

## Reference Values of Serum Biochemical Parameters in Adult Male and Female Iranian Chukar Partridge (*Alectoris Chukar*)

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**Abstract:** Blood samples were randomly collected from 88 female and 143 male sixteen-week-old healthy Iranian chukar partridges (*Alectoris chukar*), and serum biochemical parameters were measured. Inorganic phosphorous, creatinine and total bilirubin showed significant differences between male and female birds. No significant sex-based differences were observed for other values.

**Key words:** Serum biochemical parameter, Sex, Partridge (*Alectoris chukar*)

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### INTRODUCTION

Chukar, *Alectoris chukar*, is a Eurasian game bird in the family Phasianidae of the order Galliformes. This partridge has its native range in Eurasia, from North India, Pakistan and Afghanistan in the east, to southeastern Europe in the west, and is also a popular pet and valuable game bird for some people in the Middle-East. In recent years this bird has been reared intensively in Iran and farm-reared partridges are raised annually for meat production. Regarding the progressive interest in this kind of meat among Iranians and large investments in this field, providing knowledge of the biology and pathology of this bird could be quite valuable. Biochemical analysis provides a useful tool to monitor health and determine the general conditions of birds. In addition, blood biochemical studies in several avian species have been used for the diagnosis and treatment of diseases for a long time. Although there have been several studies about plasma chemistry values from some species of genus *Alectoris* (Rodriguez *et al.*, 2004, 2005, 2006, 2008, Lloyd and Gibson, 2006, Ozbey and Esen, 2007), published data about the serum biochemistry of *Alectoris chukar* (Woodard *et al.*, 1983, Ozek and Bahtiyarca, 2004, Suchy *et al.*, 2010) is limited. Also, research on partridges in Iran is very new, which makes this study even more important as it is intended to be a reference for production and future studies.

The purpose of the present study was to investigate reference values for serum biochemistry parameters of four-month-old Iranian chukar partridges and to determine the variation in these values between male and female birds.

### MATERIALS AND METHODS

#### **Bird Housing and Feeding:**

Two hundred thirty one clinically healthy Iranian partridges (*Alectoris chukar*) from both sexes were used to determine the serum biochemical parameters. They were reared in a floor-pen house from hatch to 16 weeks of age. The chukar chicks received feed and water *ad libitum*. Their diets consisted of corn, wheat, soybean extraction meal, vitamins and minerals and were fed to the partridges in 2 phases. Starter diets (24% CP and 2800 kcal ME/kg) were fed from hatch to 4 weeks of age, grower diets (22% CP and 3000 kcal ME/kg) from 5 weeks to the end. The room temperature was initially set at 35° C and was then gradually decreased (2° C each week) to 25° C. The birds were exposed to a continuous light.

#### **Biochemical Parameters:**

Blood samples were collected from the jugular veins of 88 female and 143 male Iranian partridges. Contamination of the blood samples was avoided by the accurate conduction of the blood samplings procedure.

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Feed was withdrawn 2h before blood collection. Blood collection was performed between 10:00 am and 12:00 am. Sera were separated by centrifugation at 750 g for 15 min and stored at -20 °C until the time of analysis. The serum samples were analyzed for total protein (Biuret method), cholesterol (Modified Abell-Kendall/Levey-Brodie (A-K) method), triglyceride (Enzymatic method), creatinine (Jaffe method), uric acid (Phosphotungstic acid method), calcium (Orthocresolphthalein method), inorganic phosphorus (Ammonium molybdate method), glucose (O-toluidine method), and total and direct bilirubin (Modified Vandenberg method). The enzyme activities of alkaline phosphatase (ALP) using the modified Bowers and McComb method, aspartate aminotransferase (AST) by the colorimetric method of Reitman and Frankel, and lactate dehydrogenase (LDH) by the Sigma colorimetric (Cabaud–Wroblewski) method were evaluated as well. All of the enzyme activities were measured at 37°C and the results presented in units per liter (Burtis and Ashwood, 1994). The biochemical parameters were measured using a standard autoanalyser with veterinary software (Cobas-Mira, ABX-Diagnostics, Japan).

### Statistical Analyses:

Data were analyzed by independent t test, using SPSS/PC software for windows. Males and females were analyzed separately because sex may affect the parameters studied (Rodríguez *et al.*, 2008). All values were expressed as mean  $\pm$  standard error (SEM), and  $P < 0.05$  was determined as statistically significant.

## RESULTS AND DISCUSSION

The serum chemistry values and the effect of sex on some blood parameters in 4-month-old partridges are shown in Table 1.

There was evidence for sex-related differences in three biochemical parameters including total bilirubin, creatinine and inorganic phosphorous (Table 1). The total bilirubin and creatinine values were higher in female birds, whereas the males had a higher value of inorganic phosphorous. No significant differences were detected between the other the blood parameters of the male and female partridges ( $P > 0.05$ ) (Table 1).

**Table 1:** Serum biochemistry values of sixteen-week-old male and female Iranian chukar partridges.

	Males (N=88)	Females (N=143)	Sex effect
Parameter	Mean $\pm$ SEM	Mean $\pm$ SEM	
Cholesterol (mmol/l)	4.02 $\pm$ 0.33	3.94 $\pm$ 0.51	NS
Triglyceride (mmol/l)	1.35 $\pm$ 0.18	1.86 $\pm$ 0.47	NS
Total protein(g/l)	46.3 $\pm$ 1.4	45.8 $\pm$ 3.7	NS
Uric acid ( $\mu$ mol/l)	169.52 $\pm$ 11.89	179.03 $\pm$ 20.22	NS
Creatinine ( $\mu$ mol/l)	16.97 $\pm$ 1.50	23.25 $\pm$ 1.59	**
Glucose (mmol/l)	15.95 $\pm$ 0.59	16.47 $\pm$ 0.63	NS
Total bilirubin ( $\mu$ mol/l)	2.91 $\pm$ 0.34	7.87 $\pm$ 0.22	***
Direct bilirubin ( $\mu$ mol/l)	0.34 $\pm$ 0.08	0.87 $\pm$ 0.34	NS
Calcium (mmol/l)	2.23 $\pm$ 0.04	2.29 $\pm$ 0.09	NS
Phosphorous (mmol/l)	3.94 $\pm$ 0.07	3.62 $\pm$ 0.07	**
AST (U/L)	372.15 $\pm$ 24.34	394 $\pm$ 28.32	NS
ALP (U/L)	1041.08 $\pm$ 95.60	1612.25 $\pm$ 494.57	NS
LDH (U/L)	1878.92 $\pm$ 119.95	1987.13 $\pm$ 114.95	NS

\*\* $P \leq 0.01$ ; \*\*\*  $P \leq 0.001$ ; NS =  $P > 0.05$

### Discussion:

Reference intervals for avian total protein concentration are substantially lower than those for mammalian species (Harr, 2002). The normal range of the total protein level in most birds is from 3 to 5 g/dl, which is in agreement with the results of the present study (Coles and Campbell, 1986; Coleman *et al.*, 1988; Kaneko *et al.*, 1997; Khazraiiinia *et al.*, 2006). Total protein showed no differences by sex. The total protein levels obtained in this study agree with the results obtained from Ozek and Bahtiyarca (2004), Ozbey and Esen (2007), and Suchy *et al.* (2010). Rodriguez *et al.* (2004) reported values of 3.2 g/dl and 3.6 g/dl total protein in male and female 4-month-old red-legged partridges, respectively. Thus, in our study, the total protein concentrations were slightly higher than the serum total protein concentrations reported by Rodriguez *et al.* (2004). Ozbey and Esen (2007) demonstrated that the breeding method of the rock partridges had a significant effect on the levels of total protein.

A range of avian blood glucose values have also been reported from 110-350 mg/dl (Sturkie, 1965). Coles (1977) also reported that serum glucose concentrations for most birds lie between 200 and 500 mg/dl. Woodard *et al.* (1983) reported glucose levels of male and female chukars in combined ages (1 and 7 years old) as 335

mg/dl and 330 mg/dl, respectively. Blood glucose values of 2-3-year-old non-laying partridges reported by Balasch *et al.* (1973) were 291.12 mg/dl. The glucose concentrations of 16-week-old male and female chukar partridges were also reported by Ozek and Bahtiyarca (2004). The mean value of plasma glucose in chukar partridges, reported by Suchy *et al.* (2010), was 20.04 mmol/l. The glucose concentrations in the present experiment are in agreement with the above literature. Woodard *et al.* (1983) and Balasch *et al.* (1973) determined blood glucose levels in partridges which appear to be higher than the blood glucose levels of other poultry (Altintas and Fidanci, 1993; Meluzzi *et al.*, 1993; Meredov, 1999). Sexual differences in blood glucose levels were not observed in red-legged partridges (Rodriguez *et al.*, 2004, 2006), however, Rodriguez *et al.* (2008) did report higher glucose values in male red-legged partridges than in females. Similar results were also reported by Scholtz *et al.* (2009) in Japanese quail, with males showing higher values than females. But in the present study, there were no significant effects of sex on glucose. The significant effect of the breeding method of rock partridges on serum glucose levels was also demonstrated by Ozbey and Esen (2007). In addition, many blood samples such as glucose show daily patterns of variation (Garcia-Rodriguez *et al.*, 1987; Ferrer *et al.*, 1994). Furthermore, Rodriguez *et al.* (2006) reported daily differences in glucose concentrations of red-legged partridges.

The serum calcium level in selected companion avian species has been reported from 8-14 mg/dl (Harr, 2002). Values for serum calcium were in agreement with those reported previously (Ozek and Bahtiyarca, 2004; Suchy *et al.*, 2010). Calcium levels of healthy, young, farmed partridges reported by Lloyd and Gibson (2006) were also in agreement with the present study. Woodard *et al.* (1983) reported values of 12.5 and 13.1 mg/dl calcium in combined age (1 and 7 years old) male and female partridges, respectively. In this study the serum calcium levels were lower than the serum calcium concentrations reported by Woodard *et al.* (1983), which could be due to age differences. Rodriguez *et al.* (2006) found daily variation in the serum calcium of 7-month-old red-legged partridges. The serum calcium concentration of chukars was lower than the values reported for chickens reported by Altman and Dittmer (1974), and daily calcium variations have been observed in red-legged partridges (Rodriguez *et al.*, 2006).

Woodard *et al.* demonstrated 3.3 and 3.8 mg/dl serum phosphorous levels for combined age (1 and 7 years old) male and female partridges, respectively. Serum phosphorous concentrations of 6-month-old male and female chickens were reported as 7.1 and 6.9 mg/dl, respectively (Altman and Dittmer, 1974). The serum phosphorous levels reported by Ozek and Bahtiyarca (2004) were all in consistent with values reported by Altman and Dittmer (1974). Values for serum phosphorous were considerably higher than previous reports (Altman and Dittmer, 1974; Woodard *et al.*, 1983; Ozek and Bahtiyarca, 2004; Suchy *et al.*, 2010). In the present study, sex related differences are observed for phosphorous.

Serum AST concentrations of chukars are considerably higher than the values reported by Ozbey and Esen (2007). Scholtz *et al.* (2009) demonstrated higher values in Japanese quail. In some other avian species, higher values of AST were reported in males compared with females (Scholtz *et al.*, 2009; Gylstorff and Grimm, 1998; Sribhen *et al.*, 2006), but in our study, no significant differences were observed between males and females. AST values are age-dependent to varying degrees among different species, and the cause of this age-dependent increased activity has not yet been defined (Hochleithner, 1994). Moreover, fluctuations in the serum levels of AST are difficult to interpret because of the wide distribution of this enzyme in avian tissue (Amand, 1986). Ozbey and Esen (2007) reported no significant effects of breeding method on blood AST and ALT levels. Average AST, ALP and LDH levels showed no differences between either of the sexes. According to Woodard *et al.* (1983), males generally had a significantly lower LDH than females and also LDH levels in partridges were much higher than in chickens. There were limited references for the ALP activity of avian species in the literature review. The serum alkaline phosphatase of the chukar partridge was higher than that reported for other species of birds (Campbell, 1986; Lumeij and Westerhof, 1987; Coles and Campbell 1986; Coleman *et al.*, 1988; Harr, 2002; Thrall, 2004; Nazifi *et al.*, 2008).

The blood triglyceride levels of partridges comply with those reported by Lloyd and Gibson (2006), Rodriguez *et al.* (2006) and Suchy *et al.* (2010), but were higher than the values demonstrated by Ozbey and Esen (2007) and Ozek and Bahtiyarca (2004). Reported values for cholesterol in partridges were in agreement with our results (Suchy *et al.*, 2010). In contrast, serum cholesterol levels reported by Ozek and Bahtiyarca (2004) and Rodriguez *et al.* (2004) were higher than the serum cholesterol levels of the present study. Triglycerides and cholesterol concentrations in chukar partridges showed no significant differences according to sex, but females had higher triglycerides values than males. Rodriguez *et al.* (2004) and Rodriguez *et al.* (2008) reported that plasma triglycerides in captive red-legged partridges were affected by sex females also had higher values for these parameters. Daily variation in cholesterol and triglycerides were observed in the red-legged partridges (Rodriguez *et al.*, 2006). Rodriguez *et al.* (2008) found that the sampling hour affected the circulating levels of triglycerides, but not cholesterol.

Values for uric acid were in agreement with Ozek and Bahtiyarca (2004), but lower than the values reported by Rodriguez *et al.* (2004) and Suchy *et al.* (2010). Rodriguez *et al.* (2006) reported the sex effect and daily variations on uric acid in red-legged partridges, whereas Scholtz *et al.* (2009) reported no sex related differences between male and female Japanese quail. According to Campbell (2004) the blood uric acid concentration is influenced by species, age and diet.

Sex related differences are observed for creatinine, which is a useful indicator of renal injury (Mahesh *et al.*, 2008). Serum creatinine of male chukars was significantly higher than the creatinine of females, which could be due to sex differences in nitrogen metabolism, growth and muscle mass (Szab and Milisits, 2007). Scholtz *et al.* (2009) reported no sex differences for creatinine in adult Japanese quail.

Serum concentrations of bilirubin were also affected by sex, and females had higher values than males. Significant sex-based differences were observed for bilirubin in adult Japanese quail (Scholtz *et al.*, 2009). The observed sexual differences in bilirubin in chukar partridges remain unexplained.

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