*Original Article*

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# Comparative Hematology of Various Breeds of Chicken (*Gallus gallus domesticus*)

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**Abstract**

Hematological analysis of birds reveals the health condition which may differ due to difference in age, sex breed etc. This present study aims at the evaluation of hematological parameters of eight breeds of chicken namely Aseel, Black Rock, Dahlem Red, Kadaknath, Red Cornish, Rhode Island Red, Vanaraja and White Leghorn available at poultry farms of Odisha. Five adult males and five adult females from each breed were considered for this work. Hematological parameters such as Hemoglobin per cent, Total Leukocyte Count, Total Erythrocyte Count, Packed Cell Volume, Mean Corpuscular Volume, Mean Corpuscular Hemoglobin, Mean Corpuscular Hemoglobin Concentration and Differential Leukocyte Count were taken into account. The data were subjected to ANOVA and Duncan's Multiple Range test. The hematological parameters varied within and between breeds with a sexual dimorphism. The parameters were significantly different among and between the breeds at $p<0.05$ and $p<0.01$. This investigation shows normal hematological parameters of the stated breeds of chicken. The variations recorded may be due to difference in breeds, sex, feed etc.

**Keywords:** Hematology; Chicken; Breeds; Comparison; Parameters.

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## Introduction

Hematology can assess health of birds and may aid in early recognition of disease.[4] If all parameters are normal, then it reflects healthy status of bird. In poultry birds, many factors influence blood like molting[6], overcrowding[9], etc. Therefore, establishing a certain value for a breed as a whole is difficult. The different breeds of chicken available today have descended from Red Jungle Fowl[2] and some are produced through breeding programs. So, attempts have been made to evaluate hematological differences between some breeds, since they are reared under same farm conditions and are descendents of common ancestor.

## Materials and Methods

*Study Approach*

The investigation was conducted on eight breeds of chicken (*Gallus gallus domesticus*) being maintained at poultry farms of Odisha. These breeds are Aseel, Black Rock (BR), Dahlem Red (DR), Kadaknath, Red Cornish (RC), Rhode Island Red (RIR), Vanaraja and White Leghorn (WL). Out of eight breeds, one egg type WL belonging to Mediterranean class; two meat type breeds RC and BR belonging to American class; two English breeds RIR and DR; two Indian breeds Aseel and Kadaknath and one synthetic breed Vanaraja were considered for investigation.

*Design, type of sample and sample size*

Blood samples from 10 adult individual

birds, comprising 5 males and 5 females from each breed randomly were collected.

*Sampling technique and description of data collection tools*

Samples were taken out with the help of sterile 2ml syringes [Dispo Van Single Use Syringe, Hindustan Syringes & Medical Devices Ltd., Faridabad, India] and 25 gauge needles [Dispo Van Single Use Needle, Hindustan Syringes & Medical Devices Ltd., Faridabad, India] from the wing vein known as ulnar vein of the birds aseptically [19] and collected in anticoagulant vials containing Ethylene Diamine Tetra-acetic Acid (EDTA) [$K_3$ EDTA, 2ml *13×75mm, Mfg By: HXS Tech Co., Ltd. PRC. For: Peerless Biotech Pvt. Ltd., Chennai, Tamil Nadu, India] and labeled properly. Blood smears were prepared at site on clean grease free slides [Blue Star Pic-2, Polar Industrial Corporation, Mumbai, Maharashtra, India] and air dried and fixed in methanol [Qualigens Product No.34457, Thermo Fisher Scientific India Pvt. Ltd., Mumbai, Maharashtra, India] for two minutes for later staining.[18]

*Description of methods and tools*

Estimation of hemoglobin per cent was done by Sahli's acid hematin method[18] with Sahli's hemometer [HiMedia GW 191-1NO, Plane hemometer (Square Type), HiMedia Laboratories Pvt. Ltd., Mumbai, Maharashtra, India]. TLC and TEC were counted by using hemocytometer having Neubauer's chamber[5] with the help of Turk's [HiMedia RO16-500ML, W.B.C. Diluting Fluid, HiMedia Laboratories Pvt. Ltd., Mumbai, Maharashtra, India] and Hayem's fluid [HiMedia RO13-500ML, R.B.C. Diluting Fluid (Hayemis), HiMedia Laboratories Pvt. Ltd., Mumbai, Maharashtra, India] respectively. PCV were estimated by centrifuging [REMI CENTRIFUGE, Catalogue No.C852 7/94, Serial No.GCLC-1632, REMI MOTORS, Bombay, Maharashtra, India] Wintrobe hematocrit tube method containing blood at 3,500 rpm for 15 minutes. MCV, MCH and MCHC were estimated from the values of PCV, TEC and Hb% of the blood as per appropriate formula [3]. For evaluating DLC [13], blood smears made earlier were stained with Leishman's stain and observed under Hunds Weltzar photomicroscope [MICROSCOPE H 600 WILOZYT PLAN, Serial No. 1024980, Helmut Hund GmbH, Wetzlar-Nauborn, Germany]. The results obtained were statistically analyzed for variance.[17] Significant mean differences and standard errors (mean ± SE) were separated by Duncan's Multiple Range Test (DMRT). Differences were classified as significant at $p<0.05$ and $p<0.01$.

## Results

For this study, detailed hematological analyses have been undertaken. TLC and TEC among different breeds differed significantly ($p<0.05$). The values of Hb, PCV, MCH, MCV and MCHC had high significant differences ($p<0.01$) (Table 1). The Hb% of DR male was found to be the highest among males and all the birds. The female had lower Hb% than males. Also the females of RIR and Aseel had much lower Hb% and they differed significantly from their male counter parts at $p<0.01$ level. The mean sex pooled Hb% was highest in DR breed and lowest in RC breed. The TLC (in thousands per $mm^3$) was found to be highest in RC male and in case of females; highest TLC value was shown by Kadaknath. The highest TEC was recorded in Kadaknath male and lowest in RC female. The mean sex pooled TEC was shown by Kadaknath breed of Indian class. The PCV values were almost three times the values of Hb%. Irrespective sex, breed and class PCV value ranged from 25.00±2.76 to 35.80±3.61. As far as breed is concerned, MCV value ranged from lowest in Vanaraja to highest in DR. Similarly, range values of MCH and MCHC were recorded to be 38.86± 1.80 to 101.73±14.36 and 34.66±1.11 to 38.23±1.79 respectively. The MCV, MCH and MCHC values depend upon the PCV, TEC and Hb%.

Table 1 Hematological parameters of eight breeds of chicken

| Class | Breed | Sex | Hb (%)** | TLC(thousands/ mm³)* | TEC(millions/mm³)* | PCV (%)** | MCV (µ³)** | MCH(pg)** | MCHC (%)* |
|---|---|---|---|---|---|---|---|---|---|
| **Mediterranean** | **WL** | Male(5) | 13.00±1.18 | 14334±357.04 | 1.96±0.44 | 35.80±3.61[a] | 378.71±26.21[a] | 145.95±6.30[a] | 37.93±2.84[a] |
| | | Female(5) | 11.30±0.63 | 15240±456.60 | 2.02±0.32 | 33.00±2.13[b] | 179.75±14.56[b] | 57.50±3.52[b] | 34.80±3.55[b] |
| | | **Sex pooled(10)** | **12.15±0.66** | **14787±295.76** | **1.99±0.24** | **34.40±1.92** | **279.23±34.21** | **101.73±14.36** | **36.37±2.09** |
| **English** | **RIR** | Male(5) | 12.44±0.78[a] | 13730±335.59 | 2.64±0.37 | 35.40±2.76[a] | 159.50±15.31[a] | 52.78±2.61 | 36.32±2.40 |
| | | Female(5) | 9.84±0.43[b] | 13548±310.80 | 2.01±0.33 | 30.002.63[b] | 120.20±3.84[b] | 42.23±2.62 | 34.00±2.56 |
| | | **Sex pooled(10)** | **11.14±0.57** | **13639±206.17** | **2.33±0.24** | **32.70±1.90** | **139.85±9.40** | **47.51±2.35** | **35.16±1.61** |
| | **DR** | Male(5) | 13.40±0.56 | 16034±210.94 | 2.14±0.32 | 34.40±2.39 | 386.00±38.83[a] | 112.16±3.32[a] | 34.45±1.45 |
| | | Female(5) | 12.76±0.38 | 16150±394.49 | 1.79±.31 | 35.80±2.96 | 265.57±23.63[b] | 87.07±2.63[b] | 35.89±2.15 |
| | | **Sex pooled(10)** | **13.08±0.32** | **16092±200.50** | **1.97±0.21** | **35.10±1.71** | **325.79±27.83** | **99.62±4.40** | **35.17±1.18** |
| | **Class pooled(20)** | | **12.11±0.39** | **14865.50±309.76** | **2.15±0.16** | **33.90±1.31** | **232.82±25.46** | **73.56±6.34** | **35.16±1.00** |
| **American** | **RC** | Male(5) | 9.30±0.46 | 18000±388.99 | 2.69±0.44[a] | 30.60±3.80 | 162.74±4.46[a] | 60.11±2.61[a] | 37.04±2.82 |
| | | Female(5) | 9.06±0.35 | 15692±332.31 | 1.48±0.34[b] | 30.00±3.52 | 331.62±27.37[b] | 139.87±3.32[b] | 35.46±2.99 |
| | | **Sex pooled(10)** | **9.18±1.03** | **16846±430.70** | **2.09±0.31** | **30.30±2.31** | **247.18±29.45** | **99.99±12.76** | **36.25±1.85** |
| | **BR** | Male(5) | 12.16±0.38 | 14196±349.76 | 3.05±0.49 | 35.80±3.15 | 119.18±0.80[a] | 41.15±2.87[a] | 37.95±3.52 |
| | | Female(5) | 11.44±0.72 | 14040±369.15 | 2.20±0.28 | 35.00±3.50 | 219.87±14.85[b] | 73.55±1.90[b] | 34.17±1.81 |
| | | **Sex pooled(10)** | **11.80±0.38** | **14118±228.30** | **2.62±0.28** | **35.40±2.10** | **169.53±17.26** | **57.35±5.35** | **36.06±1.86** |
| | **Class pooled(20)** | | **10.49±0.37** | **15482.00±390.50** | **2.35±0.22** | **32.85±1.66** | **208.35±19.15** | **78.67±8.40** | **36.15±1.31** |
| **Indian** | **Aseel** | Male(5) | 10.64±0.40[a] | 14250±237.29 | 1.64±0.24 | 29.00±2.99[a] | 178.72±3.13[a] | 60.66±1.21[a] | 34.16±1.78 |
| | | Female(5) | 8.80±0.41[b] | 14664±315.06 | 1.98±0.31 | 25.00±2.76[b] | 131.98±2.52[b] | 45.09±3.00[b] | 35.16±1.69 |
| | | **Sex pooled(10)** | **9.72±0.39** | **14457±187.83** | **1.81±0.18** | **27.00±1.92** | **155.35±7.61** | **52.88±2.86** | **34.66±1.11** |
| | **Kadaknath** | Male(5) | 11.52±0.59 | 17628±293.27 | 3.58±0.39 | 36.20±2.98 | 129.35±1.94 | 43.00±2.93 | 37.05±2.35[a] |
| | | Female(5) | 11.36±0.60 | 16248±457.25 | 3.22±0.45 | 35.00±3.55 | 118.45±1.71 | 41.75±2.73 | 39.42±3.15[b] |
| | | **Sex pooled(10)** | **11.49±0.38** | **16938±326.28** | **3.40±0.27** | **35.60±2.08** | **123.90±2.08** | **42.38±1.80** | **38.23±1.79** |
| | **Class pooled(20)** | | **10.58±0.33** | **15697.50±335.31** | **2.61±0.24** | **31.30±1.71** | **139.63±5.28** | **47.63±2.06** | **36.45±1.13** |
| **Synthetic** | **Vanaraja** | Male(5) | 10.38±0.69 | 15370±729.45 | 3.13±0.43 | 30.60±3.07 | 117.77±2.91 | 38.92±3.34 | 35.75±3.56 |
| | | Female(5) | 10.52±0.74 | 13484±579.20 | 2.93±0.36 | 31.40±3.15 | 116.05±3.20 | 38.81±2.25 | 37.95±2.09 |
| | | **Sex pooled(10)** | **10.45±0.45** | **14427±511.74** | **3.03±0.25** | **31.00±1.97** | **116.91±1.95** | **38.86±1.80** | **36.85±1.88** |

*Figures in parentheses are number of observations. ¶Mean±SE with different superscript in the same column differ significantly (p<0.05) †significant at p<0.05* ‡‡highly significant at p<0.01**.

*Figures in parentheses are number of observations. ¶Mean±SE with different superscript in the same column differ significantly (p<0.05), †significant at p<0.05* ‡‡highly significant at p<0.01**.

Table 2 Differential leukocyte count (DLC) of eight breeds of chicken

| Class | Breed | Sex | Lymphocyte (%)** | Monocyte (%)** | Heterophil (%)** | Eosinophil (%)* | Basophil (%)* |
|---|---|---|---|---|---|---|---|
| **Mediterranean** | **WL** | Male(5) | 60.60±2.92[a] | 3.00±0.71 | 31.40±3.75[a] | 2.80±0.58[a] | 1.60±0.51 |
| | | Female(5) | 67.00±2.92[b] | 4.00±0.45 | 24.80±2.96[b] | 1.40±0.25[b] | 1.00±0.45 |
| | | **Sex pooled(10)** | **63.80±2.10** | **3.50±0.41** | **28.10±2.37** | **2.10±0.36** | **1.30±0.32** |
| **English** | **RIR** | Male(5) | 60.00±2.71 | 3.60±0.60 | 40.40±2.63 | 1.80±0.38 | 1.60±0.81 |
| | | Female(5) | 61.60±2.86 | 3.00±0.45 | 40.20±3.21 | 2.00±0.63 | 1.80±0.38 |
| | | **Sex pooled(10)** | **60.80±1.78** | **3.30±0.35** | **40.30±1.85** | **1.90±0.33** | **1.70±0.40** |
| | **DR** | Male(5) | 61.60±2.85 | 3.80±0.58[a] | 30.00±3.49 | 2.80±0.58 | 1.00±0.55[a] |
| | | Female(5) | 58.60±2.85 | 2.60±0.51[b] | 30.00±2.52 | 2.80±0.74 | 1.80±0.67[b] |
| | | **Sex pooled(10)** | **60.10±1.86** | **3.20±0.40** | **30.00±1.92** | **2.80±0.42** | **1.40±0.41** |
| | **Class pooled(20)** | | **60.45±1.32** | **3.25±0.27** | **35.15±1.81** | **2.35±0.29** | **1.55±0.29** |
| **American** | **RC** | Male(5) | 62.60±2.43[a] | 3.80±0.58 | 31.80±2.48 | 2.80±0.38 | 1.00±0.45[a] |
| | | Female(5) | 50.20±3.13[b] | 3.20±0.74 | 33.60±2.21 | 2.20±0.49 | 2.20±0.38[b] |
| | | **Sex pooled(10)** | **56.40±2.64** | **3.50±0.43** | **32.70±1.51** | **2.50±0.29** | **1.60±0.32** |
| | **BR** | Male(5) | 59.20±3.35 | 2.80±0.80[a] | 30.80±3.73 | 2.00±0.45 | 0.60±0.68[a] |
| | | Female(5) | 60.40±2.72 | 3.80±0.58[b] | 29.20±2.70 | 2.25±0.58 | 2.80±0.38[b] |
| | | **Sex pooled(10)** | **59.80±1.93** | **3.30±0.47** | **30.00±2.07** | **2.10±0.33** | **2.20±0.40** |
| | **Class pooled(20)** | | **58.10±3.07** | **3.40±0.31** | **31.35±1.87** | **2.30±0.029** | **1.90±0.25** |
| **Indian** | **Aseel** | Male(5) | 67.40±1.21[a] | 2.40±0.51 | 22.60±1.64 | 4.00±0.71[a] | 1.00±0.32 |
| | | Female(5) | 62.80±2.42[b] | 2.20±0.38 | 22.20±2.06 | 3.00±0.71[b] | 1.00±0.32 |
| | | **Sex pooled(10)** | **65.10±1.41** | **2.30±0.28** | **22.40±1.18** | **3.50±0.47** | **1.00±0.20** |
| | **Kadaknath** | Male(5) | 56.20±2.36 | 2.60±0.51 | 34.80±1.78 | 2.20±0.58 | 1.80±0.38[a] |
| | | Female(5) | 57.60±2.07 | 2.20±0.58 | 31.80±2.52 | 2.40±0.51 | 2.80±0.38[b] |
| | | **Sex pooled(10)** | **56.90±1.42** | **2.40±0.35** | **33.30±1.46** | **2.30±0.35** | **2.30±0.28** |
| | **Class pooled(20)** | | **61.00±1.39** | **2.35±0.23** | **27.85±1.54** | **2.90±0.32** | **1.65±0.23** |
| **Synthetic** | **Vanaraja** | Male(5) | 60.00±3.55 | 1.80±0.38[a] | 39.00±3.12[a] | 2.60±0.68 | 0.80±0.38[a] |
| | | Female(5) | 59.60±3.76 | 3.00±0.84[b] | 24.40±2.78[b] | 3.00±0.71 | 2.00±0.71[b] |
| | | **Sex pooled(10)** | **59.80±2.31** | **2.40±0.45** | **31.70±2.97** | **2.80±0.44** | **1.40±0.41** |

*Figures in parentheses are number of observations. ¶Mean±SE with different superscript in the same column differ significantly ($p<0.05$)
†significant at $p<0.05$* ‡‡ highly significant at $p<0.01$**

*Figures in parentheses are number of observations. ¶Mean±SE with different superscript in the same column differ significantly ($p<0.05$) †significant at $p<0.05$*, ‡‡ highly significant at $p<0.01$**

Eosinophil and basophil revealed significant differences at $p<0.05$ level but other leukocytes, viz., lymphocytes, monocytes and heterophil are significant at $p<0.01$ level between different breeds and sexes (Table 2). Aseel male had highest lymphocyte value and also highest among all birds. The lowest value of lymphocyte was reflected by RC female. Among the eight breeds, Aseel had highest lymphocyte percentage which is the sex pooled value. The class pooled highest lymphocyte was reported in Mediterranean class of chicken which comprise of WL breed in this report. Monocytes were highest in WL female and are lowest in Vanaraja male. The monocyte values of Mediterranean, American and English class were similar as compared to Indian and Synthetic class. The range value of heterophil varied from lowest in Aseel females to highest in RIR males. The highest percentage of heterophils among the breeds was reflected by RIR. The class pooled highest heterophils was reported in English class. Eosinophils were highest in Aseel male. The lowest values of eosinophils were present in WL female. WL male, DR male and female and RC male had approximately similar values of eosinophils. Interbreed eosinophil percentage was highest in Aseel. The class pooled highest eosinophil was reported in Indian class. Basophils were highest in BR female and Kadaknath female which was true for comparison among all birds. Among males, a highest percentage of basophils were reflected by Kadaknath. Sex pooled highest basophil percentages were reported in case of Kadaknath. The class pooled highest basophil was reported in American class (Table 2).

## Discussion

The Hb% of hens is lower than cocks which are in accordance with the results of chickens from Bangladesh.[7] The results of TEC corroborated with previous reports on native chicken of Kashmir.[14] The variations shown by Hb% and TEC (in millions per $mm^3$) among males and females could be due to influence of androgen hormone causing increased erythropoiesis and estrogen causing decrease in erythropoiesis due to hemodilution.[15]

The higher TLC in males and lower in females differed with earlier studies[10] where males had less leukocyte count compared to females. The PCV values were almost three times the values of Hb%. The increase or decrease in values of PCV depends on metabolic rate.[15] The findings of these parameters tallies with the work of above mentioned authors.

Lymphocyte percentage of Aseel is approximately similar to the data reported on Assil from Sylhet region of Bangladseh.[7] Heterophils may increase during mild or moderate stress but in severe stress, heteropenia might occur.[12] Eosinophil values corroborates with earlier work. [18] Variations in eosinophil might occur due to involvement of genetic factor.[7] The rise or fall of different leukocytes depend on various aspects like breed, sex[8,16], feed[11], temperature, egg- laying and stress.[1,13] Further, the site of blood collection from the bird also plays important role in variation of leukocytes. The study revealed that though each and every breed of chicken had descended from RJF in some way or other and are recognized as *Gallus gallus domesticus* there exist differences in their blood profile and also among males and females of each breed.

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