# THE LEUCOGRAM AND OSMOTIC FRAGILITY OF ISA WHITE AND BARRED PLYMOUTH ROCK COCKS FED VARYING LEVELS OF DIETARY SALT

**Aro, S. O., Owokotomo, P. E. and Yusuff, N. O.**
*Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria.*
E-mail: sambolaro@yahoo.co.uk

**Abstract**
*This experiment was performed to determine the effect of feeding varying levels of dietary salt on the differential leucocyte count (leucogram) and osmotic fragility of Barred Plymouth Rock (BPR) and Isa White (IW) breeding cocks. Four experimental diets (control diet and three other diets) designated as: T1 (control diet with 0.25 % salt), T2 (diet with 0.50 % salt), T3 (0.75 % salt), T4 (1.00 % salt) were fed to 24 cocks of the two different breeds grouped into six birds per treatment. At the end of eight weeks of experiment, blood samples were collected through venipuncture for the determination of the leucogram and red blood cell osmotic fragility. The result obtained for the white blood cell (WBC) count showed that there was no significant breed difference in percentage neutrophils, monocytes and lymphocytes between Barred Plymouth Rock (BPR) and Isa White (IW) but percentage eosinophils (3.30±0.15 versus 3.10±0.10) and basophils (1.60±0.16 versus 1.80±0.13 ) however differed (P<0.05) between the two breeds respectively. Results on osmotic fragility revealed that the red blood cells of birds on the high salt diets were more osmotically fragile than the control diet. However, T2 conferred the least osmotic stability on the layers while T1 had the best. There was no breed difference in the osmotic fragility between the BPR and IM cocks. Also the interaction between treatment levels and breed showed that BPR breed is more sensitive to osmotic fragility at all saline concentrations and dietary levels than the IW breed. It can be concluded that increase in the dietary salt up to 1.00 % level has no significant effect on the two commercial breeding cocks as far as their differential leucocyte count is concerned. Also, The IW seemed the more osmotically stable breed as far as their erythrocytic osmotic fragility is concerned.*

**Keywords:** Barred Plymouth Rock, erythrocytes, leucocytes, Isa White, osmotic fragility.

## Introduction

The role of dietary salt is multifaceted. It is a known appetiser in foods and feeds as it is a yardstick for measuring voluntary feed intake. Palatability is also measured by the direct feel of saltiness by the palate. Salt plays the physiological role as the harbinger of the two major electrolytes of the blood – the sodium and chloride ions. Dietary salt has been shown to confer immunity on rats (http://news.sciencemag.org/biology/2015) as diets that are grossly deficient in salt result in unthriftiness and heavy mortality in livestock population. The immuno-competence and livability of stock lie therefore on the white blood cells and the functionality of its cellular components. This study therefore seeks to investigate the effects of high salt diets on the differential white blood cell counts and osmotic fragility of the red blood cells of Barred Plymouth Rock and Isa White cocks.

## Materials and Methods

The experiment was carried out at the poultry unit of the Teaching and Research Farm of the Federal University of Technology, Akure. Nigeria. A total of ten (12) Isa White cock and ten (12) Barred Plymouth rock cock of about 10-12 months of age were purchased from a reputable source and used for the experiment. The birds were acclimatized for a period of three weeks after which feeding trial commenced. The cocks were randomly allotted into four (4) dietary treatments with groups of six (6) cocks in each treatment. Each bird served as a replicate of its treatment group. The cocks were housed in a battery cage and supplied with feed and water *ad libitum* throughout the period of the experiment. Four experimental diets with varying levels of dietary salt were formulated. The first diet had salt of 0.25 kg /100 kg of feed; hence it served as the control diet (T1). The remaining diets were labelled T2 with 0.5 kg of salt/100 kg of feed, T3 with 0.75 kg of salt/100 kg of feed and T4 with 1 kg of salt/100 kg of feed respectively. The diets contained 16.8% crude protein and metabolizable energy of 2602 Kcal/kg. Table 1 shows the gross composition of the diets.

**Data Collection:** At the end of the eight weeks feeding trial, blood samples for differential white blood cell counts (leucogram) and osmotic fragility were collected into sample bottles coated with anticoagulant - Ethylene-Diamine Tetra-Acetic Acid (EDTA). The osmotic fragility was determined as previously described by Oyewale (1991) using NaCl and distilled water. All data were subjected to a 2 x 4 factorial analysis in a

completely randomized design using SAS 2008 statistical package. Mean separation where applicable was done with Duncan's multiple range test of the same statistical package and significance was accepted at 5.00% level.

## Results and Discussion

The differential White Blood Counts are presented in Table 2. The Table showed no significant difference (P>0.05) in lymphocyte, heterophil and monocyte components of the white blood counts in the Barred Plymouth Rock (BPR) and Isa White (IW) breeds. However a significant difference in eosinophil (3.30±0.15 versus 3.10±0.10) and basophil (1.60±0.16 versus 1.80±0.13) content was observed respectively in the two breeds of cock. There were significant treatment effects in the differential leucocytic counts but these differences did not follow a well defined trend except in the basophil count where the highest value (2.00%) was recorded in T4. Since basophils are a rarity in the blood (Jain, 1993), values as high as 2.00% in the white blood cells as observed under the current study could therefore indicate a case of basophilia at 1.00% of dietary salt in the feed. The osmotic fragility of the red blood cells of the birds (Table 3) showed that birds on the control diet had lower fragility in comparison with those on the high salt diets. But again, this disparity is not dependent on the salt content of the feed as T2 with lower salt content had a higher fragility than T4 with 1.00% salt content. It could also be observed from the Table that the Isa White breed seemed to be more osmotically stable than the Barred Plymouth Rock breed when their erythrocytic fragilities are called to question. The values of osmotic fragility presented in Table 3 and Figure 1 however showed a decrease in the percentage of red blood cells haemolysed per saline concentration from 0.90 %to0.00 %. This is in consonance with the report of Aro *et al.* (2013) on broiler's red blood cells.

## Conclusion

The study showed that feeding high salt diets to breeding BPR and IW cocks had no deleterious effects on their leucogram as far as the lymphocytes, heterophils, monocytes and eosinophils are concerned but a condition of basophilia could be observed when the salt content in the feed of these birds is increased to 1.00%. It could also be concluded that the IW is the more osmotically resistant breed in terms of erythrocytic osmotic fragility.

## References

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**Table 1:** Gross composition (g/100g) of the experimental diets

| INGREDIENTS | DIET 1 | DIET 2 | DIET 3 | DIET 4 | | | | |
|---|---|---|---|---|---|---|---|---|
| Maize | 54.3 | | 54.3 | | 54.3 | | 54.3 | |
| Groundnut cake (GNC) | 9.00 | | 9.00 | | 9.00 | | 9.00 | |
| Fish meal | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Soya bean meal (SBM) | 9.00 | | 9.00 | | 9.00 | | 9.00 | |
| Wheat offal | | 21.00 | 21.00 | 21.00 | 21.00 | | | |
| Bone meal | | 3.00 | | 3.00 | | 3.00 | | 3.00 |
| Limestone | | 1.50 | | 1.25 | | 1.00 | | 0.75 |
| Salt | | 0.25 | | 0.50 | | 0.75 | | 1.00 |
| Premix | | 0.25 | | 0.25 | | 0.25 | | 0.25 |
| Lysine | | 0.10 | | 0.10 | | 0.10 | | 0.10 |
| Methionine | | 0.10 | | 0.10 | | 0.10 | | 0.10 |
| **TOTAL** | | **100.00** | | **100.00** | | **100.00** | | **100.00** |
| **Calculated content:** | | | | | | | | |
| Crude Protein (%) | | 16.8 | | 16.8 | | 16.8 | | 16.8 |
| M.E = (Kcal/kg) | | 2602 | | 2602 | | 2602 | | 2602 |
| Crude Fibre (%) | | 4.51 | | 4.51 | | 4.51 | | 4.51 |
| Fat and Oil (%) | 4.47 | | 4.47 | | 4.47 | | 4.47 | |
| Calcium (%) | | 1.62 | | 1.71 | | 1.80 | | 1.88 |
| Phosphorus (%) | 1.00 | | 1.00 | | 1.00 | | 1.00 | |
| Lysine (%) | | 0.85 | | 0.85 | | 0.85 | | 0.85 |
| Methionine (%) | 0.37 | | 0.37 | | 0.37 | | 0.37 | |

**Table 2:** Differential White Blood Counts of Barred Plymouth Rock and Isa White Cocks fed diets with varying levels of dietary salt.

| Treatments | Breed | LYM (%) | HET (%) | MON (%) | EOS (%) | BAS (%) |
|---|---|---|---|---|---|---|
| | BPR | 61.00±0.33 | 21.40±0.92 | 12.70±0.79 | 3.30±0.15$^{a}$ | 1.60±0.16$^{b}$ |
| | IW | 60.80±0.25 | 21.80±0.59 | 12.50±0.6 | 3.10±0.10$^{b}$ | 1.80±0.13$^{a}$ |
| T1 | | 60.80±0.58$^{b}$ | 22.20±1.20$^{a}$ | 12.20±0.58$^{b}$ | 3.20±0.20$^{a}$ | 1.60±0.24$^{b}$ |
| T2 | | 61.60±0.24$^{a}$ | 21.40±1.33$^{a}$ | 12.20±1.11$^{b}$ | 3.20±0.20$^{a}$ | 1.60±0.24$^{b}$ |
| T3 | | 60.60±0.40$^{b}$ | 22.00±0.84$^{a}$ | 12.40±1.03$^{a}$ | 3.40±0.24$^{a}$ | 1.60±0.24$^{b}$ |
| T4 | | 60.60±0.24$^{b}$ | 20.80±1.11$^{b}$ | 13.60±1.21$^{a}$ | 3.00±0.00$^{b}$ | 2.00±0.00$^{a}$ |
| T1 | BPR | 60.67±0.88$^{b}$ | 22.00±2.00$^{b}$ | 12.67±0.88$^{b}$ | 3.33±0.33 | 1.33±0.33 |
| T1 | IW | 61.00±1.00$^{b}$ | 22.50±1.50$^{b}$ | 11.50±0.50$^{b}$ | 3.00±0.00 | 2.00±0.00 |
| T2 | BPR | 62.00±0.00$^{a}$ | 18.50±1.50$^{d}$ | 14.50±1.50$^{a}$ | 3.50±0.50 | 1.50±0.50 |
| T2 | IW | 61.33±0.33$^{b}$ | 23.33±0.67$^{a}$ | 10.67±0.67$^{c}$ | 3.00±0.00 | 1.67±0.33 |
| T3 | BPR | 61.00±1.00$^{b}$ | 23.50±0.50$^{a}$ | 10.50±1.50$^{c}$ | 3.50±0.50 | 1.50±0.50 |
| T3 | IW | 60.33±0.33$^{b}$ | 21.00±1.00$^{b}$ | 13.67±0.88$^{a}$ | 3.33±0.33 | 1.67±0.33 |
| T4 | BPR | 60.67±0.33$^{b}$ | 21.33±1.86$^{b}$ | 13.00±2.08$^{a}$ | 3.00±0.00 | 2.00±0.00 |
| T4 | IW | 60.50±0.50$^{b}$ | 20.00±1.00$^{c}$ | 14.50±0.50$^{a}$ | 3.00±0.00 | 2.00±0.00 |
| Breeds (B) | | 0.52NS | 0.73NS | 0.93NS | 0.02Sig | 0.03Sig |
| Treatments (T) | | 0.04Sig | 0.03Sig | 0.02Sig | 0.03Sig | 0.03Sig |
| T × B | | 0.03Sig | 0.01Sig | 0.01Sig | 0.83NS | 0.76NS |

*±SEM= Standard Error Mean, BPR= Barred Plymouth Rock, IW= Isa White, NS= Non Significant, T1= Diets with 0.25% salt, T2= Diets with 0.50 % salt, T3= Diets with 0.75 % salt, T4= Diets with 1.00 % of salt.*

**Table 3:** Percentage erythrocytic Osmotic fragility of Barred Plymouth Rock and Isa White Cocks fed varying levels of dietary salt.

| | | Saline Concentration | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | Breed | 0.00 | 0.10 | 0.20 | 0.30 | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 |
| | BPR | 51.89±3.99 | 48.61±3.87 | 44.57±3.59 | 40.4±3.56 | 34.49±3.59 | 29.84±3.38 | 24.6±2.47 | 19.54±2.08 | 12.93±1.72 | 0.00 |
| | IW | 52.41±4.47 | 46.91±2.92 | 42.76±2.21 | 38.46±1.96 | 33.07±1.93 | 28.51±1.95 | 24.28±1.72 | 19.2±1.86 | 13.32±1.55 | 0.00 |
| T1 | | 49.04±9.32 | 42.6±6.83 | 38.41±6.00 | 33.60±5.74 | 25.78±3.82 | 20.66±3.28 | 16.95±2.52 | 12.73±2.20 | 8.62±2.13$^{b}$ | 0.00 |
| T2 | | 57.37±2.79 | 54.22±3.07 | 50.69±3.30 | 46.51±3.52 | 42.55±4.17 | 37.55±3.80 | 31.4±2.09$^{a}$ | 25.92±1.71 | 15.49±2.48 | 0.00 |
| T3 | | 55.57±4.92 | 50.07±2.96 | 45.05±1.65 | 41.33±1.61 | 35.59±1.99 | 31.67±2.16 | 26.44±1.46 | 20.94±1.82 | 15.18±2.02 | 0.00 |
| T4 | | 46.62±4.81 | 44.15±4.49 | 40.51±2.97 | 36.28±1.65 | 31.19±1.23 | 26.81±0.58 | 22.97±0.5$^{bc}$ | 17.89±1.09 | 13.19±1.39 | 0.00 |
| T1 | BPR | 46.57±10.29 | 42.61±9.64 | 38.32±8.93 | 34.77±9.23 | 25.35±6.18 | 20.96±5.74 | 17.13±4.56 | 12.97±4.01 | 8.70±3.81 | 0.00 |
| T1 | IW | 52.75±22.97 | 42.57±13.68 | 38.54±10.98 | 31.85±8.29 | 26.43±5.54 | 20.21±2.87 | 16.67±1.12 | 12.37±0.37 | 8.49±1.28 | 0.00 |
| T2 | BPR | 62.86±5.07 | 59.75±6.52 | 55.97±7.68 | 51.39±9.18 | 48.01±11.13 | 41.53±10.73 | 32.9±6.29 | 25.73±4.44 | 11.14±3.31 | 0.00 |
| T2 | IW | 53.71±0.78 | 50.53±0.36 | 47.16±1.05 | 43.26±0.20 | 38.90±0.20 | 34.89±0.99 | 30.39±0.38 | 26.04±1.76 | 18.39±2.53 | 0.00 |
| T3 | BPR | 55.19±1.04 | 51.52±0.80 | 47.95±1.51 | 44.02±2.91 | 38.10±3.05 | 34.70±3.56 | 28.86±1.10 | 24.11±0.80 | 19.53±0.04 | 0.00 |
| T3 | IW | 55.82±8.97 | 49.10±5.27 | 43.11±1.90 | 39.54±1.35 | 33.92±2.56 | 29.65±2.50 | 24.83±1.85 | 18.83±2.29 | 12.29±1.74 | 0.00 |
| T4 | BPR | 47.69±7.60 | 45.24±7.03 | 40.95±4.43 | 36.28±2.18 | 32.21±0.84 | 27.68±0.41 | 23.68±0.20 | 18.94±0.91 | 13.94±1.14 | 0.00 |
| T4 | IW | 45.01±7.32 | 42.52±7.01 | 39.84±5.33 | 36.27±3.61 | 29.67±3.04 | 25.51±0.28 | 21.9±0.71 | 16.31±2.29 | 12.08±3.67 | 0.00 |
| Breeds (B) | | 0.86NS | 0.50NS | 0.41NS | 0.35NS | 0.28NS | 0.21NS | 0.30NS | 0.30NS | 0.79NS | 0.00NS |
| Treatments (T) | | 0.61NS | 0.34NS | 0.18NS | 0.11NS | 0.02S | 0.01S | 0.00S | 0.00S | 0.08NS | 0.00NS |
| T×B | | 0.93NS | 0.93NS | 0.88NS | 0.91NS | 0.74NS | 0.89NS | 0.94NS | 0.73NS | 0.11NS | 0.00NS |

*$^{a,ab,b,bc}$= Means of the same row but with different superscripts are statistically signi ficant ($p<0.05$), ±SEM= Standard Error Mean.*

*BV= Blood Viscosity, BPR= Barred Plymouth Rock, IW= Isa White, T1= Diets with 0.25% salt, T2= Diets with 0.50 % salt, T3= Diets with 0.75 % salt, T4= Diets with 1.00 % of salt, 0.00-0.90= saline concentration, NS= Non significant, S= Significant.*