Effect of constant-release implants of melatonin on horn growth in mouflon ram lambs, *Ovis gmelini musimon*

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A b s t r a c t . Ten mouflon rams were kept with their mothers in a captive regimen under natural photoperiod. Seven of the mouflon lambs received a series of subcutaneous implants containing 18 mg of melatonin (Melovine ®). The first implant was inserted at the time of birth and it was followed by implant insertion every two months to maintain plasma melatonin concentrations above basal levels. Three mouflon lambs were used as controls. Body weight, outer horn length and horn base circumference were measured weekly. Three implanted lambs maintained a poor body condition throughout the experiment and died early. In the remaining four implanted lambs, the pattern of body and horn growth was similar to controls. Horn length and base circumference were correlated ($P < 0.001$) with body weight in both control and melatonin-implanted mouflons. No differences between control and survivor melatonin implanted mouflons were observed in weekly body weight gain (0.86 ± 0.19 kg and 0.77 ± 0.06 kg, respectively), weekly horn length growth (0.77 ± 0.03 cm and 0.77 ± 0.02 cm, respectively) and weekly base circumference growth (0.49 ± 0.03 cm and 0.45 ± 0.03 cm, respectively).

Key words: body weight, horn length, horn base circumference, photoperiod

Introduction

The European mouflon (*Ovis gmelini musimon*), as with other highly polygynous ungulates, develops large horns and other conspicuous male secondary sexual characteristics for intra-sexual competition. The photoperiodic signal is transduced by the pineal gland into a pattern of melatonin secretion which provides an endocrinal signal to regulate the secretion of other hormones that appear to be involved in the control of horn growth, such us prolactin (L i n c o l n 1990), and most likely testosterone (L i n c o l n et al. 1980). Horn growth is highest in long days (spring and summer) and lowest in short days (autumn and winter) (L i n c o l n 1998). Consistent with this view, the photoperiod appears to be the primary environmental cue controlling seasonal horn growth in this species (S a n t i a g o - M o r e n o et al. 2005). Given that horn growth appears to be stimulated when daylength is increasing, then a lower horn growth rate should be established by an appropriate short day stimulus. In the present study, we assessed whether prolonged exposure to a short day signal from the birth date, by means constant-release implants of melatonin, can decrease the horn growth in mouflons.

Material and Methods

Ten mouflon rams born between 15 May and 15 June were kept with their mothers in a captive regimen under natural photoperiod (40º N latitude). Each of them was housed with

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its dam until five months of age, allowing natural weaning to occur. All the animals studied were from single litters. Mouflon lambs were randomly assigned to two groups: control (n = 3) and melatonin-implanted (n = 7). Mouflons in the treated group received a series of subcutaneous implants containing 18 mg of melatonin (Melovine®) on the base of the ear. The first implant was inserted at the time of birth and it was followed by successive implant insertions on 15 July and 15 September in order to mimic a short day signal (S a n t i a g o - M o r e n o et al. 2004). From birth to 49 weeks of age, body weight was recorded weekly. From 13 weeks of age, outer horn length was measured with a measuring tape. The horn base circumference around the horn-skull junction was also measured weekly from 26 weeks of age. Horn measurements were taken from both horns.

The significance of the differences between groups for the weekly body weight gain and weekly horn growth were compared by *t*-test. Weekly growth was defined as the value of a week minus the value of the preceding week. Weekly growth data were log transformed and fitted to a regression line, and their slopes values were calculated. Comparisons of growth rate were made by calculating the differences between slopes from the regression lines with a two-tailed test. A Spearman rank correlation test was conducted to assess relationships among variables. Results are presented as mean ± SEM.

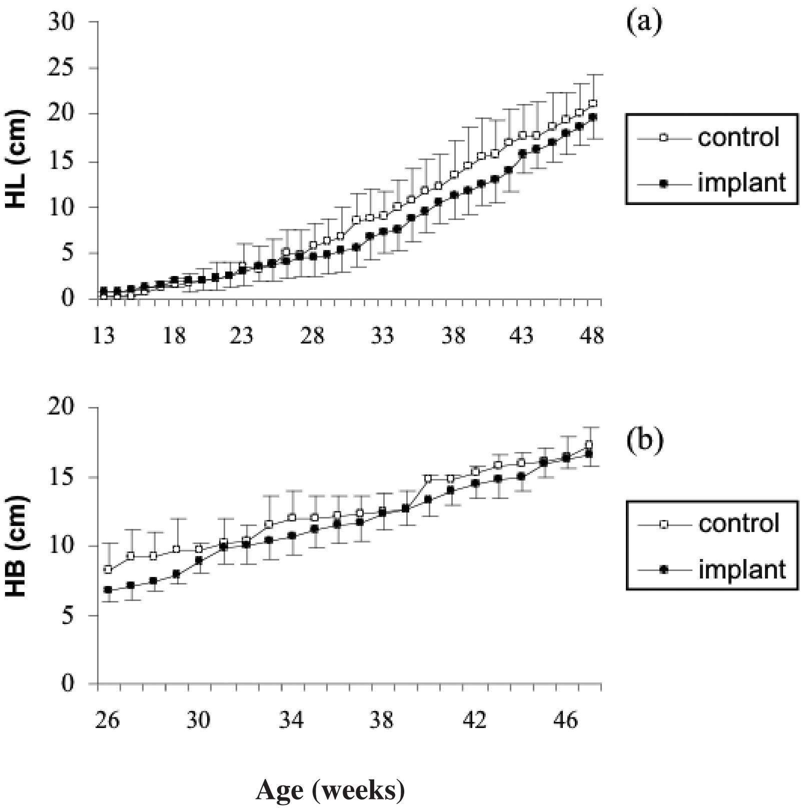

Fig. 1. Relationship of age to horn length (HL) (a) and horn base circumference (HB) (b) in survivor mouflons with melatonin implants (•) (n = 4) and controls (o) (n = 3).

Results

Three implanted lambs maintained a poor body condition throughout the experiment and died early at 8–25 weeks of age. At this stage, body weights were 4.7 kg for dead mouflon *vs* 5.9 ± 0.6 kg for controls at Week 4; 7.5 kg for dead mouflon *vs* 8.1 ± 1.9 kg for controls at Week 15 and 4 kg for dead treated mouflon *vs* 12.7 ± 1.2 kg for controls at Week 25. In the remaining four implanted lambs, the pattern of body and horn growth was similar to controls. The body weight at the time of birth was similar for controls (2.3 ± 0.1 kg) and those melatonin-implanted mouflons (2.7 ± 0.3 kg). In both control and surviving treated mouflons, horn length and base circumference growth followed a linear but not seasonal pattern (Fig. 1). No differences between groups were observed in weekly live weight gain (0.86 ± 0.19 kg in controls and 0.77 ± 0.06 kg in implanted), weekly horn length growth (0.77 ± 0.03 cm in controls and 0.77 ± 0.02 cm in implanted) and weekly base circumference growth (0.49 ± 0.03 cm in controls and 0.45 ± 0.03 cm in implanted). Horn length and base circumference were highly correlated ($P < 0.001$) with body weight in both control ($R = 0.98$ and $R = 0.97$, respectively) and melatonin-implanted mouflons ($R = 0.96$ and $R = 0.99$, respectively).

Discussion

Previous studies in Soay (a feral breed of sheep) ram lambs have illustrated that implantation with melatonin in mid-May influences overall body weight (Lincoln & Ebling 1985). Similarly, our results showed that three melatonin-implanted mouflons maintained a poor body condition and died early. This is in contrast to previous work with domestic ewe lambs (Kennaway & Gilmore 1984) where treatment with s.c. implants of melatonin failed to stop or decrease growth. Likewise, in our experiment, growth was not affected by melatonin treatment in the other four treated mouflons. These contradictory results suggest a variable response to the melatonin treatment. Since it is accepted that the horn growth, appetite, body growth and metabolism are driven, at least in part, by circulating levels of prolactin (Lincoln 1990, Ryg & Jacobsen 1982), our contradictory findings may be because implants of melatonin did not prevent the seasonal rhythm of prolactin secretion (Santiago-Moreno et al. 2004), and individual differences in the decrease of prolactin secretion should be taken into account. On the other hand, the lack of a major response in treated animals might result from a very early age of treatment, and thus they may not have been exposed to long days for long enough to render them responsive to the effect of constant melatonin (Lincoln & Ebling 1985). In the present experiment, implants of melatonin were applied near to the summer solstice (May-June), when photoperiod begins to decrease. A more homogenous effect on growth might be expected when melatonin implants are applied in February-March, when photoperiod is strongly increasing. In conclusion, implants of melatonin did not prevent the increase in body weight and horn growth in survivor animals. The horn growth was highly correlated with body weight in both control and melatonin-implanted mouflons. Thus, it seems more convincing that for mouflon ram lambs, body weight is the prevailing factor determining horn growth throughout the first year of age.

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