



Sex-related variations in hematological and sero-biochemical profiles of Kadaknath chicken

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ABSTRACT

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The studies were conducted to find out the sex-related variations in the hematological and sero-biochemical profiles of Kadaknath chicken in the Gird region of Madhya Pradesh at the ITM University, Gwalior, from June to October 2023, with thirty male and female Kadaknath chickens each. The experiment was started with the day-old chicks and lasted for 112 days. The blood samples were drawn on day 112 for the determination of haematological and sero-biochemical profiles from male and female birds from brachial wing vein. The hematological parameters were analyzed using an auto hematology analyzer, with differential counts performed on Giemsa-stained blood films. For biochemical analysis, serum samples were obtained by centrifuging blood collected in sterile vials, and parameters were measured using standard diagnostic kits. Lymphocytes, MCV, PLT, and PCT in both sexes did not differ significantly ($P \geq 0.05$). RBC and MCH were significantly higher ($P \leq 0.05$) in male blood, whereas eosinophils and TLC in female blood. WBC, haemoglobin, monocytes, MCHC, and haematocrit were significantly lower ($P \leq 0.01$), whereas basophils, heterophils, MPV, PCV, TEC, and heterophil to lymphocyte (HL) ratio were significantly higher ($P \leq 0.01$) in female blood. Phosphorus, albumin, globulin, albumin to globulin ratio, creatinine, and blood urea nitrogen (BUN) were not significantly different ($P \geq 0.05$) in between the sexes. Cholesterol content was lower ($P \leq 0.05$) in male, whereas serum glutamic pyruvic transaminase (SGPT) to alanine aminotransferase (ALT) and bilirubin in female. Calcium content was recorded to be higher ($P \leq 0.01$) in male, whereas blood glucose, total protein, and serum glutamic oxaloacetic transaminase/aspartate aminotransferase in female blood. Based on the present study, it can be inferred that the sex of chickens significantly influenced various hematological parameters such as total RBC, hemoglobin, PCV, and MCHC, primarily due to physiological differences, including hormonal fluctuations and metabolic variations between males and females. Similarly, among biochemical parameters, the mean values showed significant differences for total protein, serum cholesterol, SGOT, SGPT, calcium, and phosphorus, which can be attributed to variations in hormonal regulation, growth patterns, and nutrient metabolism associated with sex.

Keywords: Blood, Chicken, Haematology, Kadaknath, Sero-biochemistry

INTRODUCTION

The poultry industry is among the rapidly expanding sectors within India's agricultural economy, which has grown significantly over the past three decades because of the extensive government-initiated research and development that the organized private sector later adopted. Poultry farming is a long-standing, low-income rural practice among the poor. Poultry farmers typically keep their birds in backyard systems or scavenge them in neighboring fields, investing relatively little in management and health care. The expansion of poultry farming can enhance nutrition and help alleviate poverty in India by offering direct benefits from poultry production, creating employment opportunities across the poultry value chain, and increasing the consumption of poultry meat and eggs (Pica-Ciamarra & Otte, 2010).

Native poultry breeds represent crucial genetic assets for the country, owing to their resilience to local environmental conditions and natural resistance to prevalent diseases. These indigenous genetic resources remain fundamental to the poultry sector, forming the backbone of its development. However, limited data are

available regarding the productive potential and performance characteristics of indigenous chickens (Hoffman, 2005). Enhancing key economic traits through genetic improvement could significantly boost their productivity and profitability (Padhi, 2016).

Although hematological and biochemical tests have not been extensively used in avian medicine diagnosis, these may be useful diagnostic tools for tracking health, how sick birds respond to treatment plans, and providing a prognosis for some poultry diseases. A comprehensive database on the blood profiles of domestic poultry (Elagib *et al.*, 2012) and genetically standardized industrial poultry breeds (Talebi *et al.*, 2005) was developed by establishing reference values for various hematological and biochemical parameters. The established reference values are utilized in blood parameter analyses for various purposes, such as assessing poultry immune status (Seiser *et al.*, 2000), predicting potential resistance to environmental conditions (Silversides *et al.*, 1997), estimating future body weight (Singh *et al.*, 1998), diagnosing diseases (Prameela Rani *et al.*, 2011), evaluating health disorders (Harper and Lowe, 1998), and several other applications. In addition to being helpful for care and diagnosis, these data could also be included

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in breeding projects to improve the genetic makeup of native chickens (Alewi *et al.*, 2012). Understanding the typical physiological parameters under local conditions are important for effective nutrition, breeding, disease prevention, and treatment.

The tribal communities of Jhabua and Dhar districts in western Madhya Pradesh, along with neighboring regions of Gujarat and Rajasthan, predominantly rear the Kadaknath breed of chicken. This breed is known for its distinct black-colored meat, which is appreciated for its rich flavor (Panda and Mahapatra, 1989). In terms of nutritional quality, Kadaknath meat has been reported to have higher protein content, lower fat levels, and an increased concentration of essential amino acids, making it superior in taste compared to broiler meat (Haunshi *et al.*, 2022).

Prashanth *et al.* (2012) observed that hematological and sero-biochemical parameters in domestic birds tend to vary. Kishore (2024) reported the blood profile of Kadaknath broilers; however, sex-related hematological and sero-biochemical studies on Kadaknath chicken remain scarce in the literature. In light of this, the objective of the present study was to investigate sex-related variations in the hematological and sero-biochemical profiles of Kadaknath chickens in the Gird region of Madhya Pradesh.

MATERIALS AND METHODS

Agroclimatic condition

This study was conducted at the poultry farm of the School of Agriculture, ITM University, Gwalior, located at 26.140°N latitude and 78.196°E longitude, at an altitude of 197 meters above mean sea level (MSL). The soil in this region is sandy loam with a uniform topography. The area experiences a subtropical climate, receiving an average annual rainfall of approximately 700 mm. Seasonal temperature variations are significant, with summer temperatures reaching up to 48°C, while winter temperatures can drop as low as 3°C.

Experimental population

Day-old chicks of Kadaknath breed (30 females and 30 males) were randomly selected and tagged using the wing banding method. The chicks were brooded on deep litter for the first 15 days with a lighting schedule of 16 hours of light and 8 hours of darkness. The chicks were vaccinated against Marek's disease, Ranikhet disease, and Gumboro (Infectious Bursal Disease) on days 0, 7, and 14, respectively. The experiment was carried out during June to October, 2023 and lasted for 112 days. The blood samples of the chicken were drawn on the last day of the experiment.

Haematological parameters

For haematological studies, heparinized blood samples were collected from 6 birds of each group selected randomly. Haematological parameters RBCs

(million/ mm³ or million/ μ l), WBCs (thousand/mm³ or thousand/ μ l), DLC (%), Hb (g/dl), PCV (%), MCV (μ m³), MCH (pg/cell) and MCHC (g/dl) were recorded in the blood samples. The collected blood samples were analyzed for hematological parameters using an auto hematology analyzer. Differential white blood cell (WBC) counts were performed on monolayer blood smears, which were fixed with methyl alcohol and stained using Giemsa stain.

Biochemical parameters

Biochemical parameters were estimated from serum samples isolated from blood collected from six birds in each group. The blood samples were drawn into sterile vials and kept in a slanting position for 30 minutes, followed by centrifugation at 2000 rpm for 15 minutes. The biochemical parameters analyzed included total protein, albumin, globulin, albumin-to-globulin (A/G) ratio, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), cholesterol, bilirubin, blood urea nitrogen (BUN), and creatinine, using a standard diagnostic kit (Erba Pvt. Ltd.).

Statistical analysis

The data collected were analyzed by using randomized block design following the procedure of Snedecor and Cochran, (1994). The data analysis pack using 'ANOVA: Single Factor' tool of MS Office Excel.

RESULTS AND DISCUSSION

Haematological profile

The hematological profiles of male and female Kadaknath chickens have been compared in Table 1. Lymphocytes (60.62 $\pm$ 1.28; 56.78 $\pm$ 1.19%), MCV (121.24 $\pm$ 0.79; 117.77 $\pm$ 1.42 fL), PLT (60.25 $\pm$ 0.66; 61.58 $\pm$ 1.11 10³/uL), and PCT (0.04 $\pm$ 0.00; 0.05 $\pm$ 0.00%) in male and female chicken bloods were not significantly different ($P \geq 0.05$). RBC (3.20 $\pm$ 0.16; 2.61 $\pm$ 0.2010⁶/ul) and MCH (36.49 $\pm$ 0.22; 35.24 $\pm$ 0.40 pg) were significantly higher ($P \leq 0.05$) in male as compared to female blood, whereas eosinophils (1.58 $\pm$ 0.05; 1.89 $\pm$ 0.10%) in female compared to male blood. The values of WBC (29.72 $\pm$ 0.18 vs. 28.42 $\pm$ 0.33 thousand/ μ l), hemoglobin (12.47 $\pm$ 0.05 vs. 10.46 $\pm$ 0.15 g/dl), monocytes (3.54 $\pm$ 0.15 vs. 2.51 $\pm$ 0.09%), MCHC (31.58 $\pm$ 0.04 vs. 31.18 $\pm$ 0.08 g/dl), and HCT (51.54 $\pm$ 2.84 vs. 36.08 $\pm$ 2.11%) were significantly lower ($P \leq 0.01$) in females compared to males. In contrast, basophils (1.46 $\pm$ 0.06 vs. 1.73 $\pm$ 0.04%), heterophils (33.87 $\pm$ 0.59 vs. 36.10 $\pm$ 0.38%), MPV (6.31 $\pm$ 0.03 vs. 6.77 $\pm$ 0.10 fL), PCV (28.58 $\pm$ 1.1 vs. 37.22 $\pm$ 1.87%), and the H-L ratio (0.54 $\pm$ 0.02 vs. 0.65 $\pm$ 0.02) were significantly higher ($P \leq 0.01$) in females compared to males.

Most of the haematological parameters in the present study followed the ranges reported by Bhattacharjee *et al.* (2016), Saurabh *et al.* (2018), Kumar *et al.* (2021) and Acharya *et al.* (2023). The higher RBC

counts in male blood were in agreement with the report of Panigrahy *et al.* (2017), who reported that the RBC counts were comparatively lower in female Vanaraja chicken blood. Higher WBC and lymphocyte count and a lower heterophil count in male compared to female Kadaknath chickens were in line with the results of Panigrahy *et al.* (2017). Lower counts of eosinophils and basophils in males and monocytes in female Kadaknath verified the results of Bora *et al.* (2017). Sturkie (1965) reported that blood Hb and PCV were influenced by androgen hormone, which was supposed to cause a significant effect of sex on Hb concentration in Vanaraja (Panigrahy *et al.*, 2017) and Nigerian chickens (Addass *et al.*, 2012). However, Kumar and Kumbhakar (2015) reported that there was no effect of sex on the hematological values in Aseel birds. The higher level of

PCV reported in males was due to the effect of androgens (Abdi-Hachesoo *et al.* 2013), which caused the recorded trend of PCV in the present study and confirmed the findings of Addass *et al.* (2012) and Gattani *et al.* (2016), who reported higher PCV values in males than females in indigenous chickens of Saudi Arabia and in turkeys, respectively. Higher HCT in male and PLT and MPV in female Kadaknath blood confirmed the findings of Bora *et al.* (2017). Higher MCV, MCH, and MCHC values in male than female Kadaknath blood were similar to the findings reported by Isidahomen *et al.* (2011) in male Nigerian local chickens. The variation in PCT values in the present study disagreed with the results of Bora *et al.* (2017).

Sero-biochemical profile

Table 1: Haematological profile of Kadaknath chicken

Parameter	Male	Female	P-value	Significance
1. WBC (thousands/ μ l)	29.72 $\pm$ 0.18	28.42 $\pm$ 0.33	0.01	**
2. RBC (10^6 /ul)	3.20 $\pm$ 0.16	2.61 $\pm$ 0.20	0.05	*
3. Haemoglobin (g/dl)	12.47 $\pm$ 0.05	10.46 $\pm$ 0.15	0.00	**
4. Eosinophils (%)	1.58 $\pm$ 0.05	1.89 $\pm$ 0.10	0.02	*
5. Lymphocytes (%)	60.62 $\pm$ 1.28	56.78 $\pm$ 1.19	0.05	NS
6. Monocytes (%)	3.54 $\pm$ 0.15	2.51 $\pm$ 0.09	0.00	**
7. Basophils (%)	1.46 $\pm$ 0.06	1.73 $\pm$ 0.04	0.00	**
8. Heterophils (%)	33.87 $\pm$ 0.59	36.10 $\pm$ 0.38	0.01	**
9. MCV (fL)	121.24 $\pm$ 0.79	117.77 $\pm$ 1.42	0.06	NS
10. MCH (pg)	36.49 $\pm$ 0.22	35.24 $\pm$ 0.40	0.02	*
11. MCHC (g/dL)	31.58 $\pm$ 0.04	31.18 $\pm$ 0.08	0.00	**
12. PLT (10^3 /uL)	60.25 $\pm$ 0.66	61.58 $\pm$ 1.11	0.33	NS
13. MPV (fL)	6.31 $\pm$ 0.03	6.77 $\pm$ 0.10	0.00	**
14. PCT (%)	0.04 $\pm$ 0.00	0.05 $\pm$ 0.00	0.22	NS
15. HCT (%)	51.54 $\pm$ 2.84	36.08 $\pm$ 2.11	0.00	**
16. PCV (%)	28.58 $\pm$ 1.1	37.22 $\pm$ 1.87	0.00	**
17. H-L ratio	0.54 $\pm$ 0.02	0.65 $\pm$ 0.02	0.01	**

fL- femtoliters equal to 10^{-15} liters

NS-nonsignificant, *-significant ($P \leq 0.05$), **-highly significant ($P \leq 0.01$), WBC- white blood cells, RBC- Red Blood Corpuscle, MCV- mean corpuscular volume, MCH- Mean corpuscular hemoglobin, MCHC- Mean corpuscular hemoglobin concentration, PLT- platelet count, MPV- mean platelet volume, PCT- Procalcitonin, HCT- Hematocrit, PCV- packed cell volume, H-L ratio- heterophil/lymphocyte ratio.

A comparison between the sero-biochemical profiles of female and male Kadaknath chicken blood has been presented in Table 2. Phosphorus (8.66 $\pm$ 0.06; 8.79 $\pm$ 0.05 mg/dL), albumin (2.16 $\pm$ 0.02; 2.18 $\pm$ 0.02 g/dl), globulin (2.46 $\pm$ 0.02; 2.51 $\pm$ 0.03 g/ dl), A-G ratio (0.88 $\pm$ 0.01; 0.87 $\pm$ 0.02 creatinine (0.65 $\pm$ 0.04; 0.62 $\pm$ 0.04 mg/dl) and BUN (8.94 $\pm$ 0.1; 8.78 $\pm$ 0.14 mg/dl) did not differ significantly ($P \geq 0.05$) in the blood of male and female Kadaknath chickens. Cholesterol content (89.31 $\pm$ 1.18; 93.3 $\pm$ 0.76 mg/dL) was recorded lower ($P \leq 0.05$) in male compared to female blood, whereas SGPT/ALT (7.92 $\pm$ 0.07; 7.6 $\pm$ 0.08 IU/L) and Bilurubin (25.23 $\pm$ 0.18; 24.63 $\pm$ 0.11 mg/dL) were lower in female

compared to male blood. Calcium content (14.85 $\pm$ 0.09; 13.94 $\pm$ 0.08 mg/dL) was recorded higher ($P \leq 0.01$) in male compared to female blood whereas blood glucose (144.74 $\pm$ 1.08; 155.74 $\pm$ 1.48 mg/dL), total protein (4.06 $\pm$ 0.03; 4.34 $\pm$ 0.08 g/dL) and SGOT/AST (225.04 $\pm$ 3.38; 253.04 $\pm$ 1.96 IU/L) in female compared to male blood.

Similar to the present result, increased total protein in females was observed in Thai indigenous chickens (Simaraks *et al.*, 2004), native chickens of Kashmir (Pampori and Iqbal, 2007) and turkeys (Gattani *et al.*, 2016). The higher protein concentration in females could be explained by the high level of estrogen hormones in

females, which is responsible for the high content of serum globulins (Sturkie and Newman, 1951). The high cholesterol level in female chicken blood recorded in the present study was similar to that reported by Kumar and Kumbhakar (2015) and Abdi-Hachesoo et al. (2011) in Aseel chickens and in hens of Iranian indigenous chickens, respectively. Contrary to this, a nonsignificant ($P \geq 0.05$) difference was observed in total cholesterol concentration between males and females of Sudanese indigenous chickens by Elagib et al. (2012). Abdi-Hachesoo et al. (2013) observed high SGOT levels in the cocks of indigenous chickens from Iran. The present results also confirmed the findings noticed by Abdi-Hachesoo et al. (2011) and Kumar and Kumbhakar (2015) in indigenous chickens and Aseel, respectively. Similarly, Abdi-Hachesoo et al. (2013) observed high SGPT levels in the cocks of indigenous Iranian chickens. Similar to our result, high calcium levels in males were observed by Isidahomen et

al. (2011) and Abdi-Hachesoo et al. (2013). However, higher levels of Ca were observed in female Aseel chickens (Kumar and Kumbhakar, 2015), which were contrary to the present findings. However, in some other reports, the difference in calcium levels between male and female blood was insignificant (Pampori and Iqbal, 2007; Elagib et al., 2012). Significantly ($P \leq 0.05$) higher phosphorus levels in blood were observed in males than females, which was supported by the findings of Abdi-Hachesoo et al. (2013). But Pampori and Iqbal (2007), and Elagib et al. (2012) have reported that there is no significant difference in phosphorus between the sexes of indigenous chickens. Kadaknath females had significantly higher blood glucose levels than males, which was in accordance with findings in Aseel female chickens (Kumar and Kumbhakar, 2015).

Table 2: Sero-biochemical profile of Kadaknath chicken

Parameter	Male	Female	P-value	Significance
1. Blood glucose (mg/dL)	144.74±1.08	155.74±1.48	0.00	**
2. Total protein (g/dL)	4.06±0.03	4.34±0.08	0.01	**
3. Cholesterol (mg/dL)	89.31±1.18	93.3±0.76	0.02	*
4. SGOT/AST (IU/L)	225.04±3.38	253.04±1.96	0.00	**
5. SGPT/ALT (IU/L)	7.92±0.07	7.6±0.08	0.01	*
6. Bilurubin (mg/dL)	25.23±0.18	24.63±0.11	0.02	*
7. Calcium (mg/dL)	14.85±0.09	13.94±0.08	0.00	**
8. Phosphorus (mg/dL)	8.66±0.06	8.79±0.05	0.11	NS
9. Albumin (g/ dl)	2.16±0.02	2.18±0.02	0.67	NS
10. Globulin (g/ dl)	2.46±0.02	2.51±0.03	0.23	NS
11. A-G Ratio	0.88±0.01	0.87±0.02	0.56	NS
12. Creatinine (mg/dl)	0.65±0.04	0.62±0.04	0.58	NS
13. BUN (mg/dl)	8.94±0.1	8.78±0.14	0.34	NS

NS-nonsignificant, *-significant ($P \leq 0.05$), **-highly significant ($P \leq 0.01$)

CONCLUSION

Based on the present study, it can be concluded that the sex of chickens had a significant effect on different haematological parameters like total RBC, haemoglobin, PCV, and MCHC because of physiological differences, including variations in hormone levels and metabolic activity between males and females. Among biochemical parameters, the mean values differed significantly for total protein, serum cholesterol, SGOT, SGPT, calcium, and phosphorus due to differences in hormonal regulation, growth rates, and nutrient metabolism influenced by sex.

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