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Growth Performance and Haemato-biochemical Parameters of Different Breeds of Rural Chickens

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ABSTRACT

A total of 2000 un-sexed day-old-chicks of each Desi, Fayoumi and Rhode Island Red (RIR) breeds were reared and maintained on deep litter system for a period of 20 weeks. In floor pens, each breed was reared separately in a single pen until 7 weeks of age when the 2000 birds had been randomly distributed between pens, with 21 to 24 birds of the same breed per pen (2.00 to 2.50 ft^2/bird). The results had revealed that the average day old weight was the highest in RIR, intermediate in Desi and lowest in Fayoumi. The RIR breed had consumed more feed and therefore, gained the highest ($P<0.05$) weight gain than as compared to those of Desi and Fayoumi breeds at all ages of growing phase. The feed conversion was best ($P<0.05$) in RIR and lowest in Desi breed. Desi and Fayoumi chicks had a lower ($P<0.05$) mortality than the RIR breed chicks. The meat composition was found to be insignificant ($P>0.05$) amongst the three breeds. There was no significant ($P>0.05$) difference in blood glucose, triglyceride, cholesterol, calcium, protein, uric acid and alkaline phosphatase values amongst the three breeds. There was also no significant ($P>0.05$) difference in hematological values among all breeds. The total erythrocyte count, hemoglobin and packed cell volume increased with the advancement of age. However, erythrocyte sedimentation rate, mean corpuscular volume and mean corpuscular hemoglobin values decreased gradually with the advancement of age. It may be concluded that overall, RIR chickens had performed better than Fayoumi and Desi chickens. However, a lower mortality rate had been observed in Desi chickens.

Key words: Rural chicken, Body weight, Feed intake, Meat composition, Biochemical parameter

INTRODUCTION

Broiler chicken is an important protein source for human consumption, it also plays a major role in poverty alleviation, ensuring food security and generating family income at households within substandard management facilities (Islam et al., 2012). Over the past 50 years, poultry meat and egg production from individual birds in commercial flocks of broilers and layers has increased enormously, largely owing to genetic selection in the nucleus breeding flocks of poultry breeding companies and the rapid transfer of these gains to the commercial crossbred progeny. It should be also maintained that, the current breeding strategies for commercial poultry concentrate on specialized production lines, derived by intense selection from a few breeds and very large populations with a great genetic uniformity of the traits under selection (Padhi, 2016; Khawaja et al., 2016). This has resulted in genetic erosion for the unselected local breeds, which are normally less productive than synthetic hybrids (Besbes et al., 2008). The rural poultry population in most countries accounts for more than 60% of the total national poultry population (Özdemir et al., 2013). However, inadequate attention has been paid either to the evaluation of these resources or to the setting up of realistic and optimized breeding goals for their improvement. As a result, many such breeds with low productivity are at a high risk of extinction under rural production systems (FAO, 2011; Hoffmann, 2011).

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In Pakistan, prior to the establishment of the commercial poultry sector, rural poultry was the only source of eggs and meat supply. Although, commercial poultry sector has expanded with a rapid speed during the last three decades and highly productive birds have been imported for boosting production, yet rural poultry has not lost its value. Its importance can be judged from the fact that according to Livestock Wing of Ministry of Food, Agriculture and Livestock almost every family in rural areas and every one out of five families in urban areas have been associated with poultry production activities in various ways in the country (Government of Pakistan, 2012-2013). Meat contribution of rural poultry during 2012-13 was 0.109 million tons as compared to 9.912 million tons from commercial poultry production (Economic Survey 2012 and 2013). Keeping in view the very low cost of producing rural poultry, the net return from rural poultry could be several times more than that of birds produced on commercial scale. The contribution of rural poultry to household economy could be further enhanced through the genetic improvement of rural birds, in addition to their feeding, management and health status.

The indigenous birds maintained by the rural peoples are locally known as "Desi" and have been reported to gain 374.72 g of body weight at eight weeks of age (Khawaja et al. 2012a). The Fayoumi breed has been introduced in Pakistan since 1980 and is well adapted to local environmental conditions. This breed is known to gain about 364.10 g of body weight at eight weeks of age (Khawaja et al. 2012a). Due to its calm character and strong immunity against common diseases, farmers keep this breed at their homes and at farms (Rajput et al., 2005). Among the breeds imported in Pakistan, Rhode Island Red (RIR) has gained more popularity than the others due to its heavy growth rate i.e. 483.30g at eight weeks of age (Khawaja et al., 2012a). Moreover, its long stay in Pakistan has made it well adapted to the local environmental condition. Basically it is a dual purpose breed of American class and is getting more popularity in rural areas as "Golden birds" (Ashraf et al., 2003).

Desi, Fayoumi and RIR poultry breeds are being reared by the rural people of Pakistan indiscriminately and very little information is available with respect to growth of these breeds. Likewise, the literature on hematological and serum biochemical values of Desi, Fayoumi and RIR indigenous birds during the growing phase is also limited. Therefore, this study was planned to compare the growth performance and blood parameters of Desi, Fayoumi and RIR breeds to examine the best potential breed under local environmental conditions of Pakistan.

MATERIALS AND METHODS

Ethical approval

Bird ethics committee, poultry research institute, Rawalpindi, Pakistan, approved the protocol and conducting of the study.

Birds, management and experimental feed

A total of 2000 un-sexed day- old-chicks of each Desi, Fayoumi and RIR breed were obtained from hatchery of Poultry Research Institute, Rawalpindi, Pakistan. The birds were maintained in floor pens on deep litter system for a period of 20 weeks. In floor pens, each breed was reared separately in a single pen until seven weeks of age when 2000 birds were randomly distributed between pens, with 21 to 24 birds of the same breed per pen (2 to 2.50 ft^2/bird). Birds were fed manually and fresh water was made available around the clock. Nutrient content of the feed (Table 1) followed by recommendations of the NRC (1994). All birds were provided with nine hours of light per day, which was increased to 14 hours at 18 weeks with an intensity of five lux throughout. Temperature and relative humidity were between 21 to 23°C and 70%, respectively. All birds were vaccinated following a program typical of the region. Care and management of the birds followed accepted guidelines (FASS, 2010).

Table 1. Ingredients and nutrients (%) composition of diets fed to experimental birds

Dietary ingredients	Week 1 to 8	Week 9-20
Corn	35.60	42.00
Rice	23.00	12.00
Rice polish	10.00	9.48
Soyabean meal	10.00	16.00
Canola meal	8.00	6.40
Corn gluten meal (60%)	5.00	5.00
Fish meal	5.00	5.00
Lime stone	1.50	2.00
DCP	1.25	1.50
NaCl	0.33	0.27
Premix*	0.25	0.30
DL- Methionine	0.07	0.05
Total	100.00	100.00
Calculated Nutrients (%)		
ME Kcal/kg	2800	2800
CP	18.5	17
CF	3.80	4.30
EE	3.31	3.30
Ca	1.0	2.5
Available P	0.56	0.51
Lysine	1.00	0.69
Methionine	0.43	0.31

*Supplied per Kg of diet: vitamin A, 12000 IU; vitamin D3, 2200 IU; vitamin E, 10mg; vitamin K3 2mg; Vitamin B1, 1mg; vitamin B2, 5mg; vitamin B6, 1.5mg; vitamin B12, 0.01mg; Nicotinic acid, 30mg; Folic acid, 1mg; Pantothenic acid, 10mg; Biotin, 0.05mg; Choline chloride, 500mg; Copper, 10mg; Iron, 30mg; Manganese, 60mg; Zinc, 50mg; Iodine, 1mg; Selenium, 0.1mg and Cobalt, 0.1mg.

Parameter measured

The growth performance data (initial body weight, final body weight, feed intake, and feed conversion) were recorded at seven days (d) intervals. Mortality was also recorded in the rearing period. At the age of 12 and 20 weeks, meat samples of each breed from different birds were taken, dried, grounded and then subjected to proximate analysis such as percentage dry matter, crude protein, fat and total ash. Samples were analyzed using standard methods (AOAC, 2011).

Blood samples were collected from 20 birds of each breed at the age of 4, 12 and 20 weeks old and analyzed for the estimation of biochemical parameters such as glucose, triglyceride, cholesterol, calcium, protein, uric acid and Alkaline Phosphatase (ALP) and haematological parameters. For this purpose, 5 mls of blood was drawn from the brachial vein into dry clean centrifuge tubes and immediately centrifuged at 3000 rpm for 15 min. for separating serum. These samples were taken in the morning before feeding (between 8:00 to 10:00 hrs). Serum samples were stored at -20^{o} C till time of chemical analysis. Samples were then analyzed at feed testing laboratory, Poultry Research Institute, Rawalpindi. The biochemical characteristics of blood were determined calorimetrically on UV visible spectrophotometer using commercial kits and diagnostic examinations. Total protein was quantitatively measured based on colorimetric determination as described by Cannon (1974). Glucose concentration was quantitatively measured based on enzymatic colorimetric method (Trinder, 1969). Total cholesterol concentration was quantitatively determined based on enzymatic colorimetric method of Allain et al. (1974). The uric acid was determined by the method of Bergman and Shabtay (1954) through the absorbency of the supernatant at 290 mu. The activity of ALP was determined by the method described by Bergmeyer and Wanlefeld (1980). Samples (10 µl) were incubated in alkaline buffer-substrate solution (50 mM glycine and 5.5 mM p-nitrophenylphosphate (pNPP), pH10.5) for 30 minutes at 37^{o} C. The reaction was terminated by adding 0.02 M NaOH and ALP activity was determined as directly proportional to the amount of yellow pNPP anion liberated per unit time at 405 nm.

The anti-coagulated blood was also used to determine Red Blood Cell (RBC) count, Packed Cell Volume (PCV), Hemoglobin (Hb) concentration, and White Blood Cell (WBC) count. Differential WBC counts were made on monolayer blood films, fixed and stained with Giemsa-Wright's stain. Total RBC and total WBC count were determined manually by method using hemacytometer (Campbell, 1995). Packed cell volume was measured by a standard manual technique using microhematocrit capillary tubes centrifuged at 2500 rpm for 5 min. Hemoglobin concentration was measured by cyanmethemoglobin method. Erythrocyte indices i.e. Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentrations (MCHC) were calculated from total RBC, PCV and Hb (Ritchie et al., 1994), respectively.

Statistical analysis

All data were determined by using the SPSS version 16, statistical analysis program. P-value of <0.05 was considered for significant differences among groups and the comparison of means was made by using Duncan's Multiple Range Test (Steel and Torrie, 1984).

RESULTS

Performance of rural chickens

The growth performance, mortality and meat composition of Desi, Fayoumi and RIR breeds during growing phase is shown in Table 2. The average day old weight was the highest in RIR (32.79g), intermediate in Desi (30.57g) and lowest in Fayoumi (27.09g). RIR breed consumed more feed and had gained the maximum ($P<0.05$) weight as compared with those of Desi and Fayoumi breeds at all ages of growing phase, which could be explained for the variation in genotype. Similarly, there was also significant variation ($P<0.05$) in feed intake among the Desi, Fayoumi and RIR chickens during growing phase. Desi breed consumed more feed, followed by RIR and Fayoumi chickens. The feed conversion was significantly poor ($P<0.05$) in Desi while it was better ($P<0.05$) in RIR breed. During the period of the 11-20 weeks feed conversion of birds seems to be better than the period of the 0-10 weeks. The results have shown that Desi and Fayoumi chicks had lowest ($P<0.05$) mortality. The mortality during the rearing period (0-10 weeks) was higher than the growing period (11-20 weeks) in all three breeds. The meat composition had shown no-significance ($P>0.05$) difference among three breeds at 12 and 20 weeks of age.

Haemato-biochemical Parameters of rural chickens

The biochemical values in all of the three breeds are shown in Table 3. There was no significant ($P>0.05$) difference in the biochemical values among three breeds. The hematological values in three rural breeds have been depicted in Table 4. There was non-significant ($P>0.05$) difference in hematological values amongst three breeds.

It is revealed from the present findings that Total Erythrocyte Counter (TEC), Hb and PCV increased with the advancement of age, being lowest in 4 weeks and highest in 20 weeks of age. However, Erythrocyte Sedimentation Rate (ESR), MCV and MCH values decreased gradually with the advancement of age. Values of ESR in Desi, Fayoumi and RIR are inversely related with age.

Table 2. Comparative growth performance and meat composition of Desi, Fayoumi and Rhode Island Red chickens during brooding and growing periods (up to 20 weeks)

Parameters	Age (Weeks)	Breeds			P-value
		Desi	Fayoumi	Rhode Island Red	
Day old weight (g/bird)	--	30.57±0.22[a]	27.09±0.30[b]	32.79±0.38[a]	0.050
Body weight (g)	0-10	577.54±9.05[b]	547.25±7.73[c]	673.75±11.65[a]	0.001
	11-20	710.79±10.25[b]	638.39±8.86[b]	1012.61±17.21[a]	0.000
	0-20	1288.33±15.15[b]	1185.64±9.16[c]	1686.36±21.36[a]	0.000
Body weight gain (g/bird)	0-10	546.97±3.25[b]	520.16±2.56[c]	640.96±4.75[a]	0.014
	11-20	680.22±5.11[b]	611.31±3.98[c]	979.82±7.47[a]	0.002
	0-20	1257.76±4.52[b]	1158.55±3.69[c]	1653.57±5.15[a]	0.003
Average feed intake (g/bird)	0-10	4308.44±11.35[a]	3507.87±9.54[b]	3490.02±8.47[c]	0.003
	11-20	3376.25±8.96[b]	2687.62±10.58[c]	3787.16±9.67[a]	0.025
	0-20	7858.81±148.32[a]	6177.18±110.25[c]	7521.16±201.74[b]	0.000
Feed conversion	0-10	7.48±0.17[a]	6.41±0.22[a]	5.18±0.15[b]	0.000
	11-20	4.75±0.21[a]	4.21±0.18[b]	3.74±0.29[c]	0.001
	0-20	6.21±0.66[a]	5.21±0.15[b]	4.46±0.31[c]	0.001
Mortality (%)	0-10	2.01±0.04[c]	3.34±0.07[b]	6.53±0.11[a]	0.030
	11-20	1.87±0.03[b]	1.88±0.02[b]	3.35±0.08[a]	0.000
	0-20	3.87±0.05[c]	5.09±0.05[b]	9.31±0.19[a]	0.001
Meat Composition (%)					
Dry matter	12	25.13±0.12	25.45±0.15	24.82±0.17	0.140
Crude Protein	12	79.87±2.56	78.37±1.99	81.37±4.57	0.146
Crude fat	12	11.64±0.60	9.95±0.34	13.33±1.28	0.170
Total ash	12	4.52±0.05	4.55±0.02	4.50±0.12	0.150
Dry matter	20	26.18±0.11	25.52±0.19	26.85±0.24	0.164
Crude Protein	20	81.64±1.98	81.81±3.54	81.46±2.87	0.180
Crude fat	20	10.21±0.29	9.63±0.18	10.79±0.47	0.165
Total ash	20	3.93±0.10	3.79±0.09	4.08±0.15	0.189

[a-c]Means with different letters differ significantly (P □ 0.05)

Table 3. Mean values of serum glucose, triglyceride, cholesterol, calcium, protein, uric acid and alkaline phosphatase in Desi, Fayoumi and Rhode Island Red chickens at 20 weeks old

Parameters	Breeds			[†]Reference	P-Value
	Desi	Fayoumi	Rhode Island Red		
Glucose (mg/dl)	219.52±2.45	217.47±1.63	210.55±3.54	197-299	0.600
Triglycerides (mg/dl)	513.87±5.21	522.36±3.57	535.69±5.78	-	0.650
Cholesterol (mg/dl)	106.36±0.98	107.22±0.61	109.21±1.59	129-297	0.800
Calcium (mg/dl)	10.03±0.23	10.10±0.19	10.52±0.36	8.1-12	0.510
Protein (mg/dl)	5.10±0.08	4.99±0.10	5.25±0.15	3.0-4.9	0.475
Uric acid (mg/dl)	4.61±0.11	4.49±0.17	4.23±0.24	1.9-12.5	0.600
ALP (u/l)	1041.40±17.52	1054.12±12.22	1051.54±25.45	10-106	0.800

[†]Reference values of Clinical Diagnostic Division (1990)

Table 4. Normal haematological parameters in breeds of Desi, Fayoumi and Rhode Island Red breed during 4, 12 and 20 weeks of age

Parameter	Breed	Age (Weeks)		
		4	12	20
TEC (106/mm3)	Desi	1.75±0.05	1.79±0.06	2.40±0.10
	Fayoumi	2.59±0.05	3.22±0.09	3.36±0.07
	RIR	1.80±0.20	1.97±0.04	2.61±0.15
Hb concentration (gm%)	Desi	7.70±0.17	7.73±0.15	8.54±0.14
	Fayoumi	7.00±0.50	7.62±0.10	7.84±0.16
	RIR	8.03±0.17	8.10±0.09	9.24±0.18
PCV (%)	Desi	27.63±1.12	28.26±0.55	31.15±0.67
	Fayoumi	26.46±0.61	27.28±0.40	28.00±0.60
	RIR	28.02±0.44	29.00±0.46	29.10±1.10
ESR in mm in 1st hour	Desi	1.06±0.01	0.76±0.01	0.31±0.01
	Fayoumi	3.15±0.16	2.42±0.13	2.04±0.11
	RIR	3.48±0.10	3.02±0.24	2.73±0.21
MCV (cubic micron)	Desi	166.55±6.24	163.0±2.60	128.45±7.90
	Fayoumi	103.66±2.20	86.00±1.54	84.00±1.64
	RIR	164.21±11.86	150.43±9.60	113.00±5.13
MCH (micro- micro gram or pictogram)	Desi	45.61±0.85	44.68±0.31	35.33±1.24
	Fayoumi	27.75±0.34	24.22±0.42	23.76±0.09
	RIR	48.16±8.46	43.33±2.50	35.48±1.77
MCHC (%)	Desi	27.90±1.11	27.33±0.70	27.49±0.32
	Fayoumi	26.58±0.40	28.09±0.47	28.16±0.62
	RIR	29.26±0.98	28.72±0.11	31.33±1.12

TEC= Erythrocyte Nnumber; Hb= Hemoglubin; PCV= Packed Cell Volume; ESR= Erythrocyte Sedimentation Rate; MCV= Mean Corpuscular Volume; MCH= Mean Corpuscular Hemoglobin and MCHC= Mean corpuscular hemoglobin concentration

DISCUSSION

Performance of rural chickens

The average day old body weight of RIR, Desi and Fayoumi was recorded as 32.79, 30.57 and 27.09g, respectively. A similar trend had been observed by Farooq et al. (2001) and Khawaja et al. (2012a), who reported higher day-old chick weight in RIR (35.32 and 31.30g, respectively), in comparison to Desi (33.84 and 25.90g, respectively) and Fayoumi chicken (30.74 and 20.90g, respectively). Similarly, Yeasmin and Howlider (2013) indicated that live weight at hatching averaged 34.0 and 36.1 g for the Fayoumi and RIR, with insignificant sex difference for the two breeds. Recently, Kumar et al. (2014) had reported that the RIR had significantly ($p<0.05$) higher mean day old body weight (35.42±1.14 g) than that of 31.82±0.85g for Bovans White. The higher weight of newborn chicks of RIR could probably be due to the larger egg size.

This study showed that the Desi breed consumed more feed, followed by RIR and Fayoumi chickens. Kumar et al. (2014) had reported that the RIR had significantly ($p<0.05$) higher mean final body weight (1350±33.76g) and body weight gain (1314±31.77g) than those of 1220±36.55g and 1188±35.45g for Bovans White, respectively at 22 weeks of age. The values of body weight of RIR in above study have been lower than the current study. The results showing low body weight gain in Desi birds than RIR are in line with the findings of Sahota and Bhatti (2001), who had observed lower body weight gain in Desi in comparison to RIR and White Leghorn chicks at 8 weeks of age. Halima et al. (2006) reported that day old weight, final body weight, body weight gain and mortality rate in RIR were 35.2g, 1394g, 1359g and 18.3%, respectively. In the current experiment, day old weight and mortality rate of RIR was lower (32.79g and 9.31%, respectively) than the above study, however, final body weight (1686g), and body weight gain (1653.57g) were noted to have been higher than the above study. The poor growth rate in Desi chickens, as observed in the present study, could be attributed to genetic built up of the birds. Recently, Dutta et al. (2012) reported that initial and final weight of Fayoumi chickens at day old to five weeks of age were 32.1g and 359.5g, respectively. Day old weight is higher than the present study. All three breeds had poor feed utilization, the

Fayoumi consumed 255 g more feed per kg of body weight than the White Leghorn and RIR. The difference in growth rate of chicken is due to interplay of multiple genes and this trait could be improved through genetic selection (Khawaja et al., 2012b). These differences in body weight could also be attributed to environmental conditions such as seasons, temperature, humidity and management.

Feed conversion of birds during the period of the 11-20 weeks was found to have been better than the period of the 0-10 weeks. A probable explanation is that with the increase of the age of the birds, their activity and making voice loudly also increases, which requires more maintenance energy. Due to that, birds may utilize the feed more efficiently (Khawaja et al., 2012a). Haque et al. (1999) found that feed conversion ratio was at 5.7 and 4.9 for Fayoumi and RIR, respectively in a group of three male and 20 females during the 6 to 17 weeks which is almost similar in the present study.

The lowest mortality was recorded for Desi and Fayoumi chicks. These results are in accordance with Parveen et al. (2013), who had reported that higher mortality had been observed in RIR (16.50%) than Fayoumi (10.76%) and Desi chicken (6.78%) under field conditions. The lower mortality in these chickens could be attributed to the better adaptability of these chickens to the local environment and lower growth rate. In this study, the mortality during the rearing period was higher than growing period in all breeds; thus further improvement in the managerial practices is necessary in order to reduce the mortality among the chicks, regarding the fact that no particular infectious disease was reported during the experimental period. In Bangladesh, the mortality of different exotic breeds (Lohmann Brown, RIR and Fayomi) under semi-scavenging conditions was at 27.6, 32.6 and 25.2%, respectively (FAO, 2005). Recently, Tadesse (2014) had reported that the average annual mortality of chicks was about 3.98% for local, 3.7% for cross breed and 3.2% for exotic breed chicks under field condition. Average mortality of growers (birds with 2 to 6 months of age) was set at 1.97% per year for local birds, 2.3% for cross breeds and 2.2% for exotic breeds. He explained that poor protection from adverse climatic conditions (very hot and cold weather) increased the severity of disease outbreaks resulting in losses of up to 70% of the flock at 12 weeks of age in field condition.

Reports regarding meat composition in rural chicken are rare in literature for the comparison to the present composition. These results are in line with the findings of Haunshi et al. (2013) who had reported that no significant difference had been observed in meat composition of Aseel and Kadaknath rural breeds at 10 and 20 weeks of age. Similarly, Khawaja et al. (2012b) reported that meat composition had no significant ($P>0.05$) difference among pure (RIR and Fayumi) and crossbred chickens at 20 weeks of age. Poultry meat quality may be affected by several factors such as genotype, rearing condition and feeding that have an impact on muscle metabolism as well as on chemical composition. Fanatico et al. (2005) studied slow- , medium- and fast-growing genotypes raised outdoor and slaughtered at similar live weights and found no significant differences among genotypes as for dry matter, fat and ash even if slow-growing birds were numerically lower in fat. In thigh meat the differences in fat content were more relevant than in the breast, with slow growing birds showing half of the content as opposed to fast growing. Tougan et al. (2013) reported that chicken meat quality is strongly affected by genotype whereas feeding exerts a minor effect. The appropriate choice of genotype seems to play a very important role in the quality of organic chicken products.

Haemato-biochemical parameters of rural chickens

The mean values of serum glucose (219.52 mg/dl), triglyceride (513.87mg/dl), uric acid (4.61mg/dl) and total protein (5.10mg/dl) in Desi birds in the present study are close to findings of Khawaja et al. (2012a), who had reported that serum glucose (221.80mg/dl), triglyceride (528.0mg/dl), uric acid (4.75mg/dl) and total protein (5.23mg/dl) in Desi birds. Elagib et al. (2012) reported that overall mean of total protein, uric acid and cholesterol in three Sudani chickens (Betwil, Bare Neck and Large Beladi) were found as 4.27, 7.42 and 99.97mg/dl, respectively, which are close to the values of the current study except for uric acid value tending to be higher.

Bhatti et al. (2002) reported that serum cholesterol level in different strains [Desi, Fayoumi, Crossbred (RIRxFayoumi) and Naked Neck)] during pre- and post-laying period was same which implies that laying condition did not exert any extra demand on cholesterol bio-synthesis and its release in the blood circulation. In the present study, serum cholesterol of Desi, Fayoumi and RIR chickens was found within range of reference (Clinical Diagnostic Division, 1990). However, these values were lower than the values reported in crossbred (RIR male × Fayoumi female) cockerels (187.80 mg/dl) at 12 weeks of age by Khan et al. (2011).

In the process of egg formation, the availability of dietary calcium (Ca) is critical. Ovulating hens have significantly higher Ca levels than non-reproductive females (Ritchie et al., 1994). This agrees with Elagib et

al. (2012), who compared the levels of serum calcium of Sudanese rural chickens as 14.3, 14.72 and 14.48 mg/dl for Betwil, Bare Neck and Large Beladi, respectively. There was no differenece in Ca level among three breeds at laying stage in the present experiment. The birds were found to be equally affected by the stage of egg laying during which there was mobilization of Ca for shell formation. In the current experiment, the serum Ca level of three rural chickens was lower than domestic turkey (11.7-38.7 mg/dl), domestic fowl (13.2-23.7 mg/dl) and bobwhite quail (14.1-15.4 mg/dl) (Ritchie et al., 1994).

Total protein level in three rural chickens used in this study was higher (4.99-5.25mg/dl) than the reference range i.e. 3.0-4.90mg/dl (Clinical Diagnostic Division, 1990). In female birds, a considerable increase in total protein concentration occurs just prior to egg laying, which could be recognized to an estrogen-induced increase in globulins. The proteins were the yolk precursors (vitellogenin and lipoproteins), which were synthesized in the liver and transported via the plasma to the ovary where they were incorporated in the oocytes (Ritchie et al., 1994). Moreover, total proteins of hens in three chickens were lower than the normal range of the domestic turkey (5.29-7.6 mg/dl) and pheasant (male=5.65 mg/dl; female=6.06 mg/dl), but higher than the normal range of the guinea fowl (3.5-4.4 mg/dl) and common quail (3.4-3.6 mg/dl) (Ritchie et al., 1994).

In birds, uric acid is a major product of the catabolism of nitrogen, being the end product of protein/amino acid metabolism, indicates similar rate of protein/amino acid metabolism in different bird groups though genetically different (Elagib et al., 2012). Age and diet may influence the concentration of blood uric acid in birds. The uric acid values (4.23-4.61mg/dl) of three chickens in the present study are close to the values (4.16-4.63 mg/dl) determined by Bhatti et al. (2001) in Desi and Naked Neck hens. However, these values are lower than the values (7.425mg/dl) resolute by Elagib et al. (2012) in Sudanese rural chickens.

During the egg shell formation process, there is an increase in activity of ALP in the blood of laying hens (Khawaja et al., 2013) due to the calcification process. The ALP value quantitatively was lower in Desi chicken (1041.40u/l) than Fayoumi (1054.12u/l) and RIR (1051.54u/l). These results are in line with the findings of Bhatti et al. (2002), who had found lower ALP values in Desi chicken (841.51u/l) than in Fayoumi (1653.04u/l) and crossbred (RIRxFayoumi) chickens (1656.5u/l). Khawaja et al. (2013) reported that the average value of ALP (1100u/l) in crossbred chickens of RIR and Fayoumi is very close to the values of present study.

Higher ESR at early age in this study was in accordance with those of Khawaja et al. (2012a). MCV values in this study for Fayoumi are lower than Desi and RIR. Similar results were reported by Khawaja et al. (2012a). Similarly, Mean Corpuscular Hemoglobin Concentrations values are similar with those quoted by Khawaja et al. (2012a). Haematological parameters in birds have been shown to be influenced by various factors such as age, sex, season and nutrition. In general haematological parameters are affected by diurnal fluctuations or changes in daily physical and metabolic activities (Piccione et al., 2005).

CONCLUSION

It can be concluded that overall, the RIR chicken performed better than Fayoumi and Desi chickens. However, a lower mortality rate had been noticed in Desi chicken. One of the most important positive characters of rural chicken is their hardiness, which is ability to tolerate the harsh environmental condition and poor husbandry practices without much loss in production. It was suggested that the low production performance of rural breeds of chickens may be improved through improvement in husbandry practices, better healthcare and also through selection and crossbreeding. Upgradation of such rural breeds of chickens through different breeding technique helps to increase the productivity of the germplasm and also their conservation in their natural habitat as the rural people will be very happy to rear them for their adoptability to harsh environment.

Competing interests

The authors declare that they have no competing interests.

Author`s contributions

Abida Parveen, Tabinda Khawaja, Naveed Iftikhar and Saira Khan deigned and performed the experiment. Sohail Hassan Khan analyzed data and wrote the manuscript.

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