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Performance and haematological indices evaluation of laying hens fed graded levels of raw garlic

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Abstract

Garlic has been reported by various researchers to reduce lipids in both human and animal studies. Garlic was also reported to have anti-inflammatory and immunomodulatory properties in animal models. However, there is paucity of information on its effect on haematological indices of laying hens. This study was conducted to investigate the effects of inclusion of raw garlic in the diet of Nera black hens on their performance and haematological indices. One hundred and twenty 18-week-old Nera black pullets were randomly distributed to 6 dietary treatments containing 0%(T1), 1%(T2), 2%(T3), 3%(T4), 4%(T5) and 5%(T6) inclusion levels of Raw Garlic(RG) over 10 weeks. Each dietary treatment consisted of 10 replicates of 2 birds each. Feed intake, Egg weights (EW) and Hen Day Production (HDP) were recorded. Blood samples were collected at the termination of the experiment and analysed for haematological indices. Feed intake and EW were similar among treatment groups. Inclusion of 2% RG caused an increase in HDP (74.4%) when compared with birds fed 4%RG (56.2%), 5%RG (64.6%) and 0%RG (57%).Inclusion of varying levels of RG increased the haematocrit of birds in T2(32.0%), T3(33.6%), T4(29.6%), T5(32.4%), T6(35.4%) versus T1(26.0%). The inclusion of 2%RG significantly increased the white blood cell ((6.9x10^9/l) when compared with the WBC (4.8 x10^9/l) of birds fed the control diet. The values of haemoglobin, mean corpuscular volume and mean corpuscular haemoglobin concentrations were similar in all treatment groups. Inclusion of RG up to 2%increased HDP and improved the PCV of laying hens while higher RG inclusion levels (5%) had no additional economic value to laying hens.

Keywords: Raw garlic, Laying hens, performance and haematological parameters

Évaluation des performances et des indices hématologiques des poules pondeuses nourries à des niveaux gradués d'ail cru

Résumé

L'ail a été rapporté par divers chercheurs pour réduire les lipides dans les études humaines et animales. L'ail aurait également des propriétés anti-inflammatoires et immunomodulatrices dans des modèles animaux. Cependant, il y a peu d'informations sur son effet sur les indices hématologiques des poules pondeuses. Cette étude a été menée pour étudier les effets de l'inclusion d'ail cru dans l'alimentation des poules noires Nera sur leurs performances et leurs indices hématologiques. Cent vingt poulettes noires Nera âgées de 18 semaines ont été distribuées au hasard à 6 traitements diététiques contenant 0%(T1), 1%(T2), 2%(T3), 3%(T4), 4%(T5) et Niveaux d'inclusion de 5 % (T6) d'ail cru (AC) sur 10 semaines. Chaque traitement alimentaire consistait en 10 répétitions de 2 oiseaux

chacune. L'apport alimentaire, le poids des œufs (PŒ) et la production par jour de poule (PJP) ont été enregistrés. Des échantillons de sang ont été prélevés à la fin de l'expérience et analysés pour les indices hématologiques. L'apport alimentaire et le PŒ étaient similaires parmi les groupes de traitement. L'inclusion de 2 % de AC a entraîné une augmentation du PJP (74,4 %) par rapport aux oiseaux nourris avec 4 % de AC (56,2 %), 5 % de AC (64,6 %) et 0 % de AC (57 %). L'inclusion de différents niveaux de AC a augmenté l'hématocrite des oiseaux en T2(32,0%), T3(33,6%), T4(29,6%), T5(32,4%), T6(35,4%) versus T1(26,0%). L'inclusion de 2 % de AC a augmenté de manière significative le nombre de globules blancs (6,9 x 109/l) par rapport au nombre de globules blancs (4,8 x 109/l) des oiseaux nourris avec le régime témoin. Les valeurs d'hémoglobine, de volume corpusculaire moyen et de concentrations corpusculaires moyennes d'hémoglobine étaient similaires dans tous les groupes de traitement. L'inclusion de AC jusqu'à 2 % augmentait le PJP et améliorait l'hématocrite des poules pondeuses, tandis que des niveaux d'inclusion de AC plus élevés (5 %) n'avaient aucune valeur économique supplémentaire pour les poules pondeuses.

Mots clés : Ail cru, Poules pondeuses, performances et paramètres hématologiques.

Introduction

Analysis of the haematological parameters of chicken is very essential for the diagnosis of various pathological and metabolic disorders. These haematological parameters are often used in assessing the state of health of chickens (Afolabi *et al.*, 2011). Changes in serum biochemistry and haematological parameters are often used to determine various health statuses of animals and to determine stresses due to environmental, nutritional and/or pathological factors. Some blood parameters could also serve as baseline data, which could be exploited in the diagnosis of healthy chickens, combating diseases, improvement of the desirable breeds as well as designing appropriate breeding strategies for poultry birds in a particular area (Dutta *et al.,* 2013). Haematological values of poultry are often influenced by age, sex, breed, climate nutritional status, strain or species (Elagib and Ahmed, 2011; Islam *et al.*, 2004; Onyishi *et al.*, 2017). Some herbs such as garlic and ginger have been reported to improve the immune system of both humans and animals as evidenced in some haematological parameters (Adebiyi *et al.*, 2017; Ismail *et al.*, 2021). Several studies reported that garlic (*Allium sativum*) and onion (*Allium cepa* L.) have many beneficial properties such as antimicrobial, antioxidative, antithrombotic, hypolipidemic and antiplatelet aggregator in broilers (Puvača *et al.*, 2016; Reinhart *et al.*, 2009; Ur Rahman *et al.*, 2017). Garlic has also been reported to contain compounds that have hypocholesterolemic and hemolytic properties (Amagase, 2006). Although the garlic formulation of AGE (aged garlic extract) has significant anti-oxidant activity on sickle red blood cells, excessive garlic intake in animals

often leads to hemolytic anaemia (Oboh, 2004). Ismail *et al.* (2021) also reported an increase in red blood cells, haemoglobin, lymphocytes and heterocytes in broiler chickens fed garlic powder. According to Isaac *et al.* (2013) red blood cell plays a significant role in the transport of oxygen and carbon dioxide in the body. Red blood cells serve as a carrier of haemoglobin which reacts with oxygen carried in the blood to form oxyhaemoglobin during respiration. Considering the importance of haematological indices in the welfare of layers and the ability of garlic and garlic products to affect these parameters, it would be appropriate to study the influence of garlic intake on laying hens. Though, the effect of raw garlic on laying hens has not been fully explored.

This study was carried out to evaluate the influence of inclusion of varying levels of raw garlic paste on haematological parameters of laying hens

Materials and methods

Ingredient source and preparation

The garlic used was obtained from a commercial market in Nigeria. The garlic bulbs were separated into cloves, rinse with water and grind into a paste. The garlic paste was then incorporated into the feed.

Management of birds

A total of 120 Nera Black hens at 18 weeks of age were randomly distributed to 6 dietary treatments consisting of 0%(T1), 1%(T2), 2%(T3), 3%(T4), 4%(T5) and 5%(T6) inclusion levels of Raw Garlic(RG). Each dietary treatment consisted of 10 replicates of 2 birds each. The birds were housed in galvanized iron cages under an intensive management system and the birds were allowed to acclimatise for 2 weeks and the study spanned over a 10-week period. Feed and water were given *ad-libtum.*

Experimental parameters measured

The Feed intake(FI), Egg weights (EW) and Hen Day Production (HDP) were recorded. The data obtained from the amount of feed given to birds in each replicate and the leftover feed per day were used to calculate the feed intake (equation I). The egg weights were obtained by weighing the eggs laid by birds in each replicate using a digital electronic laboratory scale. The percentage of hen-day production was determined from the daily egg production records and calculated as shown in equation II**.** Blood samples were collected at the termination of the experiment and analysed for haematological indices.

Feed intake = Amount of feed given to the birds – leftover feed …..(I)

Hen-day production % =

$$\frac{\text{Total no of egg laid}}{\text{No of birds x no of days}} \times 100 \quad \text{....(II)}$$

Blood collection and laboratory analysis

The blood samples(3mls) were collected in Ethylene Diamine Tetracetic Acid (EDTA) bottles from ten birds per treatment i.e one bird per replicate at the termination of the experiment through the jugular vein. The blood samples collected were used for the analysis of haematological parameters as outlined by Lamb (1981)

and Jain (1986). The haematological parameters measured were White Blood Cell(WBC) and Red Blood Cell(RBC) differential counts, Packed Cell Volume (PCV), haemoglobin(Hb), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC).

Statistical analysis

Data were analysed by analysis of variance (ANOVA) of completely randomised design using the 2017 SPSS version 25 and the means were separated using Duncan multiple range test of the same software (IBM Corp., 2017). Values are expressed as mean (Standard error of mean (SEM)). The level of statistical significance was $p<0.05$.

Experimental diets

The composition of experimental diets has been documented (Adebiyi *et al*., 2018) and is as contained in Table 1.

Table 1: Composition of diets fed to experimental birds

Ingredients	Dietary treatments					
	1 (0%)	2 (1 %RG)	3 (2 %RG)	4 (3 %RG)	5 (4 %RG)	6 (5 *%RG)*
Maize	44.5	45.0	46.5	47.0	47.5	48.0
Palm kernel cake	9.0	9.0	8.0	8.0	8.0	8.0
Corn bran	8.0	8.0	7.0	6.0	5.0	4.0
Wheat bran	9.5	7.0	6.0	5.0	4.0	3.0
Groundnut cake	7.0	8.0	8.5	9.5	10.5	11.5
Soyabean cake	9.5	9.5	9.5	9.0	8.5	8.0
Raw garlic	0	1	2	3	4	5
Fish meal	2.0	2.0	2.0	2.0	2.0	2.0
Bonemeal	3.0	3.0	3.0	3.0	3.0	3.0
Oyster shell	6.6	6.6	6.6	6.6	6.6	6.6
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15	0.15	0.15
Total	100	100	100	1 00	100	100
Calculated values						
Crude protein(%)	17.07	17.14	17.06	17.07	17.08	17.09
Metabolizable energy (Kcal/kg)	2600	2596.5	2596. 1	2582.5	2568.9	2555.2

Results and discussion

Performance indices

The impact of dietary inclusion of graded levels ofraw garlic (RG) on the average daily feed intake (FI), egg weight (EW) and hen day production(HDP) of layers are shown in Table 2. Inclusion of 1, 2, 3, 4, and 5%) RG did not significantly affect the FI and EW. However, HDP was significantly increased at 2% inclusion level of RG in the bird's diet in comparison with birds fed control diet, 4%RG and 5%RG. The indifference in

the values of feed intake as averaged over a period of 10 weeks is an indication that inclusion of RG up to 5% has no detrimental effect on this breed of birds. These results are consistent with earlier findings (Adebiyi *et al.*, 2017; Aji *et al.*, 2011; Khan *et al.*, 2006) who reported that feed intake was not affected when both raw and sun-dried garlic were included in the diets of both broilers and laying hens. Similarly, egg weight was not affected by the inclusion of RG in the diets, which could be an indication that the birds equally utilised the feed given to them irrespective of the inclusion level of RG. The similar patterns in feed intake and egg weight reported in this study could be attributed to the fact that protein and energy utilisation of birds were not negatively affected by inclusion of graded levels of RG in the diets of laying hens. In agreement with the present study (Ao *et al.*, 2010; Canogullari *et al.*, 2010; Khan *et al.*, 2008), in their studies, found that RG and garlic products did not affect egg weight. These differences may be due to the use of different commercial garlic products quality and the preparation methods of garlic powder which may result in production of varying levels of active ingredients in the garlic product. Also, the duration of the experiment and breed are added reasons that may affect the ability of birds to efficiently utilize feed intake during the laying period. The mean Hen-Day production of laying hens as influenced by dietary inclusion of RG was significantly ($P<0.05$) different. The addition of 2% RG in layers' diet recorded the highest value for HDP over others. Though this value was statistically similar to the HDP of layers fed 1% and 3% but significantly higher than the HDP of layers fed 4%RG, 5% RG and control diet. This suggests that 2% level of RG may just be the ideal level for improving egg production of Nera black layers. This observation is in line with the findings of Rahardja *et al.* (2010) who reported significant ($P<0.05$) improvement in egg production of 27-week Hysex Brown hens fend 2% garlic powder. In contrast, (Yalçın *et al.*, 2006) reported that supplementation of SHSY-type brown layers' diet with 1, 5, and 10g/Kg garlic powder had no effect ($P>0.05$) on egg production, which may be due to the use of very low levels of garlic powder in the diet.

Table 2: Effect of dietary inclusion of varying levels of raw garlic on the performance of laying hens

Parameters	Treatments						SEM
	1 (0%)	2 (1 %RG)	3 (2 %RG)	4 (3 %RG)	5 (4 %RG)	6 (5 *%RG)*	
Average feed intake(g/bird/day)	102.7	103.4	102.8	102.2	101.7	101.2	2.30
Egg Weight (g)	58.57^{ab}	61.00^{a}	56.60^{ab}	60.45^{ab}	56.25^{ab}	55.48^{b}	2.21
Hen Day Production (%)	57.1^{ab}	65.2^{bc}	74.4^{c}	65.8^{bc}	56.2^{a}	64.6^{b}	4.1

*Not significant, ($P>0.05$) Means with the same superscript in horizontal row are not significantly different

Table 3 : Effect of dietary inclusion of varying levels of raw garlic on the Haematological parameters of laying hens

Parameters	Treatments						SEM
	1 (0%)	2 (1 %RG)	3 (2 %RG)	4 (3 %RG)	5 (4 %RG)	6 (5 *%RG)*	
PCV (%)	26.0^{b}	32.0^{a}	33.6^{a}	29.6^{ab}	32.4^{a}	35.4^{a}	2.67
HB (g/dl)*	9.06	9.80	10.68	9.30	10.00	10.65	1.51
RCB ($\times10^{12}$/l)*	3.16	4.08	4.28	3.44	3.68	4.22	1.13
MCV (fL)	81.76^{bc}	78.43^{bc}	78.51^{bc}	86.05^{a}	88.04^{a}	83.88^{abc}	4.46
MCH(pg)*	28.05	24.01	24.95	27.03	27.17	25.16	2.45
MCHC (g/dl)*	34.85	30.63	31.79	31.42	30.86	30.01	3.31
WBC ($\times10^{9}$/l)	4.8^{b}	6.5^{ab}	6.9^{a}	6.4^{ab}	5.6^{ab}	5.8^{ab}	1.21

*Not significant, Means with the same superscript in a horizontal row are not significantly different (P>0.05)

Haematological parameters

The mean haematological parameters of birds fed varying levels of raw garlic are represented in table 3. The values of RBC, Hb, MCHC and MCH were not significantly affected by inclusion of raw garlic in the diets of laying birds. It could therefore be observed that both low(1%RG) and high inclusion of raw garlic(5%RG) used in this experiment did not exert an adverse effect on the RCB, Hb, MCH and MCHC of laying hens. These are indices that have direct relationship with the oxygen-carrying capacity of the blood. This similarity in the values of RCB, Hb, MCHC and MCH could therefore be a suggestion that raw garlic has no negative impact on the transportation of oxygen into the tissues of laying hens. Thus, a reduction in red blood cell count implies decreased level of oxygen that would be carried to the tissues as well as the level of carbon dioxide returned to the lungs (Etim, 2014; Soetan *et al.*, 2013; Isaac, *et al.*, 2013; Ugwuene, 2011). The results obtained for RBC and Hb is consistent with the findings of Adebiyi *et al.*, (2017) and Ademola *et al.* (2009), who recorded insignificant differences in RBC and Hb when broilers were fed with 1, 1.5, 2 and 3% raw and sun-dried garlic. Furthermore, Noman *et al.* (2015) recorded no differences in the values RBC and Hb when Aqueous extract of garlic at 1% and 2% was administered to broiler chicks. However, the values obtained for PCV, MCV and WBC showed significant differences among the treatments. The values of PCV, MCV and WBC ranged between 26 and 35.4%, 78.43-88.04(fL) and 4.8-6.9x109/l respectively. All the birds fed RG had higher values of PCV when compared with birds fed control diets. The highest value of PCV(35.4%) was recorded in birds fed 5% RG. The improved PCV observed in birds fed 5%RG diet suggests that high inclusion of RG up to 5% could be beneficial in terms of improving PCV of laying hen. This observation is in line with the early study by Iranloye (2002) who reported

increased PCV in rats fed 200mg/kg garlic juice for 30 days. Recent studies also reported an increase in the value of PCV when aqueous garlic is administered to broiler chicks (Dar *et al.*, 2014; Khan *et al.*, 2017). High PCV, Hb, and RBC indicate improved oxygen-carrying capacity of the cells, which translate to better availability of nutrients (Oleforuh-Okoleh *et al.*, 2015). Significant differences were observed in the values of MCV among the treatment groups. The MCV of birds fed 1 and 2RG were similar to that of the control while the birds fed 3, 4, and 5%RG had increased values of MCV when compared with birds fed the control diet. However, these values were within the normal range of MCV for adult chicken. it could therefore be deduced from our results that inclusion of RG in diets of layers up 5%RG had no negative effect on the MCV. Our findings agree with the earlier study (Akgül *et al.*, 2010) who observed increase in the value of MCV of rats fed garlic(4%) and vegetables (40%). The effect of RG on WBC is reflected in table 3. Birds fed 2%RG had the highest values of WBC compared with other treatments. This result is in agreement with (Fadlalla *et al.*, 2010) who reported that WBC was increased by increased level of garlic inclusion in the diets of broiler chicks and that birds fed 0.3% garlic had higher WBC compared to birds fed 0, 0.15, and 0.45. likewise, (Ademola *et al.*, 2004) reported increase in total white blood cells by about 18.7% in garlic powder treated birds as compared to the control group. Conversely, (Zeryehun *et al.*, 2017) reported no significant increase in WBC of birds fed with garlic containing diet as compared to control birds. This result might be due to the age and strain of birds used in the experiments because WBC differs with age and among strains (Adeyemo *et al.*, 2018; Onyishi *et al.*, 2017). Besides, different analytical methods and garlic products might also result in this difference.

Conclusion

Considering the reported findings herein, it can be concluded that the supplementation of RG in layers' diets could significantly increase the HDP, PCV, MCV and WBC without adverse effects on egg production and general welfare of the bird. 2% RG supplemented group gave a better performance in relation to HDP of all the treatment groups.

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