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A. B. CONNOR, DIRECTOR

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DIVISION OF DAIRY HUSBANDRY

Wheat Versus Milo For Dairy Cows

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*Dean, School of Veterinary Medicine.
**In cooperation with U. S. Department of Agriculture.
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†As of August 1, 1933

Coarsely-ground wheat can replace ground milo in the dairy ration pound for pound when not more than fifty per cent of the grain mixture is composed of wheat and when the price of wheat justifies its use as a feed for livestock. A ration containing fifty per cent wheat was consumed with as much relish as the milo ration. Calculations made from the results of these experiments show that the wheat used contained 84.9 therms of energy per one hundred pounds of wheat, which compares very favorably with the productive energy content of 83.3 therms per one hundred pounds of the milo used, calculated from the chemical composition and digestion coefficients.

CONTENTS

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WHEAT VERSUS MILO FOR DAIRY COWS

O. C. COPELAND

Numerous inquiries concerning the feeding value of wheat for dairy cows have been received since the price of wheat has come down to about the same level as that of other grains used in the dairy rations. Heretofore wheat has usually been too high in price to be used extensively as a feed for livestock and until very recently there has been little information in the literature concerning the value of wheat compared with the other grains commonly used in dairy rations.

In 1895 Bartlett (1) of the Maine Station found wheat meal slightly superior to corn meal, pound for pound, when fed to dairy cows, especially when fed with other feeds low in protein. Hayden and Monroe (4) of the Ohio Station found that wheat fed dairy cows to the extent of one-third of the grain mixture was practically equivalent to corn in feeding value. They found the wheat ration to be fully as palatable as the corn ration. They also found that cows fed continuously for seven months on a ration containing 40% wheat showed no ill effects from this feeding. They recommended that wheat be crushed or only coarsely ground for feeding to cows since finely-ground wheat has a tendency to form a pasty, gummy mass in the course of digestion. Jacobs (5) of Panhandle Station (Oklahoma) found wheat equal to milo in the dairy ration and that at least two-thirds of the grain ration could be made up of wheat without causing a decline in milk production. He concludes that "wheat did not need supplementing with bran and required less cottonseed meal". Fitch and Cave (2) at the Kansas Station report that wheat can replace corn pound for pound up to fifty-seven per cent of the ration. However, they found some tendency for the cows to go off feed while on the wheat ration. Workers at the Kentucky Station (6) noted a slight advantage of cracked corn over cracked wheat when fed to dairy cows.

The chemical composition of wheat and milo are so nearly equal that the two feeds appear to be almost equal in feeding value. However, the chemical composition is not a direct measure of the actual feeding value of any certain feed. Other things to consider besides the chemical analysis are palatability, digestibility, productive energy, vitamin content, and the effect of the feed on the health of the animal. Some of these factors can be studied only in experimental feeding trials. The object of this investigation was to ascertain the value of coarsely-ground wheat as a substitute for ground milo in the ration of dairy cows.

PLAN OF EXPERIMENT

Two groups of six cows were used in three experiments. The cows were paired so that each pair was as nearly alike as possible as to size, previous production, stage of lactation, and age. One cow from each pair was placed in group A and her mate placed in group B. The double-reversal

method of feeding was used. In this method group A was fed the milo ration and group B the wheat ration for 28 days. In the second period of 28 days the rations were reversed with the two groups of cows, and then a third period the original ration was fed. These three 28-day periods with two groups of cows constituted one experiment. Three such experiments were completed. The first seven days of each 28-day period was used as a preliminary period during which time the animals might become accustomed to the sudden change in the ration, and the last 21 days constituted the experimental period.

Feeds

Grain and silage were weighed and fed to each cow individually in the milking barn and alfalfa hay was fed individually in a large shed, during the first two experiments. Silage was fed at the rate of 30 pounds per cow per day during the first experiment and 18 pounds per cow per day during the second experiment. Alfalfa hay was fed at

Table 1. Rations used

Feeds	Wheat ration Pounds	Milo ration Pounds
Coarsely-ground wheat	50.0	0.0
Ground milo	0.0	50.0
Wheat bran	16.7	16.7
43% Protein cottonseed meal	16.7	16.7
Ground whole oats	12.6	12.6
Ground limestone	3.0	3.0
Salt	1.0	1.0

the rate of 12½ pounds per cow per day during the first experiment, and 11 pounds per cow per day during the second experiment. Fresh water and block salt were available to the cows at all times. The cows were milked twice a day and the milk weighed to the nearest tenth of a pound.

The grain rations used in this investigation are shown in Table 1. It can be seen from this table that ground wheat or ground milo made up

Table 2. Chemical analysis of wheat and milo*

Feed	Protein	Fat	Crude fiber	Nitrogen-free extract	Water	Ash
Wheat	13.26	1.62	2.70	70.34	10.26	1.82
Milo	11.18	2.54	2.45	70.00	12.42	1.41

*Analysis made under the direction of G. S. Fraps, Division of Chemistry.

50% of the grain mixtures. Sorghum silage was used and the alfalfa hay was of choice quality. Chemical analyses of the wheat and milo used in the investigation are shown in Table 2. The wheat contained 13.26 per cent crude protein, which is about the average of soft winter wheat but lower than the hard winter wheat of the Panhandle.

EXPERIMENTAL RESULTS

The first experiment was begun November 27, 1931, and ended February 18, 1932. There were six purebred Jerseys in each group. The second experiment was started on February 19, 1932 and ended May 12, 1932. Group A consisted of six purebred Jerseys and group B consisted of four purebred Jerseys and two high-grade Jerseys. The third experiment was started May 13, 1932, and ended August 4, 1932. There were five purebred and one high-grade Jersey in group A, and four purebred and two high-grade Jerseys in Group B.

Milk Production

The summarized results of milk production, feed consumption, and changes in body weight are shown in Table 3. During the first experiment there was a difference of 2.09 pounds of milk per cow for the 21-day experimental period in favor of the milo ration in group A. In group B there was a difference of 7.32 pounds of milk per cow in favor of the milo ration, or a total of 9.41 pounds of milk per cow per 21-days in favor of the milo ration, when both groups are considered. This amounts to less than one-half pound per cow per day, which cannot be considered a significant difference caused by a superiority of one ration over the other. During the second experiment group A showed a difference of 41.22 pounds of milk per cow for the 21-day period in favor of the milo ration. However, group B showed a difference of 3.37 pounds per cow in favor of the wheat ration. A summary of the results of the two groups gives a difference of 37.85 pounds of milk per cow per 21-days in favor of the milo ration. This amounts to slightly less than 2 pounds of milk per cow per day. This difference might be considered significant if there were no differences in feed consumption or changes in body weights. An examination of Table 3 for the second experiment shows that there was no material difference in feed consumption but that the loss in body weight per cow for the 21-day period was 13.56 pounds less with the wheat ration, which would offset the difference in milk production favoring the milo ration.

Milk production during the third experiment showed a difference of 4.26 pounds of milk per cow in group A in favor of the milo ration, and in group B a difference of 10.68 pounds per cow in favor of the wheat ration, or a total of 6.42 pounds per cow per 21-day period in favor of the wheat ration. This would be only about one-third of a pound per cow per day, and could not be considered as a significant difference. A summary of the three experiments shows that the cows while on the milo ration

produced approximately three-fourths of a pound more of milk per day than while on the wheat ration. The difference is so small that it would not be ascribed to the superiority of one feed over the other.

Feed Consumption

Both groups of cows consumed approximately as much grain and roughage when they were on the milo ration as when they were on the wheat ration, as shown in Table 3. The wheat ration was consumed with just

Table 3. Average consumption of feed, production of milk, and changes in body weight during first and third 21-days minus consumption, production, and changes in weight during second 21-days

	Milo	Wheat	Hay	Milk	Body weight
Experiment 1					
Group A (started on milo)	+110.21	—110.21	—38.09	+ 2.09	—14.37
Group B (started on wheat)	—104.10	+104.10	—37.09	— 7.32	— 5.81
Difference A-B	+214.31	—214.31	— 2.00	+ 9.41	— 8.56
Experiment 2					
Group A (started on wheat)	— 91.85	+ 92.73	—30.75	—41.22	—22.69
Group B (started on milo)	+ 86.17	— 86.60	—35.58	— 3.37	—36.25
Difference A-B	—178.02	+179.33	+ 4.83	—37.85	+13.56
Experiment 3					
Group A (started on wheat)	—110.22	+106.72		— 4.26	+25.68
Group B (started on milo)	+105.48	—108.48		—10.68	+44.68
Difference A-B	—215.70	+215.20		+ 6.42	—19.00

as much relish as was the milo ration. In no instance was either ration refused by the cows. The concentrate ration was fed at the rate of one pound for every two and one-half pounds of milk produced per cow per day. Hay consumption for both groups of cows was practically the same, there being only a very small amount of refused hay weighed back for both groups.

Body Weight

Table 3 also shows summarized results of changes in body weight for both groups of cows for each of the three experiments. In the first experiment the combined results of both groups show that the loss with the milo ration was 8.56 pounds per cow for the 21-day period, or less than one-half pound per cow per day. The combined results for both groups of cows during the second experiment show a loss, with the milo ration of 13.56 per cow per 21-day period. During the third experiment the cows while on the milo ration gained 19 pounds more per cow in 21 days than while on the wheat ration, which amounts to almost a pound per cow per day.

When the milo ration was used, the loss in body weight was greater during the first two experiments and the gain in body weight was greater

during the third experiment. An average of the three experiments for changes in body weight shows a net difference of 3.12 pounds per cow for 84 days favoring the wheat ration.

Table 4 gives the equivalent of wheat consumed to milo consumed, differences in milk produced and differences in changes in body weight

Table 4. Equivalent of wheat to milo, milk and body weight

	Wheat		Milo	Hay	Milk	Body weight
Experiment 1	214.31	=	214.31	—2.00	— 9.42	+ 8.56
Experiment 2	179.33	=	178.02	—4.83	—37.82	+13.56
Experiment 3	215.20	=	215.70	----	+ 6.42	—19.00

for the three experiments. The purpose of this table is to give in the form of an equation the results shown in Table 3.

Productive Energy of Ground Wheat

In computing the rations to be used in this feeding experiment it was assumed that the productive values of wheat and milo were very nearly the same. Although the chemical analysis of the two feeds show that wheat is approximately two per cent higher in crude protein than milo, no adjustment in protein was made for this difference in formulating the two grain mixtures, as it was the object of this experiment to ascertain whether wheat could replace milo pound for pound in the dairy ration. The assumption that the two feeds were very nearly equal in productive energy was based on the therms per hundred pounds of feed, calculated from the chemical analysis of the feed and the production coefficients given by Fraps (3) in Texas Bulletin 402. Based on these calculations the productive energy of the wheat used in these experiments was 88.8 therms per one hundred pounds compared with 83.3 therms per one hundred pounds of the milo.

Table 5 gives the calculation of the productive value of wheat in therms as determined from the three experiments, the results of which are given in Table 3. Calculations were also made for the third experiment but the productive value of 74.68 therms was not included in the average because the cows were turned on pasture during this experiment and no account could be taken of the amount of pasturage consumed. The actual result of the third experiment can be used for the calculation of the productive energy of wheat only when it is assumed that the cows in the wheat ration consumed the same amount of pasturage as the cows on the milo ration, and we have no basis for such an assumption. Evidently from the results shown, the cows on the wheat ration did not consume as much pasturage as did the cows on the milo ration.

Since all feed consumed was taken into account in the first two experiments, the productive energy calculated should show with a reasonable degree of accuracy the true energy value of wheat in the dairy ration. An average of the first two experiments shows wheat to have a productive

Table 5. Calculation of productive value of wheat in therms (from equations in Table 4)

Productive energy	Experiment 1		Experiment 2		Experiment 3	
	Pounds	Productive value	Pounds	Productive value	Pounds	Productive value
Wheat x .888	214.31	190.31	179.33	159.25	215.20	191.10
Milo x .833	214.31	178.52	178.02	148.29	215.70	179.68
Milk x .300	— 9.41	— 2.82	— 37.85	— 11.35	+ 6.42	+ 1.93
Weight x 1.100	+ 8.56	+ 9.42	+ 13.56	+ 14.92	— 19.00	— 20.90
Hay x .345	— 2.00	— 0.69	— 4.83	— 1.67	-----	-----
Total + ...		187.94		163.21		181.61
Total —		3.51		13.02		20.90
Productive energy of wheat fed		184.43		150.19		160.71
Productive energy per 100 lbs. wheat		86.06		83.75		74.68

energy value of 84.9 therms per one hundred pounds, which corresponds rather closely to the 88.8 therms as calculated from the chemical analysis and the digestion coefficients. The 84.9 therms of energy per one hundred pounds of wheat is also slightly above the energy content in terms of therms per one hundred pounds for milo, which is 83.3 as shown by the calculations using the chemical analysis and the digestion coefficients. This also corresponds with the summarized results of milk production and gains in body weight shown in Table 3, where there was a slight difference in gain in body weight favoring the wheat ration. This allowance of 1.1 therms of energy per pound of gain might be a little low, as Fraps (3) gives the average of 81 tests with fattening sheep as requiring 2.6 therms of energy per pound of gain, but the energy varies with the percentage of fat put on, which is low at the beginning of the fattening period. If a pound of gain or loss in body weight for the cows contains more than 1.1 therms of energy, the productive energy of wheat as calculated from the first two experiments would also be increased.

SUMMARY

Three experiments have been conducted with dairy cows, comparing a ration containing 50 per cent coarsely-ground wheat with a ration containing 50 per cent ground milo.

The results show that wheat can replace milo, pound for pound, when not more than 50 per cent of the grain mixture is composed of wheat.

The productive energy of the wheat used, as calculated from the results of this experiment, was 84.9 therms per one hundred pounds, compared with 83.3 therms per one hundred pounds of the milo grain used, calculated from the chemical composition and digestion coefficients.

The wheat ration was consumed with just as much relish as was the milo ration.

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