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Hematological responses of broiler chickens to graded levels of Vitamin C

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ABSTRACT

One hundred and twenty-day old-chicks were used to investigate hematological responses of broiler chickens to graded levels of vitamins C. Chicks were brooded and similarly managed for 4 weeks to fully adapt them to their environment. After this, animals were randomly assigned to 4 dietary treatments with 30 birds/treatment and 3 replicates of 10 birds/replicate as: T_1 (control diet, contained basal level of vitamin C 30mg/kg of diet), T_2 (diet 2, contained 200mg of vitamin C/kg of diet), T_3 (diet 3, contained 300mg of vitamin C/kg of diet) and T_4 (diet 4, contained 400mg of vitamin C/kg of diet), respectively. The animals received their respective diets for 4 weeks. 9 birds consisting of 3 birds from each replicate per treatment were sacrificed and their blood collected for analyses: Packed cell volume (PCV), haemoblobin (Hb), red blood cell (RBC), white blood cell (WBC) and their differentials: Neutrophil (NEU), lymphocytes (LYM), monocytes (MON), oenophile (EON) and basophile (BAS). PCV of the T_1 animals was significantly ($P < 0.05$) lower than those of T_2, T_3 and T_4 groups. Hb concentration of T_1 group animals was significantly ($P < 0.05$) lower compared with T_2, T_3 and T_4 groups. The trend was similar in the RBC as there were significant differences ($P < 0.05$) in the RBC amongst treatment groups. There were no differences in the WBC ($P > 0.05$) for all treatment groups. Also, there were no differences ($P > 0.05$) in the WBC differentials for all treatment groups. It was concluded that vitamin C can improve the quality of lives for broiler chickens, especially during their growth processes via its positive effects on PCV, RBC and Hb.

Keywords: Haematology, Packed cell volume, Haemoglobin, Red and White blood cells and the Broiler chicken

1. INTRODUCTION

Blood parameters are often used as one of the major factors in determining the nutritional status of a living organism, including farm animals such as poultry. Changes seen in the constituents of blood when compared to the control values can be used to explain in part the metabolic state of an animal as well as the quality of the feed ingested by the animal (Babatunde et al., 1992). Furthermore, Ekenyem and Madubuike, (2007) showed that haematological data can also be used to ascertain the disposition of the animal to its nutrition.

Literature data have shown that nutrition can affect blood characteristics of animals. For instance, the data of Saita, (1974) demonstrated that a diet with some

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levels of benzene when fed to animals induced leukemia, erythropenia, neutrophilia, lymphocytosis and alterations in blood platelets' morphologies. Ovuru and Ekweozor, (2004) reported similar observations that the diets fed to rabbits in their studies resulted in decreased erythrocytes, platelets and packed cell volumes. On the other hand, Johnson et al., (2019) showed that dietary vitamins improved PCV levels, Hb, RBC and WBC counts in the pig as well as neutrophils and lymphocytes.

Furthermore, Okejim et al., (2020) observed that vitamin ingestion ameliorated the negatives indices of the haematological properties of pigs initially fed diets contaminated with crude oil. From these observations, it is not a gainsaying to state that nutrition has a great impact on the overall health and wellness of the animal and therefore forms the background to this current study. Therefore, the objectives of this study are to investigate the effects of graded levels of vitamin C on the PCV, Hb and RBC counts in broiler chickens and to also investigate the effects of graded levels of vitamin C on WBC counts as well as its differentials: Neutrophils, lymphocytes, eosinophils, monocytes and basophils in broiler chickens.

2. MATERIALS AND METHODS

Experimental site

This study was carried out at the poultry unit of the Teaching and Research Farm, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt. The farm is situated at latitude 4^0 48'N and longitude 6^0 48'E at the Rivers State University campus.

Animals

One hundred and twenty (120) *Agrited* day-old chicks were acquired from a reputable commercial poultry dealer in Port-Harcourt, Rivers State. The animals on arrival at the Rivers State University Teaching and Research Farm were brooded to proper pre-condition them to their new environment. The animals by the fourth week were observed to have properly adapted to their environment and thus were randomly assigned into four treatment groups of 30 birds/treatment group with 3 replications of 10 birds/replicate. The pens were properly cleaned and disinfected before the birds' arrival.

Feeders and drinkers were also properly cleaned to also ensure that the animals' environment was "pathogen-free". During the brooding period all protocols, including the necessary medications were provided. Animals were fed similar diets from day one through the end of the 4th week. Water was provided *ad libitum*. The experiment lasted for 8 weeks and thus animals received their respective experimental diets for 4 weeks.

Experimental Diets

Hybrid feed™ grower mash was used in the study. In other words, the diets fed to the animals during the last four weeks of the experimental period were similar in all nutrients except their dietary vitamin C levels as: Control or treatment 1 (T_1, contained only basal level of vitamin C, 30mg), treatment 2 (T_2, contained 200mg of vitamin C), treatment 3 (T_3, contained 300mg of vitamin C) and treatment 4 (T_4, contained 400mg of vitamin C)/kg of diet, respectively. The animals were fed these graded levels of vitamin C-based diets for 4 weeks.

Blood Sample Collection

At the end of the study period, 9 birds from each treatment group were bled for blood collection. 3 birds were randomly collected from each replicate of the four treatment groups. The blood was collected from each bird into treated tubes with ethylene diamine tetra-acetic acid (EDTA) and immediately snaps frozen for later haematological analyses.

Blood Analyses

Blood samples were analyzed by haematology auto-analyzer machine (BC-2300). Blood parameters analyzed for were: PCV, RBC count, Hb concentration, total and differential WBC counts of each treatment group.

Experimental design and Statistical analyzes

The study was designed and carried out as a completely randomized design (CRD). Data obtained were subjected to analysis of variance (ANOVA) using general linear model (GLM) procedure of SAS. Treatment means were compared using Tukey's test.

The model was: $Y_{ij} = \mu + X_i + E_{ij}$, where Y_{ij} = individual observation of the treatment, μ = population mean, X_i = effect of the i^{th} treatment and E_{ij} = the error term. An *α-level* of *0.05* was used for all statistical comparisons to represent significance.

3. RESULTS

The results of the PCV, Hb and RBC counts of broiler chickens fed graded levels of vitamin C-based diets (Table 1). The PCV of the T_1 animals although it was within the normal range was significantly ($P < 0.05$) lower than those of T_2, T_3 and T_4 animal groups. The T_4 animal group had the highest PCV value that was significantly ($P < 0.05$) higher than those of the T_2 and T_3 animal groups. For haemoglobin concentration, animals of the T_1 group demonstrated a significantly ($P < 0.05$) lower value compared with animals of the T_2, T_3 and T_4 groups. RBC counts also showed significant differences ($P < 0.05$) amongst the four treatment groups. The results of the WBC count and their differentials are in (Table 2). As in Table 2, there were no significant differences ($P > 0.05$) in WBC counts and their differentials for all dietary treatment groups.

Table 1 Means of PCV, Hb and RBC of broiler chickens fed graded levels of vitamin C-based diets

Treatments						
Item	T_1	T_2	T_3	T_4	SEM	*P-value*
PCV (%)	23.95^a	26.25^b	29.23^c	34.9^d	0.18	0.000
Hb (g/dl)	8.33^a	9.33^b	10.10^c	11.75^d	0.04	0.000
RBC (ul^3)	3.45^a	3.93^b	4.60^c	5.23^d	0.07	0.000

$^{a, b, c, d}$ Means within each row with different superscript differ significantly ($P < 0.05$)

Table 2 WBC counts and their differentials of broiler chickens fed graded levels of vitamin C-based diets

Treatments						
Item	T_1	T_2	T_3	T_4	SEM	*P-value*
WBC (ul^3)	6.8	7.2	8.8	9.3	2.8	0.13
Neu (%)	40	44	44	45	3.9	0.11
Lym (%)	50	47	48	47	2.12	0.41
Eon (%)	3	2	2	3	0.50	0.22
Mon (%)	7	7	6	5	0.62	1.00
Bas (%)	0	0	0	0	0	0

4. DISCUSSION

The wholesomeness and thus lack of deviations from normal blood morphologies and levels are indicators of the effectiveness of the dietary antioxidant vitamin C in the synthesis of antioxidant molecules for maintaining good health of the animals that ingest them (Borel et al., 2005). Blood is always used to assess the animal in terms of performance and profitability. Vitamins especially the antioxidant vitamins particularly are implicated in the overall wellness of the animal and hence increased performance and other economic indices, such as profit margins (De-La-Fuente and Victor, 2000).

Therefore, blood parameters are one of the major indices of measuring or determining the nutritional status of any living organism, including poultry. Therefore, changes observed in the blood constituents when compared to the control, for instance the T_1 group values in this current study could be used to explain at least in part the metabolic state of the animal as well as the quality of the feed of the animal (Babatunde et al., 1992; Ekenyem and Madubuike, 2007). Ekenyem and Madubuike, (2007) demonstrated that haematological parameters can be used to gain more insights about an animal and consequently to their plane of nutrition. This assertion becomes more dependable as it has been further shown that haematological parameters are affected by factors like nutrition, environment and health condition of the animal (Menzel, 1992; NRC, 2012).

One major take away from this current study was the fact that animals that received vitamin C had higher values of PCV, Hb and RBC. This observation in this study supports the fact that antioxidant vitamin C is capable of enhancing the quality of lives of broiler chickens. This finding in this study is in agreement with the data of Babatunde et al., (1992) and those of Ekenyem and Madubuike, (2007). Although, there were no differences in the WBC counts and their differentials for all treatment groups, animals on the vitamin diets had numerically higher values compared to the control.

Overall, when the findings of this study are further interpreted it demonstrates that vitamin C can stimulate a protective immune response that can be adequate to induce resistance to pathogens and possible other environmental factors that can cause ill-health. To this point, the finding of this study again is in tandem with previous researchers' works, such as those of De-la-Fuente and Victor, (2000) and Fragou et al., (2004).

5. CONCLUSION

Dietary ingestion of antioxidant vitamin C improved some haematological parameters of broiler chickens, such as PCV, Hb and RBC. This is an indication that the ingestions of the vitamin C improved the quality of lives of the broiler chickens.

Informed consent

Not applicable.

Ethical approval

The Animal ethical guidelines are followed in the study for observation & experimentation.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

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