10.3 | ... | 4.1 | ... | 1.6 | .... | 8.3 |
| May 8 | .... | 78.0 | .... | 9.9 | ... | 2.8 | ... | 1.7 | .... | 7.6 |

[1]Calculated from unpublished data by Grindley and Eckstein, University of Illinois.

equal pound for pound in feeding value to the dry matter of mature corn. In fact evidence has been presented by Osborne and Mendel[2] tending to show that the proteins of immature corn may have a higher biological value than the proteins of mature corn. They have shown that the nutritive value of the proteins of the corn embryo is distinctly higher than the nutritive value of the proteins of corn endosperm. If the development of the corn kernel can be compared with that of the wheat grain, then the embryo, with its proteins of high nutritive value, develops more rapidly and is completed sooner than the endosperm with its proteins of low nutritive value. It would appear probable from this that the proteins of soft corn are fully as valuable as, if not superior to, those of mature corn. Chemical determinations of the character of the proteins of mature and immature corn reported to date are not in sufficient accord, however, to justify any definite statement in this regard.

### Chemical Composition Not Significantly Changed in Silo

In the experiment with weanling calves (pages 19 and 20) a study was made of the chemical composition of the fresh ear-corn silage used, both as it was put into the silo and after it had gone thru the siloing process. The results are reported in Table 8. This corn was from the same field as that reported in Table 6.

The larger percentage of moisture in the silage as compared with the field sample is accounted for by the fact that 6.4 tons of water was added thru the blower to 48.39 tons of snapped ears siloed. It will be noted also that the moisture content of the sample taken March 8 was considerably less than that of the fresh silage; while that of the sample taken May 13, near the bottom of the silo, was considerably higher. This is explained by the fact that when a large amount of free water is added, it is not absorbed rapidly enough to prevent some of it from settling toward the bottom of the silo.

The results of chemical analysis, as expressed on a dry-matter basis, show no significant changes taking place during the siloing

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reports that hogs fed for 108 days on sample grade corn containing an average of 21.3 percent moisture made more rapid gains on slightly less dry matter per pound of gain than similar hogs fed old No. 3 corn containing 13.8 percent moisture. He says, "It is surprising how well pigs like soft and immature corn. They may root out a few spoiled kernels now and then, but when the self-feeders are closed down somewhat, they even eat most of these." Evvard, Lamb, and Maynard (Bul. 216, Iowa Agr. Exp. Sta., 1923) also report satisfactory results from siloing husked ears. In this experiment soft corn was purchased on the market and sorted into four grades. All grades came thru the siloing process in good condition with the exception of the poorest grade, which contained a large amount of moldy corn. Chemical studies on the resulting silage indicated that the dry matter was not unlike that of mature corn.

[2]Jour. Biol. Chem. 29, 79. 1917.

TABLE 8.—PERCENTAGE CHEMICAL COMPOSITION OF SNAPPED EAR-CORN SILAGE MADE FROM SOFT CORN: AS PUT INTO SILO AND OF RESULTING SILAGE[1]

| Date 1917 | Kind of material | Moisture | Nitrogen free extract | Crude protein | Fat | Ash | Fiber | Acidity |
|---|---|---|---|---|---|---|---|---|
| | (Results expressed on basis of fresh substance) | | | | | | | |
| Oct. 2 | Fresh snapped-corn silage as put into silo | 60.08 | 29.23 | 3.39 | 1.20 | 1.08 | 5.02 | .... |
| Mar. 8 | Silage sample | 54.85 | 33.28 | 4.39 | 2.13 | 1.01 | 4.34 | 1.41 |
| Mar. 28 | Silage sample | ..... | ..... | .... | .... | .... | .... | 2.06 |
| May 13 | Silage sample | 62.36 | 28.43 | 3.32 | 1.79 | .72 | 3.39 | 1.67 |
| | Average of silage samples | 58.60 | 30.85 | 3.85 | 1.96 | .87 | 3.87 | 1.71 |
| | Normal corn silage (Morrison) | 73.7 | 15.4 | 2.1 | .8 | 1.7 | 6.3 | .... |
| | (Results expressed on basis of dry matter) | | | | | | | |
| Oct. 2 | Fresh snapped-corn silage as put into silo | ..... | 73.2 | 8.5 | 3.0 | 2.7 | 12.6 | .... |
| | Average of above silage samples | ..... | 74.6 | 9.3 | 4.7 | 2.1 | 9.3 | .... |

[1]Analysis by H. S. Grindley.

process except a marked reduction in crude fiber and ash which is compensated for by increases in the other constituents. These differences would suggest no detrimental effects from chemical changes taking place during the siloing process.

Acidity determinations were made because of the observed pitting effect of ear-corn silage on the walls of concrete silos. The rather high acidity for the March 28 sample is suggestive of the cause of the pitting. It is not known what effect, if any, this acidity may have on the feeding value of the silage.

## SUMMARY

Six experiments involving the use of ear-corn silage for cattle feeding have been conducted at the University of Illinois beginning in 1916. The most extensive trial was made with the frosted crop of 1924, when soft corn was fed experimentally in the form of shocked corn, as standing corn pastured in the field, as broken ears brought from the field as needed, and as ear-corn silage made from the snapped ears. The ear-corn silage contained most of the husks, some shanks, and all of the grain and cob.

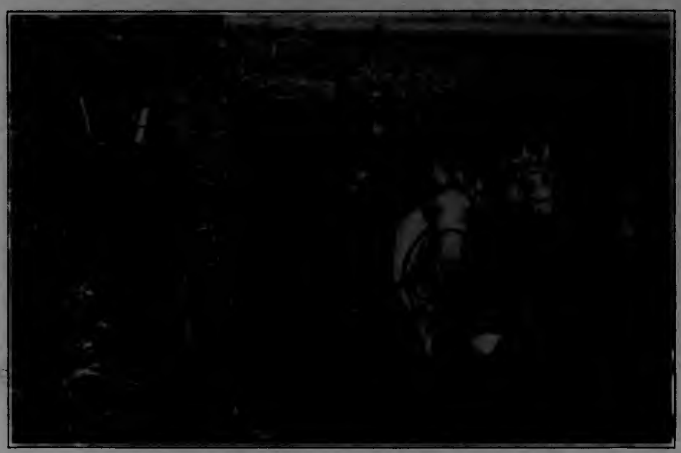

FIG. 6.—SNAPPING FROSTED CORN FOR EAR-CORN SILAGE

This mechanical picker was used on the farm of Bryce D. Smith at Genoa, Illinois. Mr. Smith used two pickers with husking rolls covered with sheet metal, and reports excellent results. He believes that the use of mechanical pickers expedited the work and reduced the cost.

In all but one of the six experiments the cattle relished well-preserved soft corn and made satisfactory gains on all forms fed.

Ranked on the basis of the combined gains produced on cattle and hogs by an acre of soft corn, ear-corn silage comes first, then

shock corn, then corn left in the field and husked as needed, and standing corn pastured by the cattle in the field, last. Pasturing or "cattling-down" of corn in the field resulted in much waste that was not recovered by the hogs following the cattle.

Gains on soft-corn rations were not so rapid as on sound mature corn, but they were just as economical considered from the standpoint of the efficiency with which the dry matter of the grain was utilized.

The total dry matter per acre in grain and cob produced in an experimental field in 1917, a bad soft-corn year, was practically equal to that produced in the same field during the normal season of 1918.

The amount of dry matter required for 100 pounds gain was practically the same whether fed in the form of soft corn or mature corn.

The addition of oats or of sound shelled corn to a ration of ear-corn silage did not prove profitable.

Some trouble was experienced with calves fed ear-corn silage in 1920 and again in 1927, but this trouble could not be definitely identified with the character of the rations fed.

As the market outlet for corn of high moisture content is very limited, feeding on the farm appears to offer the most satisfactory method for its disposal.