Ground Alfalfa as a Substitute For a Part of the Concentrates In the Dairy Ration

Ground Alfalfa As A Substitute For A Part of The Concentrates in the Dairy Ration

By

Albert O. Davis

Bachelor of Science

Murray State College

Murray, Kentucky

1948

Submitted to the Department of Dairying

Oklahoma Agricultural and Mechanical College

In Partial Fulfillment of the Requirements

For the Degree of

Master of Science

1950

APPROVED BY:

H. W. Cave
Chairman, Thesis Committee

E. R. Berousek
Member of the Thesis Committee

H. E. Olson
Head of the Department

D. C. McIntosh
Dean of the Graduate School

ACKNOWLEDGEMENT

The author wishes to take this opportunity to sincerely thank the many persons who were of service in conducting this study. Expecially appreciated was the help of the late Dr. A. H. Kuhlman. Other contributing valuable information and suggestions were Professor E. R. Berousek, Dr. H. C. Olson and Professor H. W. Cave.

TABLE OF CONTENTS

INTRODUCTION

Efficient dairy farmers have come to realize that the most economical milk production can be obtained only through the feeding of a balanced ration. A certain amount of protein is essential, and this is usually the most costly portion of the dairy ration. The high price and scarcity of high protein supplements during World War II presented a serious problem to the dairyman.

Feed cost is the largest single item in the cost of milk production. Since roughages usually are the cheapest source of total digestible nutrients and realizing dairy cattle are naturally roughage consuming animals, a large proportion of the nutrient requirements should be furnished by high quality roughage.

One important factor which should be kept in mind when substituting ground roughage for concentrates is the variability in the quality of roughage. Only high quality roughage should be used for this purpose. Another factor to remember when substituting ground alfalfa for a part of the concentrate mixture is that such a mixture is lower in total digestible nutrients than one consisting of concentrates only. Consequently slightly larger amounts of a concentrate mixture containing ground alfalfa must be fed.

This study was conducted in an effort to determine the value of ground alfalfa as a substitute for a part of the concentrate mixture in a dairy ration.

Review of Literature

Since feed cost is a major item in the cost of milk production, an important question which always confronts the dairy farmer is the proper proportion of concentrates and roughages to feed a dairy cow

for the most economical milk production.

In a study conducted by Carncross and Houk (2) in Sussex County, New York, a comparison was made of the cost of milk production when roughages made up different proportions of the ration. The cost of milk production on farms where roughages constituted seventy-two per cent of the total digestible nutrient intake was compared with that of dairy farms where the cows received only fifty-three per cent of their total digestible nutrients from roughage. They found that the feed cost of producing 100 pounds of four per cent fat corrected milk was forty-six cents less for the group receiving seventy-two per cent of their total digestible nutrients from roughage than that of the other group.

Monroe and Allen (19) conducted an investigation with purebred and high-grade Holstein cows on the effect of increasing the rate of hay feeding on the amount and cost of milk production. A comparison was made of the cost of production on a heavy and light hay ration. The results of this work showed that feed costs for production were lower and returns above feed costs were higher on the heavy hay ration.

Woll and Associates (28) made a study of the comparative cost of milk production on a heavy and light grain ration. The heavy grain feeding was at the rate of one pound of grain for each three pounds of milk while the cows on the light grain ration received one pound of grain for each five pounds of milk produced. They found no significant difference in the amount of butterfat produced, but the cows on the heavy grain feeding gained more in body weight. The authors concluded that under the conditions of the experiment heavy grain feeding was unprofitable.

The results of an intensive study conducted at Huntley, Montana, under the supervision of the United States Department of Agriculture, was reported by Dickson and Kopland (3). The investigation concerned the effect of a full grain ration, a limited grain plus roughage ration, an all roughage ration on milk production from Holstein cows capable of fairly high production. The grain mixture used in the full and limited rations consisted of two parts ground corn, two parts ground oats, two parts mill feed, and one part linseed oil meal. The average production of ten cows while on the all roughage ration was 478 pounds of butterfat, in 365 days, or 77.1 per cent as much as they produced on the full grain ration. The same cows while on the limited grain ration, of one pound of grain for each six pounds of milk, produced 584.1 pounds of butterfat, or 94.2 per cent as much as they produced on the full grain ration. The cows had previous lactation records made on a full grain ration, of one pound of grain for each three pounds of milk produced, averaging 619.9 pounds of butterfat. All records were converted to a mature equivalent basis. Milk production was most economical on the limited grain ration and most costly on the full grain ration. The authors concluded that an all roughage ration has no detrimental effect on the health and reporductive efficiency of dairy cows.

In a long time experiment, Headley (9) found no apparent physical injury to cows fed an all roughage ration throughout their productive lives. Fifteen grade Holstein cows were used in this experiment. The average production of the cows was 283 pounds of butterfat per year on alfalfa hay alone. The average butterfat production for the cows receiving grain was 331

pounds per year, which is an increase of 16.9 per cent. The net profit was greater on the no grain ration.

According to Willard (26) an average butterfat production of 310.4 pounds was obtained on an all roughage ration as compared with 323.1 pounds for Holstein cows which received barley at the rate of one pound for each five pounds of milk produced.

In a later report, Willard (27) presents additional data on this same experiment. The production records agree with those in the earlier report. The author concluded that the no grain ration was more economical. He states that it is doubtful if Holstein cows with a producing capacity of thirty to forty pounds of milk at peak of production will benefit by being fed grain as a supplement to high quality hay and irrigated pasture.

Graves and Co-workers (6) reported that 15 Holstein cows averaged 11,125 pounds of milk and 390 pounds of butterfat, on a mature equivalent basis, for twenty-four lactation periods, when fed on alfalfa hay alone. The average production on a full grain ration, of one pound of grain for each three pounds of milk produced, was 19,421 pounds of milk and 651.6 pounds of butterfat on a mature basis. The average production on the alfalfa hay ration was 57 per cent as much milk and 60 per cent as much butterfat as the cows on the full grain ration. The decline in daily milk production was more rapid when the cows were on the alfalfa hay ration than when they were on the full grain ration. From an economical standpoint, the authors concluded that many farmers would find it an economical practice to keep most of their land in permanent pasture and legumes and

grow very little grain.

Hodgson and Associates (11) concluded that Holstein cows can be maintained satisfactorily, produce healthy calves and produce a liberal amount of milk on an all roughage ration. The average production of cows on an all roughage ration was 308.1 pounds of butterfat, in 305 days, as compared with 426.6 pounds on a grain ration. of one pound of grain for each four pounds of milk produced.

Results reported by McIntyre and Ragsdale (18) show that cows on an all roughage ration consisting of alfalfa hay, corn silage and pasture, with access to minerals at all times, produced an average of 321 pounds of butterfat in 305 days. This is 80 per cent of the production of the same cows in previous lactations on a grain ration fed at the rate of one pound of grain for each three pounds of milk produced. The rate of decline in milk production was more rapid for the roughage fed group. While on roughage alone, the group lost an average of 136 pounds more in body weight than when on the full grain ration.

In a report presented by Graves and Associates (7), a comparison was made of milk production on four different rations or levels of feeding. Twelve Holstein cows were fed for one complete lactation on each of the following rations: full grain ration, alfalfa hay alone, alfalfa hay and ground barley at the rate of one pound for each 6.03 pounds of milk produced, and alfalfa hay plus corn silage. The full grain ration consisted of two parts barley, one part oats, one part wheat bran; and this ration was fed at the rate of one pound of the mixture for each

4.33 pounds of milk produced. The cows were on pasture during the pasture season. All records were converted to a mature equivalent basis. The butterfat production when compared with that on the full grain ration was as follows: 65.77 per cent as much on the alfalfa hay alone; 80.24 per cent as much on the limited grain ration; and 69.93 per cent as much on the ration consisting of alfalfa hay and corn silage.

Bachtell and Associates (1) made a comparison of milk production on a moderate and light grain ration when a liberal amount of hay and pasture is used. The cows on moderate grain feeding consumed one pound of grain for each 4.55 pounds of milk produced. While the cows on the light grain ration consumed one pound of grain for each 6.52 pounds of milk produced. Each cow in the moderate grain group consumed an average of 803 pounds more grain and 473 pounds less hay each year than the cows on the light grain ration. They found no appreciable difference in the amount of milk produced on the two rations.

Sherwood and Dean (22) compared milk production on an all alfalfa ration and an alfalfa hay plus concentrate ration. Concentrate feeding was based on butterfat production, but on an average the cows received one pound of concentrate for approximately four pounds of milk produced throughout the experiment. The cows produced an average of 266.4 pounds of butterfat on the all alfalfa hay ration as compared with 322.2 pounds on the alfalfa hay plus concentrates.

Lindsey and Archibald (16) report the results of two systems of feeding dairy cows. One system involved the feeding of a relatively large amount of roughage and a relatively small amount of

grain; while the other system involved the feeding of a relatively small amount of roughage and a relatively large amount of grain. The cows on the low roughage ration consumed slightly more total digestible nutrients than the cows on the high roughage ration. The average daily milk yield was 14.4 per cent higher for the cows in the low roughage group than it was in the high roughage group. They found the feed cost of production to be about equal on both systems of feeding.

Jensen and Associates (13) made an intesive investigation on input and output relationship in milk production. Included in this study is a comparison of the economy of various levels of grain feeding. Results of this study are shown in Figure 1.

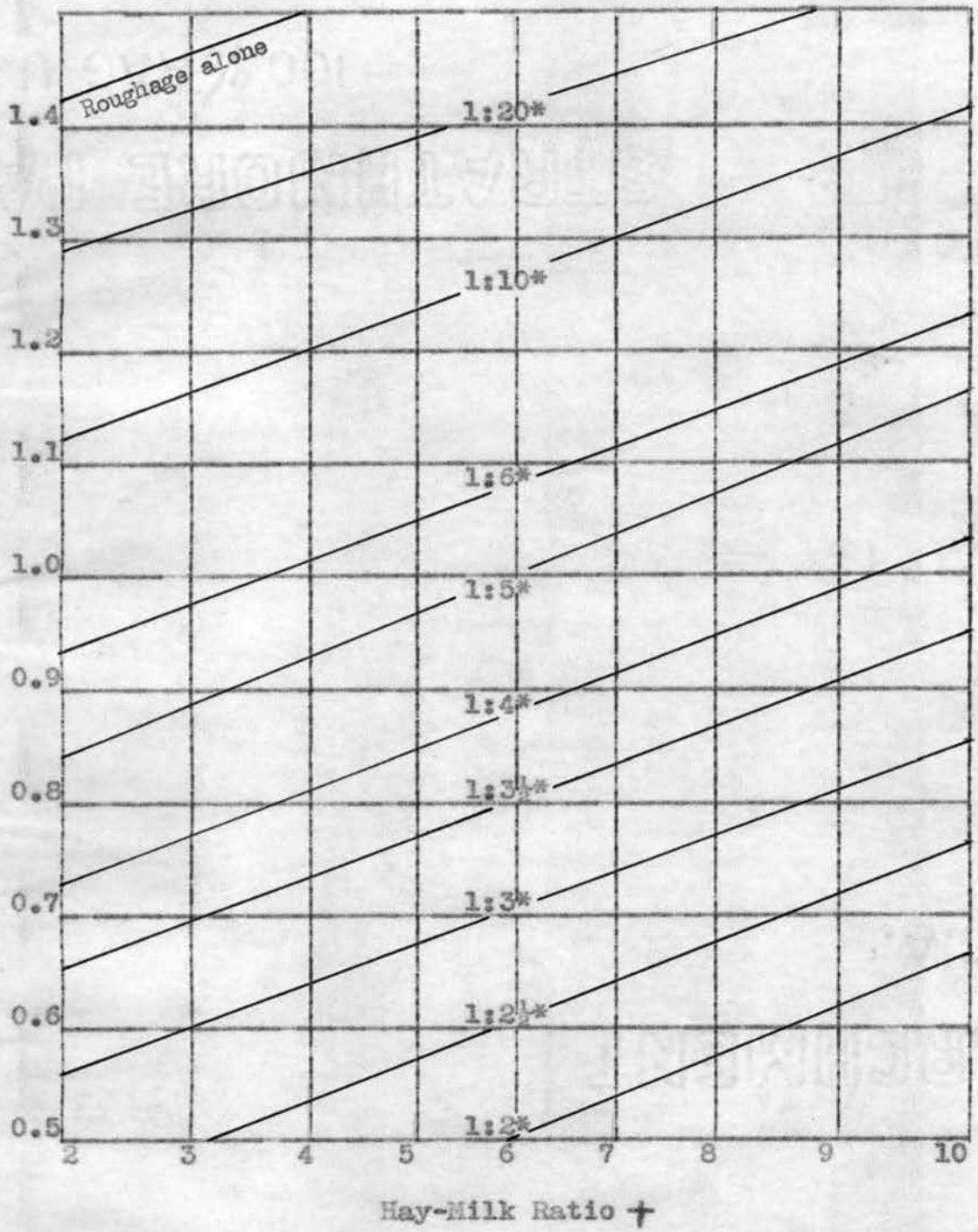

Figure 1. Chart showing the most profitable level of grain feeding when cows have free access to good roughage.

* Cows fed one pound of grain to every two pounds of milk during the lactation period are said to be fed at the level of 1:2; etc.

* Price of one hundred pounds of grain divided by price of one hundred pounds of four per cent fat corrected milk.

+ Price of one ton of hay or hay equivalent divided by price of one hundred pounds of four per cent fat-corrected milk.

The use of Fig. 1 is recommended only when a liberal amount of high quality roughage is fed. It can be seen from the Figure that when the grain-milk price ratio is one and the hay-milk price ratio is four the most economical grain feeding would be one pound of grain for each six pounds of milk produced.

Smith and Associates (23) compared the value of alfalfa hay alone and alfalfa hay supplemented with concentrates at alternate periods during the lactation. With few exceptions, feed changes were made simultaneously every 28 days on all cows. After the cows had been on alfalfa hay alone for a given time, a part of the alfalfa hay was replaced by a concentrate mixture on an equal T. D. N. basis. The lactation curves were very irregular but the cows declined faster in production when they were on the all alfalfa hay ration.

This work is in close agreement with some work done by Huffman and Duncan (12). The cows were depleted of their reserve milk-producing factors by placing them on an all roughage ration. Depletion was indicated by an initial decline and then a leveling off in milk production. After depletion, corn replaced a part of the alfalfa hay on an equal T. D. N. basis. The substitution of corn for a part of the alfalfa hay always resulted in an increased production of 4 per cent fat-corrected milk. The authors concluded that there is an unknown factor needed to balance alfalfa hay for milk production.

Hart and Humphrey (8) in emphasizing the importance of home grown rations, state alfalfa hay and cereal grains will furnish all the nutrients needed for maintenance and milk production of cows producing fifty pounds or more of milk daily.

Conflicting results have been reported when alfalfa hay replaced a part of the concentrate mixture in the dairy ration.

Soule and Barnes (25) found that when alfalfa hay was substituted for wheat bran pound for pound the alfalfa was inferior to wheat bran for milk production. They recommended feeding 1.5 pounds of alfalfa hay for each pound of wheat bran removed from the ration.

Mairs (17) presented a report of work done in comparing ground alfalfa hay and wheat bran in the dairy ration. In this experiment, the control mixture contained 50 per cent by weight of wheat bran. The experimental mixture contained ground alfalfa substituted pound for pound for the wheat bran. The experiment was divided into four periods of three weeks each. Both lots gained in weight and there was no appreciable difference in the amount of gains made by the two lots. The results of this experiment showed a decrease in milk production in every case when the cows were changed from the control ration to the experimental ration, and in most cases an increase in production when changed back to the control ration. Alfalfa meal was not recommended as a substitute for wheat bran.

One factor which undoubtedly contributed to the decrease in milk production when the cows were placed on the alfalfa meal ration was the decrease in total digestible nutrient intake; wheat bran contains 70.2 per cent and alfalfa hay contains 50.3 per cent T. D. N.

The results of a single feeding trial in which 6 cows were used was reported by Lindsey (15). He found alfalfa meal (ground alfalfa

hay) to be slightly inferior pound for pound to wheat bran for milk production.

Hills (10) of the Vermont Agricultural Experimental Station reports the results of a study on the comparative value of alfalfa meal and wheat bran. Wheat bran made up 62.5 per cent of the control ration. In the experiment alfalfa meal replaced the wheat bran. The author found that the cows produced 3 per cent less milk and butterfat on the alfalfa meal ration than they did on the wheat bran ration.

Rothwell (21) reported the results of a single reversal feeding trial in which alfalfa meal was compared with wheat bran. The control concentrate mixture contained 33.33 per cent, by weight, of wheat bran. In the experimental mixture, ground alfalfa replaced wheat bran pound for pound. The first trial consisted of three periods of two weeks each. The control mixture was fed in the first and third periods while the experimental mixture was fed in the second period. The average production of the first and third periods was compared with that of the second period. After this the cows were rearranged and the feed mixtures slightly altered. Additional information was obtained from four more feeding periods conducted in the same manner as before. After combining the feed cost of butterfat production, it was found that the average feed cost was $23.69 for each 100 pounds of fat produced on the control mixture and $24.43 for each 100 pounds of fat produced on the experimental mixture.

Fraser and Cassius (4) fed equal amounts by weight of alfalfa hay and of wheat bran with a basal ration consisting of 6 pounds of clover hay, 30 pounds of corn silage and 6 pounds of corn meal

per day for both lots. Lot I received all the choice alfalfa hay they would clean up, and lot II was given an equal amount of wheat bran, by weight. The feeding periods lasted nine and one half weeks, and then the rations were reversed. The results of this study showed alfalfa hay equal to or a little better than wheat bran for milk production.

A study made by Synder and Burnett (24) is in close agreement with the results of the previous mentioned trial. The concentrate mixture contained 28.6 per cent by weight wheat bran. In the experimental mixture chopped alfalfa hay replaced the wheat bran pound for pound. The cows received 30 pounds of silage per head daily and had access to a rack containing alfalfa hay. Twenty-two cows were fed the control mixture for an average period of 75 days. The same cows were fed a similar period under similar conditions on the experimental ration. While the cows were on the control ration they produced 22,886 pounds of milk containing 794 pounds of fat. The lot of cows lost a total of 32 pounds in weight during the period. On the experimental ration the cows produced 22,741 pounds of milk containing 786 pounds of fat and the lot of cows gained a total of 240 pounds in body weight. The author concluded that alfalfa meal is equal to wheat bran for milk production.

A fairly recent double reversal trial was conducted by Kuhlman and Cave (14), to determine the value of ground alfalfa as a substitute for a part of the concentrate mixture in the dairy ration. The experimental mixture contained 300 pounds of ground alfalfa hay which replaced 30 per cent by weight of the

corn, oats, bran and cottonseed meal of the control mixture. Approximately 10 per cent more of the experimental mixture was fed because it was lower in total digestible nutrients. Prairie hay constituted the roughage fed both lots. They reported that milk yield and body weight were maintained satisfactorily on the experimental mixture.

Experimental Procedure

Selection of Cows and Formation of Lots

Fourteen purebred cows, including 4 Holsteins, 4 Guernseys, and 6 Jerseys were selected from the college herd for this feeding experiment. Most of the cows selected were open. Cows No. 9, 11, and 14 had been bred less than a month when the experiment started. The cows were divided into two groups which were as nearly equal as possible in regard to breed, number of lactations, stage of lactation, weight and production. A ten day pre-experimental period was used in making the final selection of the cows and their assignment to the groups.

Table I shows the data on which the final selection and assignment was based.

TABLE I

Data on Cows Selected and Group Assignment

Lot I

Cow No.	Breed	Number of Lactation	Days in Milk*	Weight (Lbs.)**	Daily Milk Production (Lbs.)***	Daily Butter-fat Production (Lbs.)†
1	Holstein	3	88	1094	47.0	1.7860
3	"	3	64	1227	39.5	1.3035
5	Guernsey	3	25	985	29.4	1.2936
8	"	2	85	932	21.6	.8640
9	Jersey	6	139	891	18.3	1.1346
10	"	8	68	871	25.7	1.2850
13	"	2	74	887	26.2	1.3100
Total		27	543	6887	207.7	8.9767
Aver-age		3.86	77.6	984	29.7	1.2824

Lot II

Cow No.	Breed	Number of Lactation	Days in Milk*	Weight (Lbs.)**	(Lbs)*** Daily Milk Production	Daily Butter-Fat Production (Lbs.)†
2	Holstein	4	26	1256	46.9	1.7353
4	"	4	63	1240	38.4	1.1520
6	Guernsey	8	77	1032	25.7	1.0794
7	"	2	78	893	28.6	1.0868
11	Jersey	5	133	840	22.4	1.1648
12	"	6	59	791	29.1	1.2222
14	"	2	113	851	19.1	1.2415
Total		31	549	6903	210.2	8.6820
Aver-age		4.43	78.4	986	30.0	1.2403

* From beginning of lactation to pre-experimental period.

** Average for ten day pre-experimental period.

*** Average for ten days pre-experimental period

† Fat tests used in making these calculations were taken from the previous month's test.

Selection and Feeding of Roughage

An attempt was made to secure No. 1 alfalfa hay but due to unavoidable circumstances there was some variation in the quality of the hay used in the experiment. However, both lots received hay of comparable quality throughout the experiment. Alfalfa hay was fed at the rate of 2 pounds per 100 pounds body weight of the cows.

Concentrates Used

The control concentrate mixture consisted of 500 pounds of No. 2 ground yellow corn, 250 pounds of ground oats, 250 pounds of wheat bran, 10 pounds steamed bone meal and 10 pounds salt. The experimental mixture consisted of 300 pounds of No. 2 ground yellow corn, 175 pounds ground oats, 175 pounds of wheat bran, 300 pounds of ground alfalfa hay, 10 pounds steamed bone meal and 10 pounds salt. The ground alfalfa used in the mixture was peagreen, suncured hay purchased from the Stillwater Milling Company.

The composition of the concentrate mixtures used is shown in Table II.

TABLE II

Concentrate Mixtures Used and Their Composition*

Ingredients	Amount Lbs.	Digestible Crude Protein Lbs.	Total Digestible Nutrients Lbs.
#2 Yellow Corn	500	33.0	400.5
Ground Oats	250	23.5	175.3
Wheat Bran	250	34.3	168.0
Ground Alfalfa Hay	-	-	-
Steamed Bone Meal	10		
Salt	10		
Total	1020	90.8	734.8
Percentage		8.90	72.9
#2 Yellow Corn	350	23.1	280.4
Ground Oats	175	16.5	122.7
Wheat Bran	175	24.0	117.6
Ground Alfalfa Hay	300	31.5	150.9
Stemed Bone Meal	10		
Salt	10		
Total	1020	95.1	671.6
Percentage		9.32	65.8

* Analysis taken from the Twentieth Edition of "Feeds and Feeding" by F. B. Morrison.

It may be noted from the above table that the concentrate mixture contained approximately 1 per cent salt. Additional salt was available in a salt box in the dry lot.

The concentrate mixtures were thoroughly mixed by hand. The nutritive requirements for the cows was based on Morrison's standard (20). The cows were fed 10 per cent more total digestible nutrients than their theoritical requirements for body maintenance and milk production. This was done in order to insure a maximum milk yield and to maintain body weight. The rations were calculated at the beginning of the experiment and approximately the same nutrient intake was maintained throughout the trial. It was necessary to

feed the cows that were on the experimental ration approximately 10 per cent more of the mixture than the cows on the control ration because it was lower in total digestible nutrients.

Management of the Cows

The 90 day double-reversal trial was divided into 3 periods of 30 days each. The first 10 days of each period was used as a transitional period for reversing the rations. The experimental period consisted of the last 20 days during each period. Lot I received the control ration during the first and third periods; and the experimental ration during the second period. Lot II received the experimental ration during the first and third periods; and the control ration during the second period. All changes from one ration to the other were made gradually.

The cows were kept out of doors in a dry lot at all times when the weather was favorable, except when being fed and milked. During adverse weather conditions the cows were kept in the barn and turned out twice daily for water. The cows were watered from a tank in the dry lot. The cows were stationed in individual stalls with special boxed in mangers permitting an accurate check to be made of the feed consumed and orts. The grain allowances were weighed out for the individual cows every afternoon for the evening and morning feedings. The evening allowance was placed directly in the manger, while the morning allowance was sacked in individual sacks with the cow's name on it, and placed in front of the manger to await the morning feeding. If the weather permitted the cows to be turned out in the dry lot, the morning hay allowance was placed in the manger as soon as the cows were out of the barn after the evening milking. If

the cows were kept inside during the night the morning hay allowance was handled in the same manner as the grain mixture. The hay allowance for the evening feeding was weighed out and placed in the mangers after the cows were turned out in the dry lot in the morning. The orts were recorded daily. The cows were weighed daily, beginning about one o'clock and continued in the same order each day. A moving average of three days weights was used as the daily weight.

Cows in the experiment were milked twice daily. Milk samples of each cow were taken for six consecutive milkings near the middle of the period and tested for butterfat content during each period of the experiment.

Discussion of Results

The data obtained during the preliminary periods were not used in calculating the results of this feeding trial.

Body Weight

Fig. 2 shows the average daily weight of the lots throughout the experiment. There is some variation in body weights of the lots but they do not appear to be significant except in the latter part of the second experimental period. This drop during the second experimental period can probably be attributed to weather conditions and water consumption. The drop occured on January 10, 1949, when the weather was cold, and the cows were watered from a tank in the dry lot. A factor which indicates that the variation was influenced by weather is the close correlation between changes in the body weights of the two lots.

It may be noted from Table III that there was no appreciable gain or loss in the body weight for either lot during the experi-

ment. The cows on the control ration lost an average of 2.35 pounds for each twenty days of the trial. While the cows on the experimental mixture gained an average of .67 pounds for each twenty days of the trial.

Milk Production

The summary of data comparing the control and experimental concentrate rations in Table III shows the milk production on each ration. Milk production on the control ration is based on the average production of Lot I during period I and III; plus the production of Lot II during period II. Production on the experimental ration is based on the average production of Lot II during periods I and III; plus the production of Lot I during the second period. The average daily milk production of the cows on the control ration was 24.63 pounds of 4.40 per cent milk. The average daily milk production of the cows on the experimental ration was 24.34 pounds of 4.39 per cent milk.

Using Gaines formula (5) this production was converted to 4 per cent fat-corrected milk. On this basis the cows on the control ration produced an average of 26.11 pounds of milk per day and the cows on the experimental ration produced an average of 25.78 pounds of milk per day. This indicates that there was no significant difference in the milk production of cows on the two rations.

Fig. 3 shows the average daily production of 4 per cent fat-corrected milk. There was a decline in milk production as the experiment progressed due to the advance in lactation of

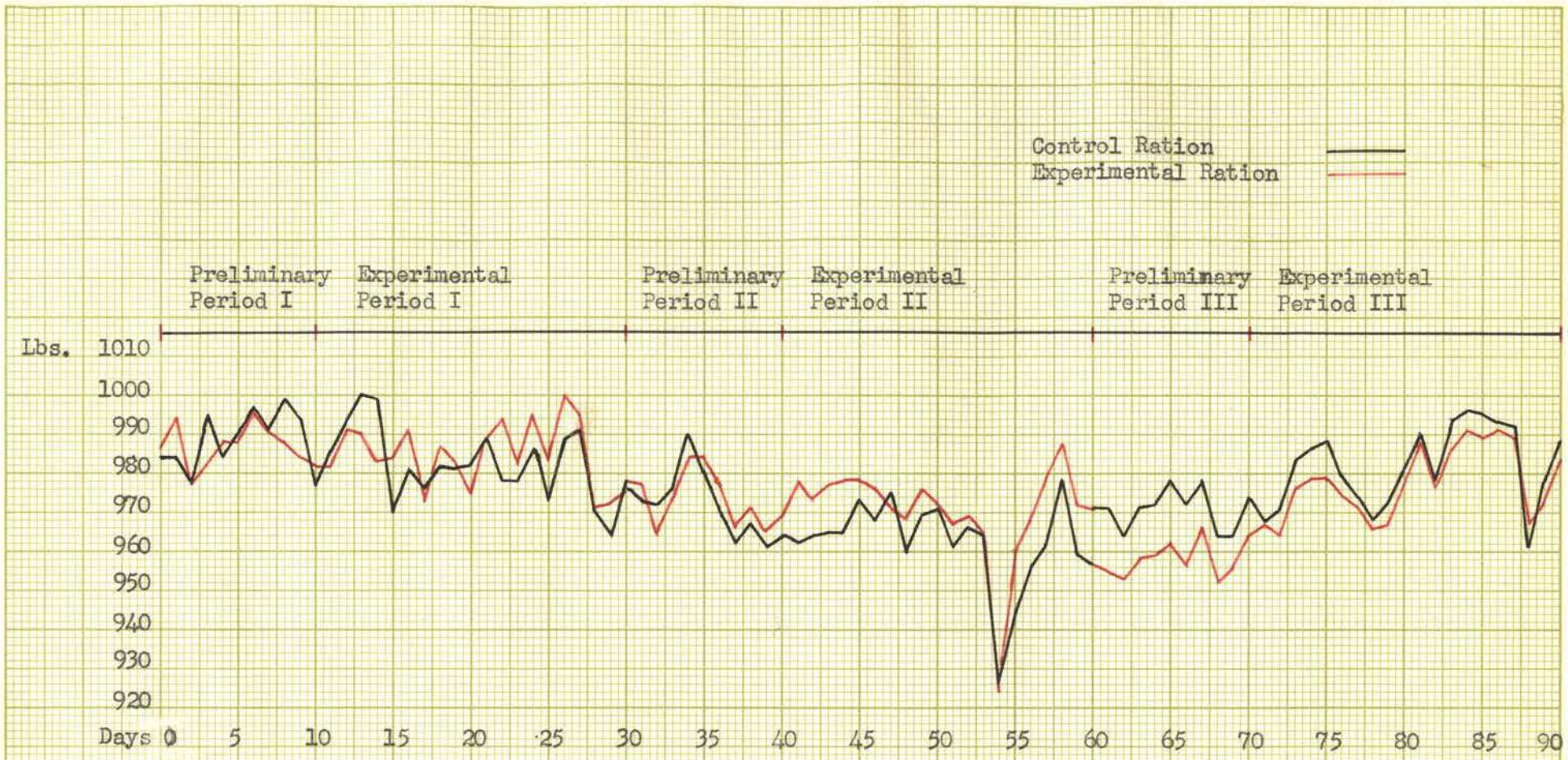

Fig. 2 – Average Daily Body Weight of Lots.

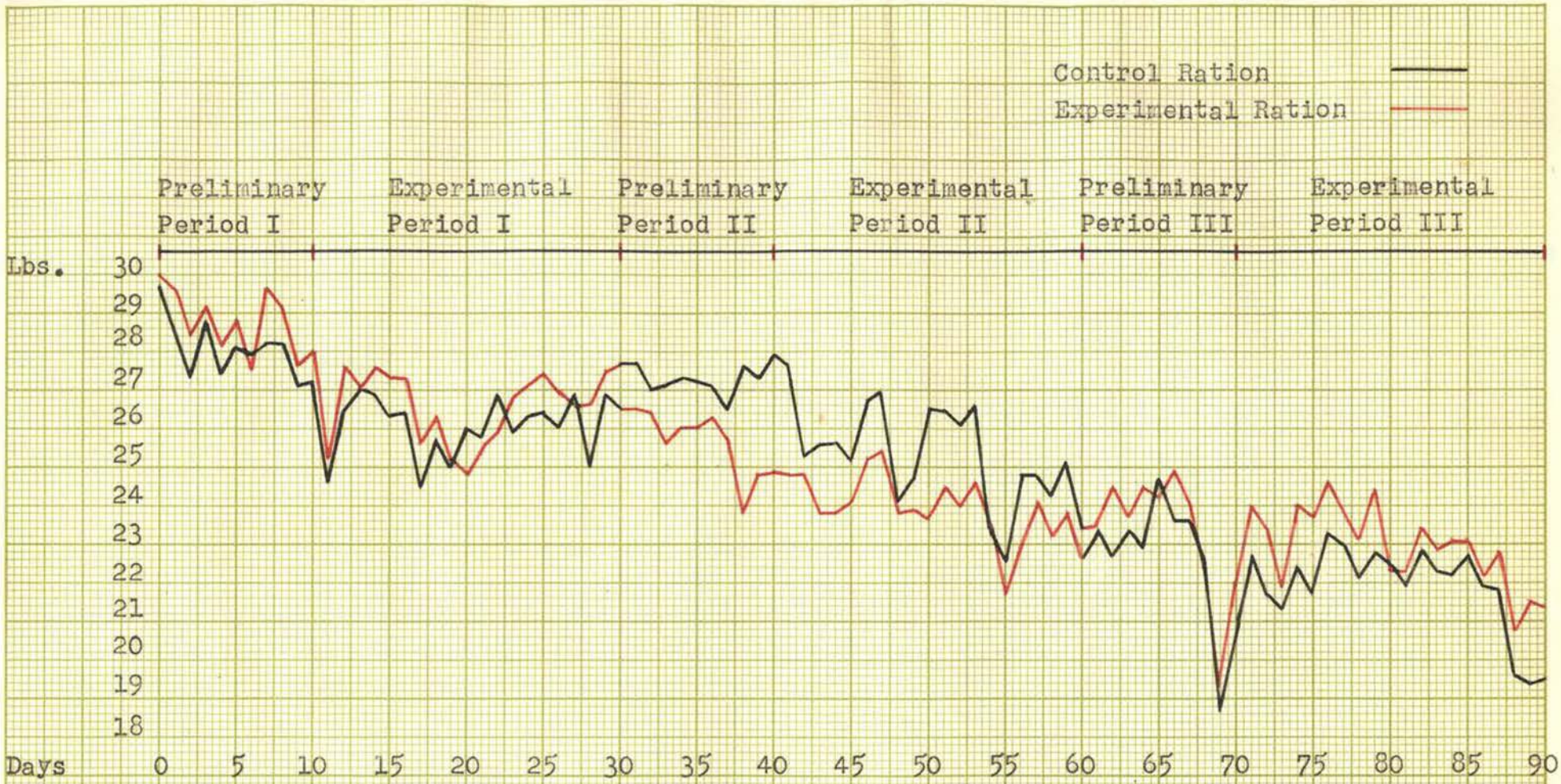

FIG. 3 - Average Daily Production of 4 Per Cent Fat Corrected Milk of Lots

the cows. It may be noted that there was an abnormal change in milk production at two points in the experiment. This can be attributed to weather conditions and water consumption since both lots reacted in the same manner.

Feed Consumption

The cows on the experimental ration consumed 9.29 per cent more concentrates than the cows on the control ration. There seemed to be no apparent difference in the palatability of the two rations. This was judged by differences in the amount of alfalfa hay refused and those differences were not significant. The cows on the control ration refused an average of .57 per cent of the alfalfa hay offered and the cows on the experimental ration refused .84 per cent.

The requirements for the production of 100 pounds of 4 per cent fat-corrected milk on the control ration was 42.38 pounds of concentrates and 78.89 pounds of alfalfa hay. The requirements for the production of 100 pounds of 4 per cent fat-corrected milk on the experimental ration was 46.90 pounds of concentrates and 79.85 pounds of alfalfa hay. On the average 14.07 pounds of ground alfalfa hay replaced 9.55 pounds of concentrates in the production of 100 pounds of 4 per cent fat-corrected milk. On an average the cows on the experimental ration consumed 3.63 pounds more hay per cow daily in the form of ground alfalfa hay, than did the cows on the control ration. This is an increase of 17.62 per cent. In this trial 100 pounds of ground alfalfa hay replaced 71.66 pounds of concentrates.

TABLE III

Summary of Data

No. of Cows - fourteen	Control Ration	Experimental Ration
Average initial weight per cow (Lbs.)	907.64	974.29
Average final weight per cow (Lbs.)	968.29	974.96
Average daily weight per cow (Lbs.)	972.11	975.83
Average gain or loss per cow in 20 days (Lbs.)	- 2.35	+.67
Milk Production		
Total milk yield (Lbs.)	6897.40	6814.75
Average per cent butterfat	4.40-	4.39+
Total butterfat yield (Lbs.)	303.38	229.50
Total yield 4% F. C. M. (Lbs.)	7309.66	7218.38
Average daily milk yield per cow (Lbs.)	24.63	24.34
Average daily yield of buttrfat per cow (Lbs.)	1.08+	1.07-
Average daily yield 4% F. C. M. per cow (Lbs.)	26.11	25.78
Total Feeds Used (Lbs.)		
Concentrate mixtures	3097.60	3385.45
Alfalfa hay offered	5800.00	5813.00
Alfalfa hay refused	33.30	48.85
Alfalfa hay consumed	5766.70	5764.15
Percent alfalfa hay refused	.57	.84
Average Daily Ration Per Cow (Lbs.)		
Concentrate mixtures	11.06	12.09
Alfalfa hay offered	20.72	20.76
Alfalfa hay refused	.12	.17
Alfalfa hay consumed	20.60	20.59
Pounds of Feed for One Hundred Lbs. 4% F. C. M.		
Concentrate mixtures	42.38	46.90
Alfalfa hay offered	79.35	80.53
Alfalfa hay consumed	78.89	79.85

THE VALUE OF GROUND ALFALFA HAY

In calculating the value of the ground alfalfa hay used in this experiment the prevailing price of feeds at the time the trial was started were used. These were as follows:

No. 2 yellow corn	$1.55 per bushel
Oats	$ .93 per bushel
Wheat bran	$45.00 per ton
Steamed bone meal	$90.00 per ton
Salt	$19.60 per ton
Alfalfa hay	$22.50 per ton

The method used in calculating the value of the ground alfalfa hay used in this trial is shown in Table IV.

TABLE IV

Calculations Used In Determining

The Value of Ground Alfalfa Hay

Ingredients	Pounds	Percent of Mixture	Needed to Produce 100 Lbs. of 4% F. C. M. Lbs.	Feed Cost Per Lb.	Total Feed Cost
Control Mixture					
#2 Yellow Corn	500	49.03	20.7731	$0.0277	$0.5754
Oats	250	24.51	10.3866	$0.0277	$0.3089
Wheat Bran	250	24.51	10.3866	$0.0225	$0.2337
Steamed Bone Meal	10	.98	.4153	$0.0450	$0.0187
Salt	10	.98	.4153	$0.0098	$0.0041
Total (Con. Mix.)	1020	100.00	42.3769		$1.1408
Alfalfa Hay			78.89	$0.01125	$0.8875
Total Cost					$2.0283
Experimental Mixture					
#2 Yellow Corn	350	34.41	16.0915	$0.0277	$0.4457
Oats	175	17.16	8.0481	$0.0297	$0.2390
Wheat Bran	175	17.16	8.0481	$0.0225	$0.1811
Ground Alfalfa Hay	300	29.41	13.7934		
Steamed Bone Meal	10	.98	.4596	$0.0450	$0.0207
Salt	10	.98	.4596	$0.0098	$0.0045
Total (Con. Mix.)	1020	100.00	46.9003		$0.8910
Alfalfa Hay			79.85	$0.01125	$0.8983
Total Cost Minus Ground Alfalfa Hay					$1.7893

It may be observed from the above table that the difference in feed cost between the control ration and the experimental ration (less the cost of the ground alfalfa hay) for the production of 100 pounds of 4 per cent fat-corrected milk is $0.2390 which represents the value of the 13.7934 pounds of ground alfalfa hay used in the experimental ration. According to these calculations the ground alfalfa hay was worth $1.73 per 100 pounds or $34.60 per ton. The value of ground alfalfa hay will of course depend on the price of the other feeds.

Since it is a recognized fact that grinding alfalfa hay does not increase its feeding value, it is reasonable to assume that if cows can be induced to consume quantities of long hay comparable to the total amount of long hay and ground hay consumed in this trial, it should be possible to obtain results similar to those secured in this trial.

Supplement To Experiment

The object of the supplement was to determine whether or not it was necessary to grind the alfalfa hay used in the concentrate mixture of the previous experiment.

Selection of Cows

Eight purebred cows, including 2 Holsteins, 2 Jerseys, 2 Guernseys and 2 Ayrshires were selected from the college herd for this feeding trial. An attempt was made to select cows which were on the average producing approximately the same quantity of milk as the cows were in the beginning of the previous experiment. On the average the cows selected produced 30.0 pounds of milk daily. This average is based on the milk production of the cows for the 3 days preceding the trial. The average butterfat production was 1.20 pounds per cow per day. This average was calculated by using the fat test for the month previous to the trial and the milk production mentioned above.

Feeds Used

The alfalfa hay used in this supplement was comparable in quality to the hay used in the main study. The same concentrate mixtures were used in this trial as were described in the previous trial.

Management of Cows

Three 10-day periods were used in determining the necessity of grinding the alfalfa hay used in the concentrate mixture of the previous mentioned experiment. The requirements for body maintenance and milk production were based on the Morrison standard (20). The cows received the experimental ration containing ground alfalfa hay plus 2 pounds of long hay per 100 pounds body weight during the first period. The second period was used as a transitional period in which the rations were changed. Starting with the second period the cows received the control mixture minus an amount of total digestible nutrients equal to those furnished by the ground alfalfa hay during the first period. This decrease in nutrient intake was supplied gradually by the addition of small amounts of hay until the cows received as much hay as they received in the first period in the form of long and ground hay combined. During the third period, the cows received the control ration plus the quantity of hay they received in the first period in the form of long and ground alfalfa hay combined.

The cows were handled in the same manner as the cows in the previous mentioned experiment. One difference that should be mentioned was in the method of watering. The cows in this supplemental trial had access to water in individual drinking cups. The weather was uniformly good throughout the supplemental trial. An accurate record was kept of the feeds offered and consumed. This trial was designed primarily as a study of feed consumption but accurate milk records as well as the daily body weight of each cow was kept in order to detect any abnormal drop in milk pro-

duction or change in body weight.

Results of Supplemental Trial

The average body weight and milk production of the cows used in this supplement is shown in Fig. IV. It may be observed that the cows declined rather rapidly in both body weight and milk production during the first few days of the trial. The change from pasture to dry lot is undoubtedly the cause of this decline. After this the body weights remained quite stable, except during the first part of the second period when the cows received less nutrients. The average decline in milk production is less rapid after the seventh day.

Feeds Consumed

Data concerning the feeds used in this trial are shown in Table V.

TABLE V

Feed Used in Supplemental Trial

	Period I	Period II	Period III
Total Feeds Used (Lbs.)			
Experimental ration	807.4	-	-
Control ration	-	624.0	622.0
Alfalfa hay offered	1700.0	1945.9	1970.1
Alfalfa hay refused (orts)	54.2	76.5	17.2
Alfalfa hay consumed	1645.8	1869.4	1952.9
Percent alfalfa hay refused (orts)	.32	.39	.09
Average daily ration per cow (Lbs.)			
Experimental ration	10.88	-	-
Control ration	-	7.80	7.78
Alfalfa hay consumed	20.57	23.37	24.41

It may be noted from the above table that in the third period while the cows were receiving an increased quantity of long hay there was less refused hay than there was in the first period. On

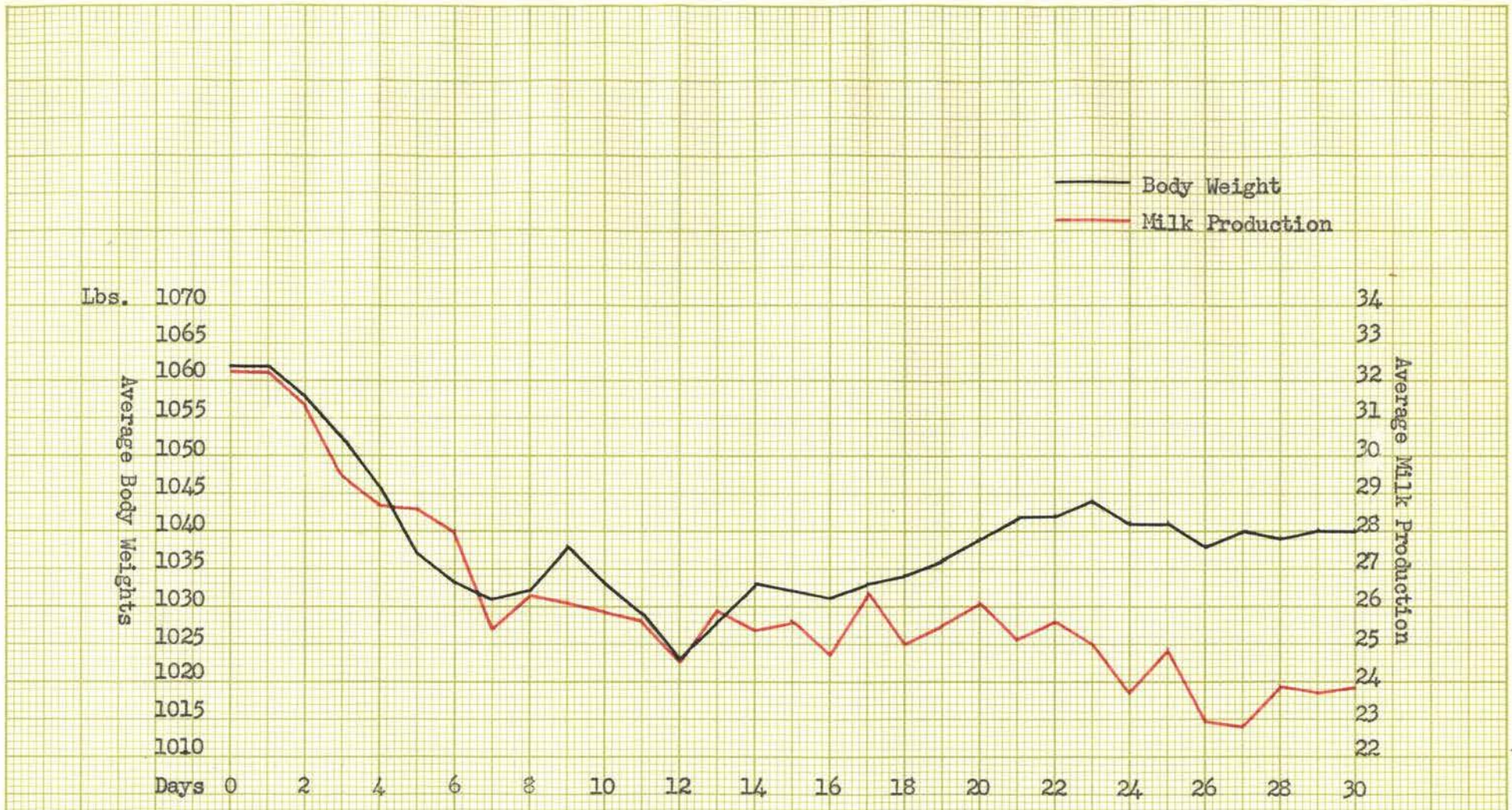

FIG. 4 - Average Body Weight and Milk Production

an average the cows consumed 3.84 pounds more long hay per cow daily during period III than they did during period I. This is an increase of 18.49 per cent.

Summary of Experimental Data

Main Trial

Fourteen cows were used in a 90 day double reversal feeding trial for the purpose of determining the value of ground alfalfa hay as a substitute for a part of the concentrate mixture in the dairy ration.

In the experimental ration ground alfalfa hay replaced 30 per cent by weight of the concentrate mixture. Approximately 10 per cent more of the experimental mixture was fed than the control mixture because it was lower in total digestible nutrients.

The average daily milk production of the cows on the control ration was 26.11 pounds of 4 per cent fat-corrected milk. While the cows on the experimental ration produced an average of 25.78 pounds of 4 per cent fat-corrected milk per cow daily.

The requirements for the production of 100 pounds of 4 per cent fat-corrected milk were 42.38 pounds of concentrates and 78.89 pounds of alfalfa hay on the control ration; and 46.90 pounds of concentrates and 79.85 pounds of alfalfa hay on the experimental ration. On the average 14.07 pounds of ground alfalfa replaced 9.55 pounds of concentrates in the production of 100 pounds of 4 per cent fat-corrected milk. The cows on the experimental ration consumed 17.62 per cent more alfalfa hay in the form of ground alfalfa hay than did the cows on the control ration.

The local price of feeds at the time this trial was started,

was used in calculating the value of the ground alfalfa hay. The ground alfalfa hay as used in this experiment was worth $34.60 per ton.

Supplementary Trial

Eight cows were used in a 30 day trial in an attempt to determine whether or not it was necessary to grind the alfalfa hay used in the concentrate mixture mentioned in the previous experiment.

The cows received the experimental ration, used in the previous trial, during the first 10 days of the experiment plus alfalfa hay fed at the rate of 2 pounds per 100 pounds body weight. The second period was used as a transitional period. During the third period the cows consumed as much long hay as they consumed in the first period in the form of long and ground alfalfa hay combined.

The cows refused less hay in the third period than they did in the first. The cows consumed 18.49 per cent more long hay during the third period than they did during the first period.

CONCLUSIONS

Body weight and milk production can be maintained satisfactorily on a concentrate ration consisting of 30 per cent ground alfalfa hay, if the same total digestible nutrient intake is maintained.

The liberal use of high quality hay for dairy cattle is an economical practice.

The ground alfalfa hay as used in this experiment was worth $34.60 per ton for milk production.

In this study 100 pounds of ground alfalfa hay were equivalent to 71.66 pounds of concentrates for milk production.

Since the cows in the supplemental trial consumed as much long hay during the third period as they consumed in the form of long and ground hay combined during the first period, there apparently was no benefit in so far as total hay consumption was concerned, from grinding a portion of the hay and feeding it with the concentrate mixture.

BIBLIOGRAPHY

1. Bachtell, B. A., Willard, C. J. and Livezey, W., Dairy Farming Based on the Liberal Use of Meadow Crops. Ohio Agr. Expt. Sta. Bull. 662, Part II, 1946.

2. Carncross, John and Houk, Joseph F. Roughages Makes Milk Profits, N. J. Agr. Expt. Sta. Cir. 505, 1947.

3. Dickson, W. F. and Kopland, D. V. Feeding Dairy Cows With and Without Grain, Mont. Agr. Expt. Sta. Bull. 293, 1934.

4. Fraser, W. J. and Cassius, H. C. Alfalfa Hay Vs Timothy Hay and Alfalfa Hay Vs Bran for Dairy Cows. Ill. Agr. Expt. Sta. Bull. 146, 1910.

5. Gaines, W. L. and Davidson, F. A. Corrections of Milk Yield for Fat Content. Ill. Agr. Expt. Sta. Bull. 245, 1923.

6. Graves, R. R., Dawson, J. R., Kopland, D. V., Watt, A. L. and Van Horn, A. G. Feeding Cows on Alfalfa Hay Alone. U. S. D. A. Tech. Bull. 610, 1938.

7. Graves, R. R., Bateman, G. Q., Shepherd, J. B. and Caine, G. B. Milk and Butterfat Production by Dairy Cows on Four Different Planes of Feeding. U. S. D. A. Tech. Bull. 724, 1940.

8. Hart, E. B. and Humphrey, G. C. Cut the Cost of Feeding Cows. Wis. Agr. Expt. Sta. Bull. 417, 1930.

9. Headley, F. B., The Economics of Feeding Alfalfa Hay and Grain to Holstein Cows. Nev. Agr. Expt. Sta. Bull. 140, 1935.

10. Hills, J. L. Feeding Trials With Cows. Vt. Agr. Expt. Sta. Rpt. pp 320-323; 475, 1906.

11. Hodgson, R. E., Knott, J. C., Miller, V. T. and Murer, H. K. The Nutritive Value of Home Grown Roughage Rations for Dairy Cattle. Wash. Ag. Expt. Sta. Bull. 366, 1938.

12. Huffman, C. F. and Duncan, C. W. The Nutritive Value of Alfalfa Hay. III. Corn as a Supplement to an All-Alfalfa Hay Ration for Milk Production. J. Dairy Sci., 32: 465-474. 1949.

13. Jensen, E., Klein, J. W., Rauchenstein, E., Woodward, T. E. and Smith, R. H. Input-Output Relationship in Milk Production. U. S. D. A. Tech. Bull. 815, 1942.

14. Kuhlman, A. H. and Cave, H. W. The Value of Adding Ground Alfalfa Hay to a Concentrate Mixture Fed With Prairie Hay in a Ration for Dairy Cow. J. Animal Sci. 7: 537-538, 1948.

15. Lindsey, J. B. Work in Animal Feeding. Mass. Agr. Expt. Sta. Rpt., Part I. pp 18-19, 1909.

16. Lindsey, J. B. and Archibald, J. G. Two Systems of Feeding Dairy Cows. Mass. Agr. Expt. Sta. Bull. 291, 1932.

17. Mairs, Thomas I. A Comparison of Alfalfa Meal and Wheat Bran for Dairy Cows. Penn. Agr. Expt. Sta. Bull. 80, 1906.

18. McIntyre, C. W. and Ragsdale, A. C. Milk Production on Roughage Without Grain. Mo. Agri. Expt. Sta. Bull. 488, 1945.

19. Monroe, C. F. and Allen, Harold. Alfalfa-Timothy Hay for the Dairy Farm. Ohio Agr. Expt. Sta. Bull. 538, Part II, 1934.

20. Morrison, F. B. Feeds and Feeding, 20th Ed. Morrisons Publishing Company, Ithaca, New York, 1936.

21. Rothwell, G. B. Alfalfa Meal Vs Bran. Canada Expt. Farms, Animal Husb. Div., Rpt., pp 11-14. 1924. (Micro-film in A & M Library).

22. Sherwood, D. H. and Dean, H. K. Feeding Alfalfa Hay Alone and With Concentrates to Dairy Cows. Oreg. Agr. Expt. Sta. Bull. 380, 1940.

23. Smith, V. R., Jones, T. R. and Haag, J. R. Alfalfa With and Without Concentrates for Milk Production. J. Dairy Sci., 28: 343-354, 1945.

24. Snyder, W. P. and Burnett, E. A. Chopped Alfalfa Vs. Bran in Grain Ration For Dairy Cows. Neb. Agr. Expt. Sta. Bull. 164, 1918.

25. Soule, A. M. and Barnes, S. E. Replacing Grain With Alfalfa in a Ration for Dairy Cows. Tenn. Agr. Expt. Sta. Bull. 70, 1904.

26. Willard, H. S. Grain Vs No Grain for Dairy Cows. Wyo. Agr. Expt. Sta. Bull. 202, 1934.

27. Willard, H. S. Roughage Feeding of Dairy Cattle. Wyo. Agr. Expt. Sta. Bull. 237, 1940.

28. Woll, F. W., Voorhies, E. C. and Castle, C. V. Heavy Vs Light Grain Feeding for Dairy Cows. Calif. Agr. Expt. Sta. Bull. 323, 1920.

Typed By:

Mary Fiegel

Stillwater, Oklahoma