Characteristics of Blood Chemical Parameters in Male and Female Quails

Noboru ITOH, Takashi MAKITA[1)] and Masateru KOIWA

Large Animal Clinical Center, Department of Veterinary Medicine, Rakuno Gakuen University, Ebetsu 069–8501 and [1)]Department of Veterinary Anatomy, Faculty of Agriculture, Yamaguchi University, 1677–1 Yoshida, Yamaguchi 753–8515, Japan

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ABSTRACT. The sexual difference in blood chemical tests and the correlation among these tests were investigated in 40 male and 40 female quails. Significant intersex differences were observed in serum total protein, total cholesterol, triglyceride, calcium, phosphorus, uric acid and glucose levels but not in alkaline phosphatase and aspartate aminotransferase levels. In the female quails, many of the blood chemicals that showed a significant sexual difference were strongly correlated with each other. — KEY WORDS: blood chemistry, quail, sexual difference.

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Blood chemistry tests are often conducted in veterinary clinics. With the recent needs for investigation of poultry health, there has been an increasing accumulation of data from blood chemical tests on poultry [1–3, 5–11].

Although there have been many studies on the usefulness of blood chemical tests for indicating the reproductive condition in chickens [5, 7, 9, 11], there have been very few studies on the blood chemistry of quails [5, 8].

We previously reported the different blood chemical characteristics in male and female quails, although we did not deal with the correlation between blood chemicals in this study [5]. Bacon *et al.* [1] investigated the correlations between plasma calcium, phosphorus, lipids and estrogen, and they discussed the significance of these correlations in conjunction with reproductive activities. Thus, investigation of the correlation between blood chemicals as well as sexual differences is needed to clarify the characteristics of blood chemical in quails.

Therefore, in this study, we investigated the correlation among blood chemical levels in quails as well as sexual differences in these levels.

Experiments were conducted on 80 clinically healthy quails (40 males and 40 females, 2 months old) obtained from Sankyo Labo Service Co., Inc. (Tokyo). The birds were fed commercial pheasant feed (BC-3, Funabashi Farms, Funabashi). Male and female quails were housed separately in mesh, wire-bottomed battery cages. From observation of the number of laying eggs in the female group, most of the female quails were considered to be in the laying period.

Blood samples (1.5 m*l*) were collected from the jugular vein of each quail, and blood chemical tests were carried out. Serum total protein (TP), total cholesterol, triglyceride, calcium, phosphorus, uric acid, glucose, alkaline phosphatase (ALP), and aspartate aminotransferase (AST) levels were measured by a 7150 Automatic Blood Chemistry Analyzer (Hitachi Co., Ltd., Tokyo) using a commercially available test kit (Kishimoto Clinical Laboratory Group, Tomakomai). Statistical significance in the difference between male and female values was determined by Student's *t* test. In addition, the correlation coefficients between chemical tests were determined [4].

The blood chemical values (mean ± SD) of the 40 male and 40 female quails tested in this study are shown in Table 1. Significant intersex differences were observed in TP, total cholesterol, triglyceride, calcium, phosphorus, uric acid and glucose. There were no sexual differences in the levels of ALP and AST.

In the female birds, TP, total cholesterol, triglyceride, calcium and phosphorus were positively correlated with each other (Table 2). Triglyceride and calcium were also positively correlated with uric acid. No correlation was found among glucose, ALP and AST.

In the male birds, except for TP and calcium, there were no correlations among TP, total cholesterol, triglyceride, calcium and phosphorus (Table 3). However, significant positive correlations were found between the following blood chemicals: TP and calcium, triglyceride and uric acid, and uric acid and ALP. In addition, significant inverse

Table 1. Blood chemical values of 40 male and 40 female quails

	Female Mean ± SD	Male Mean ± SD
Total protein (g/dl)	4.0 ± 0.7***	3.2 ± 0.5
Total cholesterol (mg/dl)	189 ± 57*	166 ± 39
Triglyceride (mg/dl)	1470 ± 770***	170 ± 54
Calcium (mEq/L)	12.7 ± 4.0***	5.1 ± 0.4
Phosphorus (mg/dl)	6.4 ± 2.2*	5.4 ± 1.4
Uric acid (mg/dl)	10.1 ± 5.7*	7.6 ± 2.5
Glucose (mg/dl)	308 ± 37*	330 ± 45
ALP (KA-U)	86 ± 47	99 ± 24
AST (IU/L)	210 ± 70	224 ± 61

*: Significantly different between male and female values ($P<0.05$). ***: Significantly different between male and female values ($P<0.001$).

Table 2. Correlation coefficients among various blood chemical values in female quails

	Total protein	Total cholesterol	Triglyceride	Calcium	Phosphorus	Uric acid	Glucose	ALP	AST
Total protein (g/dl)		0.794***	0.643***	0.500***	0.525***	0.186	0.231	0.016	0.203
Total cholesterol (mg/dl)			0.570***	0.340*	0.432**	0.032	–0.090	0.252	–0.115
Triglyceride (mg/dl)				0.630***	0.552***	0.538***	0.048	0.104	–0.129
Calcium (mEq/L)					0.710***	0.330*	0.190	0.050	0.110
Phosphorus (mg/dl)						0.106	0.040	0.002	0.105
Uric acid (mg/dl)							–0.018	0.046	0.054
Glucose (mg/dl)								0.282	–0.231
ALP (KA-U)									0.038
AST (IU/L)									

*: Significantly correlated (P<0.05). **Significantly correlated (P<0.01). ***: Significantly correlated (P<0.001).

Table 3. Correlation coefficients among various blood chemical values in male quails

	Total protein	Total cholesterol	Triglyceride	Calcium	Phosphorus	Uric acid	Glucose	ALP	AST
Total protein (g/dl)		0.106	0.185	0.758***	–0.072	–0.048	–0.353*	–0.124	0.076
Total cholesterol (mg/dl)			0.062	–0.169	–0.072	–0.229	–0.233	–0.380*	0.148
Triglyceride (mg/dl)				0.196	–0.110	0.334*	0.161	0.052	–0.350*
Calcium (mEq/L)					0.055	0.016	–0.333*	0.240	–0.192
Phosphorus (mg/dl)						–0.232	0.044	0.170	–0.192
Uric acid (mg/dl)							0.193	0.340*	0.073
Glucose (mg/dl)								0.098	–0.147
ALP (KA-U)									–0.030
AST (IU/L)									

*: Significantly correlated (P<0.05). ***: Significantly correlated (P<0.001).

correlations were found between the following blood chemicals: TP and glucose, total cholesterol and ALP, triglyceride and AST, and calcium and glucose.

TP, total cholesterol, triglyceride, calcium and phosphorus values, which showed significant sexual differences in the present study, were strongly correlated with each other in the female quails. There have been some reports on the correlation between blood chemical values and reproductive activities in birds. TP has been reported to increase more in the laying period than in the non-laying period [9, 11]. The triglyceride level was reported to vary in birds according not only to climate, hormonal influence, diet and gender but also to the level of estrogen injection in birds [3]. An increased level of total cholesterol was reported in mature female chickens [7]. Calcium was reported to be strongly correlated to the weight of the oviduct and development of ovarian follicles in the blue grouse [2]. Calcium and phosphorus are thought to increase as birds begin laying [10]. Serum calcium and phosphorus were also reported to increase following the administration of estrogen in birds [10]. All of these reports suggested that TP, calcium, phosphorus, total cholesterol and triglyceride levels may increase in female birds under reproductive conditions. However, further study is needed to determine the exact

correlation of these five blood chemicals with the reproductive condition of female quails.

In addition to TP, calcium, phosphorus, total cholesterol and triglyceride levels in female quails, TP and calcium were correlated with each other in male quails and also showed a significant sexual difference. The calcium measured in most chemical determinations is considered to be nondiffusable and bound to serum proteins; therefore, total serum calcium levels frequently rise and fall with high or low protein levels [6]. This may be one of the reasons why a correlation between calcium and TP was seen not only in the female quails but also in the male quails in the present study.

The level of uric acid in female quails was reported to be slightly higher than that in male quails [5]. In the present study, the level of uric acid in female quails was significantly higher than that in male quails, and the level of uric acid was correlated with the levels of triglyceride and calcium. A higher level of uric acid and a significant correlation of uric acid with triglyceride and calcium may be characteristic of mature female quails. There was no apparent sexual difference in the levels of ALP and AST in the present study.

In the male quails, significant inverse correlations were observed between TP and glucose, triglyceride and AST, and calcium and glucose. Among these chemicals, glucose, TP, triglyceride and calcium showed significant sexual differences; that is, significantly lower values of TP, triglyceride and calcium and a significantly higher value of glucose in male birds. Thus, a higher value of glucose and lower values of TP and calcium may be connected with the inverse correlations observed between TP and glucose and between calcium and glucose.

One interesting findings of the present study is that many of the chemical parameters showing a significant sexual difference were strongly correlated with each other. The results of this study have provided some basic data for blood chemical analysis in quails.

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