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THE EFFECT OF FEEDING ON MILK COMPOSITION*

II. THE EFFECT OF THE LEVEL OF FEEDING FOR LACTATING COWS DURING THE LATE WINTER FEEDING PERIOD ON THE CHANGES IN THE SOLID-NOT-FAT CONTENT OF MILK DURING THE SPRING GRAZING PERIOD

By

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In the previous report[4], the authors recognized marked increases in both solid-not-fat and the protein content of milk when cows were transferred from winter feeding to spring grazing. Similar trends were reported by WAITE *et al*[13] in Britain. Some workers explained these phenomena as the effect of the specific substances, such as estrogenic substances, in pasture plants[6]. Others reported, however, that these increases in content of milk constituents were mainly due to an increase of energy intake by grazing on young pasture plants which are rich in digestible carbohydrates[7].

This experiment was conducted to determine the effect of tne level of feeding for lactating cows during the late winter feeding period on the changes in milk composition which would occur soon after the animals were transferred to spring grazing.

EXPERIMENTAL PROCEDURE

Experimental Animal Six Holstein cows, previously reported[11], were used in this experiment. The cows were divided equally into two groups and received different feeding treatments.

Experimental Period and Feeding Program The experiment was conducted for 52 days, beginning on May 8 and terminating on June 30, 1961. The feeding treatment for the two groups are shown in Table 1. Each cow was fed individually in a stall with a stanchion from the beginning of the experiment until May 20. During this period, all cows received winter feeding rations.

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TABLE 1. Feeding Treatments

Group	Cow no.	Date	Feeding treatment
I	598 610 613	May 8–May 20 May 21–June 30	Winter feeding ration+Concentrate Grazing+Soilage+Concentrate
II	540 590 614	May 8–May 20 May 21–June 30	Winter feeding ration Grazing+Soilage

Five kilograms of orchard grass hay, 25 kg. of corn silage, 1 kg. of sugar beet pulp and 1 kg. of cracked oats were fed daily per cow per 500 kg. of body weight. On May 21, cow in both groups began to graze in a pasture of orchard grass from 9:00 AM to 11:30 AM and continued this grazing until the end of the experiment. During this grazing period, all cows were fed 5 kg. of wet brewers' grain daily and rye soilage from May 21 to May 31 and green orchard grass from June 1 to the end of the experiment, *ad libitum*. In addition to these feeds above mentioned, cows of Group I received a concentrate mixture at a rate of 1 kg. to 3 kg. of milk yield throughout the experiment. The amount of concentrate feeding was adjusted every week according to the average daily milk yield of the previous week. The concentrate mixture consisted of cracked oats 37%, linseed oil meal 25%, barley bran 35%, calcium carbonate 2% and salt 1%. Water was supplied *ad libitum*.

Body weight and heart girth of cows were measured at the beginning of the experiment and every 10 days thereafter. Daily records of milk yield were maintained. Two composite samples of two consecutive milkings were collected every week to determine the content of milk constituents. GERBER's method was used for butterfat test. AOAC methods[1] were used for determination of total solid, protein and casein content of milk. Lactose content was determined by LANE-EYNON method[3]. The data of the experimental results were analyzed and tested for their significances by SNEDECOR's method[10].

RESULTS AND DISCUSSION

Body Measurement and Milk Yield Table 2 shows the average body weight, heart girth and daily milk yield in both winter feeding period and grazing period. The changes of the daily milk yield during the experiment are presented in Figure 1. In both groups, the body measurements and the daily milk yields of cows were increased after cows were transferred from winter feeding to grazing. The differences in body weight were signficant in Group II ($P<0.05$)

TABLE 2. Changes of Body Measurements and Milk Yield

Group	Period	Body Weight (kg.)	Heart girth (cm.)	Milk yield (kg/day)
I	Wieter feeding	490.3	181.3	7.35
	Spring grazing	512.5	183.3*	8.92**
II	Winter feeding	459.3	179.7	8.93
	Spring grazing	490.9*	182.6**	13.43**

* Significant at 5% level
** Significant at 1% level

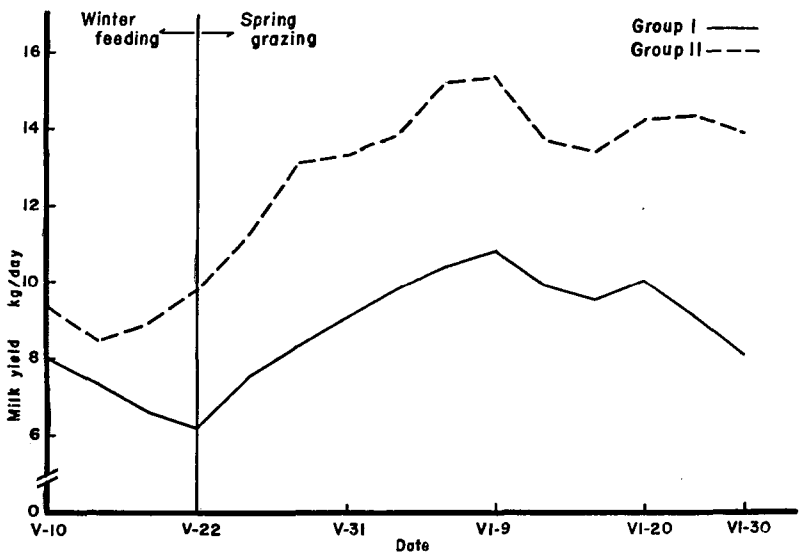

Figure 1. Changes of Milk Yield

and almost significant in Group I. There were significant differences in the heart girth of both groups ($P<0.05$ for Group I and $P<0.01$ for Group II) between winter feeding and grazing periods. The differences in milk yield were highly significant in both groups between two periods. These results might indicate that cows consumed more nutrients in the grazing period than in winter feeding period. The changes in body measurements and in daily milk yields of cows in Group I were not markedly different from those of the cows in Group II. These results were different from those expected by the difference in feeding levels. The cows in Group I were in an underfeeding condition before the experiment as were the cows in Group II. It is possible, therefore, to assume that two weeks were not long enough for the cows in

Group I to respond to a high level of feeding during the winter feeding period. This will be discussed later in relation to the changes of milk composition.

Milk Composition The results of milk composition are shown in Table 3. The changes of milk composition during the experiment were indicated in

TABLE 3. Changes In Milk Composition

Group	Period	Total solid (%)	Butter fat (%)	Protein (%)	Casein (%)	Lactose (%)	SNF (%)
I	Winetr feeding	11.28	3.38	2.74	2.10	4.09	7.90
	Spring grazing	11.69*	3.40	3.15**	2.42**	4.13**	8.28**
II	Winter feeding	11.56	3.71	2.70	2.09	4.13	7.85
	Spring grazing	11.37	3.32**	2.82**	2.15	4.20**	8.04**

* Significant at 5% level
** Significant at 1% level

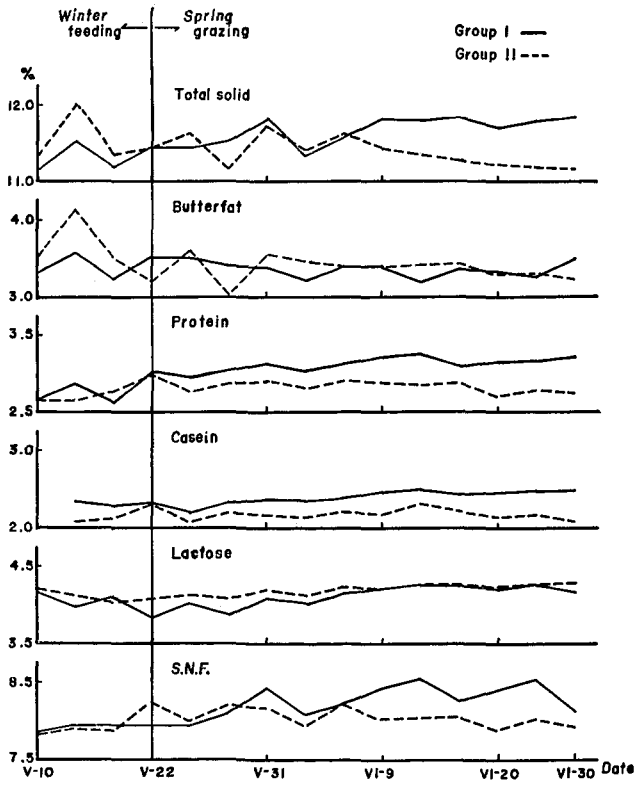

Figure 2. Changes of Milk Constituents

Figure 2. The contents of milk constituents, except for butterfat content, were increased by transferring cows from winter feeding to grazing in both groups. The total solid and butterfat content of milk from cows in Group II were decreased in the grazing period as compared with those in the winter feeding period. This difference in butterfat content between the two periods was highly significant. The differences in the protein, lactose and SNF content of milk between winter feeding and grazing periods were highly significant in both groups. The casein content of milk in the grazing period was significantly higher ($P<0.01$) than that in the winter feeding period among cows in Group I. The casein content of milk from cows in Group II was increased by grazing, but the difference between the two periods was not significant. The cows in Group I produced milk containing significantly higher ($P<0.01$) total solid during the grazing period than that during the winter feeding period. A reverse result to that seen in the cows of Group I was observed in the total solid content of milk from cows in Group II between two periods, although the difference was not significant. Similar trends in the changes of milk constituents by changing the feeding condition were observed among cows in both groups. The cows in Group I showed more marked changes in milk composition than the cows in Group II by changing the feeding condition, as shown in Table 3. These differences in changes of milk composition between the two groups might be due to the differences in either the stage of lactation, or the stage of gestation among cows in both groups. Cow no. 540, 610 and 613 were in 4 mo., 5.5 mo., and 6.5 mo. of pregnancy respectively at the end of the experiment. Others were not pregnant. WILCOX *et al*[14] reported that the SNF content was higher in pregnant cows than in non-pregnant cows after 5 mo. of pregnancy.

The level of feeding did not affect the changes of milk composition caused by transferring cows from winter feeding to grazing in this experiment. This differs from the results reported by British workers[9,12]. WAITE *et al*[12] reported that there were no effects on milk composition by feeding spring grass when cows received the same high levels of energy nutrition in either winter feeding ration or spring grass soilage. ROOK *et al*[9] conducted an experiment similar to this. They reported that the SNF content of milk was decreased by transferring cows from winter feeding to spring grazing when cows received a high level of feeding during winter feeding period, while it was increased on a low level of feeding. Bath and ROOK[2] also reported that a switch from winter feeding to spring grazing caused a considerable increase in the concentration of the ruminal volatile fatty acids, which are the main source of energy in ruminants, and the relative proportion of propionic acid which is a main

precursor of blood glucose and, consequently, of lactose. From these results, they concluded that the increase in SNF content of milk induced by transferring cows from winter feeding to spring grazing was not caused by the specific substances, such as estrogenic substances, in pasture plants, but rather by increase in a level of feeding. Table 4 shows the correlation coefficients between milk yield and milk composition calculated from the data of this experiment. There were significant positive correlations between milk yield and protein, casein, lactose and SNF content of milk. The authors previously

TABLE 4. Correlation Coefficients

	Group I†)	Group II††)	Total†††)
Milk yield × Total solid	+ 0.607*	− 0.060	+ 0.460**
" × Butterfat	− 0.109	− 0.219	− 0.048
" × Protein	+ 0.662**	+ 0.548*	+ 0.772**
" × Casein	+ 0.618**	+ 0.505*	+ 0.665**
" × Lactose	+ 0.528*	+ 0.623**	+ 0.526**
" × SNF	+ 0.691**	+ 0.455*	+ 0.761**

†) Values in this column were calculated from the data of cows in Group I
††) Values in this column were calculated from the data of cows in Group II
†††) Values in this column were calculated from the data of all cows
* Significant at 5% level
** Significant at 1% level

reported that noestrogenic substances were detected in orchard grass harvested early in spring from the same area used in this experiment by a bio-assay using ovariectomized rats[5]. This result and the correlation coefficients between milk yields and contents of milk constituents may indicate that an increase of a level of feeding is the main factor which caused the increases in the contents of SNF and itsr elated constituents induced by spring grazing in this experiment. ROOK and BALCH[8] reported that it took three weeks to establish the full effects of the intra-ruminal infusion of the volatile fatty acids upon the incease in content of milk constituents. Therefore, it is suggested that the winter feeding period in this experiment was not of sufficient length for cows in Group I to respond to a high level of feeding with regard to the milk composition as well as on the milk yield.

SUMMARY

Six Holstein cows were divided equally into two groups to determine the effect of levels of feeding during late winter feeding period on the changes in

milk composition, especially in the SNF content of milk, which would take place soon after cows were transferred to spring grazing. Cows in both groups received winter feeding rations, consisting mainly of roughages, during the first 13 days of the experiment. Then, cows were transferred to spring grazing with supplementations of soilage and this feeding was continued for 39 days up to the end of the experiment. Cows in Group I were fed a concentrate mixture in addition to these rations at a rate of 1 kg. to 3 kg. of their milk yields.

The body weight, the heart girth and the milk yields were increased significantly by changing cows from winter feeding to spring grazing in both groups.

Spring grazing caused significant increase in protein, casein, lactose and SNF content of milk as compared with those in the winter feeding period. Similar trends in the changes of milk composition induced by changing feeding conditions were observed among cows in both groups.

There were significant positive correlations between milk yields and protein, casein, lactose and SNF content of milk in both groups.

These results may indicate that the increases in the contents of SNF and its related constituents of milk observed as a result of transferring cows from winter feeding to spring grazing were caused mainly by an increase of level of feeding, although the level of feeding during winter feeding period had little effect on the changes of milk compositin in this experiment.

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