INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 7, No. 5, p. 16-29, 2015

RESEARCH PAPER OPEN ACCESS

Effect of various dietaryprotein levels on haematology and blood biochemistry of Japanese quail

Sadif Nazar[1,2,*], Muhammad Mushtaq-ul-Hassan[1], Farhat Jabeen[1]

[1]*Department of Zoology, Wildlife and Fisheries, G.C. University, Faisalabad, Pakistan*

[2]*Department of Zoology, University of Sargodha Women Campus, Faisalabad, Pakistan*

Key words: Hemoglobin, Erythrocyte, Leukocyte, Albumin, Globulin.

http://dx.doi.org/10.12692/ijb/7.5.16-29 Article published on November 14, 2015

Abstract

Protein is very crucial for growth of birds.Blood parameters are used as indicator for diagnosis of diseases. Haematological values also reflect the levels of stresses due to nutritional and environmental factors. The present study was conducted to evaluate the effect of various dietary protein levels on haematological and blood biochemistry values in different close bred flocks of Japanese quail. One thousand and eighty, day-old chicks from four different close bred flocks comprising 270 chicks having 135 of each separate sex (♂ and ♀) were divided into 3 sub-groups assigning 3 different protein levels (21, 23, 25%) having 3 replicates comprising 15 birds each. From 4th week onward 72 birds (randomly picking one bird from each replicate) were slaughtered at the end of each week. The blood samples were collected in the tubes from the jugler vein by slaughtering the birds. The blood was analysed following standard procedure to study the haematological and blood biochemistry. The results showed that strains of Japanese quail did not differ significantly in haematological parameters andblood cholesterol level from 4th to 6th week in both sexes. However, strains differ in total protein, albumin and globulin content in blood. Dietary protein level significantly affected most of haematological and biochemical parameters of blood. Highest protein level (25%) showed best performance in all the parameters except hemoglobin and cholesterol level. It is concluded that 25% protein level in feed is best for rearing of Japanese quail for meat purpose in tropics.

* **Corresponding Author:** Sadif Nazar ✉ :sadif.tasneem@gmail.com

Introduction

Protein is very crucialfor normal tissue growth of birds.Haematological and other blood parameters are important in assessing health status of quail chicks. Many factors like genotype, age, sex,diet, physiological and environmental conditions effectblood hematology and biochemistry. Theseparameters are used as indicator for diagnosis of diseases. Haematological values also reflect the levels of stresses due to nutritional and environmental factors. Blood analysis can be used as a guide for better rearing of farmed animals.

Diet has great influence on haematological parameters and blood biochemistry(Church *et al.*,1984; Babatunde *et al.*, 1987). Protein levels in diet affect packed cell volume and haemoglobin levels in blood. Their values increased as dietary protein level increased (Edozien and Switzer, 1977).It has also been observed that serum urea, total protein and creatinine contents depend on both the quality and quantity of protein supplied in the diet (Iyayi and Tewe, 1998).It has influence on metabolic processes and endocrine function in body of birds. The alterations in metabolic procesess and endocrine function are exhibited in blood parameters and hormones(Swennen *et al.,* 2005).

Haematological parameters and blood biochemistry are also influenced significantly by age and sex. Young quail had lower erythrocyte count, packed cell volume, haemoglobin content and percentage of lymphocytes than adult quail. Male birds showed higher erythrocyte count, packed cell volume, haemoglobin content and lower plasma protein than females (Nirmilan and Robinson, 2007).It was observed that male bird had higher value of glucose and female had higher concentration of total protein, albumin and cholesterol. Value of uric acid did not differ significantly between male and female birds (Scholtz*et al.*, 2009).

The most important aspect of quail farming is the cost of feed that represents 65-75 % of total cost of production. Furthermore, the most expensive ingredient in diet is protein. High protein diet increases the feed cost and ultimately cost of production. Protein level which is economically feasible should be applied. So there is dire need to optimize the protein level in feed for present flocks and also for broiler and layer separately to make the industry economically efficient. The present experiment was conducted to evaluate the effect of various dietary protein levels on haematological and blood biochemistry values in different close bred flocks of Japanese quail.

Materials and methods

This project was designed to evaluate the effect of various protein levels on haematological and blood biochemistry values of different close bred flocks (Imported, Local-I Kaleem, Local-II Saadat, Local-III Zahid) of Japanese quail (*Coturnixcoturnix japonica).*

Experimental Procedure

The experiment was conducted at Avian Research and Training (ART) Centre, Department of Poultry Production, University of Veterinary and Animal Sciences, Lahore. One thousand and eighty, day-old chicks from four different close bred flocks comprising 270 chicks having 135 of each separate sex (♂ and ♀) were divided into 3 sub-groups assigning 3 different protein levels (21, 23, 25%) having 3 replicates comprising 15 birds each. Each experimental unit was placed in 5 tier multi-deck battery cages and was subjected to standard husbandry conditions. All the chicks were weighed at one day of age then at weekly interval. Three experimental rations containing 3 different protein levels i.e., 21, 23 and 25 were prepared and offered to the chicks from day one to 6 weeks. The composition of feed is given in table 1.

Blood Analysis

From 4th week onward 72 birds (randomly picking one bird from each replicate) were slaughtered at the end of each week. The blood samples were collected in the tubes from the jugler vein by slaughtering the birds. In half portion of blood samples 0.2 ml

Heparin was added as an anticoagulant. The blood containing anticoagulant was used for haematological parameters. The remaining half portion of blood samples were centrifuged for five minutes at 2000 rpm. The blood serum without anticoagulant was used for blood biochemistry analysis.

Blood Haematology

Blood samples were frozen at - 4 °C until analysis.Hemoglobin concentration (g/dl) was determined by cyannmethemoglobin method (Benjamin, 1978). Erythrocyte sedimentation rate (mm/Ist hour) was determined by westergen method. Erythrocyte count (10^{12} /l) and Leukocyte count (10^9/l) was done with the help of a haematocytometer (Natt and Herrick, 1952). Differentials Leukocytes Countwas done according to the method ofBenjamin, 1978.

Blood Bio-chemistry

Cholesterol concentration (mg/dl) in serum was determined by enzymatic colorimetric kit Analyticon cat No. 4241. Plasma protein (g/dl) was estimated by commercially available kit Analyticon cat No. 9106. The amount of albumin (g/dl) was determined by commercial kit analyticon cat No. 9136. To calculate the amount of globulin (g/dl), the albumin content of the sample was deducted from the total protein content of the sample.

Statistical Analysis

The data were subjected to statistical analysis according to Completely Randomized Design and differences in the means were compared by LSD test at 5% probability level (Steel *et al.*, 1997).

Results and discussions

Haematology

When birds attained the age of 28 days, 72 birds (randomly picking one bird from each replicate) were slaughtered at the end of each week up to 6th week of age to study the following blood parameters.

Table 1. Composition of rations offered to the Japanese quail during experimentation.

Ingredients	IL (%)	IL (%)	IL (%)
Corn	62.2	60.5	50.3
Canola meal	2.0	6.0	6.0
Soybean meal	24.2	25.7	31.3
Wheat bran	5.3	0.8	3.8
Cooking oil	0.6	0.3	0.3
Poultry by products meal	4.0	5.0	4.5
DCP	0.8	0.8	0.8
$CaCO_3$	1.0	1.0	1.0
Nutrients			
CP	21.0	23.0	25.0
ME	2900	2899.5	2899.3
Ca	0.8	0.8	0.8
P	0.3	0.3	0.3
Lys	1.3	1.1	1.3
Meth	0.5	0.4	0.4

Hemoglobin

Data on presence of Hemoglobin(g/dl) in blood of Japanese quail from 4th to 6th week is presented in Table 2. It is evident from the table that strains of Japanese quail did not differ significantly in this parameter from 4th to 6th week in both sexes. A general trend was noted that increasing age had positive effects on hemoglobin concentration in blood. Dietary protein level influenced concentration of hemoglobin in blood non-significantly from 4th to 6th week in both sexes. These results are in accordance with Alam *et al.* (2004) and Kermanshahi *et al.* (2011) who observed that dietary protein level had no significant effects on hemoglobin level of

blood. Results also showed that female birds had higher hemoglobin concentration than males (Elaroussi*et al.,* 2007).

Total erythrocyte count (TEC)

Data regarding Total Erythrocyte Count (10^{12} /l) of blood of female and male Japanese quail from 4th to 6th week is presented in Table 3. It is clear from data that TEC did not differ among strains significantly in both sexes during 4th to 6th week of age. Dietary protein level influenced statistically significantly total erythrocyte count of female and male birds from 4th to 6th week. Total erythrocyte count of both sexes increased significantly as dietary protein level increased in feed. Minimum TEC was observed in birds fed on diet with 21% protein level and maximum with 25% protein level. Results showed that higher protein level had significant effect on total erythrocyte count. Such type of findings were also reported by previous researchers who reported that at higher dietary protein level TEC was increased (Alam*et al.*, 2004; Tollba and Nagar, 2008). General trend was noted that increasing age increased the TEC in blood from 4th to 6th week.

These results were in line of Ali *et al.*, 2012. The table also showed that interactive effect of strain and protein was statistically non-significant on total erythrocyte count of both sexes from 4th to 6th week (Table 3).

Table 2. Effect of strain and dietary protein level on Hemoglobin in blood (g/dl) of Japanese quail during different weeks of age**.**

Treatment	4th week		5th week		6th week	
	Female	Male	Female	Male	Female	Male
			A) Strain			
Kaleem	10.35	10.11	12.55	12.31	13.35	13.25
Major	10.62	10.42	12.82	12.62	13.56	13.44
Sadaat	10.47	10.06	12.67	12.25	13.79	13.66
Zahid	10.40	10.20	12.61	12.41	13.86	13.59
LSD	NS	NS	NS	NS	NS	NS
			B) Protein level			
21 %	10.15	9.84	12.35	12.04	13.32	13.22
23 %	10.47	10.21	12.67	12.41	13.63	13.47
25 %	10.76	10.54	12.96	12.74	13.97	13.76
LSD	NS	NS	NS	NS	NS	NS
			C) Interaction			
A1 X B1	10.02	9.77	12.23	11.97	13.15	13.05
A1 X B2	10.34	10.17	12.54	12.37	13.34	13.22
A1 X B3	10.69	10.41	12.89	12.61	13.56	13.49
A2 X B1	10.31	10.20	12.51	12.40	13.20	13.15
A2 X B2	10.66	10.35	12.86	12.55	13.54	13.42
A2 X B3	10.89	10.72	13.09	12.93	13.95	13.75
A3 X B1	10.18	11.78	12.38	12.03	13.56	13.40
A3 X B2	10.48	12.26	12.69	12.26	13.75	13.61
A3 X B3	10.76	12.73	12.96	12.73	14.08	13.97
A4 X B1	10.11	12.03	12.31	12.03	13.37	13.31
A4 X B2	10.34	12.49	12.59	12.49	13.89	13.65
A4 X B3	10.71	12.71	12.92	12.49	14.32	13.83
LSD	NS	NS	NS	NS	NS	NS
Mean	10.46	10.20	12.66	12.40	13.64	13.48

Means sharing different letters in a column differ significantly at P = 0.05
LSD: Least significant difference NS = Non-significant.

Table 3. Effect of strain and dietary protein level on TEC (10^{12} / l) of Japanese quail during different weeks of age.

Treatment	4th week		5th week		6th week	
	Female	Male	Female	Male	Female	Male
A) Strain						
Kaleem	7.26	7.23	8.26	8.23	8.93	9.30
Major	7.20	7.40	8.20	8.40	8.66	8.73
Sadaat	7.30	7.76	8.30	8.76	8.66	9.03
Zahid	7.10	7.56	8.09	8.56	8.50	8.66
LSD	NS	NS	NS	NS	NS	NS
B) Protein level						
21 %	6.65b	6.72c	7.65b	7.72	8.12b	8.40c
23 %	7.12b	7.49b	8.12b	8.50	8.77a	8.90b
25 %	7.87a	8.25a	8.87a	9.25	9.17a	9.49a
LSD	0.59	0.56	0.62	0.63	0.63	0.48
C) Interaction						
A1 X B1	6.80	6.89	7.80	7.90	8.10	8.80
A1 X B2	7.10	7.30	8.10	8.30	8.90	9.30
A1 X B3	7.90	7.50	8.90	8.50	9.80	9.80
A2 X B1	6.80	6.60	7.80	7.60	8.29	8.00
A2 X B2	6.90	7.80	7.90	8.80	8.80	8.80
A2 X B3	7.90	7.80	8.90	8.80	8.90	9.39
A3 X B1	6.80	6.60	7.80	7.60	8.00	8.50
A3 X B2	7.20	7.80	8.20	8.80	8.90	8.80
A3 X B3	7.90	8.90	8.90	9.90	9.10	9.80
A4 X B1	6.20	6.80	7.20	7.80	8.10	8.30
A4 X B2	7.30	7.09	8.30	8.10	8.50	8.70
A4 X B3	7.80	8.80	8.79	9.80	8.90	9.00
LSD	NS	NS	NS	NS	NS	NS
Mean	7.21	7.49	8.21	8.49	8.69	8.93

Means sharing different letters in a column differ significantly at P = 0.05.

LSD: Least significant difference NS = Non-significant.

Total Leukocytes Count (TLC)

Analysis of variance of data revealed that strain influenced statistically significantly total leukocytes count of female chicks at 4th week. Maximum total leukocytes count was observed in Sadaat (22.30) and minimum was in Zahid (19.49) in female birds while in male strain affected statistically non-significantly on total leukocyte count. At 5th and 6th week, the influence of strain remained statistically non-significant on total leukocytes count of female and male (Table 4).

Statistical analysis showed that dietary protein level influenced total leukocytes count significantly in both sexes from 4th to 6th week of age. It is evident that total leukocyte count was increased as dietary protein level was increased. Higher total leukocyte count was observed in birds fed diet with 25% protein level that was statistically at par with 23% and lower TLC was observed in birds fed with 21% protein level in both sexes. The maximum and minimum values were 25.62, 25.92 and 21.95, 22.27 in blood of female and male birds, respectively (Table 4). High protein level

in feed increased protein level in lymphocytes cells due to that TEC increased in blood. Such types of conclusions were also reported by previous researchers (Tollaba and Nagar, 2008). Cheema *et al.* (2003) observed that at higher protein level increased lymphocytes in thymus of chicken due to which immunity of bird increased. Interactive effect of strain and dietary protein level remained statistically non-significant on total leukocyte count of female and male from 4th to 6th week.

Table 4. Effect of strain and dietary protein level on blood TLC (10^9/l) of Japanese quail during different weeks of age.

Treatment	4th week		5thweek		6thweek	
	Female	Male	Female	Male	Female	Male
A) Strain						
Kaleem	21.66 ab	22.26	24.66	25.26	26.23	26.23
Major	20.03 bc	19.99	23.03	23.00	25.63	25.93
Sadaat	20.30 a	22.66	25.57	25.40	26.63	25.80
Zahid	19.49 c	20.79	22.70	22.33	27.40	27.76
LSD	1.78	NS	NS	NS	NS	NS
B) Protein level						
21 %	18.87 b	19.27 b	21.95 b	22.27 b	24.42 b	24.19 b
23 %	21.12 a	21.20 b	24.40 ab	23.80 ab	26.25 b	26.97 a
25 %	22.62 a	23.82 a	25.62 a	25.92 a	28.75 a	28.12 a
LSD	1.54	2.00	2.49	2.48	1.92	2.53
C) Interaction						
A1 X B1	18.60	20.79	21.60	23.80	24.30	24.40
A1 X B2	22.00	21.10	25.00	24.10	25.90	27.00
A1 X B3	24.40	24.90	27.40	27.90	28.50	27.30
A2 X B1	19.09	18.30	22.10	21.30	24.89	24.00
A2 X B2	20.00	19.60	23.00	22.60	25.30	25.89
A2 X B3	21.00	22.09	24.00	25.10	26.70	27.89
A3 X B1	19.00	19.30	22.33	22.30	24.09	23.10
A3 X B2	23.40	23.90	26.90	26.40	25.90	26.30
A3 X B3	24.50	24.80	27.50	27.50	29.90	28.00
A4 X B1	18.79	18.69	21.80	21.70	24.40	25.29
A4 X B2	19.10	20.20	22.70	22.09	27.90	28.70
A4 X B3	20.60	23.49	23.60	23.20	29.90	29.30
LSD	NS	NS	NS	NS	NS	NS
Mean	20.87	21.43	23.99	24.01	26.47	26.43

Means sharing different letters in a column differ significantly at P = 0.05.

LSD: Least significant difference NS = Non-significant.

Lymphocyte

It is evident from the table 5 that lymphocyte did not differed significantly among strains from 4th and 5th week in female and male birds. However, strain influenced lymphocyte % statistically significantly in female at 6th week of age. Maximum lymphocyte (30.44%) was observed in Major and minimum (28.66%) in Sadaat. Dietary protein level affected statistically significantly lymphocyte in blood of both sexes from 4th to 6th week. Lymphocyte in blood of

female and male birds increased as dietary protein level was increased. Birds fed on ration with 25% protein level showed higher lymphocyte as compared to birds fed with lower protein level 21%. Maximum lymphocyte percentage (32.16) was recorded in blood of female birds fed with feed having 25% protein in contrast 33.33% in blood of male birds fed with same level of dietary protein. 21 % protein level yielded 25.66 and 25.96% lymphocytes in female and male birds at 4th week of age. Similar results were presented by Tollba and Nagar (2008). Payne *et al.* (1990) also reported that low protein diets reduced lymphocyte number in blood circulation and spleen. According to Konashi *et al.* (2000) amino acids deficiencies affected the development of lymphoid organs and production of antibodies in chicken due to which immune response decreased. Interactive effect of strain and dietary protein level remained statistically non-significant on lymphocyte % in blood of both sexes from 4th to 6th week.

Table 5. Effect of strain and dietary protein level on Blood Lymphocytes of Japanese quail during different weeks of age.

Treatment	4th week		5thweek		6thweek	
	Female	Male	Female	Male	Female	Male
A) Strain						
Kaleem	29.00	30.11	29.55	30.11	29.55ab	29.66
Major	29.00	30.11	28.88	29.66	30.44a	30.66
Sadaat	29.22	29.77	28.88	29.88	28.66b	29.88
Zahid	30.00	30.55	28.55	30.11	30.11a	30.22
LSD	NS	NS	NS	NS	0.95	NS
B) Protein level						
21 %	26.00c	26.41c	25.66c	25.91c	26.41c	26.08c
23 %	29.33b	30.25b	29.08b	30.58b	29.58b	30.66b
25 %	32.58a	33.75a	32.16a	33.33a	33.08a	33.58a
LSD	1.16	0.89	1.32	0.74	0.82	0.75
C) Interaction						
A1 X B1	26.00	26.00	26.00	25.66	26.33	25.33
A1 X B2	28.33	30.00	30.00	31.00	29.00	30.00
A1 X B3	32.66	34.33	32.66	33.66	33.33	33.66
A2 X B1	25.33	26.66	25.00	26.00	27.00	26.33
A2 X B2	29.33	30.00	28.66	30.00	30.66	31.00
A2 X B3	32.33	33.66	33.00	33.00	33.66	34.66
A3 X B1	25.66	26.33	25.66	25.33	25.33	26.00
A3 X B2	29.33	30.00	29.33	31.33	28.00	30.66
A3 X B3	32.66	33.00	31.66	33.00	32.66	33.00
A4 X B1	27.00	26.66	26.00	26.66	27.00	26.66
A4 X B2	30.33	31.00	28.33	30.00	30.66	31.00
A4 X B3	32.66	34.00	31.33	33.66	32.66	33.00
LSD	NS	NS	NS	NS	NS	NS
Mean	29.30	30.13	28.97	29.94	29.69	30.11

Means sharing different letters in a column differ significantly at P = 0.05.

LSD: Least significant difference. NS = Non-significant.

Bloodbiochemistry

Cholesterol

Cholesterol in blood of female and male birds at age of 4th to 6th week is presented in Table 6. It is evident from the table that strain affected cholesterol level in blood statistically non-significantly in of both sexes from 4th to 6th week. Dietary protein levels influenced cholesterol level in blood statistically non-significantly in both sexes of quail from 4th to 6th week. However, it ranged from 182.93 to 200.16

mg/dl in female and 179.56to 197.44 mg/dl in male chicks of quail. Some previous researchers have also reported such types of findings (Mossad andIben, 2009).General trend was noted that increasing age increased cholesterol content in blood from 5th to 6th week. This observation was in agreement with Hassan (2010) who also reported an increase in cholesterol level in blood with age. Results also showed that female birds had higher level of blood cholesterol as compared to male birds. It might be due to physiological changes in metabolism of female birds at egg laying stage that increased cholesterol production in liver. It was incorporated in to lipoproteins which are secreted in blood and incorporated into oocytes of ovary. The table 6 also showed that interactive effect of strain and protein was statistically non-significant on cholesterol level in blood of female and male birds from 4th to 6th week of age.

Table 6. Effect of strain and dietary protein level on blood Cholesterol level (mg/dl) of Japanese quail during different weeks of age.

Treatment	4th week		5th week		6th week	
	Female	Male	Female	Male	Female	Male
A) Strain						
Kaleem	190.53	187.41	187.41	190.44	199.97	196.63
Major	192.34	189.21	189.21	190.35	202.96	200.06
Sadaat	191.00	189.37	189.37	190.90	203.84	202.72
Zahid	193.72	189.84	189.84	191.09	203.82	200.09
LSD	NS	NS	NS	NS	NS	NS
B) Protein level						
21 %	182.93	179.56	179.56	184.38	193.59	192.41
23 %	192.60	189.87	189.87	189.32	203.16	198.41
25 %	200.16	197.44	197.44	198.38	211.20	208.80
LSD	NS	NS	NS	NS	NS	NS
C) Interaction						
A1 X B1	179.90	176.32	176.32	183.84	190.20	189.32
A1 X B2	193.30	190.10	190.10	187.37	200.15	195.10
A1 X B3	198.40	195.82	195.82	200.11	209.57	205.47
A2 X B1	180.86	177.86	177.86	185.31	195.89	192.73
A2 X B2	195.86	191.87	191.87	190.28	202.36	197.77
A2 X B3	200.30	197.90	197.90	195.46	210.63	209.67
A3 X B1	182.10	180.53	180.53	182.38	193.42	196.33
A3 X B2	187.40	186.84	186.84	190.89	205.35	201.09
A3 X B3	203.49	200.75	200.75	199.42	212.76	210.75
A4 X B1	188.85	183.52	183.52	185.98	194.83	191.27
A4 X B2	193.85	190.68	190.68	188.75	204.78	199.68
A4 X B3	198.47	195.31	195.31	198.45	211.85	209.31
LSD	NS	NS	NS	NS	NS	NS
Mean	191.90	188.96	188.96	190.69	202.65	199.87

Means sharing different letters in a column differ significantly at P = 0.05

LSD: Least significant difference. NS = Non-significant.

Total Protein

Data regarding total protein level in blood is presented in table 7. The data revealed that total protein level in blood of female and male birds was affected statistically significantly by the genetics of strains at age of 4th to 5th week. Strain Kaleem showed highest 3.25 and 3.10 g/dl protein level in female and male birds, while Major showed lowest protein 2.74, 2.36 g/dl in female and male birds, respectively at 4th week of age. At 5th week Kaleem showed highest protein (3.64 and 2.99 g/dl) and Zahid showed lowest protein (3.05 and 2.66 g/dl) in female and male birds.

This difference in strains might be due to differences in their genetic makeup (Bunchask*et al.*, 2005). At 6th week strain had statistically non-significant effect on total protein of both sexes.

Table 7. Effect of strain and dietary protein level on total protein in blood (g/dl) of Japanese quail during different weeks of age.

Treatment	4th week		5th week		6th week	
	Female	Male	Female	Male	Female	Male
A) Strain						
Kaleem	3.25 a	3.10 a	3.64 a	2.99 a	4.26	3.57
Major	2.74 c	2.36 b	3.28 b	2.72 b	4.08	3.67
Sadaat	3.03 b	2.97 a	3.22 b	2.81 b	3.95	3.53
Zahid	3.15 ab	2.50 b	3.05 b	2.66 b	4.22	3.75
LSD	0.18	0.21	0.23	0.18	NS	NS
B) Protein level						
21 %	2.51 b	2.29 c	2.90 c	2.42 c	3.67 c	3.19 c
23 %	3.23 a	2.81 b	3.24 b	2.88 b	4.19 b	3.68 b
25 %	3.39 a	3.09 a	3.76 a	3.08 a	4.52 a	4.02 a
LSD	0.16	0.18	0.19	0.15	0.23	0.20
C) Interaction						
A1 X B1	2.40 ef	2.21 gh	2.88 ef	2.33 ef	4.05	3.09 f
A1 X B2	3.49 b	3.35 b	3.54 c	3.18 ab	4.35	3.38 def
A1 X B3	3.85 a	3.75 a	4.49 a	3.47 a	4.37	4.26 a
A2 X B1	2.58 de	2.17 gh	2.71 f	2.63 de	3.83	3.05 f
A2 X B2	2.78 cd	2.40 fgh	3.11 de	2.70 d	4.00	3.82 bc
A2 X B3	2.87 cd	2.51 efg	4.02 b	2.84 cd	4.42	4.14 ab
A3 X B1	2.97 c	2.68 def	3.03 def	2.17 f	3.33	3.26 ef
A3 X B2	3.02 c	2.98 cd	3.31 cd	3.05 bc	4.00	3.66 cde
A3 X B3	3.09 c	3.25 bc	3.32 cd	3.21 ab	4.52	3.68 cd
A4 X B1	2.08 f	2.12 h	2.98 def	2.55 de	3.49	3.38 def
A4 X B2	3.63 ab	2.54 efg	2.99 def	2.61 de	4.40	3.88 abc
A4 X B3	3.74 ab	2.86 de	3.20 cde	2.81 cd	4.77	3.99 abc
LSD	0.32	0.36	0.39	0.31	NS	0.40
Mean	3.04	2.73	3.30	2.79	4.13	3.63

Means sharing different letters in a column differ significantly at P = 0.05.

LSD: Least significant difference. NS = Non-significant.

Data also showed that dietary protein level influenced statistically significantly total protein level in blood of both sexes from 4th to 6th week. Highest level of total protein (3.39 and 3.09 g/dl) was observed in blood of birds fed with diet with higher level of dietary protein 25% and lowest total protein (2.51and 2.29 g/dl) was in birds fed on lower level of dietary protein 21% in both sexes at 4th week of age (Table 7). Similar trends

were noted in 5th and 6th week. These findings are strongly confirmed the findings of Mossad and Iben (2009) who also reported that higher level of dietary protein provide higher quantities of essential amino acids. Bunchask*et al.* (2005) also observed that birds fed high protein diet showed higher level of blood total protein.

Female birds showed higher level of total protein than male birds during 4th to 6th week. It might be due to secretion of estrogen hormone at 5th week when birds became sexually mature. Before egg production total protein level in blood increased to meet the requirements of egg laying. Increased protein level was due to increase of yolk precursors, vitelloginin and lipoproteins in blood before egg production (Lumeiji, 1997; Scholtz*et al.*, 2009). The trend in results that increasing age enhanced the total protein level in the blood of bird also confirmed the conclusions of Hassan, 2010.Interactive effects of strain and protein were statistically significant on total protein in blood of both sexes from 4th to 6th week of age. Table indicated that all strains showed similar response. Total protein in blood increased as dietary protein level increased in female and male birds.

Table 8. Effect of strain and dietary protein level on blood Albumin (g/dl) of Japanese quail during different weeks of age.

Treatment	4th week		5th week		6th week	
	Female	Male	Female	Male	Female	Male
A) Strain						
Kaleem	1.60 c	1.29 b	1.35	1.16	1.91	1.53 b
Major	1.91 a	1.62 a	1.33	1.13	1.79	1.53 b
Sadaat	1.53 d	1.32 b	1.22	1.33	1.93	1.25 c
Zahid	1.76 b	1.37 b	1.27	1.18	2.07	1.57 a
LSD	4.08	0.15	NS	NS	NS	5.10
			B) Protein level			
21 %	1.53 c	1.13 c	1.18 b	1.03 b	1.70 b	1.30 c
23 %	1.74 b	1.46 b	1.25 b	1.22 a	1.96 a	1.48 b
25 %	1.83 a	1.60 a	1.44 a	1.36 a	2.11 a	1.63 c
LSD	3.53	0.13	0.10	0.17	0.17	4.42
			C) Interaction			
A1 X B1	1.19k	0.71f	1.25cde	1.04	1.82	1.35d
A1 X B2	1.70f	1.51abc	1.35bcd	1.11	1.94	1.50c
A1 X B3	1.90c	1.66ab	1.46ab	1.35	1.96	1.75a
A2 X B1	1.80e	1.51abc	1.11e	1.10	1.63	1.35d
A2 X B2	1.95b	1.65ab	1.22cde	1.15	1.75	1.50c
A2 X B3	2.00a	1.70a	1.66a	1.15	2.00	1.75a
A3 X B1	1.50j	1.19de	1.19de	0.87	1.62	1.20h
A3 X B2	1.53i	1.31cde	1.23cde	1.50	2.06	1.27g
A3 X B3	1.57h	1.46abc	1.24cde	1.62	2.10	1.28f
A4 X B1	1.63g	1.13e	1.20cde	1.10	1.74	1.31e
A4 X B2	1.80e	1.40bcd	1.21cde	1.13	2.10	1.65b
A4 X B3	1.85d	1.59ab	1.40bc	1.31	2.38	1.75a
LSD	7.06	0.26	0.20	0.34	NS	8.84
Mean	1.70	1.40	1.29	1.20	1.92	1.47

Means sharing different letters in a column differ significantly at P = 0.05

LSD: Least significant difference NS = Non-significant.

Albumin

Strain had statistically significant effect on albumin level in blood of female and male birds at 4th week of age. Major had highest level of albumin in blood (1.91 g/dl) and Sadaat had lowest level (1.53 g/dl) in female birds.In male Major showed highest albumin concentration (1.62 g/dl) and Kaleem showed lowest (1.29 g/dl). At 5thand 6th week strains effects were

non-significanton albumin level of female and male birds. Dietary protein level influenced albumin level in blood statistically significantly of both sexes from 4th to 6th week of age. Table revealed that albumin level was increased when dietary protein level was increased from 21% to 25%. Maximum albumin level was observed in birds fed on diet with 25% protein level and minimum was in birds fed with 21% protein level. Albumin level in blood was higher in female birds as compared to male. In birds total protein consist of albumin and globulin. When total protein increased in blood, albumin and globulin level also increased. Age also affected albumin level in blood. Before egg laying due to secretion of estrogen hormone total protein, albumin and globulin level increased in blood (Scholtz, 2009). Interactive effect of strain and protein was statistically significant on albumin level in blood of female and male birds from 4th to 6th week except female at 6th week. Albumin level was increased as dietary protein level was increased from 21% to 25% in all strains from 4th to 6th week of age.

Table 9. Effect of strain and dietary protein level on Globulin (g/dl) of Japanese quail during different weeks of age.

Treatment	4th week		5thweek		6thweek	
	Female	Male	Female	Male	Female	Male
A) Strain						
Kaleem	1.65a	1.81a	2.28a	1.16	2.30a	2.04c
Major	0.83c	0.74d	1.94ab	1.13	2.29a	2.14bc
Sadaat	1.49b	1.64b	2.00ab	1.33	2.02c	2.28a
Zahid	1.39b	1.13c	1.78b	1.18	2.14b	2.18ab
LSD	0.12	0.09	0.35	NS	0.10	0.13
B) Protein level						
21 %	0.98b	1.16c	1.71b	1.03b	1.96c	1.89c
23 %	1.48a	1.35b	1.98b	1.22a	2.18b	2.21b
25 %	1.55a	1.48a	2.31a	1.36a	2.41a	2.39a
LSD	0.10	0.07	0.30	0.17	0.08	0.11
C) Interaction						
A1 X B1	1.22c	1.49d	1.62c	1.04	2.23bc	1.74e
A1 X B2	1.79a	1.85b	2.19bc	1.11	2.26abc	1.88de
A1 X B3	1.94a	2.08a	3.02a	1.35	2.42a	2.51a
A2 X B1	0.78d	0.66g	1.59c	1.10	2.21c	1.70e
A2 X B2	0.83d	0.75g	1.88bc	1.15	2.25abc	2.32ab
A2 X B3	0.88d	0.80g	2.35b	1.15	2.42a	2.39ab
A3 X B1	1.48b	1.49d	1.85bc	0.87	1.70e	2.06cd
A3 X B2	1.49b	1.67c	2.08bc	1.50	1.93d	2.39ab
A3 X B3	1.52b	1.78bc	2.09bc	1.62	2.42a	2.40ab
A4 X B1	0.46e	0.99f	1.78bc	1.10	1.73a	2.07ad
A4 X B2	1.83a	1.14ef	1.78bc	1.13	2.30abc	2.23bc
A4 X B3	1.89a	1.27e	1.79bc	1.31	2.40ab	2.25bc
LSD	0.21	0.15	0.61	NS	0.17	0.23
Mean	1.34	1.33	2.00	1.20	2.19	2.16

Means sharing different letters in a column differ significantly at P = 0.05

LSD: Least significant difference. NS = Non-significant.

Globulin

Globulin level in blood of both sexes from 4th to 6th week is presented in table 9. It is evident from the table that strain affected globulin level statistically significantly among strains of both sexes from 4th to 6th week except male at 5th week. Highest level of globulin (1.65, 1.81 g/dl) was showed by Kaleem and lowest by Major (0.83, 0.74 g/dl) in female and male

birds at 4th week. At 5th week in female birds highest level of globulin was showed by Kaleem (2.28 g/dl) and lowestZahid (1.78 g/dl) and in male strain affected statistically non-significantly globulin level. At 6th week maximum level of globulin was showed by Kaleem (2.30 g/dl) and lowest was by Sadaat (2.02 g/dl) in female and in male maximum globulin level was observed by Sadaat (2.28 g/dl) and lowest (2.04 g/dl) was by Kaleem (Table 9). These differences among strains might be due to differences in their genetic makeup of different strains (Bunchasak*et al.*, 2005).Interactive effects of strain and protein had statistically significant effect on globulin level in female and male birds from 4th to 6th week of age. As dietary protein level was increased, globulin level of both sexes was also increased. Globulin level in blood was increased as the dietary protein level was increased in female and male birds. Diets with high protein levels provide essential and non-essential amino acids for synthesis of globulin protein. Globulin level in blood increased as dietary protein level increased it has been confirmed by previous scientists (Tewe, 1985; Eggum, 1989; Bunchasak *et al.*, 2005).

Conclusion

Close bread flocks of Japanese quail did not differ significantly in haematological parameters and blood cholesterol level from 4th to 6th week in both sexes. However, strains differ in total protein, albumin and globulin content in blood. Dietary protein level significantly affected most of haematological and biochemical parameters of blood. Highest protein level (25%) showed best performance in all the parameters except hemoglobin and cholesterol level. It is concluded that 25% protein level in feed is best for rearing of Japanese quail for meat purpose in tropics.

Acknowledgment

We are thankful to Higher Education Commission of Pakistan for providing financial support. We also acknowledge the support of Prof. Dr. Muhammad Akram(Late) InchargeAvian Research Centre, University of Veterinary and Animal Sciences, Lahore for providing us guidance and Farm facilities.

References

Alam MS, Ahmad N, Miah MA, Islam R. 2004. Effect of supplemented dietary protein on certain hematological values and meat yield characteristics of broiler birds. Bangladesh Journal of Veterinary Medicine **2,** 121-123. http://dx.doi.org/10.3329/bjvm.v2i2.2543

Ali MA, Hmar L, Devi LI, Prava M, Lallianchhunga MC, Tolenkhomba TC. 2012. Effect of age on the haematological and biochemical profile of Japanese quail (Coturnixcoturnix japonica). International Multidisciplinary Research Journal **2,** 32-35. http://hdl.handle.net/123456789/6057

Benjamin MM. 1978. Outline of Veterinary Clinical Pathalogy.3rd Ed., The lowa State University Press, USA. http://www.cabdirect.org/abstracts/19792237048.html

Bunchasak C, Poosuwan K, Nukrae wR. 2005. Effect of Dietary protein on egg production and immunity responses of laying hens during peak production period. International Journal of Poultry Science **4,** 701-708 http://www.pjbs.org/ijps/fin445.pdf.

Cheema MA, Qureshi MA, Havenstein GB. 2003. A comparison of the immune profile of commercial broiler strains when raised on marginal and high protein diets. International Journal of Poultry Science **5,** 300-312. http://www.pjbs.org/ijps/fin108.pdf

Church JP, Young JT, Kebau CW, Kebay JC, Ken WW. 1984. Relationships among dietary constituents and specific serum clinical components of subjects eating self-selected diets. American Journal of Clinical Nutrition **40,** 1338 – 1344. http://ajcn.nutrition.org/content/40/6/1338.full.pdf

Edoziem JC, Switzer BR. 1977. Effects of dietary protein, fat and energy on blood haemoglobin and haematocrit in rat. Journal of Nutrition **107,** 1016–1021.
http://jn.nutrition.org/content/107/6/1016.full.pdf

Eggum BO. 1970. The protein quality of cassava leaves. British Journal of Nutrition **24,** 761-768.
http://dx.doi.org/10.1079/BJN19700078

Elaroussi MA, Fattah MA, Meky NH, Ezzat IE, Wakwak MM. 2007. Effects of vitamin E, age and sex on performance of Japanese quail. 1. Haematological indices and liver function. British journal of Poultry Science**48,** 669-677.
http://dx.doi.org/10.1080/00071660701687688

Hassan HMA, Abd-Elsamee MO, El-Sherbiny AE, Samy A, Mohamed MA. 2011. Effect of protein level and avizyme supplementation on performance, carcass characteristics and nitrogen excretion of broiler chicks. American- Eurasian Journal of Agriculture and Environmental Science **10,**551-560.

Iyayi EA, Tewe OO. 1998. Serum total protein, urea and creatinine levels as indices of quality of cassava diets for pigs. Tropical Veterinary medicine **16,** 59-67.

Kermanshahi H, Ziaei N, Pilevar N. 2011. Effect of dietary crude protein fluctuation on performance, blood Parameters and nutrients retention in broiler chicken during starter period.Journal Global Veterinaria **6,** 162-167.
http://profdoc.um.ac.ir/articles/a/1027439.pdf

KonashiS, TakahashiI, Akiba Y. 2000. Effects of dietary essential amino acid deficiencies on immunological variables in broiler chickens, British Journal of Nutrition **83,** 499-456.

Lumeij JT. 1997. Avian clinical biochemistry. In Kaneko JJ, Harvey JW, Bruss ML. Ed. Clinical Biochemistry of Domestic Animals.Academic Press, San Diego, CA, 857–883 P.

Mosaad GMM, Iben C. 2009. Effect of dietary energy and protein levels on growth performance, carcass yield and some blood constituents of Japanese quails *(Coturnixcoturnix Japonica).* Die Bodenkultur**60,**39-46.
https://diebodenkultur.boku.ac.at/volltexte/band-60/heft-4/mosaad.pdf

Natt PM, Herrick CA. 1952. A new blood diluent for counting the erythrocytes and leucocytes of chicken. Journal of Poultry Science **31,** 755-58.
http://dx.doi.org/10.3382/ps.0310735

Nirmalan GP, Robinson GA. 1971. Haematology of the Japanese quail (Coturnixcoturnix japonica). British Journal of Poultry Science **12,** 475-481.
http://dx.doi.org/10.1080/00071667108415903

Payne CJ, Scott TR, Dick JW, Glick B. 1990. Immunity to *Pasteurellamultocida*in protein deficient chickens. Poultry Science **69,** 2134-2142.
http://dx.doi.org/10.3382/ps.0692134

Scholtz N, Halle I, Flachowsky G, Sauerwein H. 2009. Serum chemistry reference values in adult Japanese quail (*Coturnixcoturnix japonica*) including sex-related differences.Poultry Science **88,** 1186–1190.
http://dx.doi.org/10.3382/ps.2008.00546

Swennen Q, Janssens GPJ, Millet S, Vansant G, Decuypere E, Buyse J. 2005. Effects of substitution between fat and protein on feed intake and its regulatory mechanisms in broiler chickens: Endocrine functioning and intermediary metabolism. Poultry Science**84,**1051-1057.
http://dx.doi.org/10.3382/ps.069213410.1093/ps/84.7.1051

Steel RGD, Torrie JH, Dickey D. 1997. Principles and Procedure of Statistics. A Biometrical Approach 3rd Ed. McGraw Hill BookCo. Inc., New York. 352-358 P.

Tewe OO. 1985. Protein metabolism in growing pigs

fed corn or cassava peel based diets containing graded protein levels. Research of Veterinary Science **29,** 259-66.

Tollba AAH, El-Nagar AHI. 2008. Increasing stocking density of Egyptian laying hens by using: 3- Increasing protein level & Betaine supplementation.Egypt Journal of Poultry Science **28,** 745-766.