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# Effects of melatonin on body weight, appetite and seasonal fur growth in the ferret

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## ABSTRACT

Exogenous melatonin has been demonstrated to induce early winter furring in farmed mink and fox. In an exploratory trial implants containing either 0, 4, 8, 12 or 18 mg of melatonin (Regulin. Ltd, Melbourne) were inserted subcutaneously in nine groups of ferrets (farmed fitch) The treated groups each consisted of 12 male and 12 female fitch. Forty four untreated fitch comprised the controls. The implants were administered either in mid-January to 8-week old kits or in mid-February to 12-week old kits. At 14-day intervals, all animals were weighed and the 24 hour dry matter consumption of 3 groups (with 0, 8 and 18 mg melatonin implants) measured . All pelts were graded for size, clarity, quality and colour.

The melatonin implants caused a significant increase in feed consumption two weeks after administration accompanied by an increase in weight gains. Appetite and weight gains subsequently increased in untreated fitch and weights at pelting were not significantly different between treated and untreated fitch.

Melatonin administered in January caused an early, but limited, development of the winter fur pelage. Many of these animals subsequently developed a new winter coat and pelting time was later than for untreated controls. The February treatment caused an advancement in pelt prime by up to 6 weeks compared with control animals (19 April *v* 1 June). Quality and size attributes of pelts from treated fitch were comparable to control animals. Differences between the various experimental formulations in their ability to maintain high levels of plasma melatonin for long periods was associated with the occurrence of premature moult in some groups.

These data indicate that an optimum melatonin treatment strategy has a role on fitch farms in inducing an early pelt prime with savings in feed and labour and increased management control over pelt processing but that suboptimum treatments are contraindicated for this application.

**Keywords** Ferret; fitch; melatonin; fur; growth; appetite

## INTRODUCTION

It has been recognised for many years that seasonal coat changes in mammals are regulated by photoperiod mediated through the pineal excretion of melatonin. A major role in the control of moulting in fur animals has also been attributed to the pituitary hormone prolactin (Martinet *et al.*, 1984). Decreasing levels of plasma prolactin in autumn are associated with moult and production of the winter coat and exogenous melatonin appears to mimic the action of short days on hair follicles through suppression of prolactin secretion (Martinet *et al.*, 1981; Rose *et al.*, 1987).

In the last decade, practical technology to manipulate fur growth cycles in seasonal fur bearers has emerged. Melatonin administered by slow-releasing implants during the summer induces a premature moult and growth of the winter pelage (Allain and Rougeot, 1980; Allain *et al.*, 1981; Rose *et al.*, 1985). While melatonin implants have been demonstrated to induce early winter furring in a number of farmed fur bearers including mink and fox, no reported experiments have been carried out involving farmed ferrets. A preliminary trial was carried out to develop an appropriate melatonin treatment to accelerate fitch winter fur growth.

## MATERIALS AND METHODS

### Experimental Animals and Diet

Fitch born between 22-27 November, 1987 were reared with their dams in litters of up to 12. On 21 January the kits were weaned (experimental groups 1-8) and housed in standard fitch cages on the east side of an open-walled shed where they remained until pelting. A further group of 44 fitch of the same age were weaned four weeks later on 17 February (groups 9 and 10). Each cage contained one male and one female from the same litter and only one pair from a litter was present in any treatment group. Thirty litters provided the animals for groups 1 to 8 (three to five pairs from each litter) and groups 9 and 10 comprised kits from 11 litters (one litter pair to each group).

The diet was prepared and fed twice a day to 7 April and, thereafter, once a day until pelting (composition: 30% mutton, 60% fish, 10% barley/maize). Close to pelting the diet was altered to 45% mutton, 45% fish and 10% cereal.

**TABLE 1** Experimental groups and treatment details.

| Group | Number of pairs | Age at treatment (weeks) | Implant melatonin load (mg)[1] | Comments |
|---|---|---|---|---|
| 1 | 22 | 8 | - | Untreated controls |
| Implanted 21 January | | | | |
| 2 | 12 | 8 | 0 | Sham treated |
| 3 | 12 | 8 | 4 | |
| 4 | 12 | 8 | 8 | |
| 5 | 12 | 8 | 12 | |
| 6 | 12 | 8 | 18 | Low release rate |
| 7 | 12 | 8 | 18 | High release rate |
| Implanted 17 February | | | | |
| 8 | 12 | 12 | 18 | High release rate |
| 9 | 11 | 12 | 8 | High release rate |
| 10 | 11 | 12 | 8 | Low release rate |

[1] The three 8 mg implants used in groups 4, 9 and 10 had different melatonin release profiles; the same 18 mg implant was used in groups 7 and 8.

## Experimental Treatment

On 21 January implants containing 0-18 mg of melatonin (Regulin Ltd, Melbourne) were inserted into six groups of fitch each comprising 12 male and 12 female fitch (Table 1). A further group of 44 untreated fitch acted as controls . Three further groups were implanted on 17 February. Group 8 was treated with the same 18 mg implant administered to group 7 in January while Groups 9 and 10 were treated with 8 mg implants with different melatonin release profiles. The melatonin implants were administered subcutaneously in the back of the neck with an implant gun.

## Data Collection and Analysis

All animals were weighed at weaning and each fortnight thereafter to the end of the trial. Twenty-four hour food consumption was monitored in groups 2, 4 and 6 at 14 day intervals by supplying each pair a weighed quantity of food in excess of their normal voluntary consumption and weighing the uneaten portion before the next feeding.

At winter pelt prime, the fitch were slaughtered by carbon monoxide asphyxiation. They were skinned, fleshed, dried and graded according to normal farm practice. Shedding and slipping faults indicative of moulting were noted. The pelts were graded for size, quality, clarity and colour by Danish Fur Sales (Copenhagen, Denmark) before sale at the September, 1988 auction.

Analysis of covariance was used to test for treatment effects on weight gains and feed consumption after adjusting the data for initial live weights and for initial 24 hour food consumption respectively.

# RESULTS

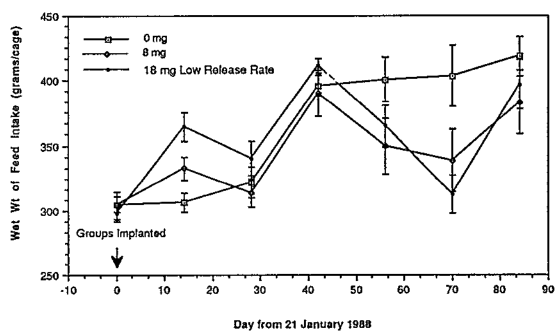


**FIG. 1** Mean wet weight of feed consumption (±SEM) measured at 14 day intervals from 21 January to 14 April in three groups implanted with 0, 8 and 18 mg of melatonin.

## Feed Intake

Treatment with 8 mg and 18 mg melatonin

implants increased feed intake significantly ($P<0.001$) above the level of sham-treated controls at two weeks; the 18 mg group consuming more than the 8 mg treated fitch (Figure 1). After 6 weeks voluntary food consumption was greater in the control group than in the melatonin implanted groups ($P<0.01$).

**Weight Changes**

Liveweight gains were initially higher in the melatonin-treated groups than in the control animals (Table 2). The effect was small but statistically significant with the effect increasing with dose rate. After six weeks the control fitch grew faster than the treated fitch and there were no significant weight differences among treatment groups by 17 March or at pelting. The February-implanted groups also showed an increased rate of growth after melatonin treatment.

**Pelt Development**

By 14 April, the untreated and sham-treated groups were proceeding normally to prime with guard hair growth close to the skin surface and blue skin colouration indicative of melanogenesis. Among treated animals the stage of fur development was highly variable. Some animals were close to winter prime. Many others showed evidence of early but weak winter fur growth. Underfur density in these animals was generally low in comparison with the normal winter pelage. Patchy localised fur growth was common and some fitch also appeared to be undergoing a

**TABLE 2** Mean group live weights (g) (adjusted for initial weights) between weaning and the commencement of pelting.

| Group [1] | Weaning weight 21 Jan | Weighing date 4 Feb | 18 Feb | 3 Mar | 17 Mar | 31 Mar | 14 Apr |
|---|---|---|---|---|---|---|---|
| Females | | | | | | | |
| 1 | 465 | 704 | 840 | 918 | 991 | 1034 | 1029 |
| 2 | 464 | 715 | 838 | 937 | 992 | 1040 | 1039 |
| 3 | 462 | 712 | 866 | 944 | 986 | 1018 | 1026 |
| 4 | 458 | 718 | 866 | 963 | 1024 | 1057 | 1067 |
| 5 | 481 | 707 | 881 | 980 | 1038 | 1059 | 1059 |
| 6 | 475 | 726 | 886 | 987 | 1024 | 1058 | 1055 |
| 7 | 472 | 729 | 903 | 989 | 1040 | 1071 | 1051 |
| 8 | 465 | 706 | 853 | 979 | 1048 | 1082 | 1064 |
| Males | | | | | | | |
| 1 | 580 | 847 | 1113 | 1349 | 1536 | 1644 | 1649 |
| 2 | 573 | 862 | 1117 | 1351 | 1521 | 1661 | 1706 |
| 3 | 583 | 853 | 1146 | 1374 | 1537 | 1637 | 1693 |
| 4 | 575 | 852 | 1115 | 1340 | 1445 | 1541 | 1614 |
| 5 | 568 | 855 | 1148 | 1380 | 1497 | 1559 | 1654 |
| 6 | 589 | 867 | 1147 | 1404 | 1543 | 1677 | 1718 |
| 7 | 590 | 861 | 1136 | 1378 | 1509 | 1589 | 1654 |
| 8 | 578 | 843 | 1119 | 1352 | 1567 | 1657 | 1713 |
| Analysis of covariance | | | | | | | |
| Treatment | | * | ** | *** | | | |
| Sex | | *** | *** | *** | *** | *** | *** |
| Trtmt.Sex | *** | *** | *** | *** | *** | *** | |
| Covariate | | | | | | | |

[1] The two February 8 mg groups (9 and 10) were not included in the analysis because of late weaning and different litter origin.

**TABLE 3** Average and range of the number of days to pelting for each treatment group from 21 January.

| Treatment groups | Females - days to pelting Mean | SEM | Range | Males - days to pelting Mean | SEM | Range |
|---|---|---|---|---|---|---|
| Control groups | | | | | | |
| untreated (1) | 133.5 | 4.0 | 112-210 | 131.6 | 1.0 | 112-134 |
| 0 mg (2) | 130.7 | 1.7 | 112-133 | 132.3 | 0.1 | 132-133 |
| 21 January implant groups | | | | | | |
| 4 mg (3) | 140.8 | 7.6 | 97-210 | 172.6 | 11.5 | 87-210 |
| 8 mg (4) | 141.1 | 6.5 | 133-210 | 128.0 | 5.0 | 89-153 |
| 12 mg (5) | 100.7 | 7.2 | 69-132 | 116.2 | 8.6 | 84-153 |
| 18 mg-low release (6) | 125.0 | 6.6 | 84-153 | 138.2 | 10.8 | 89-210 |
| 18 mg-high release (7) | 146.4 | 12.7 | 89-210 | 127.1 | 8.1 | 97-153 |
| 17 February implant groups | | | | | | |
| 18 mg-high release (8) | 103.5 | 3.5 | 89-133 | 116.1 | 4.2 | 104-134 |
| 8 mg (9) | 94.9 | 2.4 | 85-112 | 104.2 | 1.8 | 97-112 |
| 8 mg (10) | 93.8 | 2.4 | 84-104 | 103.3 | 1.8 | 89-112 |

second autumn moult. Groups 8-10 implanted in February were close to a normal winter pelt prime.

### Pelting Time

The mean group intervals to pelting from the 21 January are summarised in Table 3. Almost all the control and sham-treated fitch were pelted on or close to 2 June with no significant difference between the two groups. The 4 mg, 8mg and both 18mg January-treated groups had a wide spread of pelting dates both earlier and later than the controls. Most of the 12 mg group, especially the females, were pelted earlier than the controls. The three February-implanted groups were pelted consistently earlier than the controls. On average the females from groups 9 and 10 were pelted 40 days, and the males 30 days, earlier than the control fitch.

### Pelt Gradings

Pelts from the January-treated fitch were generally of lower quality than were pelts from untreated controls. In general treated males produced pelts lower in quality than treated females. Few male pelts from February-treated fitch were sold because of the high incidence of fur shedding and slipping (Table 4). The auction gradings for the control and February-treated female groups are summarised in Table 5. Almost all of these pelts were of high quality and clarity. Pelts from melatonin-treated groups were lighter in colour (predominantly medium) than untreated pelts (predominantly dark).

**TABLE 4** The percentage of pelts from untreated and February-treated groups with either loose hair (shedding) and/or loss of fur patches (slipping) indicative of moulting.

| | Untreated (0 mg) | February implant groups Group 8 (18 mg) | Group 9 (8 mg) | Group 10 (8 mg) |
|---|---|---|---|---|
| Female | 10 | 10 | 10 | 20 |
| Male | 0 | 33 | 71 | 89 |

## DISCUSSION

Although melatonin treatment was associated with increased voluntary intake and weight gains these effects were not sustained. At the pelting there was no difference in live weights between the treated and untreated groups. A rise in appetite and liveweight gains in mink treated with melatonin have been reported previously (Valtonen *et al.*, 1986). The increased weight gains in treated fitch are likely to be directly related to higher voluntary feed intake. However, melatonin

**TABLE 5** Gradings for quality, size, colour and clarity attributes of female pelts sold at auction (September 1988) from untreated and February-treated groups.

| Auction grade | Untreated | | February female implant groups | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Group 8 (18 mg) | | Group 9 (8 mg) | | Group 10 (8 mg) | |
| | n | % | n | % | n | % | n | % |
| Quality | | | | | | | | |
| Copenhagen selected | 15 | 48 | 2 | 18 | 4 | 50 | 4 | 67 |
| Quality I | 15 | 48 | 8 | 73 | 4 | 50 | 2 | 33 |
| Lowgrade | 1 | 3 | 1 | 9 | 0 | 0 | 0 | 0 |
| Size | | | | | | | | |
| Size 4 | 27 | 87 | 8 | 73 | 8 | 100 | 6 | 100 |
| Size 5 | 4 | 13 | 3 | 27 | 0 | 0 | 0 | 0 |
| Colour | | | | | | | | |
| Dark | 21 | 68 | 3 | 27 | 3 | 38 | 1 | 17 |
| Medium | 6 | 19 | 8 | 73 | 4 | 50 | 5 | 83 |
| Pale | 4 | 13 | 0 | 0 | 1 | 13 | 0 | 0 |
| Clarity | | | | | | | | |
| Bluish | 8 | 26 | 2 | 18 | 1 | 13 | 3 | 50 |
| Brownish or greyish | 15 | 48 | 8 | 73 | 6 | 75 | 3 | 50 |
| Reddish | 7 | 23 | 1 | 9 | 1 | 13 | 0 | 0 |
| X reddish | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |

has also been shown to increase levels of insulin-like growth factor-I in the Syrian hamster (Vriend *et al.*, 1988)

The January melatonin treatments induced variable responses in the development of prime and in pelt quality. Some stimulation of fur growth occurred in most groups but the overall quality of the resulting pelt was average to poor. In many animals a new winter coat was regrown following the melatonin-induced stimulation of early fur growth. None of the January-treated groups achieved an earlier pelt prime than groups treated in February. But the February treatment produced pelts consistently earlier and of comparable quality and value to untreated controls.

The likely cause of the shedding and slipping seen in the present experiment was the exhaustion of the melatonin implants prior to pelt prime. Plasma melatonin assay showed evidence of implant exhaustion before pelting in most treatment groups. A fall in exogenous plasma melatonin is likely to have resulted in a subsequent increase in prolactin secretion and the induction of moulting (Martinet *et al.*, 1981; Rose *et al.*, 1987). In the early treated groups the full winter pelage was not achieved at the time exogenous melatonin levels fell and a subsequent moulting and regrowth occurred that delayed pelt prime. In the late implanted groups an early prime was achieved but moulting and fur slippage was noted during pelting and processing, especially among pelts from male fitch. An earlier decline in plasma melatonin to below a critical level in the larger male fitch may explain the sex-linked difference observed in the incidence of moulting seen at pelting (Table 4).

Satisfactory grading results were obtained in only two sex-treatment groups (female fitch treated with 8 mg implants in mid-February). Only guard hair colour appeared to be effected by melatonin treatment. Valtonen *et al.* (1986) reported that melatonin-treated mink were lighter in colour than control mink and that fur density was decreased. Inhibitory effects of melatonin on the action of melanocyte stimulating hormone could be a factor in the experimental effect on fitch fur colour (Logan and Weatherhead, 1980). However, in view of the low number of pelts graded and sold from these groups, other treatment effects on pelt characteristics cannot be excluded.

## CONCLUSIONS

Appropriate treatment with melatonin can induce early winter fur growth in fitch which is comparable in quality and value to untreated animals but further experimental work is required to optimise the treatment and assess the effects on pelt quality attributes. An optimum melatonin treatment strategy has a role on fitch farms in inducing an early pelt prime with savings in feed and labour and increased management control over pelt processing but suboptimum treatments are contraindicated.

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