

## Haematology and blood biochemistry of capercaillie (*Tetrao urogallus*)

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### SUMMARY

Haematological and blood biochemical parameters of 15 capercaillie (*Tetrao urogallus*) reared in captivity have been determined. Statistically significant age differences were observed in the following parameters: haemoglobin, MCHC, total bilirubin, triglycerides, alkaline phosphatase, potassium and total proteins.

### INTRODUCTION

Capercaillie (*Tetrao urogallus*) is a mountain galliform belonging to *Tetraonidae* family, distributed all over the occidental Palaearctic. In Catalonia (northeastern Spain) it is present in the subalpine black pine tree forest (*Pinus uncinata*). In the northwest of Catalonia (Esterri d'Aneu, Lleida) exists the only centre in Spain where these birds are reared in captivity.

Domingo *et al.* (1991) described heart apex rupture and haemopericardium in capercaillie reared in captivity. Although the pathogenesis of the lesion is unclear, the tachycardia due to the unusually high excitability of these birds, and predisposition to mechanical rupture in the heart apex are considered to be the most significant factors that could cause the condition.

A total of 10% of the chicks born each year are affected and only the females between 3 and 5 months old die. In this breeding centre there are currently 15 reproductive adults, males and females.

The reason why we have studied the blood parameters of capercaillie reared in captivity is the relatively frequent presentation of the process described above and the little information about their haemophysiological parameters. We have only found one report (Gremmels, 1987) on the biochemical parameters of capercaillie.

### MATERIALS AND METHODS

#### Blood samples

Blood samples were taken from 15 healthy capercaillie, six 4-month old (one male and five females) and nine older than 2 years (four males and five females). Birds were fed on a commercial diet for wild birds supplemented with vegetable matter. The blood was

collected from the cutaneous ulnar vein. Whole blood was placed in a tube with EDTA-K<sub>3</sub> as an anticoagulant. The remainder was used for biochemical purposes, after being allowed to clot at room temperature. Samples were kept at 4°C until their arrival at the laboratory.

### Cell counts

Erythrocyte and leukocyte counts were taken on a Neubauer haemocytometer chamber, using the solution and method described by Natt & Herrick (1952). Haematocrit was obtained by means of a microhaematocrit centrifuge. Haemoglobin was assayed according to Drabkin's (1945) colorimetric method. Blood smears were stained using the commercial Diff-Quick stain.

### Erythrocyte dimensions

Erythrocyte dimensions were measured by eyepiece. Fifty red blood cells from two smears of each sample were measured. The surface area of the red cells was calculated according to the formula:  $A = \pi ab$ ,  $a$  and  $b$  being the longest and shortest radii respectively.

### Blood constituents

Serum proteins were assayed using the Biuret method. Albumin and globulins determinations were performed with electrophoresis on cellulose acetate strips. Glucose, cholesterol, total bilirubin, uric acid, urea, triglycerides, alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), creatinin kinase (CK), gamma glutamyl transferase (GGT), alkaline phosphatase, calcium and phosphorus levels, were assayed with a Kova Bio (Roche) autoanalyzer using reagents and procedures supplied by the manufacturer. Sodium and potassium were measured with a Kodak Ektachem DT system analyzer (Kodak, S.A.).

Statistical analysis of the data from the young and adult groups was done using an analysis of variance.

## RESULTS AND DISCUSSION

Tables 1 to 3 show the results of whole blood determination, erythrocyte dimensions and biochemical constituents of the blood, respectively, of the 15 capercaillie studied. Data presented in this study were obtained from captive capercaillie. This data must, therefore, be interpreted with caution, since some factors may alter their physiology in an unpredictable way.

No statistically significant age differences existed in blood composition in erythrocyte and leukocyte counts, haematocrit value or erythrocyte dimensions. However, significant age differences were found in haemoglobin content and MCHC ( $P < 0.05$ ); in young birds the haemoglobin value was 111.5 g/l and 142.9 g/l in adults. Sturkie & Griminger (1986) reported a haemoglobin value of 189 g/l in adult pheasant (*Phasianus colchicus*).

Erythrocyte dimensions of adult capercaillie ( $13.15 \times 7.41 \mu\text{m}$ ) are within the range described by Hartman & Lessler (1963) obtained from a study on erythrocytes of 124 species belonging to 46 families of wild birds ( $10.7 \times 6.1 \mu\text{m}$  to  $15.8 \times 10.2 \mu\text{m}$ ).

**Table 1.** *Haematology values (means  $\pm$  SD)*

Variable	Young (<4 months; <i>n</i> =6)	Adult (>2 years; <i>n</i> =9)
RBC ( $\times 10^{12}/l$ )	3.22 $\pm$ 0.65	3.50 $\pm$ 0.60
Haematocrit (%)	48.41 $\pm$ 6.32	50.88 $\pm$ 1.76
Haemoglobin (g/l)	111.5 $\pm$ 22.4	142.9 $\pm$ 25.2*
MCV (fl)	153.20 $\pm$ 25.50	149.57 $\pm$ 27.40
MCH (pg)	34.86 $\pm$ 6.46	42.24 $\pm$ 12.44
MCHC (g/l)	227.8 $\pm$ 24.5	279.6 $\pm$ 48.2*
WBC ( $\times 10^9/l$ )	15.60 $\pm$ 4.92	13.66 $\pm$ 3.42
Differential leukocyte count		
lymphocytes (%)	35.00 $\pm$ 10.97	42.00 $\pm$ 13.03
monocytes (%)	4.83 $\pm$ 1.94	4.44 $\pm$ 1.74
heterophils (%)	60.16 $\pm$ 11.44	53.55 $\pm$ 13.79
eosinophils (%)	—	—
basophils (%)	—	—

\**P*<0.05.**Table 2.** *Erythrocyte dimensions and surface area (means  $\pm$  SD)*

Variable	Young (<4 months; <i>n</i> =6)	Adult (>2 years; <i>n</i> =9)
Cell length ( $\mu m$ )	12.99 $\times$ 0.63	13.15 $\times$ 0.22
Cell width ( $\mu m$ )	7.36 $\times$ 0.20	7.41 $\times$ 0.13
Cell ratio L/W	1.76 $\times$ 0.12	1.77 $\times$ 0.04
Nucleus length ( $\mu m$ )	5.67 $\times$ 0.59	5.67 $\times$ 0.20
Nucleus width ( $\mu m$ )	2.38 $\times$ 0.19	2.41 $\times$ 0.13
Nucleus ratio L/W	2.40 $\times$ 0.41	2.35 $\times$ 0.19
Surface area ( $\mu^2$ )	74.94 $\times$ 3.06	76.73 $\times$ 1.91

**Table 3.** *Blood biochemistry*

Variable	Young (<4 months; <i>n</i> =6)	Adult (>2 years; <i>n</i> =9)
Glucose (mg/l)	3544.5 $\pm$ 1022.1	3956.8 $\pm$ 620.7
Cholesterol (mg/l)	4777.5 $\pm$ 893.8	3968.2 $\pm$ 921.8
Total bilirubin (mg/l)	23.0 $\pm$ 5.3	6.4 $\pm$ 5.2***
Uric acid (mg/l)	132.4 $\pm$ 16.5	114.5 $\pm$ 45.4
Urea (mg/l)	39.5 $\pm$ 45.3	45.2 $\pm$ 39.1
Triglycerides (mg/l)	763.6 $\pm$ 231.1	552.6 $\pm$ 109.8*
ALT (IU/l)	21.66 $\pm$ 5.24	23.19 $\pm$ 4.13
AST (IU/l)	553.65 $\pm$ 88.11	477.49 $\pm$ 63.11
LDH (IU/l)	881.03 $\pm$ 135.83	1095.78 $\pm$ 344.88
CK (IU/l)	1360.46 $\pm$ 757.13	3873.29 $\pm$ 4732.15
GGT (IU/l)	<0.47	<0.47
AP (IU/l)	450.97 $\pm$ 189.42	144.25 $\pm$ 55.75***
Calcium (mg/l)	118.5 $\pm$ 11.5	126.8 $\pm$ 9.8
Phosphorus (mg/l)	41.1 $\pm$ 28.2	26.3 $\pm$ 16.4
Sodium (mmol/l)	168.16 $\pm$ 30.06	149.00 $\pm$ 10.78
Potassium (mmol/l)	3.68 $\pm$ 1.07	2.75 $\pm$ 0.54*
Total protein (g/l)	49.0 $\pm$ 5.5	64.9 $\pm$ 10.4**
Albumin (%)	60.78 $\pm$ 16.98	61.97 $\pm$ 10.40
Globulin (%)	39.21 $\pm$ 16.98	38.02 $\pm$ 10.40
Albumin/globulin	2.06 $\pm$ 1.60	1.92 $\pm$ 0.82

\**P*<0.05; \*\**P*<0.01; \*\*\**P*<0.001.

Heterophils were the most abundant cells in both young and adult birds (54% and 60.18%), respectively. Therefore, capercaillie should be added to the list of birds in which heterophils (Hawkey *et al.*, 1983; Jimenez *et al.*, 1991) are the most abundant leukocytes.

Although the serum proteins value in young capercaillie (49 g/l) is in the range reported by other authors for domestic, captive (Gee *et al.*, 1981) or free-range birds (Puerta *et al.*, 1990), adult capercaillie have 64.9 g/l of total protein which represents a statistically significant difference ( $P < 0.01$ ) between both groups. This value is even higher than that described by Balash *et al.* (1973) in the pheasant (*Phasianus colchicus*). Accordingly, we cannot dismiss the possibility that the level of total proteins is not subject to age-related changes.

Plasma concentrations of urea and glucose found in our study are similar to those described by Gremmels (1987) in capercaillie (*Tetrao urogallus*), black grouse (*Lyrurus tetrix*), partridge (*Perdix perdix*) and pheasant (*Phasianus colchicus*). Although in our work capercaillie have higher uric acid concentrations than urea, these are lower than those reported by the same author in his study. Plasma values for calcium, phosphorus, sodium and potassium lie within the range reported for other avian species such as anseriforms, gruiforms and galliforms (Gee *et al.*, 1981).

Statistically significant age differences in total bilirubin ( $P < 0.001$ ), triglycerides ( $P < 0.05$ ) and alkaline phosphatase ( $P < 0.05$ ) were found. Adult capercaillie had lower levels of alkaline phosphatase than young birds. We observed a very similar value for this enzyme in young birds to that described by Gremmels (1987) in 22 young capercaillie. Statistically significant age-related differences were found in serum levels of this parameter. Perhaps the higher value found in young animals (450.97 IU/l) may be associated with their higher bone activity.

Triglycerides and alanine aminotransferase values are in the range reported in other birds (Rafael, 1980; Puerta *et al.*, 1991). However, other parameters such as cholesterol or bilirubin have higher values than those described by Gee *et al.* (1981). Aspartate aminotransferase, lactate dehydrogenase and creatinin kinase, all of them muscular enzymes, are much higher than those reported in other birds belonging to *Tetraonidae* and *Phasianidae* families (Gremmels, 1987).

Although we cannot draw definitive conclusions from these results, that could explain the process of heart rupture and haemopericardium found in capercaillie, the high value of all the muscular enzymes observed in our study, can be explained by the hyperexcitability of these birds. On the other hand, the damaged cardiac muscle could potentially cause such elevation. An inherited predisposition should be also considered.

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## RESUME

### Hématologie et constantes sanguines chez le grand Tétraz ( *Tetrao urogallus* )

Les paramètres hématologiques et biochimiques de 15 grands Tétraz (*Tetrao urogallus*) élevés en captivité ont été déterminés. Des différences significatives ont été observées en fonction de l'âge: hémoglobine, MCHC, bilirubine totale, triglycérides, phosphatase alcaline, potassium et protéines totales.

## ZUSAMMENFASSUNG

### Hämatologie und Blutbiochemie der Auerhühner (*Tetrao urogallus*)

Hämatologische Parameter und biochemische Blutwerte von 15 in Gefangenschaft aufgezogenen Auerhühnern wurden bestimmt. Statistisch signifikante Altersunterschiede wurden bei den folgenden Parametern festgestellt: Hämoglobin, MCHC, Gesamtbilirubin, Triglyceride, alkalische Phosphatase, Kalium und Gesamtproteine.

## RESUMEN

### Hematología y bioquímica sanguínea del urogallo (*Tetrao urogallus*)

Se determinaron los valores hematológicos y bioquímicos sanguíneos de 15 urogallos (*Tetrao urogallus*) mantenidos en cautividad. No se observaron diferencias estadísticamente significativas por la edad en los siguientes parámetros: hemoglobina, MHCH, bilirubina total, triglicéridos, fosfatasa alcalina, potasio y proteínas totales.