Effect of distance walked on dairy production and milk quality

N.A. THOMSON AND M.L. BARNES[1]

Flock House Agricultural Centre, Bulls, New Zealand.

ABSTRACT

A trial conducted at the Taranaki Agricultural Research Station in February 1992 examined the effects of walking milking cows extra distances on milk solids production and milk quality. The walking treatments; control (less than 0.5km/day), 4km/day and 8km/day were applied after the morning and before the afternoon milkings over an 18 day period. The 4km and 8km treatments had respectively 76 and 154 minutes/day less time out on pasture. Milk solids production was assessed on days 8, 11, 15 and 18 of the trial period. Each treatment group comprised 22 Jersey, Friesian and Jersey x Friesian cows were grazed separately throughout the trial period on similar pastures at an equal pasture allowance.

On days 8 and 11, significant depressing effects due to extra walking on milk yield and composition were recorded. Milk yield was decreased ($P<0.05$ day 8), fat % increased ($P<0.05$ day 8) and protein % decreased ($P<0.01$ day 11) which resulted in a significant decrease ($P<0.01$ on day 8 and 11) in protein yield and milk solids yield ($P<0.05$) on day 8. No effect of walking on milk yield and composition were recorded on days 15 and 18. Total milk protein and milk solids production over the two week recording period was reduced ($P<0.01$ and $P<0.05$ respectively) for the 8 km walk treatment.

Extra walking increased ($P<0.05$) somatic cell counts on day 11. A depressing effect on somatic cell counts was also observed on day 18 but differences were not significant. Cow condition score was lower ($P<0.05$) on the 8km extra walk treatment on day 8 and liveweight loss on days 8-16 was less ($P<0.01$) on the extra walking treatments.

No effect was observed on pasture herbage mass levels before or after grazing or on the rate of DM disappearance. DM intake as assessed by controlled release chromium capsules over days 8-18 also showed no treatment effect.

The effects of walking on milk production were significant in only one of a two week monitoring period and from this result it cannot be assumed the production differences and effects on milk quality recorded are repeatable.

Keywords: Walking, lactating cows, milk solids, somatic cell count.

INTRODUCTION

Little information is available in world literature on the energy cost of walking cattle. From only two trials the ARC (1984) have assumed the values of 2.0J/kg liveweight /m of horizontal movement and 28.0 J/kg liveweight /m vertical movement of extra energy required above fasting metabolism for walking. For a 400 kg liveweight cow it is calculated for an extra 4km walking/day and having to ascend 15m/walk to and from the shed the extra energy required would be 3.9MJ/day. For a pasture of 11 MJ/kgDM the increase in the daily requirement is calculated to be 0.35kg DM/cow. In New Zealand this increase has been assumed to be of little consequence because on a proportional basis it would only result in only a 2-3% increase in the energy requirement for lactation.

On farms where long walking long distances are common, cow lameness tends to be a greater problem. Dewes (1978) concluded that lameness was attributed to walking long distances in wet conditions and where abrasive materials had accumulated on concrete races and holding yards. Losses in milkfat production due to lameness reported by Dewes (1978) was 56% for heifers and 16% for mature cows. In a later study Chesterton et al (1989) found that distance walked was not a significant factor contributing to lameness but other factors associated with walking were; the average level of race maintenance and the patience shown by farmers when driving cows.

Walking lactating cows could affect production but under NZ conditions this aspect has received little research attention by and no increase in feed requirements is allowed for in herds having to walk long distances.

METHOD

Before designing a trial to examine the effects of walking on milk solids production the opinion of 14 farmers milking large herds (350 - 850 cows/herd) was obtained by telephone survey on the distances walked by their herds and whether a problem was apparent. In summary:

- Distance walked was not a problem provided lameness did not occur.
- Lameness caused major losses in production and was associated with walking long distances on poor races.
- Distances walked/farm varied from 2-7 km/milking.
- Distances walked varied markedly both within and between days on individual farms.
- Herds were seldom walked for more than 1 hour to and from milking (average walking pace 2-3 km/hour).

[1] Taranaki Agricultural Research Station, Normanby, New Zealand.

From this information the following trial design was adopted:

- Control- <0.5km/milking.
- 4km walk - Additional 2km after morning and again before afternoon milking.
- 8km walk - Additional 4km after morning and again before afternoon milking.

The 4km treatment at each walk ascended a hill of 11m elevation and the 8km treatment at each walk ascended two hills one of 34m and the other 40m elevation.

These treatments were applied daily for 18 days except on Saturdays when all cows walked the same distance as the control group. A pre-experimental period to record individual cow performance for randomisation purpose commenced on 5 February 1992, walking treatments started on 10 February (day 1) and the trial ended on 28 February (day 18) 1992. Liveweight was assessed immediately before the afternoon milking on days 0, 8 and 18, milk yield and composition was recorded on two occasions during the pre-experimental period and on days 8, 11, 15 and 18 of the experimental period. Somatic cell counts in milk was recorded on days 11 and 18. Herbage mass before and after grazing was assessed daily using the rising plate meter. The equations used to convert pasture height readings to herbage mass estimates were derived from data collected on station over a 4 year period. On day 1, 6 cows in each treatment were given a controlled release chromium capsule (CAPTEC) to assess intake. Faeces samples were collected from cows daily from day 8 to day 16 and over this period pastures, were sampled daily to grazing height for digestibility analysis by the Tilley and Terry (1963) *in vitro* method. Faeces were bulked for each cow and pastures were bulked on a treatment basis for digestibility analysis.

From information collected during the pre-experimental period, groups were balanced for age, liveweight, breed and daily milk, fat and protein yields. Twenty two mixed age Jersey, Friesian and Jersey x Friesian cows were allocated to each treatment. The pre-experimental data also served as covariats in the analysis of treatment effects.

To ensure cows were offered a similar pasture at the same allowance, trial paddocks were divided into three equal areas and each day cows were given a new paddock and randomly allocated to one of the three areas. After the morning milking each group was returned to their grazing block via their respective walking routes. Before the evening milking the groups were brought from their blocks to the shed at staggered times to ensure all groups arrived at the shed at a similar time. The longer walking treatments had less time on pasture between the morning and afternoon milking than the control group. This management method confounded distance walked with time available for grazing but it was decided this was a more realistic comparison than having all groups with similar grazing times.

RESULTS AND DISCUSSION

Walking times

The time taken for each treatment to walk the respective distances were 16, 76 and 154 minutes/day for the control, 4km and 8km treatments. The average walking pace for the experimental groups was 3km/hour and from this it is assumed the control group walked approximately 0.4km after the morning milking and before the after milking.

The additional energy required by walking treatments as calculated from published information (ARC 1984) was 2.6MJ/day and 7.1MJ/day for the 4km and 8km walked groups respectively. For pasture of a feed value of 11.0MJ/kg DM and assuming 5.7MJ/litre of milk (Holmes & Wilson, 1982) this would equate to either an increase in DM intake of 0.2 and 0.6 kgDM/cow/day or a drop in milk yield of 0.45 and 1.2 litres of milk for the 4 km and 8 km walking treatments respectively .

Animal health

No incidence of lameness in any of the treatment groups was observed.

Milk yield and composition

A depression ($P<0.05$) in milk yield for the 4 km and 8 km treatments was recorded on day 8. On day 11 there was a marked trend ($P<0.08$) for walking to depress milk yield but on days 15 and 18 no effect of walking was apparent (Table 1). On days 8 and 11 the depressions in milk yield recorded for the 4km and 8km extra distances were 0.41 litres/cow/day and 0.61 litres/cow/day. For the 4 km walk this was similar to the losses calculated but only 50% the theoretical loss in production calculated for the 8km walk.

Short term effects on milk composition on days 8 and 11 were also recorded with an increase ($P<0.05$) in fat content on day 8 for the 4km walk and a decrease ($P<0.01$) in protein content recorded for the 8km walk on day 11. The decrease in milk yield and small increase in fat % and decrease in protein % observed over days 8 and 11 is indicative of an underfeeding effect (Wilson & Davey, 1982).

TABLE 1: Effect of walking on milk yield and composition – production/cow/day.

	Milk Yield (litres)				Milkfat %				Protein %			
DAT	8	11	15	18	8	11	15	18	8	11	15	18
Control	10.86	11.35	10.67	10.06	6.53	6.17	6.41	6.45	4.25	4.29	4.25	4.22
4km walk	10.33	11.06	11.07	9.60	6.75	6.07	6/57	6.37	4.26	4.27	4.25	4.19
8km walk	10.26	10.73	10.83	9.97	6.50	6.33	6.41	6.35	4.21	4.16	4.17	4.18
Significance	*	NS	NS	NS	*	NS	NS	NS	NS	**	NS	NS
LSD	0.05	0.43	(P<0.08)		0.21	P<0.053			0.07			
	0.01	0.43	(P<0.08)						0.09			

The effects on milk yield and composition resulted in a slight reduction in fat yield (P<0.052) for the 8km walking group only on day 8 and a reduction (P<0.01) in yield of protein on days 8 and 11. These yield effects resulted in a reduction (P<0.05) in milk solids yield on day 8 and a reduced (P<0.08) milksolids yield on day 11.

TABLE 2: Effect of walking on the daily average yield of milk solids over the 11 day measurement period (production/cow/day).

Treatment	Milk Yield (litres)	Fat Yield (kg)	Protein Yield (kg)	Milk Solids Yield (kg)
Control	10.7	0.67	0.45	1.12
4km walk	10.5	0.65	0.44	1.09
8km walk	10.2	0.65	0.42	1.07
Significance	NS	NS	**	*
LSD 0.05	(P<0.052)		0.02	0.04
0.01			0.027	

Over the 14 day measurement period (Table 2) these differences in milk yield and composition resulted in a decline in milk yield (P <0.052) and a reduction in protein yield (<0.01) and milk solids yield (P <0.05) for the 8km walking treatment compared with the control. No effect of walking on fat yield was recorded. As milk protein is the most valued of the milk constituents suggests walking lactating cows long distances would affect returns from dairying. The overall effect of walking on the production of milk constituents must however be treated with caution as the effect was only significant in one or two of the four individual herd tests taken over the trial period.

Somatic Cell Counts

Somatic Cell counts in milk on day 11 increased (P<0.05) from the normal walked group for both the 4km and 8km treatments (Table 3). On day 18 a similar effect was observed but it was not significant. Cell counts over the trial period were low and below the normal herd averages for this time of the year. In herds with higher cell counts ie. greater than 200,000, penalties could possibly result on days cows walked extra distances (assuming a doubling of cell count as occurred for the 8km treatment on day 11).

TABLE 3: Somatic cell counts (000's)/cow.

	11 Days Walking	18 Days Walking
Normal Walk	99	72
4km Extra Walk	167	151
8km Extra Walk	164	100
Significance	*	NS
LSD	0.05	53

Liveweight and Condition Score

Cows gained liveweight from Day 0 to Day 8 and lost liveweight from Day 8 to Day 18 (Table 4). Over the later period (Day 8-18) cows walking 8km/day lost less (P<0.01) liveweight than either the 4km or the control treatment. Liveweight gains of grazing animals measured over short periods is relatively inaccurate as daily differences in intake and gut fill could result in variable effects on liveweight. Over the trial period (Day 0 Day 18) liveweight changes for all treatments were positive with liveweight gains of; 1, 4 and 8kg/cow recorded for the normal, 4km and 8km walked groups respectively. No major changes were recorded in the condition score of cows over the treatment period which reflects the minimal effects recorded of extra walking on cow liveweight.

TABLE 4: The effect of walking on liveweight, liveweight gain (kg/cow) and condition score (CS).

	Day 0		Day 8			Day 18		
	LWT	C.S	LWT	LWT Gain	C.S	LWT	LWT Gain	C.S
Control	395	4.5	411	22	4.6	390	-21	4.5
4km walk	387	4.5	412	22	4.6	393	-19	4.5
8km walk	386	4.5	409	19	4.5	397	-11	4.5
Significance	NS	NS	NS	NS	*	NS	**	NS
LSD	0.05	-	-	-	0.09	-	4	-
	0.01	-	-	-	-	-	5	-

HERBAGE MASS AND INTAKE ASSESSMENT

Herbage mass levels before and after grazing and rates of DM disappearance in the second and third week of the trial were similar for all the walking treatments. The average levels were; before grazing, 3180 + 57 kgDMha, after grazing 2470 + 36 kgDM/ha and an average rate of DM disappearance of 11.6 + 0.8 kgDM/cow/day. The estimation of herbage mass by methods such as a rising plate meter is subject to error; + 200-300kg DM/ha, (L'Huillier and Thomson 1987) suggesting large differences would be necessary to detect treatment effects.

Results of the intake assessments using the chromium capsules were not entirely successful. Over the assessment period 3 capsules were lost; 2 from the normal walk herd and 1 from the 8km walk herd. Analysis of the results showed no significant treatment effect and the average intake as assessed by the CAPTEC method was 15 _ 1.5kg DM/cow/day.

CONCLUSION

Walking cows extra distances significantly depressed milk protein yield, milk solids yield and increased somatic cell counts. The effects of walking were mainly on milk yield and protein content occurring in days 8 and 11 following the commencement of the walking treatments. No effects on milk were observed in the third and final week of the trial. Herbage mass levels before and after grazing, rate of DM disappearance and pasture intake were similar for the three walking treatments and offer no explanation for the differences in the yield and composition of milk observed.

The trial highlighted that walking extra distances will reduce milk solids yield, especially protein yield and de-

presses milk quality which in some situations through a high somatic cell count and severe penalties could result in a further reduction in revenue as a result walking of extra distances. These effects however were only significant in one week of a two week monitoring period and it cannot be assumed the effects observed in this study are repeatable. Further work would be necessary to substantiate these effects of walking on dairy production and milk quality.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the financial assistance to operate this trial given by the Large Herds Trust. Also the assistance of Mr G R Engelen, Farm Manager, TARS, and his staff for the daily management of the herds and B Walsh and S Thomson for setting up fences and walking the cows.

REFERENCES

A.R.C 1984. The Nutrient Requirements of Livestock. Technical Review by an Agricultural Research Council Working Party. Commonwealth Agricultural Bureaux: plOl.

Chesterton, R.D., Pfiffer, D.U., Morris, R.S., Tanner, C.M. 1989. Environmental and behavioural factors affecting the prevalence of foot lameness in New Zealand dairy herds - a case-study. *New Zealand Veterinary Journal* **37:** 135-142.

Dewes, H.F. 1978. Some aspects of lameness in dairy herds. *New Zealand Veterinary Journal* **26:** 147-8 & 157-9.

Tilley, J.M., Terry, R.A. 1963. A two stage technique for the in vitro digestion of forage crops. *Journal of the British Grassland Society* **10:** 104-111.

Holmes, C.W., Wilson, G.F. 1984. Milk Production From Pasture. *Butterworths, Wellington N.Z:* PllO.

Wilson, G.F., Davey, A.W.F. 1982. The nutrition of the grazing cow: mid and late lactation. *In:* Dairy Production from Pasture. Ed. K.L. McMillan and V.K. Taufa. *Proceedings of the Australasian Societies of Animal Production:* pp219-235.