

COLD, *AD LIB* SYSTEMS OF CALF FEEDING IN NEW ZEALAND

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SUMMARY

Calf-feeding systems at pasture based on *ad lib* access to cold liquid feeds have gained rapid acceptance by farmers. Whole milk, milk replacer powders and fermented (stored) colostrum have all been fed successfully with the latter being the most satisfactory. Liquid intakes ranged from 5 to 9 l/day with growth rates closely related to intake of milk solids. Citric acid caused slight decreases in intake and rate of gain. Hydrogen peroxide (30 volume, 5 ml/l) aided the preservation of milk fed in warm weather but produced no consistent effects on intake or gain under cool conditions. Weaning at about five weeks of age is a feasible means of controlling total milk intake. Alternatively, a longer rearing period can be used with gradual weaning by progressive restriction/dilution of milk from about four weeks or removal of the feeding drum for part of each day.

INTRODUCTION

Systems of feeding calves in which continuous access via a teat is provided to liquid feedstuff have rapidly gained in popularity with farmers in New Zealand. Some systems feed warm reconstituted milk replacer powders (MRP) via a machine but the majority utilise simple equipment (eg 200 litre plastic drums with teats) to feed colostrum, whole milk and MRP at ambient temperatures (the cold *ad lib* system). A survey of dairy farmers in the Morrinsville district by H. Yoder (pers comm) found that 21% of farmers had adopted or intended adopting the system for spring 1981 for reasons of labour saving, flexibility of labour input and increased liveweight gain.

Initial experimental work in New Zealand (Dawson et al 1980) considered fermented colostrum as a cold, *ad lib* feed and showed that calf growth rates were high and health was good. However, under practical conditions, supplies of fermented colostrum were often inadequate. Subsequent experimental work was concerned with alternative feedstuffs. Because the alternatives, (whole milk and MRP) had lower inherent stability than fermented colostrum, the value of a preservative (hydrogen peroxide) and of added citric acid was examined. High levels of intake under cold *ad lib* feeding prompted experiments on means of reducing intake while retaining the advantages of cold, *ad lib* systems.

This paper summarises work on cold, *ad lib* calf feeding on Ruakura Animal Research Station and under commercial conditions on farms and on Moanatuatua Field Research Farm, aile in the Waikato region of New Zealand.

MATERIALS AND METHODS

General

For experiments on Ruakura, male calves (two to four days of age) were bought from dairy farms and offered their liquid diet from rubber teats. In general, access to feed was continuous from the second or third day after arrival with each day's feed being added to the residues of previous feeds. Residues were discarded and drums cleaned at intervals of from one to six weeks. Calves moved to pasture seven to ten days after arrival with proprietary calf meal pellets available except where otherwise noted.

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Liquid feedstuffs and preservatives

In Experiment 1 seven groups of eight Friesian calves were fed *ad lib* for 30 days from early August; four groups on fermented colostrum and three on whole milk. One group from each feedstuff was then either weaned; fed whole milk; or fed whole milk plus 5 ml 30 volume H_2O_2 /l. The remaining group continued to receive colostrum. All five groups still on liquid feeds were weaned at 50 days. In Experiment 2 (late March) four groups of eight Friesian and Jersey calves were fed cold whole milk for 42 days. Hydrogen peroxide (30 volume) was added at 5 or 10 ml/l while a third group received granular citric acid at 1 g/l of milk. No meal was fed. In Experiment 3, MRP reconstituted at 125 g/l of water was offered *ad lib* to two groups of ten Friesian calves for 42 days from early August. One group also received granular citric acid at 12.2 g/kg MRP.

Control of intake

In Experiment 4 (mid March), four groups of 11 Friesian calves were fed from arrival on whole milk, or whole milk:water ratios of 5:1, 2:1 or 1:1 until 50 days. In Experiment 5, nine groups of 15 Friesian calves were weaned from cold, *ad lib* whole milk at 30, 40 or 50 days from mid August with maximum daily supplements of ground barley of 0, 0.75 kg or *ad lib* until 63 days.

Four groups of 25 Friesian male calves were reared under commercial conditions at Moanatuatua (Experiment 6) from late August on cold, *ad lib* whole milk with no carryover of residual milk from one day to the next. Meal was provided *ad lib* until ten weeks of age. Calves were grazed on leafy pasture from one week. In the first group milk was discontinued abruptly at six weeks of age. In the other three groups milk was available *ad lib* until the calves were four weeks of age; in the 5th, 6th and 7th weeks, daily intake was limited to eight, six and four litres respectively (group 2); eight litres of diluted milk were offered as milk:water mixtures of 7:3, 3:2 and 1:1 respectively (group 3); or the feeding drum was removed overnight, and returned for free access during the day (group 4). Groups 2, 3 and 4 were weaned at seven weeks of age.

RESULTS

Performance of the five groups not fed additives in Experiments 1, 2 and 3 (Table 1) indicated that both whole milk and MRP gave overall results similar to those obtained from fermented colostrum. However growth to about four weeks (not shown) was consistently better on fermented colostrum. The addition of citric acid to milk (Experiment 2) or MRP (Experiment 3) caused small decreases in intake and non-significant decreases in liveweight gain (Table 1). Hydrogen peroxide produced no consistent effect on intake or liveweight gain (Table 1) although it reduced spoilage in the feeding drum as judged by odour and consistency of the milk. An on-farm trial with MRP with and without H_2O_2 run concurrently with Experiment 2 also showed no difference in calf performance with H_2O_2 but improved keeping qualities of the reconstituted powder.

Dilution of whole milk (15.2% milk solids) with water (Experiment 4) had small effects on liveweight gain to weaning (800, 830, 790, 700 g/day on mixtures containing 0, 17, 33, 50% water respectively). Calves on more dilute milk drank more so that intake of whole milk (8.6, 7.8, 8.1, 6.4 l/day respectively) was little affected by extent of dilution until 50% water was offered.

The feasibility of early weaning as a means of economising on milk was indicated by growth rates to 50 days of 490 and 770 g/day for calves weaned at 30 days from milk and fermented colostrum respectively in Experiment 1. In Experiment 5, mean growth rates to 50 days were 380, 460 and 640 g/day for calves weaned

from whole milk at 30, 40 or 50 days respectively. Total milk consumption was 160, 220 and 305 l/calf respectively. Level of barley meal had little effect on growth rate as it was poorly accepted by most calves.

TABLE 1 Intake of milk (l/d) to weaning, liveweight gain (g/d) to weaning and live weight (kg) at 70 days (standard deviation in parentheses) of calves fed *ad lib* on the diets indicated

Feed type*		Additive	Milk intake	Liveweight gain to weaning	Live weight at 70 d
0-30 d	30 d-wean				
Experiment 1					
Col.	Col.	Nil	7.2 ⁺	740 (150)	97.2 (8.8)
Col.	Milk	Nil	5.8 ⁺	620 (218)	90.8 (14.4)
Col.	Milk	H ₂ O ₂ 5 ml/l ⁺	9.0 ⁺	800 (127)	98.2 (8.9)
Milk	Milk	Nil	6.3 ⁺	610 (165)	92.0 (9.1)
Milk	Milk	H ₂ O ₂ 5 ml/l ⁺	6.8 ⁺	620 (355)	84.6 (16.3)
Experiment 2					
Milk	Milk	Nil	7.4	760 (176)	77.3 (8.3)
Milk	Milk	Citric acid	6.6	700 (250)	75.6 (10.1)
Milk	Milk	H ₂ O ₂ 10 ml/l	6.5	670 (131)	74.4 (10.3)
Milk	Milk	H ₂ O ₂ 5 ml/l	6.8	720 (232)	76.6 (9.7)
Experiment 3					
MRP	MRP	Nil	8.3	790 (199)	84.3 (6.3)
MRP	MRP	Citric acid	6.8	670 (245)	81.2 (11.8)

* Col. - Fermented colostrum; Milk - Whole milk; MRP - Milk replacer powder

⁺ Applies from 30 days to weaning

The alternative weaning strategies compared in Experiment 6 had little effect on weaning weights (66.1, 68.5, 72.3 and 70.8 kg for groups 1, 2, 3 and 4 respectively); or 70-day weights (87.6, 83.7, 87.5 and 84.3 kg respectively). In the four to seven week period total milk intakes were reduced, relative to an estimated 8 litres/calf/day, by 56, 53, 76 and 68 l/calf respectively. Weaning to 70-day daily meal intakes were not affected by method of weaning, averaging 1.3, 1.0, 1.3 and 1.4 kg respectively.

DISCUSSION

Direct comparison of whole milk with fermented colostrum (Experiment 1) indicated that milk could be fed in a cold *ad lib* system almost as successfully as colostrum, although liveweight gains, especially in the first three or four weeks were lower on milk than on colostrum. No direct comparisons of MRP with other feedstuffs were made although rates of gain on MRP in Experiment 3 were similar to gains recorded on whole milk in Experiments 1 and 2. Farmer experience has also indicated that although fermented colostrum has advantages in price, in stability and in rates of gain, milk and MRP can be fed satisfactorily in these systems.

Where milk or MRP is added to residues of previous feeds, as is usual in cold, *ad lib* feeding, rapid souring occurs and is likely to be one of the factors limiting intake. The addition of citric acid to produce a comparable level of acidity (Experiments 2 and 3) reduced intake by 11 to 18% relative to milk or MRP allowed to sour naturally and is thus a possible method of reducing intake slightly under practical conditions, with little effect on keeping quality.

Experimental work with hydrogen peroxide (Table 1) was carried out in relatively cool conditions. Calves that were changed from colostrum to milk at 30 days under these conditions appeared to benefit from hydrogen peroxide although differences in growth rate were not significant. In all groups, however, milk showed better keeping qualities when H_2O_2 was added and farmer experience over two years under warmer conditions later in spring has indicated that 5 ml of 30 volume (or equivalent) hydrogen peroxide per litre can be a cheap and effective method of extending the life of whole milk in the feeding drum.

Throughout the series of trials on *ad lib* feeding a number of possible methods of economising on liquid feedstuffs have been examined. Provision of meal before weaning did not reduce colostrum consumption (Dawson *et al* 1980), because meal consumption was low while liquid feed was available *ad lib*. However, when liquid feed was withdrawn, meal consumption increased rapidly. Where meal was available in the present experiments, a similar pattern of low intake before weaning (less than 0.5 kg/d) and high intake after (1 kg/d or more) was found. The exception occurred in Experiment 5 where ground barley was poorly accepted before and after weaning even when offered *ad lib*. Thus, although meal feeding does not provide a method of reducing milk consumption before weaning, it may have a role after weaning in allowing early weaning from *ad lib* systems, provided the meal is readily accepted by calves.

Dilution with water from the beginning of *ad lib* feeding (Experiment 4) resulted in only small savings in whole milk. The milk used was from cows in late lactation producing milk with a high solids content. A subsequent attempt to dilute milk from early lactation (approximately 12% solids) with an equal volume of water was abandoned when some calves became clearly under-nourished. Thus dilution does not offer a practical method of reducing intake in young calves.

Time of weaning is an important determinant of total consumption of milk or milk substitute especially as daily rate of consumption tends to rise with age (eg Experiment 5). Calves subjected to sudden weaning from whole milk at 30 days (Experiments 1 and 5) grew more slowly (490,380 g/d) than comparable calves weaned at 50 days (610,640 g/d) but saved 126 and 145 l/calf respectively. Decisions on the relative values of extra weight gains and savings of milk will vary with economic conditions.

Experiment 6 compared three methods of gradual weaning with abrupt weaning. Dilution to spread a rationed amount of milk more evenly among calves over the last three weeks of a seven-week milk feeding period gave a saving of 76 litres of milk on the estimated consumption of undiluted milk for seven weeks and a saving of 20 litres on the consumption by calves weaned from undiluted milk at six weeks. While the other weaning methods compared gave slightly smaller milk savings, all were satisfactory indicating that a period of *ad lib* feeding for three to four weeks can be followed by a period of progressive rationing attained by a variety of means.

REFERENCES

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