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THE EFFECTS OF MELATONIN TREATMENT ON WOOL PRODUCTION IN ANGORA RABBITS

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ABSTRACT

The study involved 109 male and female angora rabbits between the initial ages of 200 and 210 days (kept according to a natural photoperiod), half of which were treated with melatonin (36 mg per rabbit) either in May prior to the summer solstice, or in July subsequent to the solstice. Other animals served as controls. Two methods of wool harvesting were used: defleecing and shearing, with 2 different intervals between wool harvests, 98 and 80 days.

Melatonin treatment increased significantly total wool production, weight of first grade wool, fibre length and wool production per day and per kg of live weight by 32%, 38%, 6%, 20% and 19% respectively. The treatment proved to be more effective in the defleeced rabbits than in those shorn. No significant difference between sexes was observed: the females yielded only 4-6 % more wool than males. The period of treatment had a significant influence on the quantity of first grade wool, with higher production observed when animals were treated in May. The melatonin treatment also led to a significant increase in feed consumption and body weight during the first weeks following melatonin treatment. Furthermore no appreciable falling out of experimental animals due to the treatment occurred.

INTRODUCTION

In moderate climates wool production in angora rabbits varies with the season; production in summer can be as much as 50 to 60 % lower than in autumn or winter (ALLAIN and THÉBAULT, 1988; ROCHAMBEAU and THÉBAULT, 1985; ROUGEOT and THÉBAULT, 1983; THÉBAULT and VRILLON, 1994; SCHLOLAUT, 1987). The relationship between wool production and photoperiodism has been corroborated by histological examinations with a proportion of 12 % inactive hair follicles in spring and 28 to 30% in summer (ROCHAMBEAU and THÉBAULT, 1985). Decrease in wool production in female angora rabbits can be prevented by administration of melatonin in summer (ROUGEOT *et al*., 1986; ALLAIN and THÉBAULT, 1988). The objective of this experiment was to examine the effect of melatonin treatment on the quantity of wool produced, fibre length, feed consumption and body weight, with particular regard to the method used for harvesting the wool, the period of melatonin administration, the sex of the animals and the interval between two harvests.

MATERIAL AND METHODS

A total of 109 German type angora rabbits of 200-210 days of age (after the third shearing or defleecing) at the beginning of the experiment were used in the study. The animals were kept in a closed building with windows, according to a natural photoperiod (46°40' N), in individual flat-deck cages. There was no climate control in the rabbit house, ventilation being provided naturally, through windows covered with mosquito net, from spring to autumn. In winter the building was heated by means of warm airflow. The temperature rose above 25 °C in summer, but remained between approximately 13 and 15 °C in winter. The animals were

fed *ad libitum* with pelleted feed (CP: 17.1, CF: 13.2, DE: 10.3 MJ/kg), and hay was given once a week to prevent trichobezoar.

The animals were assigned into two groups at random: one group treated with melatonin (M) (36 mg melatonin per animal) either in spring before the summer solstice (from May 6th to 13th), or in summer (from July 5th to 24th) and a control group (C) with no treatment. Melatonin was administered by means of Regulin subcutaneous implant, containing 18 mg melatonin (Hoechst UK Ltd., catalogue no. 0086/4176). Average body weight and weight of the wool at the previous shearing or defleecing were similar in each group. The animals were weighed and feed consumption was recorded at weekly intervals. In the experimental group treated with melatonin in May two methods for harvesting the wool, shearing and defleecing, were used. The interval between two harvests was generally 98 days, except in some animals in the summer groups, with an interval of 80 days. Throughout the experimental period hair length was measured every 10 days on three areas of the body: (1) the backbone, in the hindquarters region, (2) on the outside surface of the right thigh, and (3) at five points on the right shoulder blade. When animals were defleeced, the rabbits were fed prior to defleecing with Lagodendron-R mix (Trade Mark, Proval S.A., Paris, France). At harvest the fleeces were weighed and graded on the basis of fibre length; those graded as first class had fibres over 60 mm in length and were clean.

The data were analysed by means of the SAS GLM procedure (SAS Institute, 1993). The following variables were studied: total fleece weight, weight of 1st class wool, quantity of wool produced per day and per kg of body weight, average daily feed intake, body weight and hair length. The following fixed effect model of variance analysis was used:

$$Y_{ijklmn} = \mu + MELT_i + HM_j + P_k + S_l + I_m + b(Bw_n - Bw) + e_{ijklmn}$$

Where: Y_{ijklmn} is the *n*th observation on the *i*th experimental group, the *j*th method of fleece harvest, the *k*th treatment period, the *l*th sex, the *m*th interval between harvest; μ the overall mean; $MELT_i$ the treatment effect (i=2, melatonin or control); HM_j the harvesting method effect (j= 2, defleecing or shearing); P_k the treatment period effect (k= 2, spring or summer); S_l the sex effect (l= 2, male or female); I_m the effect of the interval between two harvests (m= 2, 98 or 80 days); *b* a linear regression coefficient for body weight (taken into account only for total and first class wool production, wool production per day and feed intake); Bw_n the individual body weight at beginning of experiment; Bw the overall mean body weight at beginning of experiment and e_{ijklmn} the random error. An additional effect due to an interaction between melatonin treatment and harvest method was introduced in the model for wool production and fibre length traits. Statistical significance for each effect, including the significance of the linear regression coefficients, was tested by means of F test.

RESULTS AND DISCUSSION

Feed intake increased up to a maximum in the 3rd week following wool harvesting and decreased gradually thereafter (table 1). In melatonin-treated groups, feed consumption was about 10 % higher than in the control group from the 2nd to the 5th week. Owing to this, body weight also increased at a faster rate among the melatonin-treated rabbits (table 2). PEARSON *et al.* (1989) and VALTONEN *et al.* (1990) observed greater feed consumption in fur bearing animals after treatment with melatonin. However, by the end of the experiment (i.e. when the animals were pelted) there was no longer any substantial difference between groups. The interaction between the melatonin treatment and the method used for harvesting the wool was

Table 1 Weekly variation in feed intake (estimates within effect) of melatonin-treated and control angora rabbits (in gram)

Weeks from the beginning of the treatment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	Kg/kg
Overall mean	125	153	160	151	140	137	137	124	128	124	113	111	105	106	12400	66,0
RSD	41	34	35	32	27	24	24	23	28	31	33	32	32	31	2060	
Melatonin treatment effect	ns	**	ns	*	**	**	*	*	*	ns	ns	ns	ns	ns	**	
melatonin (n = 52) - control (n = 50)	17	15	13	13	15	16	11	11	12	5	4	6	9	6	840	-10,1
Sex effect	*	ns	ns	ns	**	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	
male (n = 48) - female (n = 44)	27	3	3	0	20	-16	-5	0	5	-3	-6	-1	-7	-7	170	3,59
Treatment time effect	**	ns	ns	ns	**	**	***	***	***	***	***	***	***	***	***	
spring (n = 51) - summer (n=51)	28	-14	3	8	-21	-16	-41	-31	-27	-50	-48	-53	-48	-45	1050	-3,6
Harvesting method effect	ns	ns	ns	ns	ns	*	ns	*	ns	ns	**	*	***	***	*	
defleeced (n = 15) - sheared (n = 87)	-5	- 3	-9	8	-2	-20	3	17	14	17	36	25	43	45	390	5,2
Harvest interval effect	ns	ns	ns	ns	ns	ns	ns	***	**	***	-	-	-	-	***	
98 days (n = 91) - 80 days (n=11)	-27	25	8	-14	-4	18	-4	41	34	68					3390	-2,3

Kg/kg: kg mix per weight of total wool (kg), ns: P>0.05, *P<0.05, **P<0.01, ***P<0.001

Table 2 Weekly variations in the body weight (estimates within effect) of melatonin-treated and control angora rabbits (in kilogram)

Weeks from the beginning of the treatment	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Overall mean	2.93	2.98	3.09	3.19	3.27	3.31	3.37	3.38	3.43	3.45	3.47	3.46	3.49	3.48	3.43
RSD	0.32	0.28	0.31	0.29	0.29	0.30	0.32	0.31	0.32	0.33	0.35	0.35	0.36	0.36	0.35
Melatonin treatment effect	ns	ns	ns	ns	**	**	*	**	*	**	*	*	ns	*	*
melatonin - control	0.00	0.06	0.10	0.11	0.16	0.17	0.15	0.18	0.17	0.20	0.16	0.16	0.14	0.15	0.16
Sex effect	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
male - female	-0.31	-0.24	0.16	-0.28	-0.26	-0.26	-0.23	-0.30	-0.31	-0.31	-0.37	-0.38	-0.38	-0.38	-0.35
Treatment time effect	*	***	*	*	*	ns	ns	ns	ns	ns	ns	*	*	**	***
spring - summer	0.16	0.24	0.16	0.13	0.18	0.11	0.12	-0.02	0.01	-0.05	-0.09	-0.19	-0.22	-0.29	-0.32
Harvesting method effect	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns	ns
defleeced - sheared	0.02	-0.03	-0.05	-0.19	-0.18	-0.19	-0.25	-0.13	-0.19	-0.04	-0.04	0.11	0.13	0.22	0.04
Harvest interval effect	***	***	**	**	**	*	*	ns	ns	ns	ns	ns	-	-	-
98 days - 80 days	-0.54	-0.50	-0.36	-0.29	-0.28	-0.28	-0.27	-0.28	-0.11	0.03	0.12	0.24			

ns: P>0.05, *P<0.05, **P<0.01, ***P<0.001

only significant at the end of the experimental period (table 1). From the 5th week the feed intake of the rabbits treated in summer was significantly higher than that of those treated in spring, and by the 14th week the difference between the two groups had risen to 30 to 35 %. In fact, the main part of wool growth occurred during summer, i.e. in the warm season, and in autumn in animals treated in spring and summer respectively. LEBAS and THÉBAULT (1988) also observed a decrease in feed consumption during summer. Feed intake in the defleeced rabbits exceeded that in the shorn group significantly, by 22 to 45 %, from the 8th to the 14th week. While feed consumption among the defleeced rabbits was still increasing in the 11th to the 14th week, the feed intake of the other group was already decreasing by that time.

In the melatonin treated group, **body weight** was significantly higher than in the controls from the 4th week (table 2). The time of melatonin administration influenced body weight mainly in the final phase of the experimental period (i.e. when the rabbits had long wool). In that phase the body weight of the angora rabbits treated in spring (i.e. those having long wool in summer) lagged behind that of those treated in July.

Exogenous melatonin administration exerted a considerable effect on the **quantity of wool produced.** Total fleece weight as well as weight of first grade wool, and quantity of wool produced per day and per kg of live weight were 30 to 34 % higher in the melatonin treated group than in the controls (table 3). These findings are similar to observations from previous studies performed on French angora does (ROUGEOT *et al*. 1986, ALLAIN and THÉBAULT 1988) treated with melatonin in spring. There was a significant interaction between treatment and harvesting method on wool production traits (table 3).

Table 3. Wool traits (estimates within effect) of melatonin-treated and control angora rabbits

Trait	Fleece weight (g) (estimates within effect)			
	total	1st class	per day	per kg Bw
Overall mean	188	100	1.95	58.7
RSD	27	27	0.28	9.0
Melatonin treatment effect	**	**	**	*
melatonin (n=48) - control (n=47)	48	28	0.47	13.5
Sex effect	ns	ns	ns	ns
male (n = 56) - female (n=39)	-10	-4	0.10	0.0
Treatment time effect	ns	***	ns	ns
spring (n = 48) - summer (n=47)	-5	-38	-0.06	1.3
Harvesting method effect	ns	***	ns	ns
defleeced (n = 13) - sheared (n=82)	-6	74	-0.05	-2.1
Harvest interval effect	***	***	*	***
98 days (n = 86) - 80 days (n = 9)	58	51	0.28	17.6
Melatonin X harvest method	*	**	*	ns

ns: P>0.05, *P<0.05, **P<0.01, ***P<0.001, Bw = body weight

The treatment given proved more effective in the defleeced rabbits than in those shorn. The time of melatonin administration exerted a significant influence only on the quantity of first class wool produced, with higher production observed in rabbits treated in July (table 3). Other significant effects were observed. As expected, wool production increased with the interval between two harvests: a difference of 43 % in total fleece weight was observed when the interval between harvest increased from 80 to 98 days. But there was no significant sex

effect (table 3). The females having larger body weight yielded only 4 to 6 % more wool than the males. Literature data (ROCHAMBEAU and THÉBAULT, 1990) indicate larger differences between the sexes (11 to 18 %) than those observed in this study. It is connected to the different number of hairs per hair follicle group (LANSZKI *et al*., 2000).

Table 4. Fibre length (estimates within effect) on melatonin-treated and control angora rabbits

Days from the beginning of treatment	10	20	30	40	50	60	70	80	90	98
Overall mean	9.3	18.5	27.9	36.9	45.5	54.2	60.5	67.6	72.6	77.4
RSD	2.0	2.2	2.2	3.1	3.8	4.1	3.6	3.7	4.1	4.4
Melatonin treatment effect	*	***	***	***	***	***	***	***	***	***
melatonin - control	0.2	1.3	1.5	2.9	4.6	4.7	4.0	4.6	4.5	4.4
Sex effect	***	**	***	***	***	***	***	*	***	***
male - female	0.7	0.3	-0.9	0.8	2.5	1.9	1.4	0.5	1.3	2.1
Treatment time effect	***	**	***	***	***	***	***	ns	ns	***
spring - summer	0.9	0.5	3.1	3.1	3.1	1.1	1.0	-0.1	0.0	1.0
Harvesting method effect	***	***	***	***	***	***	***	***	***	***
defleeced - sheared	10.7	12.9	13.0	13.5	10.9	9.9	7.6	9.3	5.4	5.2
Harvest interval effect	***	*	ns	***	ns	***	*	***	-	-
98 days - 80 days	-3.3	-0.5	0.0	1.6	-0.6	3.7	-1.2	-5.6		
Melatonin X harvest method	ns	ns	ns	*	***	***	*	***	**	***

ns: P>0.05, *P<0.05, **P<0.01, ***P<0.001

Melatonin treatment always led to a significant increase in **fibre length** (table 4), which explained in part the increased in total wool production observed in treated rabbits. A significant interaction between the treatment and the method used for harvesting the wool was found (table 4). Melatonin treatment led to greater differences in fibre length among the defleeced rabbits than among those shorn (8.6 % and 2.6 % respectively). The effect of the time of treatment proved substantial only in the first phase of the experiment (i.e. up to the 50th day). Fibre length in rabbits treated in spring was 7 to 14 % greater than in those treated in summer. But this effect had ceased by the second phase of the investigation and no significant difference was observed at the end of the experiment. Other significant effects were observed. Fibre length was 1-12 % longer in males than in females (table 4). Throughout the experimental period wool was longer in shorn than in defleeced rabbits (table 4). This difference was mainly due to the harvest method. When rabbits are defleeced the whole fibre is removed from the skin, while with shearing the fibres are cut to a length of a few millimetres above the surface of the skin. However, the growth rate in fibre length was higher in defleeced rabbits than in shorn ones throughout the experimental period.

At the end of the experimental period no significant change in falling out rate (through mortality or sickness) could be ascribed to the effect of the melatonin treatment.

CONCLUSIONS

Melatonin treatment, when administrated around the summer solstice, was efficient in eliminating the summer decrease in wool production and resulted in a considerable improvement in the wool traits. The angora rabbits treated with melatonin surpassed the

control group substantially with respect to the total quantity of wool produced, that of wool graded as first class, the quantity of wool produced per day and per kilogram live weight, and also fibre length. With respect to the time of melatonin administration, before or after the summer solstice, no differences on total wool production were observed, but first grade wool was produced in larger quantities when melatonin was given in July. Melatonin treatment seemed to be more effective in defleeced rabbits than in shorn ones - it is important in economic point of view (OSSARD *et al*., 1995), but no differences were observed with respect to the sex of the animals. The effect of melatonin treatment on hair follicle activity can be find in an other paper (LANSZKI *et al*., 2000)

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