INFLUENCE OF PHOTOPERIOD TREATMENTS ON PATTERN OF TESTOSTERONE SECRETION AND TESTICULAR VOLUME AT CARPATINA BREED

Elena Şogorescu[1*], Stela Zamfirescu[1], Andreea Hortanse Anghel[2], Dorina Nadolu[2], N. Dobrin[1]

[1] Faculty of Natural and Agricultural Sciences, Ovidius University, Constanta, Romania
[2] Department of Sheep and Goat Reproduction and Biotechnologies, ICDCOC Palas, Constanta, Romania

Abstract

Photoperiod is a major environmental factor of regulation of testosterone secretion and testicular volume. The bucks of the control batch (n=10) remained in a open shelters under natural day light and ambient temperature while the experimental batch (n=10) were placed in light-proof shelters and were exposed to alternations of 3 months of long days and 3 months of natural photoperiod. In light-treated batch, the photoperiodic changes by long days inhibited the testosterone secretion. Testicular volume was higher during normal days than long days although the amplitude of the variations was reduced compared to control groups. In photoperiod treated batch, testosterone secretion increased after 2 weeks of exposure to normal days and decreased within a 4 weeks after the beginning of exposure to long days.

Key words: testosterone, testicular volume, Carpatina bucks, photoperiod treatments

INTRODUCTION

Carpatina, Alpine, Saanen and Mediterranean breeds exhibit seasonal variations of their sexual activity [4], [8], [9], [10]. Increasing duration of days starting from winter to spring reduces the reproductive activity to Carpatina bucks. Decreasing duration of days starting from summer to autumn had the inverse effects, stimulated the testosterone level between August and September. Carpatina bucks like Alpine and Saanen breeds present the seasonal variations of testicular volume, with minimal values between January and April and maximal between September and December [3], [9].

In the present study, was tested the hypothesis that Carpatina bucks are responsive to variations of photoperiod treatments because was suggest by the different authors that photoperiod can control the annual reproductive cycle of bucks in temperate areas.

*Corresponding author: sogorescuelena@yahoo.com
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MATERIAL AND METHODS

Location and animals

The studies were conducted on the experimental farm of Caprirom and the biochemical determinations of testosterone were realized at Ovidius University- Laboratory of Cellular and Molecular Biology, Constanta, Romania. The experiment started on 15/12/2010 to 26/05/2011. Weights of bucks were between 37-45 kg. Feed of animals was reported previously [9].

Photoperiod treatments

The bucks of the control batch (n=10) remained in an open shelters under natural day light and ambient temperature throughout the experiment. Experimental batch (n=10) were placed in light-proof shelters and were exposed to alternations of 3 months of long days (LD: 16 h of light/day; lights-on: 06:00 h, lights-off: 22:00 h) and 3 months of natural photoperiod.

The photoperiodic treatment started on December 15th 2010 to March 15th 2011 for experimental groups. In room, light was provided by 4 fluorescent tubes giving a light intensity of 300 lx measured laterally to the eyes of the animals. Changes in sexual activity of males were studied on the

experiment in order to evaluate the efficiency of photoperiodic treatments.

Measurements

Plasma testosterone was analyzed in blood samples collected once a week. The blood was recovered by jugular venipuncture with vacutainers (Ref. 360211, BD. Diagnostic, UK) and vacutests (Vacuum tubes, Italy, Li –heparin 95 IU, 4 ml, Ref. 12010). The blood samples were centrifuged at 1500 rpm, for 10 minutes. The plasma samples were stocked at -20^{0}C. The testosterone concentrations were determinate by RIA method (DRG Diagnostics, RIA-4386, and Germany). The intra-assay precision was found: 0.69 ng/ml; 4.35 ng/ml and 9.82 ng/ml with coefficients of variation: 4.6; 3.3 and 4.4. The inter-assay precision was found: 0.55 ng/ml; 3.51 ng/ml with coefficients of variation: 6.2; 4.8.The percent of recovery was between 86.4-124.5% in function of measured and expected concentration. Testicular volume was measured every two weeks between January 6th to May 26th 2011 using the water volume dislodged on the cylinder method.

Data analysis

Plasma testosterone levels and testicular volumes on bucks were done using analysis of variance (mixed model ANOVA/MANOVA). Means with different superscript which are significant different was calculated with T-test (T-test independent samples) with Stasoft package. The graphic representations were realized with Stasoft package. Also was examined the parametric Pearson linear correlation and Spearman rank order correlation test between testosterone level and testicular volume with Statext v 1.4.2 package.

RESULTS

Testosterone level on experimental and control animals

Table 1 shows the mean of testosterone level on Carpatina bucks. On local breeds we considered the basal values of testosterone concentrations on 1 ng/ml. The testosterone concentrations on experimental and control animals in December were over basal level.

During the photoperiodic treatments of long day on experimental animals it was observed a decreasing of testosterone concentration in January as expected. For experimental animals was observed an increasing of testosterone level beginning with January to March comparative with control animals when testosterone level presents a strong decreasing between January to March. The lowest values of plasmatic testosterone level on control animals were found on March.

At the end of the long day treatment (mid-March), experimental bucks were maintained under natural photoperiod. The increase of testosterone concentration was then observed from March to May, but testosterone levels remained at basal levels. For control animals testosterone level presents a strong increasing for April (over then basal level) and a strong decreasing for May. At May, testosterone level on experimental animals was higher than testosterone level on control animals. Long days treatments inhibit testosterone level and natural photoperiod stimulate testosterone level on experimental animals (figure 1). Photoperiodic treatments have an important role in stimulate the sexual activity on experimental animals and the bucks will be able to stimulate the ovulatory response on goats.

Table 1 Testosterone concentrations on experimental and control animals (ng/ml)

Testosterone concentrations (ng/ml)			
No.	Month	Experimental animals mean ± S.D.	Control animals mean ± S.D.
1.	December	1.447±0.68^{a}	1.384±0.53^{c}
2.	January	0.704±0.40^{b}	0.974±0.73^{a}
3.	February	0.860±0.33^{ab}	0.957±0.48^{a}
4.	March	1.033±0.51^{ab}	0.416±0.25^{b}
5.	April	0.897±0.95^{ab}	1.396±1.46^{a}
6.	May	0.918±0.52^{ab}	0.498±0.37^{b}

***Note**:* Means (±SD) with different superscript are significant different (a, b P<0.05; c, b P ≤0.001) and ^{ab} means (±SD) with the same superscript are not significant different (P≥0.05).

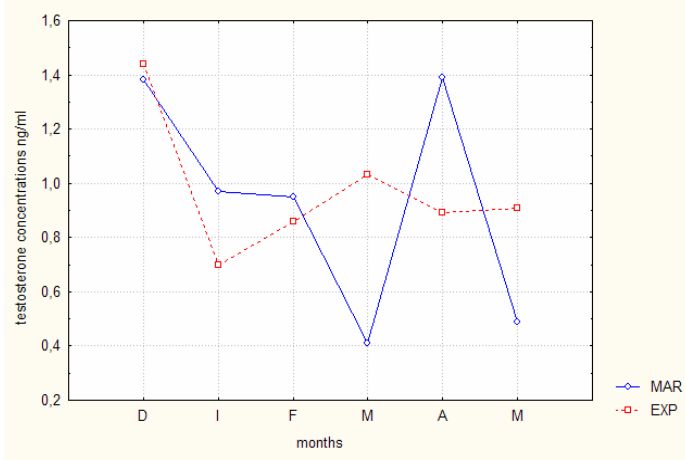

Figure 1 Profile of testosterone level on Carpatina bucks

Legend: MAR-control animals; EXP-experimental animals; D-December; I-January; F-February; M-March; A-April; M-May.

Testicular volume on experimental and control animals

The monthly mean of testicular volume of the Carpatina bucks are shown in table 2. From January to March for control animals the testicular volume decreased. During the long day treatment (February to March) the testicular volume decreased on experimental animals. The lowest values of testicular volume were found on March. The bucks remained on natural photoperiod from mid-March. We observed an increase of testicular volume from March to May, on experimental animals. At control animals, the testicular volume had a increasing for April and a decreasing on May. At May, testicular volume on experimental animals was higher than testicular volume on control animals (figure 2).

Correlations between testosterone concentrations and testicular volume

Testicular volume was correlated for Carpathian bucks with the testosterone concentration by Pearson linear correlation ($r=0.13$; $P<0.05$-experimental lot vs. $r=-0.23$; $P<0.05$-control lot) and correlated by Spearman rank order correlation coefficient test ($RS=0.1$; $P<0.01$-experimental lot vs. $RS=-0.3$; $P<0.05$- control lot).

Table 2 Testicular volumes on experimental and control animals (ml)

Testicular volumes (ml)			
Nb	Month	Experimental animals mean ± S.D.	Control animals mean ± S.D.
1.	January	286.66 ± 46.33^{ab}	375 ± 51.28^{a}
2.	February	306.66 ± 38.81^{c}	311.66 ± 25.62^{c}
3.	March	268.75 ± 24.16^{a}	291.66 ± 30.60^{d}
4.	April	316.66 ± 36.16^{c}	321.66 ± 35.44^{ab}
5.	May	333.33 ± 44.12^{b}	283.33 ± 23.38^{b}

***Note**:* Means (±SD) with different superscript are significant different (a, b $P<0.005$; a, c $P<0.05$; a, d $P<0.01$) and ^{ab}means (±SD) with the same superscript are not significant different ($P\geq0.05$).

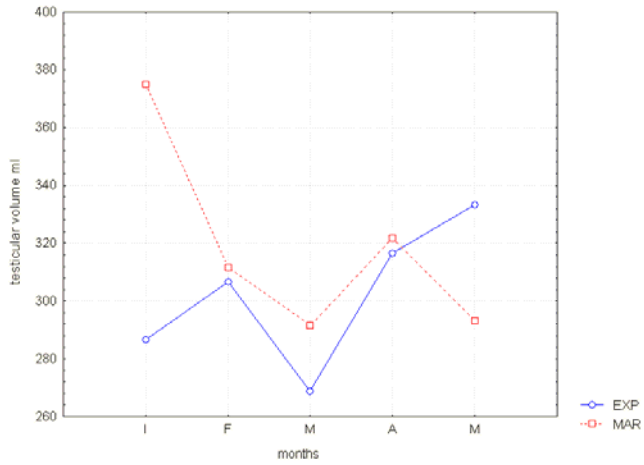

Figure 2 Profile of volume testicular on Carpatina bucks

Legend: MAR-control animals; EXP-experimental animals; D-December; I-January; F-February; M-March; A-April; M-May.

DISCUSSIONS

In light-treated groups, the photoperiodic changes by long days inhibited the testosterone secretion. Testicular weight was higher during normal than long days although the amplitude of the variations was reduced compared to control groups.

In the control group exposed to natural variations in photoperiod, plasma testosterone concentrations and testicular volume displayed seasonal variations those reported previously in males of the same breed in the same conditions [9]. Photoperiod is a potent factor that controls testosterone secretion and regulates to a lesser extent testicular volume on experimental animals. Photoperiod determinate the increased of testosterone secretion and testicular volume [5], [7], [11], [12].

On experimental batch, testosterone secretion increased after about one month of exposure to normal days and decreased after long days, probably due to refractoriness to stimulatory normal days [1]. The Carpatina bucks present seasonal variations with followed characteristics: a decreased of their sexual activity from February to April and the reproductive season starts in September and finish in January with peak of sexual activity in August and September. The Carpatina bucks present a decreased of testicular volume from February to May and an increased of this was observed beginning with summer to autumn.

The lowest mean of testicular volume for the entire year on Carpatina bucks was in May. In summer the testicular volume was augmented but the highest value was observed in September [9]. In photoperiod treated batch, these seasonal variations were modified: testosterone secretion increased after 2 weeks of exposure to normal days and decreased within a 4 weeks after the beginning of exposure to long days and testicular weight was higher in normal days than in long days. This response to photoperiod was similar in other breeds of goats. Alpine bucks exposed to alternations of 2 months of 16L: 8D and 2 mo of 8L:16D, display a strong increase of testosterone secretion after 4 weeks of short days and a decrease after 2 weeks of long days [6]. The results obtained in experimental group of males submitted to long days confirm that the photoperiodic treatment inhibited the testosterone secretion on males [6]. In controlled bucks, during the no-breeding season increase testicular volume independent from LH secretion [5], [11], [12]. In long-day treated groups, the photoperiod treatment stimulated testosterone secretion between February and March and a

decline on testicular weight. Moreover, the acute rises in plasma testosterone concentrations in long-day treated bucks probably enhanced the inhibition of LH release by testosterone negative feedback, which also may have participated in the reduction in testicular size [2], [4].

CONCLUSIONS

The present data extend this conclusion by showing that photoperiod is a major environmental factor of regulation of testosterone secretion and testicular volume. Photoperiod play a crucial role in timing of goat's physiology with respect to seasonal fluctuations on temperate environment.

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