MISSOURI

AGRICULTURAL COLLEGE EXPERIMENT STATION.

BULLETIN No. 8.

EXPERIMENTS ON FEEDING ENSILAGE AGAINST DRY FODDER.

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FEEDING ENSILAGE AGAINST DRY FODDER.

HON. JOHN HINTON,

President Board of Curators University of Missouri and Agricultural College :

Bulletin No. 7 considered the harvesting and storage of food for ensilage. This one will compare the nutritrive value of ensilage to similar food, dry stored.

The conditions and cost of storage were set forth in Bulletin No. 7. For the convenience of the reader, I will re-state the pivotal facts touching the food used.

I. Alternate sets of rows of sugar corn were put, one set in a stone silo and the other set in a compact body in a barn.

II. Alternate sets of four rows each of field corn were put one set in silo and the other in the barn over the sugar corn fodder.

III. The ensilage was well preserved and formed what is known as sweet ensilage, yet containing a moderate amount of acid, but lost 34.3 per cent. of its dry matter.

IV. The field fodder corn kept very nicely in the barn, losing but a little over one per cent. of dry matter.

V. In all respects the dry stored half was secured and preserved at a decided advantage over that put into the silo.

VI. The sugar corn was grown by the then Director,

Prof. Schweitzer, after the old and abandoned fashion, of very thick sowing in drills only 16 inches apart. This was badly down, owing to a severe wind and rain storm, and to its natural inability to stand up when grown thus compactly. This material was not suitable for the trial, and so heated in the mow as to be unpalatable to the stock, yet was fed with the results recorded in this bulletin. The field corn fodder kept nicely, both in the barn and in the silo. It is an old claim that food, when dried, has less feeding value than it has in its green state. Experiments abroad, and some general trials by myself do not corroborate this view. A discussion of this subject is not called for, inasmuch as ensilage is not green food in the sense implied, because acids are developed in it, and a reduction of some of its protein to amides seem to occur, as seen by Bulletin No. 7, while other reductions may occur. The carbohydrates are in a large degree lost and the food so changed in nature as to prohibit its consideration as natural green food. Its value cannot be ascertained by abstract reasoning. Actual feeding trials of ensilage by the side of the same food air dried is the only possible way at present of arriving at a satisfactory conclusion.

Prof. Geo. H. Cook, of New Jersey, was the first one in this country, amid the wildly extravagant claims of enthusiasts, to perceive this fact. Prof. Henry, of Wisconsin, followed his method save that he stored his fodder in separate bundles with open air spaces around them. Prof. Cook kept his air dried fodder in the open air. Neither method can do full justice to air dried fodder as both methods involve unnatural losses—one by excessive action of air and rain and the other by the free action of the air whereby changes are facilitated in the body of each plant by the ready current of air and moisture surrounding them. The dry fodder pressed into a large compact mass, like ensilage in a silo, feels less fully the action of air in inducing chemical changes just as the compact fodder of the silo does.

Both of the above gentlemen found no material difference between the feeding value of a ton of green food put in the silo and the same ton dried and fed as dry fodder.

I should collate the data for this bulletin already arrived at in this country in feeding of ensilage, but know of no single trial, the above mentioned trials come nearest the mark, amid them all that is calculated to give the relative practical value of ensilage against dry food. The one I have to relate has faults of analyses. I will be pardoned for the above remarks of criticism in view of the fact that our farmers are anxiously awaiting data, in the meanwhile being influenced by rosy views put forth by those who have tried ensilage, including experimenters.

On account of the great public interest shown in the silo, and as I believe the yet exaggerated claims for it, even on the part of some of our investigators, I suggest that those experimenters who use short alternating periods of ensilage and dry foods have almost no element of critical comparisons to rest upon. Palatableness, fluctuating conditions, changed weight of stomach with change of food, especially favorable to ensilage, and the uncertainty of the influence of the water, etc., of the ensilage on body water and the brevity of the periods used, leave everything to guess-work, with the factors involved likely to give a false showing favorable to ensilage. Others have tried ensilage of corn against hay or some other dried fodder. Years of experience with me have shown unmistakably that it is highly unsafe to depend upon an equal number of pounds of digestible food as now ascertained to give an equal growth when derived from two sources. Also that a combination of many foods and that a combination of dry corn fodder and grain on the basis of present digestion tables is likely to show unfavorably to the hay ration, as such ensilage trials have shown unfavorably

for hay. As noted the few comparisons of ensilage with the same fodder air dried have had the errors above stated. Notwithstanding these facts the large accumulation of the data of Europe and America in my possession fail to show that a ton of dry matter taken out of a silo is superior to a ton of dry matter dry stored. If this be approximately true, then when considered in connection with the facts given in Bulletin No. 7, I am unable to urge the silo upon our farmers in a region where cheap food abounds.

The following trials will show no greater nutritive value for a pound of dry matter of ensilage fed than for a pound of dry matter in the same fodder saved by the air drying process. In the case of the cows it shows that the ensilage was more palatable and more ensilage was therefore eaten. This factor is always of practical value in feeding and sometimes becomes the determining one.

As stated in Bulletin No. 7, I have no confidence that the water of the field corn ensilage, or that used in the first feeding period represents its actual water contents, but much less, inasmuch as the chemist omitted the precaution of drying the ensilage on its receipt. In the air dried state the same mistake occurred. But the loss from the ensilage will be the most. To correct this error, for which I am not responsible, nor for the system which involved it, I shall make the calculations of the ensilage approximately upon the ash content, a fair basis, or give it a water content of 76 per ct. This will correspond with the water content of the other layers in their water shrinkages and cannot be far wrong. The water content of the dry stored field corn I shall make 22 per cent. This is arbitrary, yet from the study of other analyses of stover from the same loft I know that it is approximately right.

If there is any error in this estimate it is certainly against the dry storage system, as the water content

used is lower than that given by other investigators. If it is too low, of course it makes the amount of dry matter calculated as fed too much. And on the other hand the shrinkage in the loft as before noted is too little. But fortunately I have a completely conclusive test on the practical side of the case which gives to the scientific side of the inquiry while not a precise yet a general and definite result.

So far as the scientific side is concerned I may say in the just interest of the readers of bulletins that the analysis of a mite upon which to gauge tons of food is liable to carry the figures for the mass quite astray, and precision is not so great as may seem on the face of figures. They approximate while greater precision is found in many averages.

The check above referred to on my results is found in the fact that although 1320 lbs. more was put into the silo than into the loft, that in the loft dry stored fed 6 cattle 3 days longer than that in the silo, while 660 lbs. or 1-10 of that put in still remained unused. This is final so far as the practical results are concerned provided the growth is the same.

I will state that more complete analytical study of the question would have been made had not the resignation of the assistant chemist left the chemist, who is a teacher in the University, without aid.

FEEDING TRIAL.

The weights given in all cases will be the average of two or three days weighings. Steers, nice grade short-horns, two years of age, were weighed before watering in the morning once a week. Food weighed into and refuse weighed out of feed boxes. At present only the condensed figures will be given and in such shape that our farmers can see the result without going through a confused mass of details that may be given later.

Two lots of three steers each were fed at the farm December 6 to 12. Lot 1 weighed 2800 pounds and lot

2, 2806 pounds. From December 12 to January 10 both lots were fed alike to ascertain their relative growing capacity and if alike then when fed ensilage to one lot and the food from which ensilage was made, air dried, to the other, the presumption would be that any variation of growth would be due to the foods given. To still further measure any variation due to food influence at the close of a long feeding period of ensilage they were to be returned to like foods again. This change of my usual system of conducting a trial is due to the necessity of adopting a method of more carefully measuring the influence of the watery food on the weight of the stomach and the water content of the body when ensilage fed. I believe that a given growth of a steer from ensilage will not have the value that it would have from the same food dried, being somewhat disorganized and more watery, and affecting the tissues of the body.

Ate in 30 Days. Dec. 12-Jan. 10.	Corn Fodder.	Grain.	Ensilage.	Hay.	Straw.	Total Eaten.	Gain.
Lot I.....	228 lbs.	823 lbs.	1094 lbs.	377 lbs.	78 lbs.	2600 lbs.	128 lbs.
Lot II	221 lbs.	818 lbs.	1107 lbs.	346 lbe.	68 lbs.	2560 lbs.	101 lbs.

Lot 2 gained less than lot 1 from December 6 to December 12, and steadily less. It ate a little less, but not quite enough to account for the difference in gain.

ENSILAGE PERIOD.

Lot 1—Fed on 150 pounds field corn ensilage, cut past roasting stage, 12 pounds timothy hay, 12 pounds meal consisting of two parts bran and one part cotton seed meal, and six pounds wheat straw.

Lot 2—45 pounds field corn, cut in alternate rows with the ensilage field corn and air dried, and other food as above. Effort was made to give the same amount of dry matter in the fodder corn as in the ensilage, and as seen the same amounts of other foods.

ATE JAN. 14–FEB. 11—28 DAYS.

	Ensilage.	Hay.	Straw.	Bran.	Cotton Seed Meal.	Grain.
Lot I	4400 lbs.	174 lbs.	13 lbs.	224 lbs.	112 lbs.	117 lbs.
	Dry Fodder					
Lot II.....	1073 lbs.	326 lbs.	30 lbs.	224 lbs.	112 lbs.	104 lbs.

TOTAL AMOUNT FED OR REFUSE OUT.

	Ensilage.	Hay.	Straw.	Bran.	Cotton Seed Meal.
Lot I.....	4725 lbs.	336 lbs.	41 lbs.	224 lbs.	112 lbs.
	Dry Fodder				
Lot II.....	1417 lbs.	336 lbs.	61 lbs.	224 lbs.	112 lbs.

	Total dry matter given.	Total dry matter eaten.	Total dry matter given for a pound of gain.	Total dry matter eaten for a pound of gain.
Lot I.....	1763 lbs.	1513 lbs.	15.07 lbs.	12.93 lbs.
Lot II.....	1734 lbs.	1442 lbs.	16.67 lbs.	13.86 lbs.

Total pounds of dry matter put into the silo required for a pound of gain for ensilage fed lot, 22.94 pounds.

Total pounds of dry matter put into the barn loft for a pound of gain, 17.65 pounds.

The above calculation is based upon the fact that 71.98 per cent. of the dry matter fed in the ensilage fed lot was derived from ensilage and upon the assumption that it furnished its pro rata of growth per pound of dry matter required.

The shrinkage of the fodder and loss by spoiling in the silo of the field corn fodder was 34.30 per cent.

The air dried fodder is treated in the same way.

In the above data it will be seen that the cattle left uneaten of ensilage fed corn fodder, 7 per cent. and of the dried fodder 24.29 per cent.

The above feeding period for these steers and for a trial with cows closed at this point for field corn, because the ensilage in the silo stored in the same amount as that put in the loft calculated in the green state, had given out, while as before stated the dry fodder yet remained in considerable quantity. The trial went right on as before, feeding from the sweet corn layers of the silo and loft.

SWEET CORN ENSILAGE.

I have already remarked the character of the sweet corn ensilage and the same air dried. It is an unnecessary condition. I use only the first month of the period as after that date the sweet corn fodder dry stored, became so far injured that the steers would eat only maintenance rations, and hence no gain occurred. Even after this date per unit of dry matter eaten was as effective as the ensilage half. After closing its use in the dry form, I substituted ordinary corn fodder from which the ears had been removed, and this fodder gave a gain and as good results as the ensilage. There were 100 tons of this fodder in fine condition burned up in the barn on May 3, that had gone finely through the winter. Injured fodder is unnecessary when grown right.

ATE FEB. 11th, TO MAR. 4th,

	Engilage.	Hay.	Bran.	Cotton seed.	Gain.
Lot I.....	3422 lbs.	168 lbs.	167 lbs.	88 lbs.	101 lbs.
Lot II.....	Dry Fodder 792 lbs.	262 lbs.	167 lbs.	88 lbs.	94 lbs.

TOTAL AMOUNT GIVEN.

	Ensilage.	Hay.	Bran.	Cotton Seed Meal
Lot I.....	3846 lbs.	264 lbs.	167 lbs.	88 lbs.
Lot II.....	Dry Fodder 1152 lbs.	264 lbs.	167 lbs.	88 lbs.

	Total Dry Matter Given.	Total Dry Matter Eaten.	Total Dry Matter Given For a Pound of Gain.	Total Dry Matter Eaten For a Pound of Gain.
Lot I.....	1249 lbs.	1079 lbs.	12.86 lbs.	10.69 lbs.
Lot II.....	1886 lbs.	1093 lbs.	14.76 lbs.	11.60 lbs.

Total dry matter put into silo for a pound of gain for ensilage fed lot 23.28 pounds. For dry fodder fed lot 16.29 pounds.

Average number of pounds of dry matter eaten of ensilage for both periods for one pound of gain, 11.81 pounds; and of dry fodder, 12.73 pounds. Of the food given it stands as 13.72 pounds is to 15.79 pounds. And for the food put into the silo, the only true test of the merits of the two systems, as 23.11 pounds is to 16.97 pounds. Again the food in the loft holds out longer than it does in the silo.

A review of above facts shows that the two lots ate of dry matter almost identical amounts, but that the ensilage lot in 49 days gained 20 pounds the most in live weight. But in the preliminary feeding period of 30 days those that became the ensilage lot gained 27 pounds the most, so that during the ensilage period those on dry fodder maintained their relative growth better than the ensilage fed lot.

After the close of above period the ensilage lot was continued 46 days longer on ensilage, and the other lot were put upon corn stover or field corn fodder, until each lot went to pasture—the dry food fed lot rather doing the best. It was my intention to slaughter each lot at this point, and so arranged with the butcher, in order to study the influence of food on the growth of the dry matter of the body. Conditions not favoring, I turned them into pasture where each had the same food again. I reasoned that if the ensilage fed steers carried more water in the stomach and tissues and the conver-

sion of albuminoids of the food to amides and carbonaceous matter to acids and into other products of questionable value, the live weight might, for a time, especially through the action of green watery food, by which means too much water is taken into the system, induce a live weight gain that is not a substantial gain. If such a surmise has any basis of fact in it, it should show itself in the other gain of the steers, being less on the ensilage fed lot, inasmuch as they would have to replace any watery gain by solid matter.

The burning of our splendidly equipped barn in some doubtful way with all of our scales, prevented frequent weights. I had the steers driven to town on May 31st, having been in pasture since April 20th. They were weighed in the morning and allowed to stand in cattle yards all day and were then weighed at night again.

	When Turned out April 30th.	Morning, May 31st.	Night, May 31st.
Ensilage Lot	3190 lbs.	3440 lbs.	3345 lbs.
Dry Fodder Lot	2938 lbs.	3330 lbs.	3195 lbs.

The ensilage lot weighed 252 pounds the most when they went to pasture and 128 pounds most on May 31st. The dry fodder fed lot had seemingly gained 124 pounds on them, but only seemingly so, as the ensilage fed lot ate 150 pounds of ensilage daily, while the other lot ate 45 pounds. The ensilage lot sprung up in weight 105 pounds in a day. This was corrected by a few days fitting period, even after ensilage was fed in order to eliminate this erroneous factor so commonly overlooked by farmers and amateur feeders.

This they would lose quickly. Subtracting it, still 19 pounds the most gain is made by the dry fodder fed steers., and steers whose growing powers in the first preliminary feeding period were found to be less than the others. They were badly and thoughtlessly run, two of

them, in driving up to weigh, which doubtless had its effect.

While these figures are not offered as proof, they are evidence in a small way only, it is true, of the position taken. Personal observations, general principles, and a trial in Germany, lead me to predict with a feeling of security, that future observers will find that ensilage-fed steers will show less ratio of dry matter in growth than dry food fed steers will.

As I shall not be likely to be in the way of making the trial, I hope that future experimenters in this line will thus go to the bottom of this question.

FEEDING COWS ON ENSILAGE.

Two lots of three cows each were put up to the foods before named, one lot to ensilage and one lot to the same food air dried.

By an oversight they were not weighed by the party in charge of the trial until Dec. 24 while the trial began Dec. 12.

Lot I. fed ensilage, weighed..... ..... Dec. 24th 2593 lbs. Jan. 15th 2607 lbs.
Lot II. fed dry fodder, weighed.....Dec. 24th 3032 lbs. Jan. 15th 3112 lbs.
Lot I. gave month of fitting period. ..... 1660 lbs. milk.
Lot II. gave month of fitting period.....1658½ lbs. milk.

From the records which were kept in full detail, I shall condense in order to make brief and clear the facts secured.

Dec. 12th began for lot I. ensilage from field corn, and for lot II. dry corn fodder.

ATE FROM DEC. 12 TO JAN. 15.

	Ensilage.	Grain.	Hay.	Straw.
Lot I.....	4917 lbs.	828 lbs.	318 lbs.	140 lbs.
Lot II..... ...	Dry Fodder 1192 lbs.	828 lbs.	372 lbs.	156 lbs.

The hay was timothy and the grain equal parts of bran, corn and cob meal and cotton seed meal, 12 lbs.

of the mixture being given daily, and 4 lbs. each of straw and timothy hay.

FOOD GIVEN.

	Ensilage.	Hay.	Straw.	Grain.
Lot I.....	6120 lbs.	408 lbs.	294 lbs.	828 lbs.
Lot I.I.....	Dry Fodder 1836 lbs.	408 lbs.	294 lbs.	828 lbs.

	Total dry matter given.	Total dry matter eaten	Total dry matter given for a lb. milk solids.	Total dry matter given for a lb. of butter.	Total dry matter given for a lb. of solids.	Total dry matter given for a lb. of butter.
Lot I.....	2801 lbs.	2298 lbs.	12.7 lbs.	39.14 lbs.	10.4 lbs.	32.11 lbs.
Lot II.....	2755 lbs.	2108 lbs.	16.8 lbs.	48.76 lbs.	12.4 lbs.	37.31 lbs.

Pounds of fodder as put in the silo required for a pound of solids of milk, 19.3 lbs. and for air dried fodder 17.7 lbs. It will be understood by the reader that the solids of milk is all, save the water of milk, and measures the growth, from the food or its production, and the nutritive value of the milk.

Lot I. yield of milk Dec. 12 to Jan. 15..... 1573 lbs.
ot II. yield of milk Dec. 12 to Jan. 15..... 1288 lbs.

BUTTER YIELD—TOTAL OF TWO SETTINGS.

Lot I. 208 lbs. milk gave 29.15 lbs. cream and 9 lbs. 7½ ozs. butter, or 21.98 lbs. milk made a pound of butter.
Lot II. 162.79 lbs. milk gave 21.07 lbs. cream and 7 lbs. 2.2 ozs. butter, or 22.79 lbs. milk made a pound of butter.
Lot I. milk solids—average of lot morning and evening..... 13.94 fats 4.19
Lot II. milk solids—average of lot morning and evening..... 13.17 fats 3.86
Lot I. gave 8.71 lbs. fat for 208 lbs. milk, or 8.61 per cent. more butter than fat.
Lot II. gave 6.28 lbs. fat for 162.7 lbs. milk, or 13.58 per cent. more butter than fat.

The skim milk of the dry fodder fed lot showed but .44 per cent. fat, while that from the ensilage fed lot showed .55 per cent. fat. Contrary to other trials, the dry fodder fed lot raised its butter fat more perfectly; this may be due to the cows fed, or to the fact that this trial was of corn fodder against corn fodder, the corn fodder being well preserved.

The feeding of this period is clearly in favor of the dry storage in the efficiency of the nutrients fed, despite the contrary surface appearance. I started out with the intention of giving the same amount of dry fodder to each lot, but the ensilage fed lot actually received more and ate a larger proportion of that which they received. Now more than one half of the food given to a cow goes to merely maintain existence, leaving less than one half for production. The German data make 1.75 per cent. of live weight daily necessary to maintain life. Applying these figures it will be seen that lot one, or ensilage fed lot should have used 1543 lbs. dry matter in the 34 days for maintenance, leaving 755 lbs. for milk production, or a pound of milk would be produced on 0.47 lbs. dry matter used as excess food. Lot II. should have used 1803 lbs. for maintenance and have had left as excess food for production, 305 lbs. dry matter, or a pound of dry matter produced 0.23 lbs of milk, dry matter being air dried fodder, is much more effective than is dry matter from ensilage.

While I am sure that the Germans overestimate the amount needed for maintenance, yet the dry food has been unquestionably the most effective pound against pound eaten.

It will be noticed that the cows receiving the dry food maintained their weight best or gained most. Thus far in the trial the conditions have been equitable, each lot of cows having given in a month of preliminary feeding equal amounts of milk, save that in the ensilage period, the dry food fed lot ate less than the ensilage fed lot.

Analysis and fuller data for this and the following period will be found in the appendix.

CHANGE OF FOOD.

Lot I. was fed in this second period on dry corn fodder, and lot II. on ensilage, thus reversing the foods to note the possible influence of variation in the cows not due to food.

This change took place January 15. They were fed on field corn ensilage and field corn dried, until February, just as before, save that the food was reversed. After February 11, they were fed on sweet corn fodder dried, and the same put in the silo. This is the same sweet corn several times alluded to. The cows ate it with relish from the silo, but not from the loft during the last twenty days when the poorest fodder was reached. I then cut down the ensilage to conform nearer to the low amount of dry fodder being eaten. The small amounts consumed reduced the milk yield, and presents an unfavorable showing of milk production. Nevertheless the contrast of ensilage and dry corn-fodder is maintained and the results will give a fair comparison.

The argument might well be made that the fact that the cows ate a low amount of dry fodder and thereby gave a reduced yield, is against the dry fodder in a practical or economic sense were it not for the fact that the sugar corn was in a condition unnecessary to that well grown, and that the field grown corn kept well, as well as the fodder corn of the farm crib.

Again we need not grow sugar corn for dry storage if it is in the fodder. Possibly and probably I under-dried it, not being accustomed to storing sugar corn. Indeed the weight, when housed, had become not very heavily curtailed from the green state, being over one-half the weight of its green state.

Lot I. Weight of cows January 25, 2571 lbs. Weight March 20, 2566 lbs. Food, dry fodder.

Lot II. Weight of cows January 25, 3098 lbs. Weight March 20, 3082 lbs. Food, dry fodder.

January 15 to January 25 is skipped in weights because the first influence of change to green food is inevitably to increase their weight, for 180 pounds green food in the place of 54 pounds dry fodder, must make the animals weigh more at weighing time.

Lot I. Milk given January 15 to March 20..... ....2170 lbs.

Lot II. Or ensilage lot, gave January 15 to March 20..... ... ...2248 lbs.

BUTTER PRODUCED.

The milk was set February 1, and again February 21. I give the average of the two trials:

Lot I. Made from 303 lbs. 13 oz. milk, 53 lbs. 11 oz. cream and 16 lbs. 8½ oz. butter.
Lot II. Made from 333 lbs. milk, 58 lbs 11½ oz. cream, and 14 lbs. 1 oz. butter.

Lot I. Pounds of milk required for one pound of butter ..... .18 lbs. 6 oz
Lot II. Pounds of milk required for one pound of butter.. ....23 lbs. 11 oz.

FOOD CONSUMED.

Field corn fodder and ensilage were given until February 11, when sweet corn fodder and ensilage were fed. The cows did better relatively than the steers on dry sweet corn fodder when fed against sweet corn ensilage. In fact the cows did better on dry sweet corn fodder against sweet corn ensilage than they did on field corn fodder against field corn ensilage.

The following butter yields will show the influence of sweet corn versus field corn for butter:

Pounds of milk of dried field corn fodder for pound of butter, lot 1.....19.78½
Pounds of milk of dried sugar corn fodder for pound of butter, lot 1..... ....17.17
Pounds of milk of ensilage field corn fodder for pound of butter, lot 2..... 24.92
Pounds of milk of ensilage sugar corn fodder for pound of butter, lot 2.....22.78

The sweet corn fodder had the appearance of being more valuable for cows than for steers, and dry sweet corn seems more valuable for butter than ensilage sweet corn. Our butter was better from dry food than from ensilage. This fact is undoubted in this case. Samples of butter from each were set for a test of their keeping qualities. There was observed no marked difference in the quality on May 22, although I would have selected that from the dry fodder lot as the best kept, and that from sweet corn fodder as better than that from field corn, although the latter was made 27 days before the other.

	Dry Fodder.	Hay.	Straw.	Mixed Meals.
Ate Lot I.....	Field Corn, 913 lbs. Sugar Corn, 964 lbs.	690 lbs.	20 lbs.	1134 lbs.
	Ensilage.			
Ate Lot II.....	Field Corn, 4401 lbs. Sweet Corn, 4801 lbs.	540 lbs.	10 lbs.	1134 lbs.
	Dry Fodder.			
Given Lot I	Field Corn, 1458 lbs. Sugar Corn, 1674 lbs.	741 lbs.	30 lbs.	1134 lbs.
	Ensilage.			
Given Lot II.	Field Corn, 4860 lbs. Ensilage, 4960 lbs.	741 lbs.	30 lbs.	1134 lbs.

	Total dry matter given.	Total dry matter eaten.	Total dry matter given for a lb. milk solids.	Total dry matter given for a lb. of butter.	Total dry matter eaten for a pound of milk solids.	Total dry matter eaten for a pound of butter.
Lot I..... ..	4142 lbs.	3089 lbs.	13.5 lbs.	35.06 lbs.	10.1 lbs.	26.15 lbs.
Lot II..... Ensilage lot	3844 lbs.	3511 lbs.	13.2 lbs.	40.74 lbs.	12.0 lbs.	37.21 lbs.

On the basis that the ensilage that was fed lost in the silo the same as the average loss of the whole ensilage put into it, or 34.3 per cent., it required 62 pounds of dry matter for a pound of butter, while it required but 37.1 pounds of dry stored fodder to produce a pound of butter.

Taking the average of the two feedings of the pounds of dry food given in ensilage for a pound of butter, it is found that 39.94 pounds are required, and for a pound of solids 12.9 pounds. The dry stored fodder as the average of the two feeding periods required 41.91 pounds of dry matter fed for a pound of butter, and 15.1 pounds for a pound of milk solids. The pounds of dry matter of ensilage actually eaten for a pound of butter was 34.66 pounds, and of dry stored fodder was 31.73 pounds. The milk solids stood as 11.20 pounds of dry matter of ensilage to 11.25 pounds for the dry stored for a pound of milk solids.

The average analyses of the milk solids should have been given before and are for night and morning.

	Solids.	Fats.
Lot I. Fed with dry fodder.....	14.06 per cent.	5.16 per cent.
Lot II. Fed with ensilage.....	12.93 per cent.	4.22 per cent.
Average of both periods from dry fodder...	13.61 per cent.	4.48 per cent.
Average of both periods from ensilage.....	13.43 per cent.	4.20 per cent.

It is interesting to note that the dry fodder gave the most solids and most fat. This fact lends strong color to the view before mentioned that the growth of steer on ensilage would be more watery. Here the milk is found to be 1.34 per cent. more solids when fed dry food. This is small but it is accompanied by a gain of weight of the cows of 75 pounds, whereas the ensilage fed cows gain but two pounds. These facts have a clear bearing on the case.

It will be noticed that the extra gain of the cows on dry food over the ensilage fed cows is greater than that of the ensilage fed steers over the dry fodder fed steers. If we could set the cow trial against the steer trial it would appear that for a pound of dry matter actually eaten the trial is a close draw, that is a pound of dry matter in ensilage is worth no more than a pound of dry matter in the dry stored food, with all the errors and imperfections of the trial militating against the dry fodder, so that it is my belief that critical data will show that the ensilage of to-day will not produce as much dry matter growth as an equal amount of dry matter of the green food dry stored. The difference may be small.

If the question is considered upon the basis of the actual food harvested, the dry storage system is decidedly more productive.

The skim milk, I omitted to state, was not analyzed during the last period. The butter produced was 6.84 per cent. more from the dry food fed lot than fat in the

milk, while with the ensilage fed lot it was identical. An analysis of the butter could alone show the relative amount of fat recovered in the absence of an analysis of the skim milk, but it is evident that in both periods the milk is as churnable as it is now termed, from the dry food fed cows as from the ensilage fed cows. This is made evident by the analyses of the skim milk in the first period and by the following data:

Dry fodder fed cows, average pounds of milk required for a pound of butter for both periods is 20.58 pounds.

The ensilage fed lot required 22.79 pounds of milk for a pound of butter.

These figures I believe to be all normal and likely to recur in cows fed as I fed those used in this trial.

The dry food used in this trial was cut and crushed with a Lyon cutter and crusher. The fodder stood some ten to thirteen days in the field before housing—weather favorable.

The details of the above trial were under the successful charge of H. J. Waters, B. A. S., Assistant Agriculturalist, who carried them forward with intelligence and care.

CONCLUSIONS AND REVIEW OF DATA.

I. Bulletin No. 7 gives data showing that corn fodder may be successfully dry stored and at cheaper rates, both for protection and labor than when stored in the green state.

II. This Bulletin shows that a given amount of food dry stored lasted markedly longer than the same amount of food put into the silo.

III. The ratio of growth of dry food fed steers was as great or greater than the ensilage fed steers when compared with the growth of each lot when fed alike; yet the growth of ensilage fed steers was greater.

IV. The ensilage fed steers seem to have made a more water or less substantial growth than those dry

fed and probably did not make really as great growth of solid matter.

V. Sugar corn proved a better food for cows and poorer for steers than field corn fodder.

VI. Dry fodder for cows proved more effective, especially dried sugar corn, than ensilage.

VII. Cows fed on dry fodder gave the richest milk, 20.58 lbs. of the former making a pound of butter, while 22.79 lbs. of the latter were required.

VIII. The dry fodder fed cows was the best churning milk, or raised the largest ratio of its fat in the milk.

IX. The dry fodder fed cows gave the largest per cent. of solids in the milk.

X. The dry food gave the best butter which seemed to keep better.

XI. The dry food was cheaper handled.

XII. The cows maintained their live weight best on dry food.

XIII. The trial on the whole favors the view that a pound of organic matter will produce more growth of solid or dry substance when eaten in the air dried state, than when stored in the silo, but the question in this trial is an evenly balanced one on this point.

XIV. The trial as a whole shows that the air drying method with dry storage in a good barn in a compact form, is decidedly the more economical method of the two.

XV. In a very bad year the disadvantages of the air drying system might be equal to the disadvantages of the silo, but they would have to be severe to warrant stock raisers in Missouri in investing in the silo extensively. The facts secured will not warrant me in advising our farmers to build silos, until a radical change in the effectiveness and economy of the silo is made, or a radical change occurs in surrounding conditions.

Respectfully submitted,

J. W. SANBORN,

Director.

APPENDIX.

I have not thought it best to give the long number of daily weighings of milk of each of the six cows used in the trial, nor the daily weighings of food. It is both costly and confusing to the average reader to have so much of the tables of detail mixed up with the few grains of the upshot of the whole matter. Where three animals on each side of a trial are used, or six in all, and matters were normal, it is of no pressing importance to science that daily weighings be published in detail. If deemed best or there is a desire for it, the full data can be given in the annual report.

The somewhat essential analytical data, I will give in this non-disturbing position. I have omitted, after partially completing it, a table of digestible nutrients. As the foods fed were identical except that one was put through the silo where the nutritive ratio did not much change the two tables would show similar nutritive ratios, and would therefore have but little bearing on the object of this trial.

The following table gives the analyses of the food fed.

	Water.	Ash.	Fat.	Fibre.	Protein.	Carbohydrates.
Field Corn Ensilage....	64.11	2.14	1.06	9.06	3.40	20.23
Sweet Corn Ensilage....	79.27	1.10	.91	5.04	1.79	11.89
Field Corn Dried.....	15.53	2.77	.18	17.31	1.75	62.46
Sweet Corn Dried.....	19.07	3.35	2.39	27.27	9.49	38.48
Bran.....	13.67	5.18	2.87	8.35	17.33	52.96
Cotton Seed Meal.....	8.59	6.99	8.44	7.27	42.10	26.61
Timothy.....	13.19	4.98	1.66	30.45	5.86	43.86
Corn and Cob Meal. ...	18.22	1.12	2.93	4.62	10.32	62.79
Uneaten Field Corn Ensilage.....	.....	.....	.....	.....	.....	.....
Uneaten Sweet Corn Fodder.....	26.47	4.92	.74	27.18	6.52	34.17
Uneaten Sweet Corn Ensilage.....	76.61	1.61	.46	7.18	2.70	11.44
Uneaten Corn Fodder...	9.68	4.50	.76	36.23	5.59	43.24

The preceding analyses were made by B. von Herff, assistant chemist of the Station. The ensilage and dry fodder corn were in the laboratory when he came to work, as before noted.

The analyses of milk for the first period of feeding were made by Prof. Paul Schweitzer, Chemist of the Station. The night's milk was not analyzed until the next morning, the party who delivered it not notifying the Chemist of its delivery. But notwithstanding this fact the range of the specific gravity is difficult to account for.

The milk of the second period was analyzed by Prof. von Herff.

		MORNING'S MILK.					EVENING'S MILK.				
		Specific gravity, per cent.	Fat—per cent.	Sugar, per cent.	Coseine and Salts, per cent.	Total Solids, per cent.	Specific gravity, per cent.	Fat, per cent.	Sugar, per cent.	Cosein and Salts, per cent.	Total Solids, per cent.
Lot I .... Ensilage Fed..	No. 1 ...	1.0342	3.71	4.38	5.01	13.10	1.0261	3.32	4.19	4.73	12.24
	No. 2....	1.0347	5.22	5.31	5.22	15.75	1.0257	5.36	5.02	5.20	15.88
	No. 3....	1.0333	3.79	4.31	5.47	13.57	1.0289	3.74	4.02	5.33	13.09
Eed dry fodder	No. 4 ..	1.0263	4.38	4.27	4.87	13.52	1.0225	3.40	4.18	4 90	12.48
Lot II	No. 5 .	1.0306	3.60	4.16	5.48	13.24	1.0226	3.81	4.20	5.24	13.25
	No. 6 ...	1.0325	4.09	4.01	5.26	13.36	1.0212	3.86	4.27	5.03	13.16
Average....			4.13			13.74		3.91			13.35

Second Period under change of Food—Lot I now having Dry Fodder and Lot II Ensilage.

Lot I..... ..... Dry Fodder...	No. 1 ...	.....	5.37	... .	.....	13 79	.....	4.90	.....	.....	13.13
	No. 2....	....	5.30	....	.....	15.47	.. ..	5.15	....	....	15.06
	No. 3....	....	4.93	... .	....	14.10	.....	4.97	.....	....	13.80
Lot II..... Ensilage	No. 4....	. . ..	4.20	....	. . .. ..	12.57	..... .	4.29	.....	.....	12.33
	No. 5....	... .	4.19	....	....	13.29	....	4.07	....	.. ..	12.83
	No. 6....	.....	4.58	....	.....	13.66	....	4.01	....	....	12.91
Average			4.76			13.81		4.56			13.34

It will be noticed that in both periods that both fat and milk solids are less at evening than in the morning, and in a similar ratio.

In our milking the time between the night and morning milkings is the longer period of the two.

The analysis of skim milk was before noted. The solids were as 9.45 is to 9.55, the former being the corn fodder lot.

A study of the figures will show that the ratio of the fats to the total solids varied, which bears upon an old and disputed question. It will also be seen that the milk in the sugar corn period was richer than in the field corn period, but the cows were giving less milk and were further from the period of dropping their calves.