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Some effects of feeding pasture silage as a supplement to pasture on reproductive performance in lactating dairy cows

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ABSTRACT

Supplementation of a ryegrass/white clover pasture diet with pasture silage is a common management practice in New Zealand dairy herds. The effect of this supplementation during early lactation on reproductive performance has not been investigated. Five herds of 20 cows were formed before calving commenced on June 1 1992. From August 5 to September 4, two of these herds were fed 5 kg dry matter/cow/day of pasture silage in addition to the ryegrass/white clover pasture offered to all herds. Pasture silage supplementation did not alter the intervals from calving to first ovulation, first oestrus, or to conception. However, it reduced the first service conception rate (37.5 % vs 53.3 %; (sed = ± 10.0 %), for pasture and silage and pasture only cows; respectively).

A positive effect on reproductive performance of pasture silage supplementation was not demonstrated in this trial.

Keywords: Dairy; supplementation; silage; pasture; reproduction.

INTRODUCTION

A cow's requirements for milk production and maintenance often exceed the nutrients supplied by feed intake in the early postpartum period leading to a period of negative energy balance (Butler *et al.*, 1981). The degree and duration of this negative energy balance may influence the interval from calving to the resumption of cyclic ovarian activity (Butler *et al.*, 1981; Staples *et al.*, 1990; Lucy *et al.*, 1992a). Increases in the quantity and/or quality of feed in the early postpartum period may reduce the depth or duration of negative energy balance and hence reduce the interval to resumption of cyclicity. However, supplementary feeding may also increase milk production (Broster *et al.*, 1969) and consequently increase the negative energy balance (Lucy *et al.*, 1992b). The factors that influence how nutrients are partitioned to milk production or to increasing body reserves are not fully understood. Genetic potential of the cow, previous feeding history, production levels before the feeding of supplements, and the body composition at the time of supplementation all may influence this partitioning (Broster *et al.*, 1969).

It was expected that providing pasture silage in addition to pasture in sufficient quantities to increase milk production, body condition score and liveweight, would not affect reproductive performance.

METHOD

Five herds, each comprising of 18 Friesian and 2 Jersey animals of which 20% were heifers were established on June 1, 1992 (Clark, 1993). The herds were balanced for breed, age, breeding index and expected calving date.

Two herds were fed 5 kg dry matter (DM)/cow of moderate quality pasture silage (estimated ME = 10.8 MJ/kg DM and crude protein = 13.3%) daily for 30 days from August 5 in addition to ryegrass/white clover pasture. The other three herds were fed a solely ryegrass/white clover pasture diet at the same allowance as the silage treated herds. Each herd had its own farmlet which consisted of 13, 0.4 ha paddocks. Pasture was fed on a rotational basis with a new area of pasture being offered every 24 hours. The rotation length was approximately 70 days at calving, decreasing to 13 to 15 days during the mating period. Total dry matter (kg DM/ha) was estimated visually (Hutton and Parker, 1973) pre- and post-grazing 3 times weekly throughout the trial. The pasture allowance (kgDM/cow/day) was calculated as the pre-grazing DM/ha multiplied by the area (ha) offered, divided by the number of cows in the group. Dry matter disappearance (DMD) was calculated as the difference between the pre- and post-grazing estimates of total DM multiplied by the area of pasture offered and divided by the number of cows per herd. Total DMI (kg/cow/day) was calculated as the sum of the pasture DMD and the supplement DM offered. The mean daily pasture allowance, the pasture DM intake/cow and the total DM/cow were calculated by averaging the 3 times weekly estimates across each calendar month. Differences among daily averages were tested by one-way ANOVA with treatment as the main effect. Condition score and liveweight were recorded for each animal at fortnightly intervals (Macdonald and Macmillan, 1993).

Milk production for each animal was estimated on a weekly basis. Composite subsamples were analysed for milkfat and protein concentration by an infra-red technique (Milko-scan, N. Foss electrical, Denmark). A second milk sample was collected twice weekly from 10 animals selected randomly from each herd for analysis of progesterone concentration (Coat-a-Count, DPC, Calif, USA). The ovulation date was defined as being 5 days before the first milk sample containing more than 1.5 ng/ml of progesterone.

Oestrous detection was performed from calving onwards by twice daily observation for behaviour associated with

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oestrus (standing while being mounted by another cow) and inspection of tail paint (Macmillan and Curnow, 1977) as cows moved to and from the yards at milking time. A silent ovulation was defined as having occurred where oestrus was not detected within 3 days of the estimated date of ovulation.

The seasonal artificial breeding program commenced on October 5 and continued until November 11. All inseminations were performed by one experienced technician using commercially available semen. A bull was placed with each of the herds from November 12 to December 25. Conception date was confirmed by 2 positive manual pregnancy tests and/or by subsequent calving date (i.e. calving date-282 days).

The intervals from calving to first ovulation, first oestrus and to conception were calculated for each cow. The values for the production variables (volume, milkfat and protein (kg/cow/day)) and liveweight and condition score were averaged across each calendar month (July to December; n=4 or 5 or n=2 or 3 recordings/month for the production variables and liveweight and condition score; respectively) to produce mean daily figures for further analyses. A General Linear Model (GLM; SAS Version 6, SAS institute Inc, Cary, NC, USA) with calving date, age (2,3 or >3 years old), breed (Friesian or Jersey) and treatment (supplement or no supplement) as the main effects was fitted. Discrete data were analysed by χ^2 or by logistic regression (Catmod, SAS) with calving date, age, breed and treatment included as factors.

RESULTS

Silage supplementation increased the total DMI and reduced pasture DMD in August, increased the pasture allowance in November and the pasture DMD and the total DMI in December (Figure 1).

Silage supplementation increased milk production (volume, milkfat and protein) during August and September (Figure 2), liveweight in August and condition score in August, September and October; respectively (Figure 3).

Silage supplementation did not affect the percentage of animals ovulating, or detected in behavioural oestrus before the start of the insemination period and did not affect the percentage of cows expressing oestrus coincident with either the first or second ovulation (Table I). Silage supplementation did not affect the intervals from calving to first postpartum ovulation, first oestrus or to conception (Table I). Supplemented cows had a lower conception rate to first service and required a greater number of services per conception than unsupplemented cows (Table I).

DISCUSSION

Pasture silage supplementation in the first month of lactation was associated with increased total daily DMI. The pasture allowance in November was higher for the silage supplemented herds. This may have been due to 'carryover' effects of the silage supplementation in August. There was an increase in milk production and a smaller loss of liveweight and condition score during and following the period of supplementation. Supplementation did not alter the interval to first ovulation or oestrus, but reduced conception rate to first service and increased the number of services/conception.

FIGURE 1: Average (± sem of herd means) daily pasture allowance (kgDM/cow/day; a), pasture dry matter disappearance (kg/cow/day; b) and total dry matter intake (kg/cow/day; c) for herds fed either pasture (o; n=3 herds) or pasture and pasture silage (●; n=2 herds; *= p<0.05 within month among treatment).

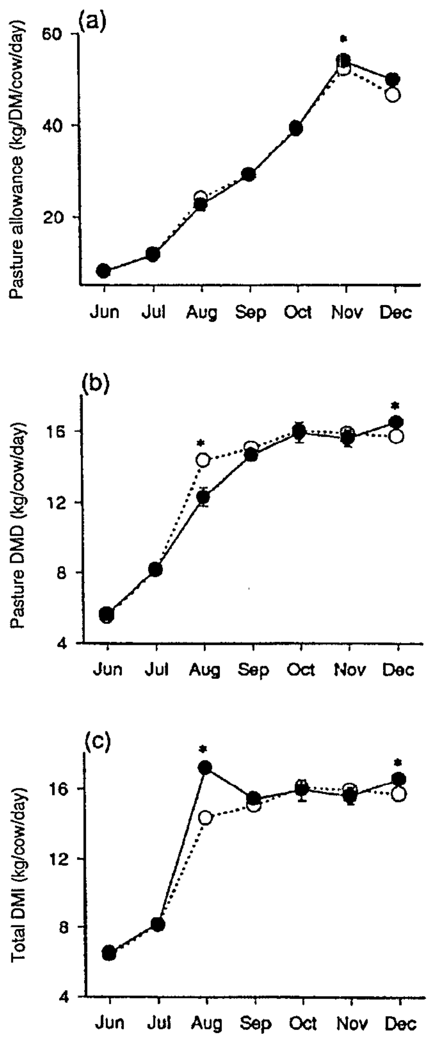


TABLE I: The reproductive performance of cows fed either pasture silage and pasture (Silage and pasture; n=40) or pasture (Pasture; n=60) alone.

	Silage and Pasture	Pasture	Diff ± sed
Ovulation before mating (%)	95	80	15 ± 12.1
Oestrus before mating (%)	90	80	10 ± 7.1
Oestrus detected at 1st ovulation (%)	9	11	-2 ± 6.1
Oestrus detected at 2nd ovulation (%)	84	74	10 ± 8.1
Calving to 1st ovulation (days)	29.6	31.6	-2.0 ± 4.0
Calving to 1st oestrus (days)	31.7	36.9	-5.2 ± 4.1
21 day submission rate (%)	93	87	6 ± 6.0
1st service conception rate (%)	38	53	-15^ ± 10.0
2nd service conception rate (%)	56	65	-9 ± 13.6
Services/conception	2.0	1.5	0.5* ± 0.2
Non pregnant at end of mating (%)	5	13	-8 ± 5.6
Calving to conception (days)	102.3	96.6	5.7 ± 4.8

^ p =0.09; *p<0.05.

FIGURE 2: Average (± sem of herd means) daily volume (a), milkfat (b) and protein (c) production (kg/cow/day) for herds fed either pasture (o; n=3 herds) or pasture and pasture silage (●; n=2 herds; *= p<0.05 within month among treatment).

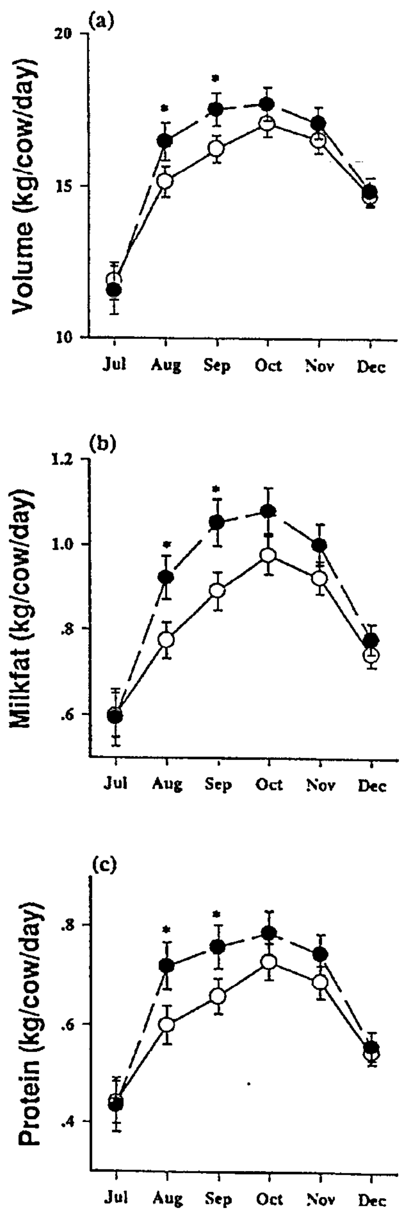
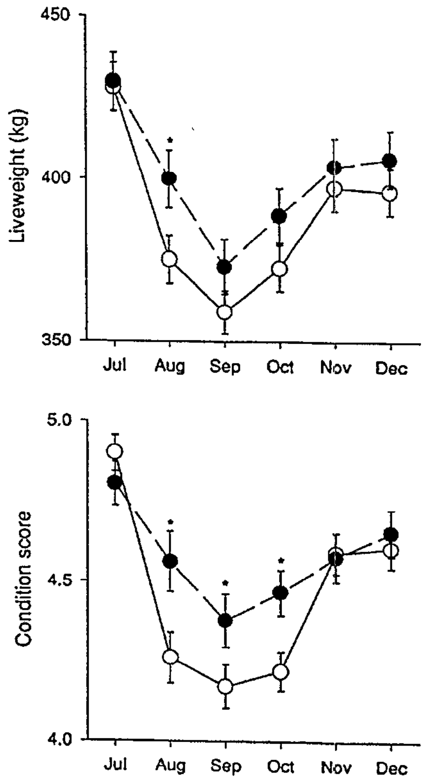


FIGURE 3: Average (± sem of herd means) liveweight (kg; upper panel) and condition score (lower panel) for herds fed either pasture (o; n=3 herds) or pasture and pasture silage (●; n=2 herds; *= p<0.05 within month among treatment).



Milk production, liveweight, condition score, and nutrient partitioning are interrelated, and reproduction performance may be directly or indirectly affected by changes of one or more of these factors induced by silage feeding. Alternately, silage may be exerting its affects independent of changes in any of these factors.

Only half of a large number of studies (reviewed by Esslemont, 1979) found a relationship between production and reproduction and the direction of that relationship varied among studies. For example, conception rate was positively related to production in one study, had no relationship in four studies and had a negative relationship in three studies. Increases in liveweight leading up to mating have been shown to have a positive (King, 1968), nil (Moller and Shannon, 1972; Broster, 1973) or a deleterious affect (Ducker *et al.*, 1985) on conception rate.

The variable relationships found among production, liveweight and condition score and reproductive performance may be partially explained in terms of differences in energy balance and partitioning of feed intake. Cows at the same level of production may have different levels of feed intake, different partitioning of this intake and be undergoing different rates of body tissue mobilisation and hence be at widely different energy balances. Prolonged periods of negative energy balance are associated with extended periods of postpartum anoestrum (Butler *et al.*, 1981; Staples *et al.*, 1990). Extended intervals to resumption of cyclic activity are associated with extended intervals from calving to conception (Thatcher and Wilcox, 1973). However, the relationship between conception rate and energy balance at the time of insemination has not been established. In one trial, cows with a prolonged period of negative energy balance had higher conception rates than animals which quickly regained positive energy balance (Ducker *et al.*, 1985). However, in another trial cows gaining weight (and presumably in positive energy balance) had higher conception rates than those losing weight approaching mating (Youdan and King, 1977).

In the present trial no estimate of energy balance was made. However, reduced loss of liveweight and condition score and the increased production in the supplemented cows indicate that it is unlikely they were in negative energy balance for either longer or to a greater degree than the unsupplemented cows. This suggests that the observed reduction in conception rate was not associated with changes in body composition or milk yield, and that pasture silage may have had a direct affect on conception rate.

Ensiling pasture changes the chemical composition of the pasture (Ekern and Vik-Mo, 1979). Plant proteins are degraded by ensiling leading to a higher proportion of the nitrogen being present in the form of non-protein nitrogen (NPN), of which some may be lost. The crude protein (CP) levels of silage are likely to be lower than the pasture from which they are made. In the present study the CP was estimated as 13% of DM. NPN may represent up to 2/3rds of the CP in silage compared to 10 to 15% in spring pasture (Holmes and Wilson, 1984). The intake of CP and of NPN may have been higher in the silage supplemented herds during the period of supplementation than the control herds. Elevations of dietary CP, rumen degradable protein (RDP) and undegraded dietary protein (UDP) have been associated with reduced conception rates (Ferguson and Chalupa, 1989; Canfield *et al.*, 1990). The mechanism for this is unclear, but may be associated with increased blood concentrations of the nitrogen metabolism product, urea (BUN; Canfield *et al.*, 1990). BUN is water soluble and rapidly excreted in urine. In the present trial, the silage supplementation ceased four weeks before the start of mating, following which time any elevation in BUN produced by increased dietary protein intake would probably have returned to control levels. Elevated BUN has been shown to have deleterious effects on sperm viability and embryos in-vivo (Canfield *et al.*, 1990). Potentially, a period of elevated BUN before the mating period could have damaged the oocytes of small antral follicles which were subsequently ovulated during the mating period, leading to a depression of conception rate.

Fungal mycotoxins may be present in pasture or be produced by fungal growth during ensiling. Fungal mycotoxins, for example zearalenone, have been found in New Zealand pastures (di Menna *et al.*, 1987) and have been shown to have deleterious effects on reproductive performance (Smith *et al.*, 1990). No fungal growth was observed on the pasture silage fed in this trial and there was no evidence of refusal of the pasture silage as may be expected with contaminated silage. However, no direct testing for the presence of mycotoxins was undertaken.

CONCLUSION

Pasture silage supplementation during the first month of lactation increased feed intake and milk yield and reduced loss of liveweight and condition score. However, no beneficial affects on reproductive performance could be demonstrated. There was a reduction in conception rate to first service that could not be explained in terms of changes in body composition or milk yield. The negative affect of silage feeding on conception rate may have been mediated via 'carryover' changes in pasture quantity or quality, presence of mycotoxins in the silage, or some effect of increased dietary protein intake during the period of silage supplementation.

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