Tail docked dairy cattle: fly induced behaviour and adrenal responsiveness to ACTH

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ABSTRACT

Five sets of rising five year old Holstein-Friesian non-lactating identical twin cows were studied from February to April 1994. One member from each twin pair had been tail docked at 18 months of age while the other member had its tail intact. The animals were observed weekly at three different times of day; 7 am, 12 noon and 3 pm. At low fly levels there were no significant differences in the frequencies of either front (e.g. leg stamping) or rear (e.g. tail flicking) focused fly-induced behaviours between the two treatments. At high fly levels there were no significant differences in front focused behaviours but the docked animals performed significantly more rear focused behaviours than the non-docked cows (e.g. 96 vs 34 tailflicks at 12 noon, $p<0.05$).

The adrenocorticol responses to intravenous injection of 0.05mg ACTH (Synacthen, CIBA-GEIGY) or saline was assessed four times throughout the experiment. The animals were blood sampled at time - 1 min, 50 and 120 min relative to the time of injection of ACTH or saline. There were no significant differences in plasma cortisol concentrations in response to ACTH injection between treatments.

Tail docked cows had elevated levels of fly induced behaviour but did not have an altered adrenal cortex function. This suggests that behaviour is a more sensitive indicator of the effects of fly predation than adrenal response to ACTH. Sensitive physiological indicators of chronic stress need to be developed for the assessment of husbandry practices.

Keywords: taildocking cattle; biting flies; behaviour; cortisol; ACTH.

INTRODUCTION

Tail docking of cattle is a common practice on many New Zealand dairy farms. Anecdotal reports suggest that this practice enhances udder and milk hygiene and improves milker comfort during milking. A recent survey of attitudes to farm animal welfare issues (Matthews, Loveridge and Guerin, 1994) indicated that about 60% of the general (non-farming) public had concerns about taildocking. The level of concern amongst non-dairy farmers was 53% and was 34% amongst dairy farmers. The main reason for concern amongst both farmers and the general public was that cattle without tails would have a reduced ability to remove flies. Studies by Wilson (1972) and Ladewig and Matthews (1992) have shown that higher numbers of biting flies (*Stomoxys calcitrans*) are present on docked cattle. Predation of cattle by biting flies can lead to altered grazing behaviour (Dougherty, *et al.*, 1993) and decreased production and increased levels of stress (Campbell and Berry, 1989). The aim of the current study was to determine the effects of taildocking of dairy cows on biting fly numbers on cattle and the resultant effect on the adrenal cortex response to ACTH challenge as a marker of stress.

The assessment of the adrenal response followed the procedures used by von Borrell and Ladewig (1992) and Verkerk *et al.*, (1994) : plasma cortisol concentrations were monitored following administration of a physiological dose of adrenocorticotropic hormone (ACTH). Both behavioural and physiological measures were compared in docked and non-docked twin pairs during periods of high and low fly abundance.

MATERIALS AND METHODS

Animals

Five pairs of non-lactating 5yr old Holstein-Friesian identical twin cows were used. One member of each twin set had been docked in accordance with prescribed methods at 18 months of age (Animals Protection (Docking of Tails) Regulations (1972)). The animals were kept at pasture for the duration of the study.

Behavioural observations

All of the cows were individually identified and observed three times per day (7 am, 12 noon, and 3 pm) at approximately weekly intervals in the summer and autumn of 1994. All incidences of fly-induced behaviours were observed separately for the front (front leg stamps, panniculus muscle reflex) and rear (rear leg stamps, tail flicks) for one side of each animal for 2 min, alternating between docked and non-docked cattle. This procedure was repeated three times, thereby giving a total of 6 min of observations for one side of each animal at each time of the day. In addition, the number of flies on the front and rear legs were scored three times for each animal at each observation period (time of day).

ACTH challenge and cortisol assay

The adrenocortical response of each animal to intravenous injection of 0.05mg ACTH (Synacthen, CIBA-Geigy) was assessed three times (March, April and May) and to saline once only (June). Animals were yarded at 9.00 am and three blood samples were taken by venipuncture from the tail vein

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at time -1 min (baseline), 50 min and 120 min relative to the injection of ACTH. During the experimental period all cows were injected on one occasion with saline instead of ACTH as a control treatment. The blood samples were placed in ice water and centrifuged within 3hr. Plasma was aspirated and stored at -20°C until assayed for cortisol using an in-house radioimmunoassay (Ingram *et al.*, 1994). The intraassay variation was 9.8%. All samples were assayed in one run so there was no interassay variation.

Statistical Analyses

Differences between behaviours and fly abundance at the front and rear of animals and between docked and non-docked cows were analysed using non parametric procedures (Wilcoxon matched pairs signed ranks test, Siegel, 1956) and the physiological measures were analysed by GLM ANOVA (Minitab version 8.2) for the effects of treatment (docked and non-docked), month of challenge, twin pair and treatment by month interaction.

RESULTS

Behavioural measures

The mean frequencies of fly-induced behaviours and flies present on cattle over the whole experimental period were calculated for each observation period (time of day) for each animal. The mean (and standard error) of these individual measures is shown in Table 1. The frequencies are expressed per 6 min per animal (one side only) as each observation period comprised of three 2 min observations. There were no flies nor fly-induced behaviours on either the docked or non-docked cattle during the 7 am observation period. The prevalence of flies and associated behaviours were similar during both afternoon observation periods. During these periods there were no significant differences between docked and non-docked cattle in the fly loadings or fly-induced behaviours on the front of the cattle.

In contrast there were more flies present and higher rates of fly-induced behaviours on the rear of docked than non-docked cattle during both afternoon observation periods ($p<0.05$).

Mean fly loadings over the 12 noon and 3pm observation periods in the four weeks prior to each ACTH challenge were 16 and 28 per 6 min, respectively, for the non-docked and docked animals (Challenge 1), and 10 and 19 per 6 min, respectively (Challenge 2). The fly loadings were not significantly different between challenges. The average fly loadings were zero prior to Challenge 3 and the saline injection.

Cortisol response

The integrated area under the cortisol response curves (AUC) between time zero and 120 min and the plasma cortisol concentration at each sampling point were used to assess the adrenocortical response to ACTH challenge (Verkerk, *et al.*, 1994). Table 2 shows the mean (and standard errors) of the AUC data for each challenge in docked and non-docked animals. There were no significant differences in AUC between docked and non-docked cattle at each ACTH challenge and with saline. The AUC with saline was significantly less than the response to ACTH for both treatment groups ($p<0.05$). There were significant differences between twin pairs in AUC ($p<0.05$).

TABLE 1: The mean (s.e.) frequencies (per 6 min) of flies and fly-induced behaviours on the front and rear of docked (- tail) and non-docked (+ tail) cows at three different times of the day over the whole season.

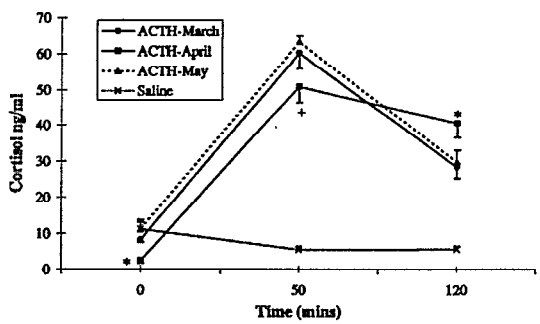
	7 am		12 noon		3 pm	
	+ Tail	- Tail	+ Tail	- Tail	+ Tail	-Tail
Front						
No of flies	0	0	11(2)	9(3)	12(6)	8(3)
Pan. reflex	0	0	20(2)	23(3)	23(4)	20(3)
Stamp	0	0	2(0)	2(0)	3(0)	3(0)
Rear						
No. of flies	0	0	1(0)	15(4)	1(1)	15(4)
Tail flick	0	0	34(1)	96(5)	27(2)	69(6)
Stamp	0	0	1(0)	5(1)	1(0)	5(1)

TABLE 2: The means (s.e.) of the individual cortisol responses to ACTH or saline injection as measured by the area under the response curve.

	Area under Curve (ng/ml)	
ACTH Challenge	+ tail	- tail
1	4864(589)	4766(378)
2	4571(658)	4499(290)
3	5067(355)	5191(262)
Saline	827(153)	781(74)

There was no significant difference in plasma cortisol concentration between docked and non-docked cattle at any sampling occasion, thus, the data were combined. The mean plasma cortisol concentrations at each sampling time for each challenge are shown in Figure 1.

FIGURE 1: Mean plasma cortisol concentration (pooled over treatments) at each sampling time for each ACTH challenge and saline administration. The standard error bars are also shown.



The basal cortisol level was lower at the second ACTH challenge than for the other ACTH challenges or saline injections ($p<0.05$). At 50 min and 120 min, the cortisol concentrations were significantly higher following ACTH injection than saline injection ($p<0.05$). In addition, the cortisol values following the second ACTH challenge were higher at 120 min ($p<0.05$) and tended to be lower at 50 min ($p<0.10$) than those following the first and third challenges. Drought conditions prevailed in the 3 to 4 weeks prior to the second challenge and pasture intake had been less than that required for maintenance levels of feeding.

DISCUSSION

During the period of the study there were no differences between docked and non-docked cattle in the fly loadings on the front of the cows, nor in the rates of occurrence of front-focussed behaviours directed at these flies. There were consistently higher numbers of flies on the rear of the docked than non-docked cows. The frequencies of the behaviours directed at the rear flies were also higher on the docked animals. The two main types of behaviour used to dislodge flies from the rear were tailflicking and rear leg stamping. The increased frequencies of both of these activities by docked animals is consistent with the results of a previous study (Ladewig and Matthews, 1992).

It is difficult to explain the large increase in tailflicking activity, given the ineffectiveness of this response in dislodging flies. In addition, the frequency of leg stamping on the docked animals is perhaps surprisingly low given that it is one the few alternative behaviours available for removing flies. Other activities such as grazing may have precedence over foot stamping. These observations suggest that the presence of biting flies constituted a source of irritation, but the degree of discomfort experienced by the cattle is not easily quantifiable from behavioural measures alone.

The measures of adrenocortical response showed no differences between docked and non-docked animals, nor between treatments at high and low levels of fly predation despite the behavioural differences. This may not be surprising. Several studies have shown that management practices have relatively little effect on cortisol output (following an ACTH challenge) except where the stress is particularly severe and prolonged (Friend *et al.*, 1977; Roman-Ponce *et al.*, 1981; Zavy *et al.*, 1990). For example, in the experiment reported by Friend *et al.*, crowding stress in mature cattle did not alter adrenal output of cortisol until the space allowance was reduced to 2.97 m^2 of lot space and 0.5 m^2 of free stall space per cow. Control conditions were 15 m^2 of lot space and 1 m^2 of free stall space.

In the current study, cortisol concentration appeared to be altered by a relatively severe nutritional challenge yet was unaffected by fly loadings or docking treatment. This could imply that the additional flies on docked animals constituted, at most, a moderate stressor. Additional studies using measures of sympathetic nervous system activity such as changes in heart rate are required to quantify any physiological stress that may be experienced by cattle at the various fly loadings observed in the current study.

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REFERENCES

Campbell, J.B. and Berry, I.L. 1989. Economic thresholds for stable flies on confined livestock. Miscellaneous Publications of the Entomological Society of America **74:** 18-22.

Dougherty, C.T., Knapp, F.W., Burrus, P.B., Willis, D.C., Cornelius, P.L. and Bradley, N.W. 1993. Multiple releases of stable flies (*Stomoxys calcitrans L*) and behaviour of grazing beef cattle. *Applied Animal Behaviour Science* **38:** 191-212.

Friend, T.H., Polan, C.E., Gwazdauskas, F.C. Heald, C.W. 1977. Adrenal glucocorticoid response to exogenous adrenocorticotropin mediated by density and social disruption in lactating cows. *Journal of Dairy Science,* **60:** 1958-1963.

Ingram, J. R., Matthews, L. R., McDonald , R. M. 1994. A stress free blood sampling technique for free ranging animals. *Proceedings of the New Zealand Society of Animal Production* **54:** 39-42

Ladewig, J., Matthews, L. R. 1992. The importance of physiological measurements in farm animal stress research. *Proceedings of the New Zealand Society of Animal Production* **52:** 77-79

Matthews, L. R., Loveridge, A., Guerin, B. 1994. Animal welfare issues and attitudes in New Zealand. Animal Behaviour and Welfare Research Centre, AgResearch, Hamilton New Zealand. 63Pp.

Roman-Ponce, H., Thatcher, W.W., Wilcox, C.J. 1981. Hormonal interrelationships and physiological responses of lactating dairy cows to a shade management system in a subtropical environment. Theriogenology, 16: 139-154.

Verkerk, G.A., Macmillan, K.L. and McLeay, L.M. 1994. Adrenal cortex response to adrenocorticotropic hormone in dairy cattle. *Domestic Animal Endocrinology* **11:** 115-123.

Von Borell, E., Ladewig, J. 1992. Relationship between behaviour and adrenocortical response pattern in domestic pigs. *Applied Animal Behaviour Science* **34:** 195-205.

Wilson, G.D.A.1972. Docking cow's tails. Ruakura Farmers Conference, Ruakura. Pp158-165.

Zavy, M.T. Juniewicz, P.E., Phillips, W.A., Von Tungeln, D.L. 1990. Effect of initial restraint, weaning, and transport stress on baseline and ACTH stimulated cortisol responses in beef calves of different genotypes. *American Journal Veterinary Research* **53:** 551-557.