Effects of Melatonin on Growth Performance and Fur Quality of Rex Rabbits (Postprint)

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Abstract

This experiment aimed to investigate the effects of melatonin on growth performance and fur quality in rex rabbits. A single-factor experimental design was adopted, and 200 healthy growing rex rabbits aged 55-60 days with similar body weight were selected and randomly divided into 4 groups, with 50 rabbits per group. The control group was fed a basal diet, while the experimental groups were fed experimental diets containing different levels of melatonin (10, 25, 40 mg/kg). The experimental period lasted 99 days. The results showed that: at 60-150 days of age, the average daily gain in each experimental group was extremely significantly higher than that in the control group ($P<0.01$), and the feed-to-gain ratio in each experimental group was extremely significantly lower than that in the control group ($P<0.01$). At 90, 120, 130, and 150 days of age, the hair density in each experimental group was extremely significantly higher than that in the control group ($P<0.01$). In the 40 mg/kg experimental group, the skin thickness of the hip, shoulder, and abdomen was significantly or extremely significantly lower than that in the control group ($P<0.05$ or $P<0.01$). It can be concluded that melatonin can increase the average daily gain, decrease the feed-to-gain ratio, and simultaneously improve the hair density of rex rabbits, promoting early maturation of rex rabbit pelts.

Full Text

Effects of Melatonin on Growth Performance and Fur Quality of Rex Rabbits

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Abstract

This study investigated the effects of dietary melatonin supplementation on growth performance and fur quality in Rex rabbits. A single-factor experimental design was employed with 200 healthy growing Rex rabbits aged 55–60 days, randomly allocated into four groups of 50 rabbits each. The control group received a basal diet, while the experimental groups were fed diets supplemented with melatonin at three levels (10, 25, and 40 mg/kg). The 99-day feeding trial demonstrated that from 60 to 150 days of age, all melatonin-supplemented groups exhibited significantly higher average daily gain ($P<0.01$) and significantly lower feed-to-gain ratio ($P<0.01$) compared to the control. Furthermore, hair density was significantly elevated in all treatment groups at 90, 120, 130, and 150 days of age ($P<0.01$). The 40 mg/kg group showed significantly reduced pelt thickness in the buttocks, shoulder, and abdominal regions compared to controls ($P<0.05$ or $P<0.01$). These findings indicate that dietary melatonin supplementation enhances growth rate, improves feed efficiency, increases hair density, and promotes earlier pelt maturation in Rex rabbits.

Keywords: Rex rabbit; melatonin; growth performance; fur quality

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Introduction

Rex rabbits (*Oryctolagus cuniculus*), also known as Rex rabbits, are a breed primarily valued for their pelts, which are characterized by fine, dense, flat-lying fur with diverse color patterns, excellent luster, and superior warmth retention due to the soft, lightweight nature of the skin. According to the natural growth and molting patterns of Rex rabbits, producing high-quality pelts requires a raising period of 5–6 months, with target slaughter weights exceeding 2.75 kg. This extended production cycle results in relatively low economic returns.

Previous research on melatonin application in rabbits and angora rabbits has primarily focused on implantation or spraying methods applied directly to pelleted feed. However, no studies have investigated the direct incorporation of melatonin into diets as a premix additive. Given that melatonin is widely present in the gastrointestinal tract and that melatonin binding sites exist throughout the intestinal mucosa and basement membrane, and considering documented effects of melatonin supplementation on growth performance in other livestock species, this experiment was designed to determine the optimal dietary inclusion level of melatonin for Rex rabbit production.

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Materials and Methods

Experimental Animals

The experiment utilized 200 growing Rex rabbits aged 55–60 days with similar initial body weights.

Diet Composition and Nutrient Levels

Following nutritional evaluation of feed ingredients, a basal diet was formulated using corn, wheat bran, soybean meal, alcohol protein, cottonseed meal, rapeseed meal, millet straw, and peanut shells according to growth rabbit feeding standards. Experimental diets were prepared by supplementing the basal diet premix with 0.1% melatonin premix additive at three inclusion levels (10, 25, and 40 mg/kg). All diets were processed into pellets with a diameter of 4–6 mm. The composition and nutrient levels of the basal diet are presented in Table 1 .

Table 1 Composition and nutrient levels of the basal diet (DM basis), %

Item	Content
Ingredients	
Corn	
Wheat bran	
Soybean meal	
Alcohol protein	
Cottonseed meal	
Rapeseed meal	
Peanut shell	
Rice straw	
Alfalfa meal	
Pine needle powder	
$CaHPO_4$	
Limestone	
Zeolite	
NaCl	
Premix[1]	
Total	
Nutrient levels[2]	
DE/(MJ/kg)	
CP	
CF	
Ash	
Ca	
NDF	

Item	Content
ADF	

[1]The premix provided the following per kilogram of diet: VA 6,000 IU, VD_3 1,000 IU, VE 40 mg, Lys 2.0 g, Met 1.0 g, Cu (as copper sulfate) 50 mg, Fe (as ferrous sulfate) 50 mg, Zn (as zinc sulfate) 50 mg, Mn (as manganese sulfate) 10 mg.
[2]DE was a calculated value, while the others were measured values.

Experimental Design and Management

Two hundred healthy white Rex rabbits aged 55–60 days were randomly assigned to four groups (n=50) based on body weight and sex. The control group received the basal diet, while experimental groups I, II, and III received diets supplemented with 10, 25, and 40 mg/kg melatonin, respectively. A 5-day pretrial period preceded the 99-day experimental period. Prior to the trial, all rabbit housing and cages were thoroughly cleaned and disinfected. All experimental rabbits were housed individually in cages within the same facility, with identical vaccination protocols, management practices, and sanitary conditions. Health status was monitored and recorded throughout the trial. Rabbits were fed twice daily at 08:00 and 17:00, with feed intake recorded, and had ad libitum access to water.

Measurement Indicators and Methods

Initial body weight was measured after overnight fasting before the morning feeding on day 1. Body weight was subsequently measured at 90, 120, and 150 days of age after overnight fasting. Daily feed intake was recorded to calculate average daily gain (ADG), average daily feed intake (ADFI), and feed-to-gain ratio (F/G). Hair density in the buttocks region was measured at 90, 120, 130, and 150 days of age using the method described by Gu Zilin et al. [1], with three measurements taken and averaged. Following slaughter, pelt length and width were measured to calculate pelt area. Pelt thickness was measured at the buttocks, abdomen, and shoulder regions using industrial calipers, with two measurements per site averaged. Hair breaking strength and diameter were determined by the Shanxi Fiber Inspection Bureau. Coarse wool rate was determined by manual counting of 200 randomly selected hairs.

Data Processing

Data were initially processed using Excel 2007, followed by one-way ANOVA using the SPSS 19.0 statistical software package. Duncan's multiple comparison test was applied where appropriate. Results are expressed as mean ± standard deviation.

Results

Effects of Melatonin on Growth Performance of Rex Rabbits

As shown in Table 2 , body weight at 150 days of age was significantly higher in all melatonin-supplemented groups compared to the control (P<0.05), with group II showing the optimal performance.

Table 2 Effects of melatonin on body weight of Rex rabbits, g

Days of age	Groups	Control	I	II	III
90		1,604.55$±134.61|1,558.09±124.69|1,608.66±141.55|1,588.95±129.61||120|1,964.20±16			

In the same column, values with different small letter superscripts indicate significant difference (P<0.05), while different capital letter superscripts indicate highly significant difference (P<0.01). The same or no letter superscripts indicate no significant difference (P>0.05). This applies to all tables.

Table 3 reveals that from 121–150 days of age, ADG was significantly higher in all treatment groups compared to the control (P<0.01), with group I showing the highest value. Over the entire experimental period (60–150 days), all melatonin groups exhibited significantly greater ADG than the control (P<0.01). No significant differences in ADFI were observed among groups at any stage (P>0.05). The feed-to-gain ratios for the control and groups I, II, and III during 121–150 days were 12.92, 10.35, 11.36, and 10.38, respectively, with groups I and III significantly lower than the control (P<0.05). Over the entire period, all treatment groups showed significantly lower F/G than the control (P<0.01). These results demonstrate that dietary melatonin supplementation improves growth performance in Rex rabbits.

Table 3 Effects of melatonin on growth performance of Rex rabbits

Item	Days of age	Control	I	II	III
ADG, g	60–90	11.54$±2.68|11.28±2.87*ab*|12.24±2.78|12.00±3.07|||91–120|11.75±2.87*Aa*			
		$*ADFI, g*$			
		*|60–90|97.81±1.24|96.74±4.00|97.46±1.62|96.97±2.69|||91–120|116.79±1			
		$*F/G*$			
		*|60–90|8.51±1.89|8.56±2.37|8.53±2.83|11.73±2.99*ab*|||91–120|11.24±3.92			

Effects of Melatonin on Fur Quality of Rex Rabbits

Table 4 demonstrates that hair density was significantly higher in all treatment groups compared to the control at 90, 120, 130, and 150 days of age (P<0.01). Hair density increased with melatonin supplementation level at 130 and 150 days of age. Notably, hair density in treatment groups reached the control

group' s 150-day level by 130 days of age, indicating that melatonin advanced pelt maturity by approximately 20 days, thereby improving economic returns.

Table 4 Effects of melatonin on hair density of Rex rabbits, hairs/cm^2

Days of age	Control	I	II	III
90	18,257.76$±1,030.13*Aa*|19,222.32±1,170.23*Bb*|19,215.02±1,153.51*Bb*|19,126.31±			

Table 5 shows no significant differences in salted pelt area among groups (P>0.05). However, pelt thickness in the buttocks region was significantly greater in the control group compared to groups II and III (P<0.01), but not different from group I (P>0.05). Group I buttocks thickness was significantly greater than group II (P<0.01) but not different from group III (P>0.05), with no difference between groups II and III (P>0.05). Shoulder pelt thickness was significantly greater in the control and groups I and II compared to group III (P<0.05), though no differences existed among the first three groups. Abdominal pelt thickness was significantly greater in the control and group I compared to groups II and III (P<0.01), with no difference between the control and group I.

Table 5 Effects of melatonin on salted pelt performance of Rex rabbits after slaughter

Groups	Pelt area, cm^2	Pelt thickness, mm		
		Buttocks	Shoulder	Belly
Control	1,026.25$±86.40|0.92±0.10*Aa*|0.87±0.09*ab*|0.92±0.08*Aa*||*I*|1,139.38±142.22|0.88±0.13*ABab*|0.8			

Table 6 indicates no significant differences in hair breaking elongation, breaking strength, or diameter among groups (P>0.05).

Table 6 Effects of melatonin on strength and diameter of Rex rabbit hair

Groups	Breaking elongation, %	Breaking strength, cN/dtex	Diameter, m
Control	35.78$±0.49|1.35±0.22|14.43±0.72||*I*|34.28±1.43|1.13±0.24|14.83±1.21||*II*|34.37±1.48|1.31±0.15|14		

Table 7 reveals no significant differences in coarse wool rate in the buttocks and shoulder regions among groups (P>0.05). However, the abdominal coarse wool rate in group I was significantly lower than in groups II and III (P<0.05), though not different from the control.

Table 7 Effects of melatonin on coarse wool rate of Rex rabbits, %

Groups	Buttocks	Shoulder	Belly
Control	6.91$±4.09|6.60±2.93|5.61±2.08||*I*|6.37±2.52|9.80±2.62|7.64±3.14||*II*|8.70±3.43|7.32±2.47		

Discussion

Current research on melatonin application in livestock primarily focuses on reproductive activity, reproductive performance, immune function, antioxidant capacity, and fur maturation. In recent years, melatonin has been widely used in fur animal production in northeastern China, mainly through exogenous administration to induce early fur maturation. Sheng Xue et al. [2] demonstrated that melatonin implants advanced fur maturity by 1–2 months in 2,600 silver foxes and 250 blue foxes. Kong Qingsong et al. [3] reported that melatonin implants advanced winter pelt maturation by 28–42 days in juvenile raccoon dogs and 42–56 days in adult females, with optimal results achieved when implanted in early July for juveniles and June for adult females. In mink production, Liu Nianhai et al. [4] found that melatonin promoted metabolism, fur growth, and early fur maturation. The present study similarly demonstrated that dietary melatonin advanced pelt maturity in Rex rabbits by 20 days.

Previous studies on rabbits have yielded varied results. Fu Xiangwei et al. [5] reported that subcutaneous melatonin implants did not significantly affect growth performance but significantly increased hair density, consistent with our findings regarding hair density, though our study additionally showed improved growth rate. Gu Zilin et al. [6] found that subcutaneous melatonin implants significantly increased post-weaning growth rate, accelerated hair follicle differentiation, increased hair density, and promoted skin thickening and maturation. In contrast, our study observed reduced salted pelt thickness, which may be attributed to differences in measurement techniques: live measurements assess double-layer pelt thickness affected by hair, subcutaneous fat, skin structure, and elasticity, whereas salted pelt thickness measures dehydrated pelt directly. The specific mechanisms underlying this discrepancy require further investigation.

Shen Wei et al. [7] reported that melatonin did not affect coarse or fine hair length in Pearl angora rabbits, but increased summer hair production primarily through enhanced hair density. Allain et al. [8] demonstrated that melatonin significantly increased summer wool production and hair follicle number in angora rabbits without affecting hair length, suggesting that melatonin' s effect on density exceeds its effect on length. Li Na et al. [9] found that dietary melatonin significantly increased pelt area and hair density in Rex rabbits, though our study observed minimal impact on pelt area. Liu Yajuan et al. [10] reported that melatonin implants improved ADG and reduced F/G in Rex rabbits, consistent with our findings. In contrast, Feng Yang et al. [11] found no significant effect of melatonin on ADG in Rex rabbits.

In summary, dietary melatonin supplementation improves ADG and reduces F/G in Rex rabbits while significantly increasing hair density and improving

fur quality, enabling earlier market readiness. However, at higher supplementation levels, salted pelt thickness was reduced, and the incremental increase in hair density became non-significant. Based on these results, the recommended dietary melatonin inclusion level is 10 mg/kg.

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Note: Figure translations are in progress. See original paper for figures.