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RESEARCH ARTICLE

A comparative study of some hematological parameters of broiler and indigenous breeds of poultry

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Abstract

The investigational trials were conducted on day-old, total ninety chicks of broilers and indigenous (IND) poultry breeds in controlled conditions to analyze some hematological parameters. Water and basal diet were provided *ad libitum*. The experiment was carried out for 20 weeks. A total of 40 blood samples 20 for each breed were collected in a randomized manner through a brachial cut at the end of the trial. Hematological parameters, i.e., RBCs (10^6/µl), WBCs (10^3/µL), Lymphocytes (10^3/µL), Monocytes (10^3/µL), PLTs (10^3/µL), Hb (g/dL), Ht (%), MCV (fL), MCH (pg), and MCHC (g/dL) were analyzed. Two-tailed Student t-test was applied to compare the means ($p<0.05$) of hematological parameters of both breeds. The findings exhibited that total RBCs, PLTs, and Hb concentration, were considerably higher ($p<0.05$) in IND chickens than broilers. On the other hand, the total WBCs, Lymphocytes, and Monocytes were remarkably higher ($p<0.05$) in broilers than the IND breed. However, no statistically important distinction ($p>0.05$) noted in both breeds in Ht, MCV, MCH, and MCHC parameters.

Keywords: Broilers; Hematological Analysis; Hematological Parameters; Indigenous Chickens.

1. Introduction

The tremendous increment in the world population has caused the severe depletion of feeding resources and a tremendous increase in poverty. In very recent times, the poultry industry is striving to fulfill the demand for provision of high nutritional white meat (Ebrahimi *et al*., 2013), plummeting poverty and scarcity via green jobs generation, and eventually raise everyday comforts (Gueye, 2009; Mengesha, 2013). Much attention has been focused on the poultry industry for its compatibility with dietary legislation with religious and ethnic groups (Shah *et al*., 2021).

For utilization purposes, chickens are categorized into single-purpose- layers and broilers, dual-purpose- for eggs and meat, and multipurpose- for general use in daily life including commercial broiler and layer chickens (Mustafa and Muneer, 2013). Multiuse indigenous (IND) rural chickens can produces eggs and meat, also yield ornamental feathers as an amusing aspect (Halima *et al*., 2007). Free-ranging IND village chickens possess high genomic diversity, are usually sturdier, disease-resistant, have a long lifespan, and give useful services to the social and cultural life (Msoffe *et al*., 2005; Mapiye *et al*., 2008; Padhi, 2016; Fathi *et al*., 2017). IND chickens are essential contributors to human sustenance diversification by assuming a pivotal role in production (Mtileni *et al*., 2009), in religious rituals, give pleasure wellspring as game and presentation as comradeship (Larson *et al*., 2012).

Due to fast growth and short harvesting time, broiler farming has developed much faster than IND chicken farming around the world. Broiler chickens are typically raised in unfertile areas with heightened stocking concentrations resulting in various health issues (Bessei, 2006).

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It is linked to elevated development rates, small levels of workouts, and elevated body weights (Knowles *et al*., 2008; Reiter and Bessei, 2009). In Pakistan, native and broiler chickens play a noteworthy role in eliminating the breach between daily demand and animal protein supply.

Blood hemato-biochemical parameters are used to assess an animal's nutritional and clinical health conditions (Olorede and Longe, 2000; Aderemi, 2004; Khan and Zafar, 2005; Doyle, 2006; Olafedehan *et al*., 2010). These profiles give us significant data for the analysis of avian immunology, pathology, environmental, and/or pathological stresses, and bird health (Adeyemi *et al*., 2000; Togun *et al*., 2007; Bonadiman *et al*., 2009; Afolabi *et al*., 2011), which are used as to improve the animal's health status (Ladokun *et al*., 2008). It is extensively used in birds like chicken (Adeyemi *et al*., 2000), Helmeted guineafowl-*Numida meleagris* (Onyeanusi, 2007), Pigeon-*Columba livia domestica* (Pavlak *et al*., 2005), Japanese quail-*Coturnix japonica* (Arora, 2010), and Bronze turkey-*Meleagris gallopavo* (Schmidt *et al*., 2009), etc.

The hereditary traits, nutritional, physiological, ecological relationships, and environmental characteristics have a significant impact on the hemato-biochemical profiles of different breeds of poultry (Ovuru and Ekweozor, 2004; Subhadarsini and Silpa, 2020). These circumstances are of utmost importance in animal selection that is hereditarily resilient to specific diseases and unfavorable environmental circumstances (Isaac *et al*., 2013; Mmereole, 2008). As stated by Isaac *et al.* (2013), an animal having a good blood profile may exhibit excellent performance. Hence, current exploratory trials were carried out for the difference and comparison haemato-biochemical parameters of broiler and IND breeds of poultry.

2. Materials and methods

2.1. Experimental Birds

This research study was deliberated from January to May 2021 at the University of Central Punjab, Lahore, Pakistan. Experimental IND chicks were acquired from a local market of 27/SP village, District Pakpattan, and broiler chicks were taken from a poultry farm at Pakpattan city. These chickens were housed under their conventional feeding habits and environmental factors (Subhadarsini and Silpa, 2020).

Uniformity in the management of chicks was maintained. Both flocks were offered with the appropriate amount of commercially available poultry mash and crumble feeds and replenished twice daily. Potable fresh water was provided *ad libitum* during whole study retro. After brooding, feeders and drinkers were fixed in such a way that birds can continuously eat and drink.

2.2. Blood Sampling

In the 20^{th} week of the investigational study (Khawaja *et al*., 2016; Parveen *et al.*, 2017), sampling was done using 5 mL Syringes, 22 Gauge x 1-1/2 Inch Needles. Before ejaculating blood, plumes were removed and ethanol (70%) was employed with cotton swab to distend the wing vein (Duah *et al.*, 2020). Samples were amassed from the live chickens by piercing the lower side of brachial vein of the wing with full consideration of animal welfare.

In each sample collection, a sterilized syringe with a needle was used and then discarded it. A total of 40 blood samples including broilers (n=20) and IND (n=20) were collected in a randomized design. The samples were instantly transferred into 3 ml of glass vials pretreated with Tripotassium Ethylenediamine Tetraacetic Acid (K_3EDTA) and meticulously quiver to mix the sample with the K_3EDTA. It inhibits blood coagulation. Blood samples were

labeled properly and instantly placed in a deep freezer to prevent degradation of the samples.

2.3. Haematological Analysis

The hemato-biochemical analysis was carried out deliberately to examine the hematological values of RBCs, WBCs, Lymphocytes, Monocytes, Platelets (PLTs), Hemoglobin Concentration (Hb), Hematocrit (Ht), MCV, MCH, and MCHC (Abdulwahid and Oleiwi, 2021) as shown in Table 1.

Neubauer Hemocytometer was used for determining the total number of RBCs and WBCs (Abuoghaba, 2018). Lymphocytes and Monocytes were counted using DLC standard procedures defined by Wakenell (2010). PLT counting was done while performing DLC by using Compound Microscope (Mayengbam *et al*., 2020). Sahli's Haemoglobinometer was employed to measure Hb concentration (Patil *et al*., 2013). Ht was calculated using the Microhematocrit Capillary Tube, centrifuged at 10,000 RPM for 5 minutes (López *et al*., 2018; Duah *et al*., 2020).

Following formulae were used to evaluate the MCV, MCH, and MCHC values (Odunitan-Wayas *et al*., 2018);

$$\text{MCV (fL)} = \frac{\text{Ht (\%)} \times 10}{\text{RBC (millions / µL)}}$$

$$\text{MCH (pg)} = \frac{\text{Hb (g / dL)} \times 10}{\text{RBC (millions / µL)}}$$

$$\text{MCHC (g/dL)} = \frac{\text{Hb (g / dL)} \times 100}{\text{Ht (\%)}}$$

2.4. Statistical Analysis

The hemato-biochemical constraints were denoted as Mean±SE in both breeds, using the latest MS Excel Spreadsheet 2019. A two-tailed Student t-test was applied to compare the means ($p<0.05$) of hematological parameters of both breeds (Alam *et al*., 2020). *"Two-Sample Assuming Equal Variances"* was used as a *type* in employing t-test.

3. Results and discissions

Hematological parameters, i.e., RBC (10^6/µl), WBC (10^3/µL), Monocytes (10^3/µL), Lymphocytes (10^3/µL), PLTs (10^3/µL), Hb (g/dL), Ht (%), MCV (fL), MCH (pg), and MCHC (g/dL), were measured and listed in Table 1.

3.1. Total RBCs (Red Blood Cells)

The findings of the present study depicted different numbers of RBCs in both breeds, as shown in Table 1. The RBC (10^6/µl) values vary from 3.55±0.07 to 2.49±0.05 for IND and broilers respectively. The RBCs values were statistically greater ($p<0.05$) in IND as compared to broilers. Similar studies by Subhadarsini and Silpa (2020) enumerated the almost same amount of RBCs in both breeds. By contrast, these outcomes contradict the present study.

Parveen *et al*. (2017) found the amplification of RBCs and Hb with the development and growth of chicks. That fulfills the O_2 requirements of the growing chicks. RBCs serve as transporters of O_2 and CO_2 through Hb (Chineke *et al*., 2006). Therefore, a lower number of RBCs possess a lower concentration of Hb which leads to less amount of the O_2 that would be transported to the tissue and the CO_2 level that returns to the lungs (Soetan *et al*., 2013; Ugwuene, 2011).

3.2. Total WBCs (White Blood Cells)

Presented results of this study shows that total WBCs (10^3/µL) ranges from 80.33±2.47 to 18.82±1.39 for broiler and IND breeds, respectively. The WBC values were higher ($p<0.05$) in broiler in comarison to IND chickens. Previous studies concluded different results.

Different breeds of poultry exhibited substantial and noteworthy distinctions except WBCs.

The main functions of WBCs combat against inflammation defend against antigens, microorganisms, unfamiliar particles, and produce or at least transport and distribute immunoglobins in the immune reaction. So, organisms with low WBC numbers are at high risk of infectious diseases (Soetan *et al*., 2013) and also improve adaptations to the harsh environment and resistance against diseases (Iwuji and Herbert, 2012; Kabir *et al*., 2011). Any type of emotional or physical stress can also cause WBC count to dwindle.

3.3. Total Lymphocyte Count

We found considerably different number of Lymphocytes in both breeds. The total number of Lymphocytes (10^3/µL) varies from 70.83±2.17 to 11.98±0.94 for broiler and IND breeds, respectively. The Lymphocyte values were statistically greater ($p<0.05$) in broilers than IND chickens. Alam *et al*. (2020) conducted a study on hemato-biochemical and serum profiles of broiler and IND breeds of poultry. He also found considerably lower hemato-biochemical parameters of IND chickens as compared to broiler.

3.4. Total Monocyte Count

The total number of monocytes (10^3/µL) were 5.13±0.13 to 3.21±0.18 for broiler and IND breeds, respectively. The total number of monocytes was substantially distinct in both breeds, statistically greater ($p<0.05$) in broiler as compared to IND chickens. Even so, Subhadarsini and Silpa (2020) found no noteworthy difference ($p>0.05$) between monocytes in both breeds broiler and IND breeds. Subsequently, they stated the effect of different feeding habits, environmental factors, and immunity, etc. on the hemato-biochemical profiles of both varieties. These parameters change because of the aforementioned factors.

3.5. Total PLTs (Platelet Cells)

The findings demonstrated that Total PLTs (10^3/µL) range from 62.56±1.43 to 36.78±2.66 for IND and broilers, respectively. This variance was large enough to be statistically important. PLTs values were statistically greater in IND as compared to broilers. *Dutta et al*. (2013) designed a study on five different varieties of chicken to investigate the hemato-biochemical profiles of different breeds. They found that all hemato-biochemical parameters exhibited substantial and noteworthy distinctions among the different breeds of poultry ($p<0.01$).

3.6. Hb (Hemoglobin) Concentration

During the present study, we found a statistically pivotal ($p<0.05$) difference between Hb (g/dL) concentrations of IND and broilers *i.e.* 11.48±0.33 to 7.69±0.10, respectively. The Hb concentration was statistically higher in IND as compared to broilers. Subhadarsini and Silpa (2020) revealed the noteworthy increased Hb concentration in IND breed and as a consequence of its higher oxygen utilization, it was probably suggested more dynamic than the broiler. The finding suggested that the different breeds have different Hb concentrations for oxygen consumption, accordingly.

Hb is a metalloprotein that contains iron, it is an oxygen-transporter protein attached to RBCs of all vertebrates (Sidell and O'Brien, 2006; Etim *et al*., 2014). The physiological function of Hb is to deliver O_2 into animal tissues to oxidize the consumed food to produce ATP which will be utilized for other biological processes as well as transportation of CO_2 out of the animal's body (Omiyale *et al*., 2012). Low Hb concentration leads to inactivity in chickens (as in broilers).

3.7. Ht (Hematocrit) Volume

The study showed that Ht values in both breeds were not considerably dissimilar ($p>0.05$). Ht (%) values range from 31.53±1.60 to 42.21±1.71 for broilers and IND chickens respectively. There was no significant difference observed in both breeds. Ht (PCV) is the %age of RBCs in the blood. Ht plays a vital role in carrying O_2 and absorbed nutrients (Isaac *et al*., 2013). A high level of Ht causes a decrease in circulating plasma volume and eventually results in polycythemia. Conversely, Subhadarsini and Silpa (2020) observed remarkably higher Ht values ($p<0.001$) in IND than that of broiler chicken. Khawaja *et al*. (2016) and Parveen *et al*. (2017) studied hematological parameters of different, commercial, and single-purpose breeds and claimed that the RBC, Hb, and PCV were amplified as the chicks growed.

Table 1. Comparison of Some Hematological Parameters of Broiler and IND Breeds of Poultry

Hematological Parameters	Different Breeds	Mean ± SE
RBC (10^6/µl)	In Broiler	2.49 ±0.05
	In IND	3.55 ±0.07
WBC (10^3/µL)	In Broiler	80.33 ±2.47
	In IND	18.82 ±1.39
Lymphocytes (10^3/µL)	In Broiler	70.83 ±2.17
	In IND	11.98 ±0.94
Monocytes (10^3/µL)	In Broiler	5.13 ±0.13
	In IND	3.21 ±0.18
PLT (10^3/µL)	In Broiler	36.78 ±2.66
	In IND	62.56 ±1.43
Hb (g/dL)	In Broiler	7.69 ±0.10
	In IND	11.48 ±0.33
Ht (%)	In Broiler	31.53 ±1.60
	In IND	42.21 ±1.71
MCV (fL)	In Broiler	126.75 ±7.50
	In IND	118.76 ±4.86
MCH (pg)	In Broiler	31.71 ±0.56
	In IND	32.29 ±1.08
MCHC (g/dL)	In Broiler	25.02 ±1.31
	In IND	27.19 ±1.70

3.8. MCV, MCH & MCHC

The findings exhibited that MCV, MCH, and MCHC values in both breeds did not considerably varied. MCV values range from 118.76±4.86 to 126.75±7.50 for IND and broilers respectively. The MCH values range from 31.71±0.56 to 32.29±1.08 for broilers and IND chickens respectively. The MCHC values range from 25.02±1.31 to 27.19±1.70 for broilers and IND chickens respectively. MCH and MCHC levels represent blood profile status and decrease with age (Khawaja *et al*. 2016; Parveen *et al*. 2017), *e.g.* lower are anemia indication (Aster, 2004). Previous studies published remarkably higher MCH, and MCV values in IND than that of broiler chickens (Subhadarsini and Silpa, 2020).

4. Conclusion

The findings for two different breeds of poultry revealed that two, unlike breeds, have had some substantial changes in some critical blood parameters, while some of which are non-significant. The findings exhibited that total RBC (10^6/µl), PLT (10^3/µL), and Hb (g/dL) concentration was significantly higher in IND chickens which were 3.55±0.07, 62.56±1.43, and 11.48±0.33 as compared to broilers, 2.49±0.05, 36.78±2.66, 7.69±0.10, respectively. The total number of WBC (10^3/µL), Lymphocytes (10^3/µL), and Monocytes (10^3/µL) were significantly higher in broilers which were 80.33±2.47, 70.83±2.17, and 5.13±0.13 as compared to IND breed, 18.82±1.39, 11.98±0.94, and 3.21±0.18, respectively.

However, the findings revealed that the Ht (%), MCV (fL), MCH (pg), and MCHC (g/dL), values were not statistically different in both breeds. The Ht values range from 31.53±1.60 to 42.21±1.71 for broilers and IND chickens respectively. The MCV values range from 118.76±4.86 to 126.75±7.50 for IND and broilers respectively. The MCH values range from 31.71±0.56 to 32.29±1.08 for broilers and IND chickens respectively. The MCHC values range from 25.02±1.31 to 27.19±1.70 for broilers and IND chickens respectively. Thus, in Ht (%), MCV (fL), MCH (pg), and MCHC (g/dL), there was no significant distinction noted in both breeds.

The comparative hematological study of IND and broiler chickens can determine the health status for diagnosing and treating birds properly. In different regions of the world, the hemato-biochemical constraints of different breeds of poultry are varied. Even different breeds, strains and gender with different feeding habits and feed supplements have different hematological profiles (Turcu *et al*., 2011; Beski and Al-Sardary, 2015; Sugiharto *et al*., 2018; Alam *et al*., 2020; Adewole *et al*., 2021; Oyedele *et al*., 2021). Moreover, different microorganisms (Alwaleed *et al*., 2021; Maoba *et al*., 2021), some floral parts, essential oils and phytochemicals (Abdulazeez *et al*., 2016; Abuoghaba, 2018; Iqbal and Bayram, 2021; Sunu *et al*., 2021) have been found to have remarkable impacts on serum and hemato-biochemical profiles of chickens.

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