USE OF SALIVARY CORTISOL AS AN INDICATOR OF STRESS DUE TO MANAGEMENT PRACTICES IN SHEEP AND CALVES

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SUMMARY

Saliva collection and cortisol radioimmunoassay techniques were developed to enable frequent, "non-stressful" monitoring of stress in sheep and calves. Thus, transitory stress responses due to transport, castration or confinement have been recorded and compared. Significant increases in salivary cortisol concentration occurred in sheep exposed to rough transport or when first confined in metabolism cages, and in calves following transportation or surgical castration. (Keywords: stress, sheep, calves, transport, castration.)

INTRODUCTION

Physiological indicators which are relevant to animal welfare, and particularly to the assessment of stress in farm animals, are the subject of much discussion and research today (see Smidt 1983). Amongst these, plasma cortisol measurement has been quite commonly used to monitor stress in sheep (Kilgour and de Langen 1970; Moberg et al. 1980) and cattle (Stephens and Toner 1975; Carter et al. 1983).

Recently we reported a method for measuring salivary cortisol which gives a reliable estimation of "free" plasma cortisol (Fell et al. 1985a). We have now used this technique to study theeffectsof yarding, transportation, and confinement on sheep, and the effects of castration, and transportation on calves. This paper presents results indicating the relative stress of these procedures as assessed by salivary cortisol.

MATERIALS AND METHODS

A simple suction device described by Fell et al. (1985a) was used to aspirate saliva (normally 1–2 ml within 10–30 seconds) from the side of the mouth near the opening of the parotid duct. Minimal physical restraint is required because the animal is occupied chewing on the tubing. Samples were frozen, thawed, and centrifuged before the measurement of cortisol in the supernatant using a radioimmunoassay kit (Farmos Diagnostica – Australian Laboratory Services, Rockdale, N.S.W.).

RESULTS

Comparative values for salivary cortisol (mean ± S.E.) in sheep following yarding or transportation are 'shown in Table 1. Baseline values for salivary cortisol in "trained" sheep of about 2 nmol/l were obtained. Somewhat higher values ranging from 4-8 nmol/l occurred in "untrained" sheep after yarding or after road transport, with higher values of 22 nmol/l in sheep following 30 minutes of rough transport on a trailer. Significant increases in salivary cortisol were also obtained when sheep were being acclimatized to metabolism cages for two hours each day (Figure 1). However, on the third day of this treatment and during continuous residence in the metabolism cages, thereafter, no significant rise in cortisol was found in the sheep.

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Table 1 Levels of salivary cortisol in sheep in relation to management activity

Management activity	No. of sheep	Salivary cortisol (nmol/l) Mean	S.E. (±)
* Trained‡ ewes sampled in race	8	1.8	0.37
* Trained ewes sampled in pens	10	1.8	0.85
Untrained ewes sampled in race	50	4.1	0.47
Untrained ewes sampled in race after 6 h road transport on a two-tiered truck	50	3.9	0.21
Untrained late-pregnant ewes sampled in race immediately after yarding	21	7.6	0.59
Untrained postpartum ewes sampled in race immediately after yarding	15	6.9	1.03
Trained ewes sampled after 30 min rough transport on a trailer	8	21.9	3.15

* From the same flock of 50 Merino x Border Leicester ewes reared at Agricultural Research Centre, Tamworth and transported to Richmond at 15 months of age.

† Merino ewes at Agricultural Research and Veterinary Centre, Orange.

‡ "Trained" indicates that the animals had been handled in a race by these operators at least five times previously.

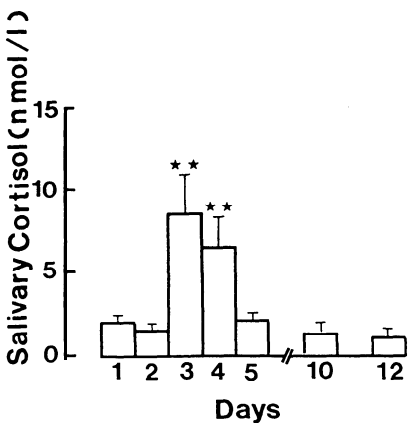

Fig. 1. Changes in salivary cortisol concentration (mean ± S.E.) in 10 crossbred wethers introduced to metabolism cages on Days 3-5, and sampled 30 min after being lifted into the metabolism cages each day. Pretreatment samples were taken on Days 1 and 2, and the sheep were also sampled on Days 10 and 12 during continuous residence in the metabolism cages-
** P<0.01

With "trained" calves, baseline values of salivary cortisol of about 2 nmol/l were obtained, as shown in Table 2. Higher mean values of 11 nmol/l were found after two hours of road transport, and 16 nmol/l after 30 minutes of various trucking manoeuvres during the initial phase of road transport. Comparison of two methods of castration in calves (Table 2) gave peak salivary cortisol values after one hour. Highest mean values of 10.2 nmol/l were found after surgical castration compared with only 3.2 nmol/l after fitting of rubber rings.

Table 2 Levels of salivary cortisol in trained calves in relation to management activity

Management activity	No. of calves	Salivary cortisol (nmol/l) Mean	S.E. (±)
* Calves sampled in race	19	1.6	0.18
Male calves sampled 1 h after fitting rubber rings for castration (Fell et al. 1985b)	10	3.2	0.63
Male calves sampled 1 h after surgical castration (Fell et al. 1985b)	9	10.2	2.64
* Calves sampled immediately after 2 h of road transport in an enclosed truck	19	11.0	1.61
* Calves sampled after 30 min of stop-start trucking, i.e. the initial phase of the 2 h road transport	19	16.0	2.29

* This group of 19 calves had 15 males and 4 females, a mixture of dairy and beef breeds and an age range of 1 to 3 months.

DISCUSSION

These results show the feasibility of monitoring the adrenocortical stress response in sheep and calves in saliva. Baseline values for salivary cortisol indicating a "non-stressed" state can be obtained with a small amount of training of the animals, and the direct effect of stressors such as transport and castration can then be conveniently measured in this way. Thus, differences between animals and between alternative management procedures can be studied using this methodology.

It is of interest that sheep did not appear to be stressed after six hours of road transport under good conditions when compared with 30 minutes rough transportation, and this supports the observations of Kilgour (1976) that sheep handled gently and transported in their own group will travel well. With calves it was apparent that the stress of castration, as measured by salivary cortisol, was no greater than transportation, which confirms the earlier findings of Johnston and Buckland (1976) who compared management stresses by plasma corticoid levels.

Additional work is now being planned to examine stress in the field situation because recent work has indicated (see Dantzer and Mormède, 1983) that, with untrained animals, the emotional response to handling can be a greater stressor

than those described in this paper. We have observed much higher salivary cortisol values of up to 90 nmol/l in "spot" samples from alarmed calves. Peak values of about 70 nmol/l have also been found in sheep following stimulation of the adrenal with ACTH (Fell et al. 1985a). We acknowledge that a simple adrenocortical model of stress is not adequate to answer all the questions about management stress in livestock, and further research, including measurements of other hormones, is in progress.

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