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An attempt to suppress the rut-associated loss of live weight in stags by immunocastration

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ABSTRACT

Two trials were conducted to study the effectiveness of vaccination of stags against gonadotrophin-releasing hormone (GnRH) for minimising the deleterious effects of the rut on their live weight and body condition. In March 2000, mature red deer stags (n = 10) received a s.c. injection of 1.0 ml of vaccine (Improvac®) or saline solution (controls) and a second injection three weeks later. Liveweight loss in the 10 weeks following the initial injection was not affected by the treatment (mean loss 28.6 ± 4.0 kg and 28.1 ± 4.2 kg for vaccinated and control groups, respectively). Plasma testosterone concentration was lower ($P<0.05$) in the vaccinated stags but there was no effect on scrotal diameter. In the following year, stags (n = 10) were injected with 2.0 ml of the vaccine or saline on 18 January and 8 February. Mean liveweight loss in 21 weeks was similar for vaccinated and control groups (41.2 ± 8.2 kg and 38.8 ± 7.2 kg, respectively) and there was no treatment effect on the reduction in body condition score. Although vaccinated stags had a lower ($P<0.05$) mean plasma testosterone concentration than control stags, this effect can be entirely attributed to stags (3 out of 4) that had been vaccinated in the previous year's trial. It is concluded that vaccination of stags against GnRH does not overcome the loss in live weight which is associated with the rut in these animals.

Keywords: deer; stags; GnRH; immunocastration.

INTRODUCTION

During the breeding season, adult deer stags that are farmed primarily for production of velvet antlers undergo changes in physiology and behaviour that impose a risk to their welfare and reduce the efficiency of production. Over this period, stags lose up to 30% of live weight through inappetence and increased physical activity (fighting, fence pacing, etc.) and some receive injuries. It can be dangerous for humans to intervene and pasture management is compromised. (See Nicol and Keeley, these proceedings.) We have attempted to modify these breeding season-related changes by using immunocastration to suppress reproductive signals. Unlike surgical castration, it was expected that the effects of immunocastration would be reversible, hence, allowing stags to maintain their normal pattern of antler casting and growth.

MATERIALS AND METHODS

Twenty adult red deer stags aged 3 to 11 years (mean 7 years) maintained on pasture at the Deer Unit on the Lincoln University Research Farm were used in the first trial carried out in autumn 2000. In 2001 the second trial used 13 of the same stags plus seven replacements. Stags were allocated to groups so that age, live weight, velvet antler weight and previous treatment were balanced between treatments. The procedures used were approved by the Lincoln University Animal Ethics Committee.

Autumn 2000

Ten stags were each injected s.c. with 1.0 ml of anti-gonadotrophin releasing hormone vaccine (anti-GnRH, Improvac®, CSL Limited, Victoria, Australia) on 1 March 2000 and with a second injection three weeks later on 24 March. Another 10 stags received injections of 1.0 ml saline solution on the same occasions (control group). Live weight, scrotal diameter (anterior-posterior width of testes measured by plate calipers) and injection site on the neck were monitored approximately 3-weekly until 12 May 2000. A 10-ml blood sample was collected by jugular venipuncture on each occasion and the plasma harvested for testosterone radioimmunoassay (Shi and Barrell, 1992).

Autumn 2001

Ten stags were injected s.c. with 2.0 ml of the anti-GnRH vaccine on 18 January 2001 and with a second injection 3 weeks later (on 8 February). Another 10 stags (controls) received saline solution only. Thereafter, stags were monitored and sampled as described for autumn 2000 (above) and they were scored for body condition (Audigé *et al*., 1998) and behavioural observations were made.

Statistical analyses

Between-group comparisons were performed using repeated-measures analysis of variance and least significant difference, within-group changes in body condition score and scrotal diameter were analysed by linear regression. In the case of testosterone, data were transformed to their logarithm (base 10) prior to analysis.

RESULTS

Autumn 2000

Mean liveweight loss of immunised stags (28.6 ± 4.0 kg) was not different to that of control stags (28.1 ± 4.2 kg) during the 10 weeks following the initial vaccination (Figure 1). There was a significant ($P<0.05$) reduction in mean plasma testosterone concentration in immunised stags (Figure 2), but the reduction in scrotal diameter was not different to that of the control stags (mean scrotal diameter of vaccinated stags declined from 6.2 ± 0.2 cm to 5.3 ± 0.2 cm and that of control stags declined from 6.3 ± 0.2 cm to 5.3 ± 0.1 cm). One of the vaccinated stags developed a palpable thickening of subcutaneous tissue at the injection site that declined in size during the study.

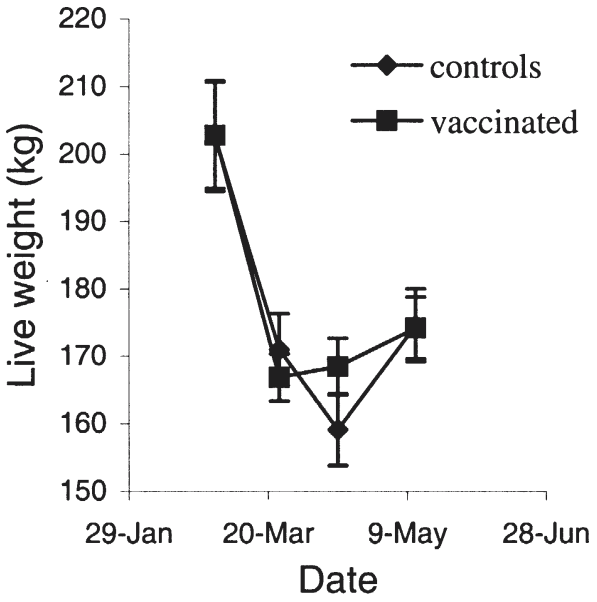

FIGURE 1. Changes in mean live weight (± SEM) of red deer stags vaccinated against GnRH on 1 and 24 March 2000.

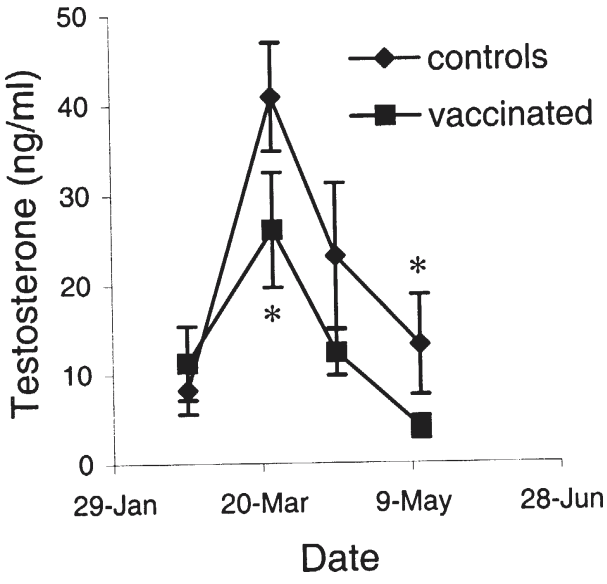

FIGURE 2. Changes in mean plasma testosterone concentration (± SEM) of red deer stags vaccinated against GnRH on 1 and 24 March 2000. * Between-group means different.

Autumn 2001

During the 21 weeks following the initial injection, vaccinated stags had a mean liveweight loss of 41.2 ± 8.2 kg that was similar to that of control stags, 38.8 ± 7.2 kg (Figure 3), as was the reduction in body condition score (mean body condition score of vaccinated stags declined from 5.0 ± 0.1 to 3.50 ± 0.1 and that of control stags declined from 5.0 ± 0.1 to 3.2 ± 0.2, between 18 Jan and 8 May). Vaccinated stags had a high incidence (7 out of 10) of transient skin lesions (open abscess or palpable thickness) at the injection site. Mean plasma testosterone concentration was significantly ($P<0.05$) lower in the vaccinated stags (Figure 4), and the reduction in scrotal diameter (from 6.0 ± 0.24 and 5.9 ± 0.26 cm to 5.0 ± 0.18 and 4.9 ± 0.10 cm, controls and vaccinated, respectively) appeared to occur earlier than in the control stags. However, most of the effects of vaccination on these mean data are attributable to the 4 stags in this study that had been vaccinated in the previous year's trial, especially in the case of plasma testosterone concentration during the 3 months following injection of the vaccine. Three of these four stags were noteworthy also in that they cast their antler buttons and grew velvet antlers (up to 36 cm length) and did not display any rutting behaviour during this period, although this behaviour was observed in all the other stags. Liveweight loss tended to be more gradual in these animals and all three shared the highest body condition score of 4 on 8 May, when that of all other stags did not exceed 3.7 (c.f. means given above: 3.2 and 3.5).

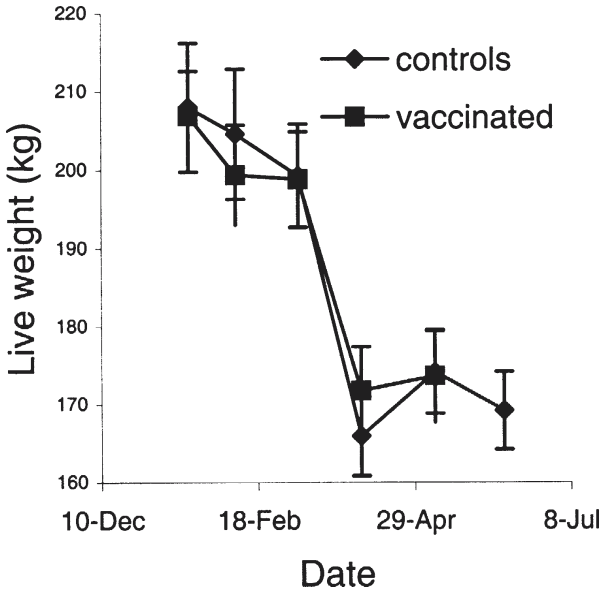

FIGURE 3. Changes in mean live weight (+ SEM) of red deer stags vaccinated against GnRH on 18 January and 8 February 2001.

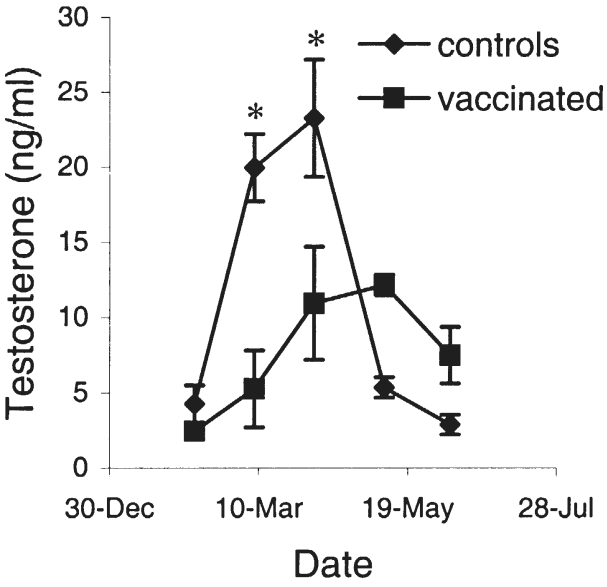

FIGURE 4. Changes in mean plasma testosterone concentration (± SEM) of red deer stags vaccinated against GnRH on 18 January and 8 February 2001. * Between-group means different.

DISCUSSION

These results showed no effect of immunisation against GnRH on the magnitude of the liveweight loss that occurred in these stags during the breeding season even though circulating concentrations of testosterone were depressed. However, the vaccination regime used here appeared to have limited effect on reproductive parameters, except in the stags that received the immunisation in both years. In those cases, there was some antler growth that would be considered undesirable in farmed animals.

The effectiveness of immunisation against GnRH is dependent on a sufficient antibody titre being achieved (Thompson, 2000). This was not measured in the present studies. Immunisation against GnRH using other vaccine preparations has been successful in reducing reproductive function in red deer (Lincoln *et al*., 1982; Freudenberger *et al*., 1993),white-tailed deer (Miller *et al*., 2000), bulls (Jago *et al*., 1997; Cook *et al*., 2000) and other species (see review by Thompson, 2000). It is not possible to compare effectiveness of the different preparations on liveweight loss in red deer stags among the published studies. Lincoln *et al*. (1982) did not report effects on live weight and Freudenberger *et al*. (1993) studied yearling stags which were neither sexually mature nor able to undergo the rut-associated losses in live weight of the magnitude exhibited by mature stags in the current study.

The limited effect of vaccination that was recorded here on plasma testosterone concentration with no effect on scrotal diameter, except in the case of three stags that were immunised in both years, indicates that the antibody response to the two-injection immunisation schedule in a single season may have been poor in the case of the vaccine preparation used in these studies. This is borne out by the finding that only animals which received extra booster injections showed a response to the vaccination. Consequently, it is not possible to rule out immunocastration as an avenue for minimising the deleterious effects of the rut in stags, based on these results. In the stags that showed strongest evidence of a response to vaccination (n = 3), there was a trend towards less liveweight loss and higher body condition score. However, this was offset by the growth of antlers in these three stags and the occurrence of skin lesions in many vaccinated stags. Both of these factors would rule against current use of immunocastration in commercial applications. Further development of this approach to minimising loss of live weight in stags will require a vaccine that reduces circulating testosterone concentration to a level which may influence behaviour and liveweight loss, but not to the point where it induces regrowth of velvet antlers.

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