GRADUATE THESIS

CORN AND COB MEAL AND COTTON SEED MEAL VS. BRAN FOR DAIRY COWS.

PRESENTED BY

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INTRODUCTION

Corn-andCob Meal and Cotton-Seed-Meal vs Bran for Dairy Cows.

There is no longer any question as to the profitable nature of dairy farming in the South. The reasearch work done at the State Experiment Stations and on the farms of the more progressive farmers show that the South offers exceptionally favorable conditions for dairy enterprises. Texas Fever was once considered a barrier to the raising of good cattle in the South,but through the untiring efforts of the investigators,a practical method of controlling this disease has been discovered,so that it is now possible to maintain paying herds no matter how plentiful the ticks may be which transmit the germs of disease. The feeds afforded by this part of the country are admirably adapted to the needs of the dairyman. Cotton seed is produced in unlimited quantities at his very door. Corn,which can be successfully used as the basis of a dairy ration either as corn meal or as corn-and-cob meal,can be easily raised. The forage plants too,are abundant. Corn for silage and stover can be grown all over the South and in many localities hay may be made successfully from native grasses or leguminous crops which will yield paying crops. In some sections alfalfa has already become quite well established and other nitrogenous hays such as cow-pea hay,and soja-bean hay can be worked into the crop rotation with beneficial results (both in the way of feed and as a soil renovator.)

The demand for dairy products in the South is very great in large in some cities the price of good milk,butter and cream is double and treble what it can be produced for. In Charlotte,N.C.,the market price for milk is 10 cents a quart,while in that county it can be produced profitably at half that price. Some of the railroads are offering to guarantee a profitable return for all butter and cream made along their lines. The fast trains north and south afford excellent ship-

ping facilities to the southern center of population which the demand is in excess of the supply at highly remunerative prices. Summing up the situation; the South is an ideal section for the location of diary frams. However, care must be taken to insure economical feeding and the breeding up of a good herd if profitable returns are to be secured.

PLAN OF THIS EXPERIMENT.

This experiment was designed to answer two questions, "What shall we use for a roughage ration?" and "Can the protein in one feed be substituted for an equal amount of protein in another". As already stated silage, stover, and hay are the chief roughage crops grown here and so they have been compared with reference to their ability to maintain the flow of milk, As a test of the comparative values of protein from different sources wheat bran was fed against a mixture of cottonseed meal and corn-and-cob meal having the same amount of digestable protein per hundred pounds of grain.

For the work six groupd of four animals each were fed as follows.

Group 1 Bran and Silage

" 2 " " Stover.

" 3 " " Hay

" 4 Corn and cob meal (360½ parts) and cotton seed meal (139½ parts) and Silage.

" 5 " " " " " "

" 6 " " " and stover

Each animal was given a little more grain than she would have received a grain ration having a narrower nutritive ratio, and all the roughness she would consume.

The following table shows the comparison of the digestible nutrients and their comparison to the standards. In this table the results are worked out on the basis of one head per day.

	Dry Matter	Protein	Carbohydrates and Fats	Nutritive Ratio
	lb.	lbs.	lbs.	
Wolff's Standard	24.0	2.5	13.4	1:5.4
Wisconsin Standard	24.5	2.2	14.9	1:6.8
Group 1	17.9	1.9	10.0	1:5.2
2	18.1	1.7	9.6	1:5.6
3	22.1	1.9	12.1	1:6.4
4	16.8	1.8	11.1	1:6.2
5	18.5	1.7	13.2	1:7.2
6	22.5	1.9	14.4	1:7.6

Here we find quite a departure from the standards, not so much in the nutritive ratio as in the amounts of dry matter, and digestible nutrients.

In separating these animals into groups great care was taken to see that each group should consist as far as possible of animals that were known to yield about the same quality and quantity of milk and butter. Only a few 2 year old animals were used and these were distributed through the several groups. The older animals were arranged by groups according to their records of production in the yearly fair summary. Unusual care was therefore exercised to insure a division of the animals.

These animals had been on good pasture up to November, at which time they were brought to the barns, where they were kept under favorable conditions as to light, air, and sanitation. Once daily they were turned into the exercising lots where they were allowed free access to water. If the weather was pleasant they were allowed to remain in these lots for several hours. They were fed morning and night on a mixed grain ration, and a roughage ration of silage and stover, The experiment proper commenced January 1st, but the treatment of the animals was the same as before.

FEEDS

SILAGE

The silage was grown on the experiment station farm,and was made from Leaming corn,but in the late dough stage,and preserved in round wooden silos. These silos were almost new and in good condition and on the whole the silage was preserved in good shape. All the decayed silage from the top and around the dorrs was thrown out and only the very best was fed during the experiment. On account of the very rainy season of 1905 there was not a very high percentage of corn in the silage. In fact the corn did not grow at any time as it should have. The prolonged rains kept it ffom maturing as fully as was desirable and hence when cut for the silo owing to the danger of frost,it was not in proper condition and did not make as satisfactory as silage or as is usually obtained.

STOVER.

The stover was also grown on the experiment Station Farm. It was shredded from Leaming corn which had been cut a little later than usual,and the bundles were shocked in the field and left for some time. Several rains materially damaged its feeding qualities during this time. But the injury from these sources was nothing compared to the destructive effect of a hail storm which occcurred during the growing season and practically destroyed all the leaves on the crop. The stover would therefore not be regarded as a fair sample.

HAY.

The hay was by all means the poorest of the feeds used. The first part of the summer was dry and the last very wet and weeds were proponderate in the hay,which was of course very coarse. This may have been overcome to some extent by the fact that the hay was cut before using.

BRAN.

The bran was purcahsed from wholesale dealer of good reputation and was higher than the average in protein but not in digestible fats.

COTTON SEED MEAL.

The cotton seed meal was fresh from the mill and was of excellent quality and high in protein.

CORN AND COB MEAL.

The corn and cob meal was ground from Leaming corn grown on the farm. The grinding was done in the barn and all meals was ground twice to reduce it to the desired degree of fineness. The wide nutritive ratio of corn caused the mixture with cotton seed meal to have a wider ratio than the bran.

Following is a table showing analysis and cost of feeds.

TABLE SHOWING % OF DIGESTIBLE NUTRIENTS.

Feed	Dry Matter	Protein	Carbo-Hydrates	Fats	Cost per Cwt.
Bran	87.7	12.4	35.9	2.7	$0.97
Corn and Cob Meal	84.9	4.7	59.8	2.9	0.80
Cotton Seed Meal	91.8	35.7	17.3	12.2	1.36
Silage	20.9	0.8	11.6	0.6	.15 &.07½
Hay	86.8	2.7	43.2	1.3	.45
Stover	59.9	1.4	31.0	1.3	.20

The feeds were given in two equal parts daily, one half in the morning and one half in the afternoon. The uneaten feed was collected each morning before the morning feed was given, weighed and the amount credited to the animals as not having been eaten. When there was much waste the foughage ration was once cut down until the animal seemed ready to again take a full feed, at no time was there any waste of concentrates.

MILKING

The animals were all milked twice daily, morning and evening

and the milk weighed, and the amount recorded on a specially ruled sheet kept by the scales for that purpose. Out of each milking a small sample was taken and put in a bottle containing one tablet of Bi-chloride of mercury, and kept to the end of the month, when fat and solid not fat determinations were made.

RECORDS

The amounts of feed and waste were recorded in a feed book especially propared for the work, and at the end of the month the amount of digestible nutrients was worked out according to the digestion coefficients given on the preceeding page. The monthly milk record was made up from the amount of milk recorded at the scales, and the fat and solid not fat determinations made from the composite sample that had been collected at each milking.

THE RESULTS

In the following table may be found the total amount of feeds consumed and the yield of milk and butter.

Group		Concentrates	Silage	Stover	Hay	Cost	Milk lbs.	Butter lbs.
1		5614	15732			$72.61	6529	273
2	Bran	4987		6553		58.42	69.05	276
3		5006			6967	73.39	6857	296
4		5225	16563			74.88	8191	354
5	Mixed grain	5339		6699		64.20	6487	278
6		5510			6503	79.49	76.19	360

Now comparing these yields with the cost of the feeds we get the following table of net gains.

Financial Statement

Animals on Bran

Group	Roughage	Cost feed	Value Milk	Value Butter	Profit Milk	Profit Butter
1	Silage	72.61	$151.82	$68.53	$79.22	4.08
2	Stover	58.42	160.52	69.26	102.08	10.84
3	Hay	73.39	159.23	74.31	85.84	.90

Animals on Mixed Grain

4	Silage	74.88	$188.16	$88.89	$113.28	14.01
5	Stover	64.20	151.28	69.51	87.08	5.31
6	Hay	79.49	177.19	89.34	97.70	9.87

Taking from this table the figures comparing the yields from the groups fed the various roughage rations we have; Groups 1 and 4 together on silage made a net profit of $192.50,on milk and $9.93 on butter,groups 2 and 5 on stover a profit of $189.16 on milk and $16.15 on butter,and groups 3 and 6 made a profit of $183.54 on milk and $10.77 on butter.

The results to be drawn from these two talbe are very obvious. At a glance we see that the silage fed animals yielded the most milk, having an advantage of 250 pounds over those fed hay,and there was also an advantage of $6.39 in cost of feed in favor of the silage fed animals as against those fed hay. Stover fell 1328 pounds below the silage in the yield of milk,and $14.87 in cost of feed. This would apparently place the stover group first,but the falling off in yield was too great to be overcome and as a result the silage fed groups showed a profit over the stover fed groups. Comparing the cost of making a pound of milk we find that on silage one pound of milk was produced at $0.010,on stover $.0112 and on hay $0.011.

The results when estimated as butter do not fully correspond with those of the milk. With the milk the order of preference was silage,

stover,hay. Now we have silage producing 637 pounds of butter,stover 554, hay 656,which gives stover 102 pounds of butter in advance of hay,this is worth $25.50; but the stover ration was $30.12 cents cheaper than the hay ration,so that stover ration has the preference over hay in this case. Silage comes last with a net profit of $9.96,while stover netted a profit of $16.15,and hay $10.77.

So far all the returns have been calculated on the basis of totals,now they will be taken up on the basis of amounts per head per day.

Group	lbs. Consumed per day	concentrates consumed per head per day.	Cost of feed per head per day.
1) on	34 Silage	12	$0.15
2 (Bran	14 Stover	11	.12
3)	15 Hay	11	.15
4) on	35 Silage	11	.16
5 (mixed	14 stover	11	.14
6) grain	14 hay	12	.17

These results correspond throughout with those worked for the entire period and so change no conclusions.

CHANGING THE VALUATION OF SILAGE.

In the foregoing statements the cost of silage has been calculated at $3 per ton,which was the actual cost of producing the crop. The reason for this abnormally high cost was that heavy applications of manure was made to the fields last year. So crediting this to soil improvement and calculating the silage $1.50 per hundred,which is much nearer the average cost we observe quite a change in the results. This would reduce the cost of the feed of the two silage fed groups $47.34 and may be the table of profits on milk and butter had as follows:

Profits with Silage Calculated at $1.59 per ton.

Groups	Profit Milk	Profit Butter
1-4 Silage	$239.84	$57.27
205 stover	189.16	16.15

Profits with Silage calculated at $1.59 per ton cont'd.

Groups	Profit Milk	Profit Butter
3-6 Hay	$183.54	$10.77

After this change there remains no question as to the comparative values of the feeds. When calculated as milk this advantage in profit is $50.68; as butter $41.12.

Another very important item is that of waste which has been left entirely out of account in these tables. In the stover fed groups the waste at times was very heavy, considerably more so than in the hay, but at no time was this enough to offset the advantage shown by the tables in favor of the stover. On the silage work the waste was practically nothing. Taking this into consideration the benefits from feeding silage are enhanced in value.

THE GRAIN RATION.

In answering the question concerning the grain ration, namely, whether or not the protein in one food can be substituted for that in another these results secured in this test are quite drfinite. It has been though that the basis of the grain ration for dairy cows must consist of ~~nothing~~ wheat bran, and that nothing could be substituted for brain with either profitable or beneficial results. In this case the grouping was the same but in combining the groups instead of taking those that had received the same roughage ration, tje comparison was made with those receiving the same kind of concentrates. This arrangement placed in each lot the groups receiving the same roughage ration. In results the three groups receiving the mixed grain surpassed the bran fed animals in gross yield of milk and butter and also in profits on both these products.

Group		Amount Produced Milk lbs.	Butter lbs.	Profit Milk	Butter
1 & 4	Fed				
2 & 5	Bran	20391	845	$267.14	$ 7.66
3 & 6	Mixed Grain	22297	992	298.06	29.19

Subtracting the profits obtained from the bran fed animals from those of the mixed grain groups wer have an advantage on milk of $30.92 and on butter of $21.53.

CONCLUSIONS

(1) Neither Silage, Stover, nor Hay is a sufficient Roughage ration for cows in full flow of milk.

(2) Fed singly hay more nearly kept up the flow of milk.

(3) On account of the large amount of waste in feeding both stover and hay, and the very small amount in feeding silage and the very close results obtained in feeding, when the silage was charged at $3.00 per ton, the advantage is in favor of the silage. Of course, the greater adaptibility of some farms to the production of the other roughages might offset this advantage at times.

(4) Any of these rations will keep coes up to their normal weight while in milk.

(5) Pound for pound the protein from the mixed grain ration produced more milk than the protein from the bran. Consequently the mixed grain ration is preferable. This affords an ideal substitute for bran which contains an extremely low amount of digestible nutirent for the cost.

(6) This experiment indicates that the source of protein is not such a vital consideration when a sufficient quantity is contained in a hundred pounds of the feed.

(7) Ranked according to their relative merits when silage is estimated at $1.50 per ton these three roughages would be placed, silage, stover, hay.

BIBLIOGRAPHY

New Jersey,Rept.1903.

Soiling vs.silage,the average yield of butter for six months on soiling crops was 171.3 pounds and for the same length of time on silage,154.5 a difference of 16.8. pounds.

Oregon,Rept.1903.

A test of silage vs.hay showed but little difference in feeding value,the milk from silage fed cows had a slight odor.

Ohio,Bul.155.

Silage can be made to take the place of a considerable amount of the grain in a dairy ration.

New Hampshire,Bul.92.

The best silage is made from corn when the ears are filled and nearly matured.

Tennessee,Record 4,No.1.

Points out the value of silage with reference to other roughage rations, see Bulletin in Library.

Maine,Bil.106.

In changing from a ration in which corn silage forms the bulk of the roughage ration to one in which a part of the silage is soy beans,the grain ration can be reduced one pound.

Creamery gazette,1899,No.11.

Discusses the relative merits of grain,and soiling,and roughage rations for milk cows.

TABLE SHOWING THE AMOUNTS OF MILK AND BUTTER PRODUCED DURING THE EXPERIMENT

No. of months	Milk Yield	Fat Test %	Butter produced lbs.	Lactometer test %	Value Milk	Value Butter	Profit Milk	Profit Butter
Group I, on Silage and Bran								
I	492.9	3.4	I9.7	3I.8	$II.46	$4.93	$6.59	$.07
2	386.0	3.6	I6.5	3I.2	9.03	4.II	4.59-	.33
3	378.8	3.7	I6.8	32.3	8.84	4.24	6.97	-.60
4	372.3	3.5	I5.4	32.I	8.66	I3.85	4.65	-.I5
Total	I629.9		68.40	I27.4	37.99	I7.I3	I9.85	I.0I
Average	407.7	3.6	I7.I	3I.8	9.49	4.28	4.96	.25
Group II, Stover and Bran.								
I	487.9	3.4	I9.6	30.5	II.32	4.89	7.58	I.I6
2	45I.6	3.3	I7.2	30.3	I0.49	4.37	7.04	.92
3	4I6.9	3.4	I6.9	3I.8	9.69	4.23	5.89	.43
4	370.6	3.5	I5.2	3I.0	8.62	3.8I	5.0I	.I9
Total	I727.0		68.9	I23.6	40 .I2	I7.30	25.52	2.70
Average	43I.7	3.6	I7.2	30.9	10.03	4.32	6.38	.67
Group III, Hay and Bran.								
1	504.6	3.7	23.4	30.8	11.73	5.35	6.80	.42
2	405.9	3.5	16.7	30.6	9.43	4.19	5.08	.16
3	438.0	3.7	19.1	31.3	18.12	4.77	5.24	.10
4	366.1	3.7	16.2	31.0	8.51	4.59	4.86	.13
Total	1714.6		75.4	123.7	37.79	18.37	19.44	.03
Average	428.6	3.6	18.8	30.9	9.45	4.59	4.86	.01
Group IV, on Silage and Mixed Grain								
1	591.3	3.6	24.9	30.7	13.73	6.23	8.91	1.41
2	496.5	3.8	22.5	31.2	11.54	5.64	7.08	1.18
3	507.9	3.8	22.9	31.8	11.80	5.27	6.94	.86
4	427.4	3.7	18.5	32.1	9.96	4.63	5.38	.05
Total	2023.1		88.8	125.8	47.03	22.22	28.31	3.50
Average	505.8	3.7	22.2	31.8	11.78	5.55	7.08	.87
Group V, on Stover and Mixed Grain.								
1	471.1	3.6	19.8	30.6	10.95	4.96	6.71	.72
2	401.9	3.6	17.2	30.8	9.34	4.31	5.47	.44
3	404.2	3.5	I7.0	32.1	9.35	4.22	5.09	.04
4	344.8	3.8	15.5	41.9	8.17	3.88	4.53	.24
Total	1632.0		69.5	125.40	37.81	17.37	21.80	1.36
Average	408.0	3.6	17.4	31.3	9.45	4.34	5.45	.58
Group VI, on Hay and Mixed Grain.								
1	511.5	3.8	22.9	30.6	11.89	5.47	7.19	.77
2	465.6	4.3	23.7	30.6	10.83	5.94	6.35	1.45
3	514.2	4.1	24.5	31.6	11.95	5.87	6.55	.47
4	413.8	3.9	19.2	31.6	9.62	4.80	4.59	.22
Total	1905.1		90.3	124.4	44.29	22.08	24.67	2.47
Average	476.5	4.1	22.6	31.1	11.07	5.52	6.17	.62

The same scheme of tabulation was used in this table as in the table of feeds, No,1, and arrangement in the table is the same.

TABLE OF
KIND, AMOUNT, AND COMPOSITION OF FOODS 1905

Roughage	Concentrates	Dry Matter	Digestible Matter	Nutritive Ratio	Cost of feed	No. of Months
Silage and Bran, Group I						
921	373	551.2	375.4	1:5.4	$4.36	1
978	336	499.1	332.8	1:5.2	4.44	2
1094	372	554.9	370.4	1:5.2	4.84	3
939	323	453.5	301.7	1:5.4	4.00	4
3932	1406	2058.7	1380.3	21.2	$18.14	Total
983	351	514.7	345.1	1:5.3	4.53	Average
Stover and Bran, Group II.						
416	336	545.9	341.4	1:5.5	3.74	1
398	309	509.0	314.9	1:5.6	3.45	2
426	341	560.5	350.1	1:5.5	3.80	3
487	336	514.4	324.1	1:5.4	3.61	4
1727	1321	2129.8	1330.5	22.0	14.60	Total
432	440	532.4	332.6	1:5.5	3.65	Average
Hay and Bran, Group III						
472	325	695.5	423.4	1:6.4	4.93	1
405	294	609.4	396.7	1:6.2	4.35	2
462	325	689.0	423.1	1:6.1	4.88	3
402	306	560.7	359.8	1:5.9	4.19	4
1741	1250	2554.6	1603.0	24.6	18.35	Total
435	312	638.6	400.7	1:6.1	4.58	Average
Silage and Cotton Seed, and Corn and Cob Meal, Group V						
1055	341	526.9	396.4	1:6.2	4.82	1
968	308	474.8	364.1	1:6.3	4.46	2
1087	340	547.7	400.7	1:6.2	4.86	3
1030	316	458.4	376.9	1:6.3	4.58	4
4140	1305	2007.8	1588.3	25.0	18.72	Total
1035	326	501.9	384.6	6.2	4.68	Average
Stover with Mixed Concentrates, Group V.						
428	356	481.7	409.3	1:6.5	4.24	1
417	322	526.7	377.2	1:6.5	3.87	2
441	356	576.1	413.4	1:6.6	4.26	3
388	299	460.2	389.1	1:6.7	3.64	4
1674	1333	2044.7	1589.0	26.3	16.01	Total
418	333	511.2	397.2	1:6.6	4.00	Average
Hay with Mixed Grain Ration, Group VI.						
405	356	678.7	460.9	1:6.7	4.70	1
417	322	543.2	389.5	1:6.4	5.39	2
448	342	698.5	482.0	1:6.9	4.49	3
387	375	603.8	468.3	1:6.7	5.02	4
1686	1395	2524.2	1800.7	26.7	19.60	Total
406	349	631.0	450.2	1:6.7	4.90	Average

The figures for each period are the average of the food consumed by the four cows in that group for one month, thus the final average is equivalent to the performance of one cow for sixteen months, averaged by monthly periods.