Original Contribution

**BLOOD PLASMA BIOCHEMICAL PARAMETERS OF CAPTIVE
BLACK-NECKED PHEASANT (*PHASIANUS COLCHICUS*),
GRAY PARTRIDGE (*PERDIX PERDIX*) AND CHUKAR PARTRIDGE
(*ALECTORIS CHUKAR*) OF BOTH SEXES IN BULGARIA**

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ABSTRACT

In the study, 36 (n=12 by species, n=6 by sex) blood samples were taken from a captive, adult, clinically healthy, Black-necked pheasants or Southern Caucasus pheasants (*Phasianus col. colchicus*), Gray partridge (*Perdix perdix*), and Chukar partridge (*Alectoris chukar*) for plasma biochemical analyses. The investigated plasma biochemical parameters were Creatinine, Uric acid, Aspartate aminotransferase (AST), and Alanine aminotransferase (ALT). Significant differences ($P<0.05$) among both sexes were found in the activity of ALT in Black-necked pheasants. Creatinine levels are relatively close in value between the sexes in all three species, slightly higher in males. Uric acid values in male birds are much higher than in female game birds in all three species. AST and ALT activities in male pheasants were higher when compared to the females, while the trend was reversed in sex at Gray partridges.

Key words: Plasma biochemistry values, plasma blood analysis, pheasants, Gray partridge, Chukar, game birds.

INTRODUCTION

One of the most common game birds in Europe and Asia are Black-necked pheasants or Southern Caucasus pheasants (*Phasianus col. colchicus*), Gray partridge (*Perdix perdix*) and Chukar partridge (*Alectoris chukar*) from the order Galliformes, family Phasianidae. They are very widespread as feathered game and are very often used for hunting (1, 2). Over the recent years, the industrial pheasant farms worldwide were developed as a new agricultural activity with the purpose of producing more meat and therefore the pheasant population has reached a new peak nowadays (3, 4). Despite the fact that plasma biochemistry analyses are significantly important and widely used in the diagnostic of different illnesses in several birds, a very limited amount of information exists for pheasants,

partridges and chukars (5, 6). Some studies have researched the biochemical parameters in pheasants (7, 8) but the values of plasma chemistry parameters in partridges and chukars are still too insufficient (9, 10). Because of that, precise and useful biochemical analyses are extremely important and needed. Generally, blood test can be executed for several reasons as a screening procedure to evaluate overall health (11, 12). Since the clinical signs of illness in birds are frequently very slight, clinical chemistry is needed to assess cellular damage (13, 14).

MATERIALS AND METHODS

Game birds were allocated in breeding aviaries. The birds were nourished with a patent pellet formulated for pheasants (HL-TopMix OOD Company, Bulgaria) ad libitum and had access to clear water constantly. The adult animals were 52-54 week-old in the reproduction season: Black-necked pheasants allocated in families with one male and seven females; Gray partridges in pair; Chukars in families with one male and four females. All

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birds were vaccinated against Newcastle disease virus and were treated against parasites. The blood samples were gathered from the ulnar wing vein (vena cutanea ulnaris superficialis) from 36 adult pheasants, partridges and chukars: (12 by species; n=6 by sex). Approximately 0.5ml whole blood was taken from each bird and instantly put into blood collection tubes that contained heparin. Samples were processed in 1–3 hours after the collection. The plasma biochemical parameters: Creatinine ($\mu\text{mol/l}$), Uric acid ($\mu\text{mol/l}$), Aspartate aminotransferase (AST) (U/l) and Alanine aminotransferase (ALT) (U/l) were measured using a standard automatic biochemical analyser (BS-120, Mindray, China). All birds were selected randomly from breeding aviaries. We got Permission to use animals in experiments №280 aviary-bred wild birds issued by Bulgarian food safety agency. The data were processed with IBM SPSS Statistics (SPSS-Inc., 2019, SPSS Reference Guide 26 SPSS, Chicago, USA) using descriptive statistics with frequency distribution tables. Male and female

birds were analyzed apart from each other, as sex may affect the reliability of the study. All values were expressed as mean $\pm$ with standard error and $P \leq 0.05$ was determined as statistically important.

RESULTS

The average values of selected plasma biochemical parameters for adult male and female Black-necked pheasants were determined (**Table 1**). Major differences in plasma ALT 29.50 ± 1.98 were observed in both men and women. The rest blood parameters creatinine, uric acid and AST did not show significant differences between males and females. The mean values of selected plasma biochemical parameters for adult male and female Gray partridges were determined (**Table 2**). The general biochemical blood values including Creatinine, Uric acid, AST and ALT values were 56.17 ± 1.16 , 548.67 ± 55.64 , 411.42 ± 41.84 and 31.92 ± 2.63 , respectively. All these parameters between adult male and female Gray partridges were no significant ($p > 0.05$).

Table 1. Plasma biochemical parameters for male and female Black-necked pheasants (n=12) in captivity in Bulgaria

Parameters	Male (n= 6) Mean $\pm$ SE (Min-Max)	Female (n= 6) Mean $\pm$ SE (Min-Max)	P-value
Creatinine ($\mu\text{mol/l}$)	54.00 ± 2.42 (48.00 – 61.00)	53.00 ± 2.00 (48.00 – 62.00)	1.00 ^a
Uric acid ($\mu\text{mol/l}$)	241.00 ± 39.97 (136.00 – 394.00)	208.50 ± 38.95 (114.00 – 388.00)	0.64 ^a
AST (U/l)	394.33 ± 9.13 (359.00 – 418.00)	381.50 ± 8.64 (355.00 – 402.00)	1.00 ^a
ALT (U/l)	31.33 ± 3.59 (23.00 – 48.00)	27.67 ± 1.72 (22.00 – 33.00)	0.005 ^b

^a = Non-significant ($P > 0.05$); ^b = Significant ($P < 0.05$); SE = Standard error

Table 2 Plasma biochemical parameters for male and female Gray partridges (n=12) in captivity in Bulgaria

Parameters	Male (n= 6) Mean $\pm$ SE (Min-Max)	Female (n= 6) Mean $\pm$ SE (Min-Max)	P-value
Creatinine ($\mu\text{mol/l}$)	56.33 ± 2.06 (51.00 – 65.00)	56.00 ± 1.29 (53.00 – 62.00)	0.15 ^a
Uric acid ($\mu\text{mol/l}$)	635.33 ± 37.45 (536.00 – 739.00)	462 ± 95.99 (157.00 – 743.00)	0.30 ^a
AST (U/l)	383.67 ± 74.63 (145.00 – 528.00)	439.17 ± 42.73 (317.00 – 557.00)	0.58 ^a
ALT (U/l)	28.50 ± 3.490 (22.00 – 45.00)	35.33 ± 3.68 (22.00 – 47.00)	0.98 ^a

^a = Non-significant ($P > 0.05$); ^b = Significant ($P < 0.05$); SE = Standard error

The mean values of selected plasma biochemical parameters for adult Chukar birds were determined (**Table 3**). The overall biochemical blood values including Creatinine, Uric acid, AST and ALT values were $52.67 \pm$

1.07 , 427.25 ± 44.80 , 428.00 ± 29.03 and 28.08 ± 1.98 , respectively. All these parameters between adult male and female Chukars were no significant.

Table 3. Plasma biochemical parameters for male and female Chukar partridges (n=12) in captivity in Bulgaria

Parameters	Male (n= 6) Mean $\pm$ SE (Min- Max)	Female (n= 6) Mean $\pm$ SE (Min- Max)	P-value
Creatinine ($\mu\text{mol/l}$)	54.50 ± 1.18 (51.00 – 59.00)	50.83 ± 1.54 (44.00 – 55.00)	0.08 ^a
Uric acid ($\mu\text{mol/l}$)	548.17 ± 50.67 (365.00 – 695.00)	306.33 ± 20.37 (245.00 – 363.00)	0.81 ^a
AST (U/l)	432.50 ± 21.01 (365.00 – 490.00)	423.50 ± 57.08 (235.00 – 587.00)	0.45 ^a
ALT (U/l)	26.17 ± 1.74 (22.00 – 31.00)	29.00 ± 3.57 (18.00 – 41.00)	0.51 ^a

^a = Non-significant (P>0.05); ^b = Significant (P<0.05); SE = Standard error

DISCUSSION

The mean values of selected plasma biochemical parameters Creatinine, Uric acid, AST and ALT for adult male and female Black-necked pheasants were similar to Ring-necked pheasants (15,13), Common pheasants (6) and pheasant hens (8):

The scores for Creatinine in males 30.94 ± 4.42 and females 24.75 ± 7.95 were lower (13), and twice as low in males 23.249 ± 0.13 and females 20.24 ± 0.11 (15) Ring-necked pheasants from our results for male 54.00 ± 2.42 and female 53.00 ± 2.00 Black-necked pheasants.

The levels of Uric acid in male 440.15 ± 166.54 and female 541.86 ± 172.49 Ring-necked pheasants (13) were twice as high as 217.10 ± 1.6 male and 233.16 ± 1.3 female Ring-necked pheasants (15) and our results in males 241.00 ± 39.97 and females 208.50 ± 38.95 Black-necked pheasants. The results in Common pheasants for Uric acid 117.60 ± 87.92 were lower than our 224.75 ± 27.05 and other authors (6), which may be influenced by various factors – diet, season and age. However, the levels of Uric acid in laying Common pheasant hens are 240.5 ± 28.7 at the initial period and 296.7 ± 23.1 at the end of laying (8), are relatively close to the values obtained by us in Black-necked pheasant hens. The activity of AST was similar (slightly decreased) in adult male 354 ± 61.8 and female 335.8 ± 88.82 Ring-necked pheasants (13), as in our data for adult male 394.33 ± 9.13 and female 381.50 ± 8.64 Black-necked pheasants.

In contrast, AST activities were significantly lower in adult male 262 ± 50 and female 228 ± 55 Ring-necked pheasants (15). The activity of AST in Common pheasant hens in the initial laying period was lower 293.5 ± 20 , in contrast to its values in the final period 387.1 ± 27.6 (8), which was significantly close to our results in Black-necked pheasant hens.

The ALT values were recorded for male 16.5 ± 5 and female 13.7 ± 4 Ring-necked pheasants (15) and 17.18 ± 0.041 for Common pheasants (6), respectively lower than our values in males 31.33 ± 3.59 , females 27.67 ± 1.72 and total for both sexes 29.50 ± 1.98 in Black-necked pheasants, the differences were due to the fact that our data were made during the breeding period, in contrast to the other openings.

The mean values of selected plasma biochemical parameters Creatinine, Uric acid, AST and ALT for adult male and female Gray partridges and Chukar partridges were compared to the same game birds (6), Gray partridges (9), Chukar partridges (10) and Red-legged partridges (5):

Our studies of Creatinine values in male 56.33 ± 2.06 and female 56.00 ± 1.29 Gray partridges were very close to the values found in our male 54.50 ± 1.18 and female 50.83 ± 1.54 Chukar partridges. Compared to male Red-legged partridges (*Alectoris rufa*), Creatinine values 35.36 ± 0.1 were lower than our data (5). However, Creatinine in males 4019.59 ± 15.609 ($45.47 \pm 15.609 \mu\text{l}$) and females 6497.40 ± 18.825 ($73.5 \pm 18.825 \mu\text{l}$) Chukar partridges were extremely high (10).

The data for Uric acid in Gray partridges were 608.46 ± 418.91 (9), which is slightly higher than our data 548.67 ± 55.64 for the same species, while there was a lower value for Uric acid $439,600 \pm 166,510$ in Gray partridges (6), this may be the length of the diet and the age of game birds. Our results for Uric acid in adult male 635.33 ± 37.45 and female 462 ± 95.99 Gray partridges, respectively, were close to our results in adult male 548.17 ± 50.67 and female 306.33 ± 20.37 Chukar partridges. The research of (6) for Uric acid values 206.50 ± 56.890 at Chukar partridges were almost twice lower than our 427.25 ± 44.80 , this difference was most likely due to the different latitude and their nutrition. However, Uric acid levels measured in male 404.46 ± 1.9 Red-legged partridges (*Alectoris rufa*) (5) were closer to our male 548.17 ± 50.67 Chukar partridges.

The activity of AST in Gray partridges was 287.06 ± 1.93 (9), which is lower activity than our 411.42 ± 41.84 in the same species. Our AST data for adult male 383.67 ± 74.63 and female 439.17 ± 42.73 Gray partridges were close to our values for adult male 432.50 ± 21.01 and 423.50 ± 57.08 female Chukar partridges. The differences in AST activity in males 1091.18 ± 4.681 (18.55 ± 4.681 μ l) and females 4022.35 ± 50.59 (68.38 ± 50.59 μ l) Chukar partridges were extremely high (10).

The activity of ALT in Gray partridges was 40.59 ± 0.13 (9), your values were 31.92 ± 2.63 averages, and the lowest 18.23 ± 0.069 (6) at birds of the same species. Our studies of ALT activity compared to male 28.50 ± 3.490 and female 35.33 ± 3.68 Gray partridges, with male 26.17 ± 1.74 and female 29.00 ± 3.57 Chukar partridges, showed an increase in Gray partridges, which is a species difference. The activity of ALT in Chukar partridges was 5.70 ± 0.039 (6) were lower than our data 28.08 ± 1.98 at Chukars. While AST activity in males 782.94 ± 3.879 (13.31 ± 3.879 μ l) and females 815.88 ± 3.711 (3.87 ± 3.711 μ l) Chukar partridges were extremely high (10).

CONCLUSION

Creatinine levels are relatively close in value between the sexes in all three species, slightly higher in males. Uric acid values in male birds are much higher than in female game birds in all three species. AST and ALT activities were higher in males and lower in female pheasants, while the trend was reversed in sex at Gray partridges; the data at Chukar partridges were contradictory.

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