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A COMPARISON OF THREE RATIONS FOR DAIRY CATTLE

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Introduction:

Many dairy cows in New Zealand require feed to supplement pasture during the late summer months and silage made from pasture is often used for this purpose. The use of silage has been advocated partly because silage-making fits into New Zealand grassland farming economy, and partly because silage has been regarded as a good and relatively inexpensive food for dairy cows. Although pasture silage has been used in New Zealand and Holland for a considerable number of years there is little published information, based on experimental work, relating to its value as a food for cows in milk. In New Zealand information is needed on the value of different types of silage for this purpose and in addition, on the comparative value of pasture silages and crops such as chou moellier, soft turnips and special pastures which might be used as alternative summer supplements to pasture.

This study was concerned with a comparison of the performance of cows fed on pasture silage as a sole ration with that on a ration of chou moellier and silage and another of meal and silage. The silage and meal ration was not regarded as one which might be used in practice in New Zealand because of the high cost of meal in relation to the price of milk, but to provide a comparison with cows reasonably well fed under the conditions of the experiment.

Review of Literature.

The majority of workers concerned with the feeding value of pasture silage have determined the proportions of different fractions such as crude fibre and protein of various types of silage by chemical means and have, in some cases, carried out digestability trials in which sheep and steers have usually been used. (Watson & Horton, 1936, Sears et al (1942), Archibald (1946), Watson (1948).

A few cases of experiments in which lactating cows were used have been reported, but in some of these little confidence could be placed in conclusions based on the results as the numbers of cows involved were very small and group feeding types of experiments were used.

Graves et al (1933) fed six Friesian cows on grass silage alone. They ate, on the average, 83.9lb. of silage per day and produced 1.17lb. of butterfat per day. In another experiment in the next year three cows ate 20.8 to 34.4lb. of dry matter per day as silage and 29.9 to 41.7lb. per day as hay. They produced 20.5 to 41.8lb. of milk per day, but as in the previous experiment, they lost weight rapidly.

In a group trial extending over three years and in which thirty cows were used Hodgson et al (1937) compared three rations for dairy cows. One was hay made from grass and clover, another silage made from grass and clover or oats and peas, and the third was partly silage and partly hay. During the summer months the cows were allowed to graze on pasture in addition to receiving the above rations. The average productions of butterfat of the cows on the three rations were

very similar, but during the winter the cows on silage did not eat as much dry matter as those on the other ration and consequently did not maintain their weight as well.

Graves et al (1938) found that four cows fed only silage made from immature grass did not eat as much dry matter either in terms of absolute weight or in relation to their theoretical requirements as four cows fed only hay made from the same fields. Neither group of cows produced as well as in lactations when they were fed on a "full diet" of hay and concentrates. The experiment cannot be considered satisfactory from the point of view of comparison between rations, but it was of value in showing that cows could live and produce when fed only hay or silage for at least a year.

At the Dairy Research Institute, Campbell (1939) found that cows did not produce as well on silage alone or on hay and silage as when meal was added to the roughage ration. The solids-not-fat content of the milk when the cows were on roughage ration alone was lower than on roughage plus concentrates.

Data on the dry matter intake of dry Jersey cows fed silage, hay, or silage and hay was obtained by Choy (1948). Cows fed hay or hay and silage ate more dry matter than those fed silage alone.

Comparisons between these results are difficult as the types of silage used by the workers probably varied considerably.

Experimental:

MATERIAL AND METHODS.

1. **Animals Used:** Twelve cows were used in this study. Three were two-year-old animals, two Jersey-Polled Angus-cross, and one Jersey-Aryshire-cross. The remaining nine were grade or pedigree Jerseys. All were spring calvers and none had been in milk for longer than five months when the experiment was started.

2. **Experimental Design:** The experimental design used was a double cross over type described by Cochran et al (1941). This design makes it possible to estimate the "carry-over" effects of the rations used, that is, to find the effect on the performance of the animals of the ration fed in the previous period.

FEEDING.

Rations Used: The daily rations were as follows:—

A. Silage ad lib.
B. 60lb. of chou moellier plus silage ad lib.
C. 50lb. of silage plus meal ad lib. or well in excess of theoretical requirements.

The silage was made on the D.R.I. farm in the spring of 1949 from permanent pasture of perennial ryegrass with some white clover. The stack held 45 tons of material. The pH of three samples of silage taken during the experiment were 5.5, 5.6, 5.7.

The chou moellier was grown on the Massey College farm and was good leafy material with few heavy stems.

The meal mixture was 4½ parts copra meal, 4½ parts Moose meal (linseed meal), and one part bran.

The composition of the constituents of the rations, for separate periods, were as follows:

TABLE I.

ANALYSIS OF MEALS

DRY MATTER BASIS

PERIOD	SILAGE			CHOU MOELLIER			MEAL		
	I.	II.	III.	I.	II.	III.	I.	II.	III.
Crude Protein (N x 6.25)	11.7	11.0	12.6	10.2	9.8	7.9	27.6	28.7	29.1
Ash	10.6	9.7	10.7	10.5	14.3	10.7	5.8	5.8	5.7
Ether Extract	—	—	—	—	—	—	6.9	3.8	5.9
N.F.E. (by difference)	37.9	38.4	36.6	60.6	51.6	59.4	52.0	54.0	51.8
Crude Fibre	39.8	40.9	40 1	18.7	24.3	22.0	7.7	7.7	7.5
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Original D.M. % in sample		15.7			16.7			93.0	

Management and Feeding:

The cows were muzzled and kept in a grass paddock except when being fed and milked. The muzzles were of leather and the cows could drink quite easily while wearing them.

From a fortnight before the experiment commenced the cows were muzzled for part of the day, and for a week before the start they were muzzled all the time except when being fed. During this period all the cows were fed on the same ration and became accustomed to the system of management. The cows were fed three times daily in large wooden bails. At the 6 a.m. and 12 noon feeds they were allowed to remain eating as long as they liked and after the 4 p.m. they were allowed three hours, by which time they had usually finished. The total feeding time amounted to about seven and a-half hours daily.

The quantity of feed given each cow was weighed and samples were taken for the determination of dry matter percentages daily. After the morning feed all wasted feed was weighed and samples were taken for dry matter determinations.

The cows on meal and silage were given a third of their meal at each feed and after most of the meal was eaten the silage was fed, 20lb. given out mid-day and 15lb. at each of the other feeds.

Cows on chou moellier and silage were given 30lb. of chou moellier at mid-day, followed by the remaining 30lb. if they ate the first lot quickly. In the evenings they had the remainder of their chou moellier followed by silage, and in the morning silage plus any chou moellier left in their boxes. Those on silage alone were given 30lb. at first and more was added in 10 to 30lb. lots as necessary. On the last two rations the cows always had a surplus of feed and on the meal and silage diet most of them refused some meal, and those that did not had much more than they theoretically required.

Dry Matter Determinations:

The samples were dried in ovens at the Grasslands Division, D.S.I.R. The ovens were run at a temperature of 150 deg. F. approx. and have an air draught. Perkins (1943) found that a proportion of the dry matter of silage samples (up to 10%) could be lost by this method of drying. It is not known whether any such loss did occur in these dry matter determinations but it is likely that the figures are a little low on this account.

Milk Sampling and Analyses:

The cows were milked twice daily and the milk was weighed at each milking. Composite samples were taken for the determination of butterfat, solids-not-fat, and total protein percentages on five consecutive days of each week.

Weighing of Animals:

The cows were weighed once each week and in addition on the last day of each experimental period.

Results:

TABLE II.

	RATIONS				
	Silage	60lb. Chou Moellier Silage ad lib.	Meal Silage 50ib. approx. ad lib.	Significance of differences Between Ration Means	Silage Ch. Moellier and Silage
Dry Matter) Adjusted Means*	12.8	15.7	18.5	x x	x x
Intake lb.) Unadjusted Means	13.2	15.7	18.3		
Butterfat Yield lb. „ „	16.3	18.1	21.2	x x	x
Milk Yield lb. „ „	0.88	0.96	1.16	x x	x x
Fat corrected milk lb. „	19.8	21.7	26.0	x x	x x
Butterfat% (Unw.)	5.43	5.36	5.51	N.S.	
Total Protein% (Unw.)	3.12	3.08	3.28	x x	N.S.

* Means adjusted for the carry-over effect of the ration fed in previous period.

(Unw.): Unweighted mean.
x x: Significant at 1% level.
x: Significant at 5% level.
N.S.: Not significant.

(1) Dry Matter Intake:

As shown in Table II., the cows ate more dry matter on the silage and meal than on the other two rations, and the consumption of silage alone was less than silage and chou moellier. Even on the silage and meal ration the intake was rather low. As far as dry matter intake was concerned the rations differed significantly in carryover effect, silage depressed the dry matter intake in the subsequent period, silage chou moellier raised it a little in comparison with silage, and silage and meal raised it to a greater extent. The mean dry matter intakes freed from carryover effects are shown in the first line of figures in Table II.

(2) Production:

As the rations did not differ significantly in their carryover effects on production the unadjusted daily means have been presented in Table II. The adjusted means were calculated and the yields on silage were slightly lower and those on silage and meal slightly higher than the figures shown in Table II. Adjusted means for milk composition data differed little from the unadjusted means.

(a) Yield of Milk and Butterfat: The yields of milk, fat corrected milk and butterfat were higher on silage and meal and lowest on silage alone, the differences being highly significant except for the comparison between silage, and silage plus chou moellier in the case of butterfat yields, where the difference was significant.

(b) Milk Composition: The butterfat content of the milk produced on the different rations did not differ significantly, but the protein content of the milk produced by the cows on the silage and meal ration was higher than when they were on the other two rations.

(3) **Body Weight Changes:**

Because of changes in the contents of the alimentary tracts the changes in body weights could not be measured accurately, but in almost all cases the cows lost weight on silage and on silage and chou moellier and gained a little on silage and meal. One cow gained slightly during her period on silage but was producing very little at the time.

DISCUSSION:

As the rations differed in quality it is not possible to determine whether the differences in yield were due entirely to differences in dry matter intake. An analysis of covariance showed that the differences between the yields of butterfat were not significant when allowance had been made for variation in butterfat yield associated with variation in dry matter intake, but the periods included were so short that qualitative differences between the rations may not have had sufficient time to become apparent.

The low protein content of the milk when the cows were on silage or silage and chou moellier may have been caused by the low dry matter intakes on these rations, or partly by the low protein content of these rations. In previous work at this Institute (Riddet et al, 1942) and elsewhere it has been found that a low plane of nutrition will cause the protein content of milk to fall. Although the two poorer diets were low in protein there was no way of separating the effects of plane of nutrition generally and the level of specific nutrients in the diet.

The mixed rations may have been better than the silage alone because of associated effects of feedstuffs, but as far as digestability is concerned work by C. J. Watson et al (1939) has shown no associative effects between roughages and succulent feeds.

SUMMARY:

(1) Three rations for cows in milk were combined in a double crossover type of experiment.

(2) A ration of silage plus meal proved better than one of silage and chou mollier which was, in turn, better than silage alone as far as yield of milk, butterfat and milk energy were concerned. On the first ration the total protein content of the milk was higher than on the other two rations. All these differences were highly significant except that between silage and silage plus chou moellier which was significant. Differences in the butterfat content of the milk were not significant.

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Discussion on Mr. Flux's Paper

DR. FILMER: Could pasture be one of the rations in an experiment using this experimental design?

MR. FLUX: Yes, but if information on the food intakes of the animals was required, the development of an accurate method of estimating the intakes of grazing animals for short periods would be needed, or the pasture would have to be cut and fed in boxes. This would be difficult to do in a dry summer when little grass long enough for cutting was available.

MR. RANSTEAD: Would irrigated pasture be useful for this purpose?

Mr. FLUX: Yes, if you were interested in feeding the type of material grown on irrigated land.

MR. D. M. SMITH: Why were these particular feedstuffs used, particularly silage, which is such a variable feed?

DR. CAMPBELL: Supported the use of silage in this trial as it is a commonly used feedstuff, and although it was undoubtedly variable, a start had to be made at some point to find something about its value as a feed for lactating cows. One of the rations used should be of high quality, hence the meal and silage. The low protein percentages on the silage and silage and chou moellier rations was interesting as a fall in the solid-not-fat content of the milk of cows which were underfed had been found at the Dairy Research Institute.

MR. FLUX: Silage and meal ration could be used as a basis of comparison within the experiment but it was not intended that it should be used as a standard with which to compare feeds in different experiments.

DR. L. R. WALLACE: Why did the cows on silage and meal eat more dry matter than those on the other two rations?

MR. FLUX: As some of the cows appeared to dislike silage it is probable that differences in palatability of the rations affected dry matter intake although this may not have been the only factor involved

DR. WALLACE: Was the lower total protein percentage of the milk of the cows on silage and silage plus chou moellier necessarily caused by underfeeding? Might not some qualitative difference between the rations, such as protein content, have been responsible?

MR. FLUX: As the animals on these two rations did not eat much the low protein percentage was probably due to underfeeding, though qualitative differences in rations might have been responsible for some of the differences.