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AGRICULTURAL EXPERIMENT STATION

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**Tankage**  
**as a Source of Protein**  
**For Dairy Cows**

By **J. G. Archibald**

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Tankage, especially the better grades, has a common use as poultry and hog feed, but interest in it as a source of protein for dairy cattle is of very recent development. This bulletin is based on investigations of the value of tankage for milk production.

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MASSACHUSETTS STATE COLLEGE  
AMHERST, MASS.

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# TANKAGE AS A SOURCE OF PROTEIN FOR DAIRY COWS

By J. G. Archibald, Assistant Research Professor of Animal Husbandry<sup>1</sup>

## INTRODUCTION

Tankage, a common article in the feed and fertilizer market, is a by-product of the meat packing industry, and consists of a mixture of meat scraps, trimmings, and bones, the residue from the preparation of the standard market cuts of meat. It is cooked at high temperatures to sterilize it and to render out most of the fat, and is then dried and ground. The final product is a fine, quite dry meal varying in color from light to dark brown and with a characteristic though not objectionable odor. It is composed almost entirely of protein, calcium (lime), and phosphorus. The source of the last two mentioned is bone, and since the proportions of meat and bone vary, there are several grades of tankage with varying percentages of protein, lime and phosphorus. Tankage is generally sold on the basis of its protein content and the grades vary from 45 percent protein or less, which is usually known as "meat and bone", to 60 percent protein, which is sometimes referred to as "meat meal".

The better grades of tankage have been fed to hogs and poultry for years and to beef cattle to some extent more recently. It is only very recently, however, that it has been thought of as a possible source of protein for dairy cows. At present there is a relative scarcity of protein supplements of plant origin due largely to the drouth of 1934, while at the same time tankage is plentiful and its price per unit of protein is rather attractive. Furthermore, certain investigations have demonstrated an apparent superiority of animal proteins over plant proteins for nutritive purposes.

In view of these facts it was decided to conduct at this station an investigation of the value of tankage for milk production. This was done during the winter of 1934-35, the feeding trial lasting somewhat over five months, from November 19 to April 27.

## METHOD OF CONDUCTING THE INVESTIGATION

Twenty-four cows were chosen from the State College herd and divided into two groups of twelve each, as similar as possible with respect to breed, age, live weight, stage of lactation, amount of milk being produced and fat test of the milk. Table 1 shows that the groups were quite similar in all respects.

The tankage used in the experiment was a high-grade, dry-rendered product. It was compared with a mixture of soybean meal and cottonseed meal. The groups of cows were fed by the double reversal method, one group receiving the tankage ration for forty days while the other received the soybean-cottonseed ration. At the end of that time the rations were reversed, the group which had been receiving tankage being changed to the soybean-cottonseed ration and

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*vice versa*. The rations were reversed three times so that each group received each ration for two different periods of forty days each. Results have been reckoned from the last thirty days of each period, the first ten days being considered preliminary, to allow the cows to become accustomed to the change in feed and to offset any lag in the effect of the previous ration on milk production. Table 2 shows the schedule of the experiment.

The composition of the grain mixtures is given in Table 3.

TABLE 1.—STATUS OF THE TWO GROUPS OF COWS AT THE BEGINNING OF THE EXPERIMENT.

	Group A	Group B
Breed:		
Shorthorns.....	3	2
Ayrshires.....	1	2
Holsteins.....	4	4
Guernseys.....	3	2
Jerseys.....	1	2
Average age.....	5 years 4 months	5 years 6 months
Average weight.....	1148 pounds	1147 pounds
Average stage in lactation.....	81 days	77 days
Average daily milk yield.....	32.8 pounds	32.8 pounds
Average butter fat.....	4.18 per cent	4.35 per cent

TABLE 2.—SCHEDULE OF FEEDING PERIODS.

Period	Ration fed to Group A	Ration fed to Group B
Nov. 19—Dec. 28, inclusive	Soybean-cottonseed	Tankage
Dec. 29—Feb. 6, inclusive	Tankage	Soybean-cottonseed
Feb. 7—Mar. 18, inclusive	Soybean-cottonseed	Tankage
Mar. 19—Apr. 27, inclusive	Tankage	Soybean-cottonseed

TABLE 3.—FORMULAS OF GRAIN MIXTURES.

Ingredients	Soybean- cottonseed Meal	Tankage
	Mixture (Pounds)	Mixture (Pounds)
Wheat bran.....	400	400
Ground oats.....	500	500
Hominy feed.....	640	640
Soybean meal (41% protein)....	200	...
Cottonseed meal (41% protein)...	200	...
Corn starch.....	...	100
Tankage.....	...	340
Steamed bone meal.....	40	...
Salt.....	20	20
TOTAL.....	2000	2000

TABLE 4.—AMOUNTS OF FEED EATEN.

Feed	Soybean-Cottonseed Ration		Tankage Ration	
	Total for the Group (Pounds)	Daily Average per Cow (Pounds)	Total for the Group (Pounds)	Daily Average per Cow (Pounds)
Hay and rowen <sup>1</sup> .....	15,813	11.30	15,807	11.29
Corn silage.....	46,320	33.09	46,335	33.10
Mangels <sup>2</sup> .....	6,387	4.56	6,383	4.56
Dried beet pulp <sup>3</sup> .....	3,070	2.19	3,075	2.20
Grain.....	12,726	9.09	12,740	9.10

<sup>1</sup>Amounts of hay and rowen combined in order to enable deduction of small amount of waste which consisted entirely of hay and rowen, the proportions of which in the waste it was impracticable, if not impossible, to determine. The amount of rowen fed was about one-third of the total reported above and was the same for both groups.

<sup>2</sup>The supply of mangels was insufficient to last through the winter. They were fed from the beginning of the experiment in November up to February 3.

<sup>3</sup>Moistened with an approximately equal amount of water before feeding.

TABLE 5.—COMPOSITION OF THE FEEDS.<sup>1</sup>

Material	Water	Ash	Crude Protein	Crude Fiber	Nitrogen-free Extract	Crude Fat
Hay.....	10.57	5.64	8.35	32.57	40.85	2.01
Rowen.....	10.57	6.01	11.79	25.65	43.55	2.43
<del>Grain.....</del>	76.40	1.23	1.99	6.26	13.45	.67
Mangels.....	94.49	.98	.64	.53	3.29	.06
Dried beet pulp.....	13.93	2.90	9.68	18.38	54.57	.55
Soybean-cottonseed meal mixture.....	12.11	5.73	18.81	6.93	50.74	5.69
Tankage mixture.....	11.74	8.01	19.36	6.34	48.60	5.96

<sup>1</sup>Expressed on the basis of percentages in the materials as fed, except dried beet pulp to which water was added before feeding.

TABLE 6.—AVERAGE DAILY INTAKE OF NUTRIENTS PER COW.<sup>1</sup>

	Soybean-cottonseed Ration	Tankage Ration
Total dry matter.....	28.04 pounds	28.08 pounds
Total ash.....	1.69 pounds	1.90 pounds
Digestible protein.....	2.38 pounds	2.46 pounds
Total digestible nutrients.....	19.15 pounds	19.24 pounds
Net energy.....	18.51 therms	18.60 therms
Nutritive ratio.....	1:7.0	1:6.8

<sup>1</sup>This includes all material fed—not merely the grain mixtures.

The composition of the feeds as set forth in Table 5 has been used together with average digestion coefficients to obtain the intake of nutrients as recorded in Table 6. It will be noted that the intake was slightly higher on the tankage ration than on the soybean-cottonseed ration. This was unintentional, and was due chiefly to the fact that the grain mixture which contained the tankage proved to be somewhat higher than the other mixture in ash, protein, and fat. Preliminary calculation when the formulas of the mixtures were decided on had indicated the composition of the two to be in theory nearly identical. The tankage analyzed somewhat above its guarantee for protein, which accounts in part for the discrepancy.

## RESULTS OF THE FEEDING TRIAL

### Palatability of the Tankage

No difficulty was experienced in getting the cows to eat the grain mixture which contained tankage. One cow refused her grain on the first day of the trial but not thereafter. The herdsman states that in general the cows did not clean up the tankage mixture as quickly as they did the soybean-cottonseed; but, as already stated, they did not refuse it. The amount of tankage in the grain was 17 percent.

### Changes in Live Weight

The cows were weighed when the trial was started and thereafter at the end of each forty-day feeding period, just previous to the change of rations.

Table 7 shows that there was a slightly superior gain in weight on the tankage ration, but calculation of the probable error of the average values given shows that the difference in favor of the tankage is not significant.

### General Appearance of the Cows

All animals in the experiment were graded for condition twice during the season. The average grade was "good" tending toward "excellent" as the experiment and the barn feeding season drew to an end. No differences were apparent to the eye in the condition of the animals on the two rations.

### Milk Production

A summary of milk production on the two rations appears in Table 8. The figures given have been corrected to a uniform fat basis of 4 percent according to the usual formula ( $.4M + 15F$ ), in which M equals actual milk production and F equals calculated fat production based on the fat test of the milk and the actual milk production. Due to a close agreement between the butterfat tests for the two groups of cows, the corrected values in Table 8 do not differ greatly from the actual milk production.

Table 8 shows a slight difference in milk production in favor of the tankage ration, but calculation of probable error shows that this difference is not significant.

### Composition of the Milk

Composite milk samples were taken from each group of cows about midway of each feeding period. The sampling period was two days in length and samples from individual cows in a group were pooled to make a group sample. Table 9 shows that there was no significant difference between the rations in this respect.

TABLE 7.—SUMMARY OF AVERAGE GAINS IN LIVE WEIGHT.

	On Soybean- cottonseed Ration (Pounds)	On Tankage Ration (Pounds)
First 40-day feeding period . . . . .	18	15
Second 40-day feeding period . . . . .	17	26
Third 40-day feeding period . . . . .	42	45
Fourth 40-day feeding period . . . . .	-7	-5
Net total . . . . .	70*	81*

\*These values represent average gains by individual cows.

TABLE 8.—MILK PRODUCTION (CORRECTED TO 4 PERCENT FAT).

	On Soybean- cottonseed Ration (Pounds)	On Tankage Ration (Pounds)
First 30-day period . . . . .	11,273.0	11,213.9
Second 30-day period . . . . .	10,402.6	10,745.6
Third 30-day period . . . . .	9,052.8	9,670.8
Fourth 30-day period . . . . .	8,614.3	8,396.7
Total production . . . . .	39,342.7	40,027.0
Average daily production per cow <sup>1</sup>	28.1	28.6

<sup>1</sup>Obtained by dividing the total by 1400, the number of cow days on each ration. If all individuals in each group had milked throughout the duration of the experiment, the number of cow days would have been 1440. One cow in each group dried off sooner than anticipated, and both were removed on the same day—forty days previous to the end of the experiment.

TABLE 9.—COMPOSITION OF THE MILK (PERCENTAGES).

	On Soybean- cottonseed Ration	On Tankage Ration
Total solids . . . . .	12.76	12.77
Fat . . . . .	3.96	3.99
Ash . . . . .	.731	.728

### Flavor of the Milk

The composite samples taken for analysis were also scored for flavor, preservative having been purposely omitted with this in mind. The samples were kept sweet by refrigeration and scored (except in one instance) on the same day on which the final aliquots were taken.<sup>1</sup>

On the samples taken in December and April the decision was 3 to 1 that the milk from the cows receiving the soybean-cottonseed ration had slightly the

<sup>1</sup>Acknowledgement is made to M. J. Mack and H. G. Lindquist of the Department of Dairy Industry of Massachusetts State College, who with two graduate assistants made the tests for milk flavor; also to W. S. Mueller of the same department, who tested the whipping quality of the cream.

better flavor. On the samples taken in January and March the decision was unanimous that the milk from the cows receiving the tankage ration was slightly the better as regards flavor.

The decision was also evenly divided as regards the groups of cows, which rules out individuality of the animals as a factor in influencing the flavor. It may be concluded that the tankage did not affect the flavor of the milk in any way.

### Whipping Quality of the Cream

The entire production of each group of cows for one milking was kept separate on two occasions, the cream was separated, and a representative portion of each lot was submitted to the whipping test. To quote the statement of the member of the Department of Dairy Industry who made the test,—“the cream obtained from samples A and B was found to be equal in whipping rate, degree of stiffness and overrun. No objectionable flavor was detected.”

## SUMMARY AND CONCLUSIONS

High-grade, dry-rendered tankage has been compared as regards its suitability for dairy cows with a mixture of soybean meal and cottonseed meal. The comparison has been made by means of the double reversal method using twenty-four cows in the State College herd, divided into two groups of twelve each. The feeding period extended over 160 days, each group of cows being on each ration at two different times for periods 40 days in length. Tankage made up 17 per cent of the experimental grain ration, and supplied digestible protein equal in amount to that in the 10 percent each of soybean meal and cottonseed meal which the control ration contained.

No difficulty was experienced in getting the cows to eat the grain ration which contained the tankage.

There was no significant difference in the effect of the tankage ration as compared with the soybean-cottonseed ration in any of the following respects: Gain in weight, general appearance of the cows, milk production, composition and flavor of the milk, and whipping quality of the cream.

Insofar as these results are concerned, it seems that high-grade tankage can be safely added to the list of protein feeds for dairy cows, provided the usual precautions for feeding protein concentrates are observed. In addition to its protein, tankage carries a considerable amount of bone, which can take the place of the bone meal so often added as a mineral supplement to mixed feeds.



The amounts of soybean meal and cottonseed meal in the grain mixture were chosen as typical of the percentages of these ingredients occurring in commercial dairy rations. With two exceptions the mixtures were similar. Due to its somewhat higher protein content, 340 pounds of tankage furnished an amount of digestible protein equivalent to that contained in 200 pounds each of the two oil meals. Because of the presence of bone in the tankage, bone meal was not included in that mixture. The difference ( $60+40=100$  pounds) was made up by including in the tankage mixture 100 pounds of corn starch per ton. Corn starch was chosen for this purpose because it did not add to the mixture any further protein or minerals.

Except for the variation in the grain mixtures the rations were kept as nearly identical as possible. The other feeds were hay, rowen, corn silage, mangels, and dried beet pulp. Table 4 shows that the average daily intake of feed by the two groups was practically identical. The only feed wasted was small amounts of hay and rowen, which were about the same in each group and constituted about 6.0 percent of the combined amount of hay and rowen fed and about 2.3 percent of the total dry matter of the entire ration.