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Concentration of testosterone in blood serum in roosters of the Polbar breed depending on age

Poziom testosteronu w surowicy krwi u kogutów rasy polbar
w zależności od wieku

Summary. The aim of this study was to determine the level of testosterone in roosters of the Polbar breed at 8, 12 and 18 weeks of age. Testosterone concentration in blood serum was determined in each of 50 roosters, using a device called Mini Vidas ® enzymatic method – fluorescent ELFA (Enzyme Linked Fluorescent Assay). Steroid hormone – testosterone in roosters of the Polbar breed showed upward trends of the hormone in blood serum with the maturation of sexual organs responsible for its production. The increase in testosterone in roosters was rapid in each of the periods. It should be noted that roosters subjected to the experiment did not yet reach sexual maturation. The level of testosterone in the blood serum increased with the age of the roosters. Variability occurs in roosters affected by the substantial range of concentrations of testosterone.

Key words: testosterone, roosters, Polbar

INTRODUCTION

Testosterone was first isolated from the tissue core in 1935 [Turner and Bagnara 1978]. Production of this hormone occurs in the parenchymal cells under the dominant influence of the testicular luteinizing hormone. It is not stored there however. In adult birds, the number of cells already subject to seasonal fluctuations, which are correlated with age and male gonadal hormone activity. The proliferation of interstitial tissue occurs at the same time as the growth and development of one of the cephalic appendages. The comb is an indicator of androgen activity. The nuclei of males secrete steroid hormones in the very early stages of fetal development. Production of

testosterone is not subject to the control of pituitary tropic hormones and the hormone alone is in the form of testosterone sulfate [Sturkie 1970].

Testosterone and other androgens cause the intensification of anabolic processes in the body. This includes an increase in the rate of metabolism. It also affects protein synthesis in the tissues, due to a positive nitrogen balance. The male sex hormone with estrogen contributes to the retention of calcium in the bones, which increases their weight. Testosterone stimulates the activity of osteoclasts in bone formation, as well as accelerates ossification of long bones. This is important in shaping the adult male skeleton. The androgenic hormone also has effects on erythropoiesis erythropoietin synthesis, leading to males having a higher hematocrit count than females. Some of the important functions of testosterone in the male reproductive system is the regulation of spermatogenesis. Creating sperm from spermatogonia depends mainly on the concentration of this hormone [Sturkie 1970]. In cocks, which have already been sexually mature a phenomenon occurs in the social hierarchy. Individuals that are subordinated, have less-developed nuclei and the beginning of spermatogenesis occurs later than in individuals that dominate in the flock [Turner and Bagnara 1978].

Testosterone production can be influenced by phytoestrogens [Opałka *et al.* 2008]. Their work involves specific interactions with enzymes involved in the process of steroidogenesis. These compounds cause a number of changes from the hypothalamus through the pituitary gland and ending in male gonads. A hormone-like chemical structure belonging to the endogenous estrogen. The concentration of testosterone in the blood can be increased in the cocks using substances with anti-estrogenic properties [Lisowski *et al.* 2003].

The aim of this study was to determine the level of testosterone in serum in the cocks of the Polbar breed at 8, 12 and 18 weeks of age.

MATERIALS AND METHODS

The research material was blood, which in each case was collected from 50 cocks of the Polbar breed at 8, 12, and 18 weeks of age, kept at the Teaching and Research Station for Small Animals named Laura Kaufman, belonging to the Department of Biological Basis of Animal Production, of the University of Life Sciences in Lublin. Birds were kept on litter straw in standardized conditions. During the rearing period they stayed in a room with windows, and after puberty were transferred to a windowless poultry house, which is programmed in 14 hours of day light and optimum temperatures from 16 to 20ºC. Cocks were fed ad libitum compound all-mash DKM-1 and DKM-2 during the rearing period, and after the reclassification of a mix DJ. Blood samples were taken in the morning, after 12 hours of starving leaf veins. Serum was obtained from blood collected into VenosafeTM tubes with a capacity of 4 ml, containing a clotting activator. The specified level of serum was used to find testosterone levels. Testosterone concentration were determined using a device called Mini Vidas® enzymatic – fluorescent method – ELFA (Enzyme Linked Fluorescent Assay).

The obtained data was statistically analyzed and the results are summarized in the table, showing the average, standard deviation and minimum and maximum values.

Verification of the significance of differences was performed using the one-way analysis of variance.

RESULTS AND DISCUSSION

In Table 1 we see the results of testosterone in cocks at 8, 12 and 18 weeks of age. A particularly large increase in concentration was noted at 18 weeks of age, which can be explained by males entering puberty. The obtained values of the level of testosterone concentration in blood plasma increased with the age of the cocks. A statistically significant difference was seen between the mean values of testosterone in each of the periods studied. This hormone tripled its concentration, between 8, 12 and 18 weeks of age in the cocks. So far, little published literature describing the level of testosterone in serum of sexually immature roosters. There is no such data, especially for the Polbar breed.

Table 1. The level of testosterone in the blood serum in cocks Polbar breed depending on age ($n = 50$, $\bar{x} \pm sd$)

Tabela 1. Poziom testosteronu w surowicy krwi kogutów rasy polbar w zależności od wieku ($n = 50$, $\bar{x} \pm s$)

Wiek (tydzień życia) Age (in weeks)	Testosteron, ng/ml Testosterone, ng/ml	SD	Zakres Range
8	0.16^{c}	±0.13	0.05–0.51
12	0.52^{b}	±0.30	0.10–1.07
18	1.62^{a}	±0.87	0.31–4.19
Average Średnia	0.84	±0.82	0.05–4.19

[a, b, c] the mean values marked with different letters in the columns significantly differed at $P \leq 0.05$
[a, b, c] średnie oznaczone różnymi literami różnią się istotnie w obrębie płci przy $P \leq 0,05$

In a cock we see that plasma testosterone concentration changes during the breeding season. With increases in March and reaching a maximum level in April, while in May again reducing to a basic level. This fact explains the molting process, which occurs at this time in these birds [Stunden *et al.* 1998].

As demonstrated, testosterone has the ability to metabolize other naturally occurring androgens in animals [Lofts and Massa 1980]. These hormones are just as active as testosterone alone, which with the participation of the enzyme 5-α reductase it is fairly easily converted to androstenedione or DHT. There are large deviations in the values of this hormone, and may be the result of the Polbar breeds prevalence in blood testosterone but not the other androgens. The level of testosterone in the blood regulates the secretion of LH on the principle of negative feedback. This results in a reduction in the male hormone production by testicular interstitial cells. Lotfs and Massa [1980] showed that the secretion of the luteinizing hormone concentrated in plasma is the highest in birds during the breeding season or in the gonads which are stimulated to growth by a factor of light. Decreases are seen when the male birds become insensitive to the photoperiod. Polbar cocks underwent this experiment when they had not yet

reached puberty. Therefore it can be expected, that there will be increased levels of testosterone in the blood serum in the subsequent months of their lives.

The action of testosterone is manifested in the following, sex, body build, comb size, voice and other II – row sex characteristics. Moreover, along with other adrenal hormones, which also run its synthesis and affect the water – electrolyte balance. Knowing about the influence of male sex hormones on the appearance of cockerels may even provide information on their showy plumage that distinguishes them from females, and it becomes even greater after removal of the reproductive glands [Gałuszkówna 1964]. The color of feathers in males after castration does not change [Sturkie 1970]. This demonstrates the inhibitory effect of sex hormones on plumage color and the construction and development of spurs [Gałuszkówna 1964]. Removal of the gonads in males also entails other consequences which are reflected in the bird's habits. Animals free of testicles are unable to synthesize steroid hormones, gaining weight due to fat deposition and reduced levels of glycogen in the muscles, blood, phosphocreatine and ATP. Also changes in the individuals temperament, because there are no hormones that stimulate the nervous system, thus the animal becomes the sleepy and quiet [Gałuszkówna 1964].

There is a negative correlation between the hormones characteristic in a particular breed [Rząsa 2007]. The administration of large amounts of estrogen in cocks inhibits the action of reproductive glands, and may even lead to testicular atrophy in males [Gałuszkówna 1964].

The administration of testosterone to hens, causes the functional left ovary to be transformed through ovotestis. While the right ovary undergoes retrogression normally turns into the masculine gonad able to secrete androgens. Consequently, the hen begins to exhibit characteristics typical of the male. A comb of considerable size appears, colorful plumage, spurs, and behavioral features characteristic of a cockerels crowing [Sturkie 1970].

CONCLUSIONS

The steroid hormone – testosterone in cocks of the Polbar breed showed upward trends in the serum with genital maturation responsible for its production. The increase in testosterone in cockerels was intense in each of the periods. It should be noted that roosters subjected to the experiment have not yet reached puberty.

As mentioned, a large effect on the concentration of hormones in blood plasma are due to a variety of factors including genes that affect the physiology of the body. Explaining this fact are the results obtained in a large range of numerical data on concentrations of testosterone in individuals maintained under the same conditions.

There are few publications as well as reports on sex hormone concentrations in blood serum of sexually immature individuals. Therefore it is difficult to compare to the results obtained in the Polbar breed with results of other breeds and even species of domestic fowl. Concentrations of sex hormones in the blood serum of hens bred in genetically consolidated areas may serve as reference values for poultry.

1. Testosterone levels in serum increased with the age of cocks.

2. Interindividual variability occurs in roosters affected by a considerable range of concentrations of testosterone.

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Streszczenie. Celem pracy było określenie poziomu testosteronu u kogutów rasy polbar w 8, 12 i 18 tygodniu życia. W surowicy krwi, którą każdorazowo pobrano od 50 kogutów, oznaczono koncentrację testosteronu przy pomocy urządzenia Mini® Vidas metodą enzymatyczno-fluorescencyjną ELFA (Enzyme Linked Fluorescent Assay). Hormon steroidowy – testosteron u kogutów rasy polbar wykazywał tendencje wzrostowe w surowicy krwi w miarę dojrzewania narządów płciowych odpowiedzialnych za jego produkcję. Wzrost testosteronu u kogutków był gwałtowny w każdym z badanych okresów. Należy podkreślić, że koguty poddane eksperymentowi nie osiągnęły jeszcze dojrzałości płciowej. Poziom testosteronu w surowicy krwi wzrastał wraz z wiekiem kogutów. Zmienność osobnicza występująca u kogutów wpłynęła na znaczny zakres stężeń testosteronu.

Słowa kluczowe: testosteron, koguty, polbar