Haematological response of broiler chickens to garlic (*Allium sativum*) as an additive

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Abstract

An experiment was carried out to investigate the effects of using garlic (*Allium sativum*) as an additive on haematological profile in broiler chicken production. The study was carried out at Livestock Investigation Department (L.I.D) of the National Veterinary Research Institute (N.V.R.I), Vom. The experiment lasted eight weeks. A total of 144, one day-old broiler chicks of Arbor acre breed were used for the study in a completely randomized design (CRD). The birds were allotted into four (4) dietary treatments with each having three (3) replicates. Processed and ground garlic was added into the drinking water of each treatment at 0g, 3g, 6g and 9g per liter of drinking water representing treatments 1, 2, 3 and 4, respectively. The result of haematological analysis showed that all the parameters were significantly ($P < 0.05$) different across the dietary treatments. The white blood cells in T4 (12.13) which is higher than 10.21, 8.65 and 7.68 respectively. This indicates that the health of the birds was challenged in T4 even though they are all within the normal range (Merck's Manual, 1998). Packed cell volume (PCV) level of T4 was the Lowest among the dietary treatments. It can therefore be concluded that garlic used as an additive in drinking water showed no deleterious effect in haematological parameters of broiler chickens rather it boosted their immunity.

Keywords: Broilers, garlic, haematology, blood, feed additive.

Introduction

Blood assay is a sensitive indicator that reveals the health status in animals and has been an indispensable tool in the diagnosis, treatment and prognosis of many diseases (Owen *et al.*, 2008). Haematological indices are index and a reflection of the status of the blood available for an animal to meet its physiological, biochemical and metabolic necessities (Ewuola *et al.*, 2004). Blood examination gives the opportunity to investigate the presence of several metabolites and other constituents and helps detect conditions of stress, which can be nutritional, environmental or physical (Aderemi, 2004). Blood has been shown as an important index of physiological, pathological and nutritional status in the animal (Olorede *et al.*, 1995; Ewuola *et al.*, 2004). Amusa *et al.*, (2015) reported that haematological components are also

valuable in monitoring feed toxicity especially with feed constituents that affects the formation of blood. Aletor and Egberongbe, (1992) reported that the blood variables most consistently affected by dietary influences include red blood counts, packed cell volume, plasma protein and glucose. Packed Cell Volume (PCV) is a measure of the health status of birds, as low PCV indicates anaemia which is a condition in which there are too few red blood cells or red blood cells are deficient in haemoglobin resulting in poor health (Yip, 2000). Red blood cells (RBC) functions as a carrier of haemoglobin which carries oxygen to the tissues and carbon dioxide to the lungs. Garlic (*Allium sativum*) has been known and utilized as spice and herbal remedy for more than 4000 years and most likely originate from central China (Kuetter *et al.*, 2000). Its

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utilization as an important plant of nutritional and medicinal values has been widely reported (Mansoub, 2011; Stanacev *et al.*, 2011). The beneficial effect of *Allium sativum* on animal performance resulted from its antimicrobial, antioxidative and antihypertensive properties (Konjufca *et al.*, 1997; Sivam, 2001). It has a mode of action similar to antibiotics due to its content of pungent substances and the pungent substances in garlic leads to higher production of saliva and gastric juices (Ibrahim *et al.*, 2004). Probably these pungent substances contain some properties that act as antibiotics in garlic and bring out its antimicrobial and antioxidants effects. Garlic has been found to be effective against pathogenic bacteria in herbal medicine since ancient time. In fact in Iraq, in Veterinary Medicine, garlic was used for treatment of birds suffering from different microbial diseases (Mendham, 2011). In Chinese folklore medicine, garlic has been said to cure just about everything from common cold and flu to plague. It further stated that garlic has sulphuric compound and in general a stronger tasting clove which has more sulphurous content and hence more potential medicinal value. The bacteria in the body do not evolve resistance to garlic as they do with many pharmaceutical antibiotics (Mendham, 2011). Therefore, in areas or places where there is no antibiotics insight, garlic can be used as an immediate suitable substitute which can suppress the action of the bacteria in the body. Whatever an animal consumed the effect can be analyzed and found out through the blood system if it is not seen physically, whether the impact is positive or negative to the body.

Materials and methods

Experimental site

The experiment was conducted at the poultry section of the Federal College of

Animal Health and Production Technology (FCAH&PT), L.I.D of the National Veterinary Research Institute (N.V.R.I), Vom, Plateau State, Nigeria.

Purchase of test ingredient

The test ingredient garlic (*Allium sativum*) bulbs were purchased from a local market in Maiduguri, Borno State of Nigeria, and were transported to where the experiment took place.

Processing of test ingredient

The test ingredient (*Allium sativum*) was carefully peeled and weighed according to the level of inclusion in different dietary treatments. They were then ground accordingly using mortar and pestle, after pounding, it was scooped, and the mortar rinsed and added to the scooped garlic and water was added to make up the quantity needed for drinking water of the chickens.

Experimental diets

Fresh ground garlic was incorporated into their water at graded levels of 0g/l, 3g/l, 6g/l and 9g/l representing treatments 1, 2, 3 and 4, respectively. The pound garlic was first administered to the birds through their water when they were two weeks old for two days, then after every 2 weeks for 2 days until the birds were of table size. Formulated and compounded feed were provided *ad libitum* (Table 1) throughout the duration of the experimental period which lasted 8 weeks. Feed was formulated to contain 23% and 20% CP at the starter and the finisher phases of the broiler chicks according to (NRC, 1994) standard of formulation.

Experimental design and management of birds

One hundred and forty-four, day old broiler chicks of Arbor acre breed were allotted randomly into pens and were assigned into four treatments consisting of 36 birds per treatment; each treatment contained three replicates having twelve birds each in a completely randomized design (CRD). 200 watt bulbs were used to generate light and

warmth during the brooding period. Garlic was added into their drinking water at 0, 3, 6 and 9g per liter of water for treatments 1, 2, 3 and 4, respectively at the starter and finisher phases. Antibiotic was given at day old for 5 days and multivitamins was given subsequently for the next 3 days, while 200 watts bulbs were used as source of heat and light to the birds. The birds were vaccinated with dose of Newcastle diseases vaccine (Lasota) through their drinking water and gumboro vaccine was also administered to the birds orally. Vaccination schedule and medications were strictly observed in the

course of the study. Feed and water were provided to the birds *ad libitum*, the proximate composition and haematological parameters were analyzed. The experimental birds were randomly allotted into pens demarcated with wood and wire mesh with a small door. The birds were fed with formulated and compounded experimental feed and water given *ad libitum*. The weights of the birds were taken before the commencement of the study to obtain their initial weight and weight gain on weekly bases other parameters taken were feed intake, feed conversion ratio etc.

Table 1: Composition of Experimental diets starter phase (0-4 weeks)

Ingredients	Level of inclusion			
	0g	3g	6g	9g
Maize	48.96	48.96	48.96	48.96
Soya bean meal	34.19	34.19	34.19	34.19
Wheat offal	9.00	9.00	9.00	9.00
Fish meal	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50
Lime stone	1.50	1.50	1.50	1.50
Methionine	0.15	0.15	0.15	1.50
Lysine	0.15	0.15	0.15	0.15
*Premix	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
CP (%)	23.00	23.00	23.00	23.00
ME (kcal/kg)	2775	2775	2775	2775
Crude fibre (%)	4.94	4.94	4.94	4.94
Ether extract (%)	4.62	4.62	4.62	4.62
Calcium (%)	1.49	1.49	1.49	1.49
Available	0.55	0.55	0.55	0.55
Phosphorus (%)				
Lysine (%)	1.43	1.43	1.43	1.43
Methionine (%)	0.56	0.56	0.56	0.56

*Vitamin premix supplied/kg diet: Vit. A, 9,000 IU; Vit.D₃, 2,000 IU; Vit.E, 18 IU; Vit.B₁, 1.8mg; Vit.B₂, 6.6mg; Vit.B₃, 10mg; Vit.B₅, 30mg; Vit.B₆, 3.0mg; Vit.B₉, 1mg; Vit.B₁₂, 1.5mg; Vit.K₃, 2mg; Vit. H₂, 0.01mg; folic acid, 0.21mg; nicotinic acid, 0.65mg; biotin, 0.14mg; choline, 500mg; Fe, 50mg; Mn, 100mg; Cu, 10mg; Zn, 85mg; I, 1mg; Se, 0.2mg.

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Table 2: Composition of Experimental diets finisher phase (5-8 weeks)

Ingredients	Level of inclusion			
	0g	3g	6g	9g
Maize	54.96	54.96	54.96	54.96
Soya bean meal	27.24	27.24	27.24	27.24
Wheat offal	10.00	10.00	10.00	10.00
Fish meal	2.00	2.00	2.00	2.00
Bon meal	3.00	3.00	3.00	3.00
Lime stone	2.00	2.00	2.00	2.00
Methionine	0.15	0.15	0.15	0.15
Lysine	0.15	0.15	0.15	0.15
*Premix	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
CP (%)	20.00	20.00	20.00	20.00
ME (kcal/kg)	2809	2809	2809	2809
Crude fibre (%)	4.57	4.57	4.57	4.57
Ether extract (%)	4.38	4.38	4.38	4.38
Calcium (%)	1.69	1.69	1.69	1.69
Available	0.59	0.59	0.59	0.59
Phosphorus (%)				
Lysine (%)	1.23	1.23	1.23	1.23
Methionine (%)	0.51	0.51	0.51	0.51

*Vitamin premix supplied/kg diet: Vit. A, 9,000 IU; Vit.D₃, 2,000 IU; Vit.E, 18 IU; Vit.B₁, 1.8mg; Vit.B₂, 6.6mg; Vit.B₃, 10mg; Vit.B₅, 30mg; Vit.B₆, 3.0mg; Vit.B₉, 1mg; Vit.B₁₂, 1.5mg; Vit.K₃, 2mg; Vit. H₂, 0.01mg; folic acid, 0.21mg; nicotinic acid, 0.65mg; biotin, 0.14mg; choline, 500mg; Fe, 50mg; Mn, 100mg; Cu, 10mg; Zn, 85mg; I, 1mg; Se, 0.2mg.

Laboratory Analysis

Proximate composition

The sample of garlic was taken to Biochemistry Department of the National Veterinary Research Institute (NVRI), Vom for proximate composition according to the method of AOAC (1990).

Blood collection

Blood samples were collected from 2 birds in each replicate and put into EDTA bottles and taken to the haematological Department of the Federal College of Veterinary Medical Laboratory Technology, National Veterinary Research Institute (NVRI), Vom, where the samples were analyzed according to the method of Decie and Lewis, (2006).

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA), SPSS (2006),

statistical difference between means were separated using Duncan's multiple range test option of the same software.

Results and discussion

The result of proximate composition of garlic is presented in Table 3. The result revealed that fresh garlic contains some substantial amount of water 63.45g/100g. However, the protein content is very low (6.80) consequently, fibre (4.80), fat (0.55) and all other parameters are low, all measured in g/100g. This result indicates that garlic has very low nutritional value and so cannot be used as feed ingredient for animals. It also contains small amount of some minerals like calcium (0.12) and phosphorus (0.09).

Table 3: Proximate Composition of garlic (g/100g)

Sample	Composition
Moisture	63.45
Crude Protein	6.80
Crude Fibre	4.80
Crude Fat	0.55
Ash	1.25
Nitrogen Free Extract	50.05
Calcium	0.12
Phosphorus	0.09

The result of the haematological indices of broiler chickens fed garlic as an additive is presented in Table 4. There are significant differences among all the parameters measured. Haematological parameters in birds showed their health status and also reveal the efficient use of the feed consumed by the animal. The significant difference among all the treatment groups suggests that garlic had an effect on the blood indices of broilers. The result of WBC revealed that blood collected from birds fed treatments 1 (10.21), 2 (7.68) and 3 (8.65) were within the normal range ($3-11 \times 10^9/L$) while birds fed in treatment 4 (12.13) had above the normal range ($12.13 \times 10^9/L$) according to (Merck's Manual, 1998). The significant ($P < 0.05$) difference in white blood cells suggested that there may be the presence of foreign body or antigen in the circulatory system. The WBC usually fights against diseases in the body and their high presence indicates that the birds were stressed thus a rapid production of WBC in the bone marrow to carry out its function of protecting the body adequately as observed in treatment 4. The WBC plays prominent roles in disease resistance especially with respect to the production of antibodies and the process of phagocytosis (Soetan *et al.*, 2013). Haemoglobin (Hb) result indicates that treatment 2 had highest value (17.14g/dL) which is above the normal range, treatments 1, 3 and 4 were within the normal range of 7-11 g/dL according to (Merck's Manual, 1998). This means that the birds in treatments 1, 3 and 4 had normal cellular respiration within the tissues in

their bodies and could transport oxygen round the body to the vital areas, while those in treatment 2 had some difficulties in effective cellular respiration. Hb is responsible for cellular respiration which is important in metabolic reactions (Frandsen, 1981; McDonald *et al.*, 1995). The PCV values were within the normal range (27-42 %) according to (Merck's Manual, 1998) which also indicates enough amount of blood in the birds suggesting that the birds were not anaemic or dehydrated during the experiment and garlic may not have caused shortage of blood in the birds. It also means that the birds had high oxygen carrying capacity which gave them the ability to withstand stress that might have occurred within the body system. This agreed with Aster, (2004) that low PCV value indicates anaemia while high PCV value suggests dehydration. Heterophil result showed that they were within the normal value of 40-70 % according to (Merck's Manual, 1998). The results showed that lymphocytes range (55.67-73.17) were above the normal values 20-50 % according to (Merck's Manual, 1998). This result suggests that the birds had some health issues that made their bodies to produce a lot more of the lymphocytes cells. This is probably an indication that the birds had some infections that were dealt with by the WBC and lymphocytes. Lymphocytes are involved in the protection of the body from viral infection and harmful germs (Akinkunle, 2010). The monocytes result revealed that treatments 1 and 4 were within the normal range 0-3 %

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according to (Merck's Manual, 1998) while treatments 2 and 3 were above the normal

range, especially treatment 3 that had 11.67 % which is very high.

Table 4. Haematological indices of broilers fed garlic as an additive

Parameters	T1	T2	T3	T4	SEM	Ref. value*
WBC (x10 ⁹ /l)	10.21 ^b	7.68 ^c	8.65 ^c	12.13 ^a	0.68	1.0-9.5
Haemoglobin (g/dl)	10.50 ^b	17.14 ^a	9.48 ^b	10.82 ^b	2.26	7-11
PCV (%)	32.33 ^{ad}	40.83 ^a	32.67 ^{ab}	30.60 ^{ac}	2.52	27-42
Neutrophil (%)	33.17 ^a	24.17 ^b	33.17 ^a	23.50 ^c	7.68	50-60
Lymphocytes (%)	69.33 ^b	68.33 ^c	55.67 ^d	73.17 ^a	8.21	20-50
Monocytes (%)	0.83 ^{ad}	5.33 ^b	11.67 ^a	2.67 ^c	3.98	0-3

Note: All the means with the same subscripts are statistically significant at 5% level.

KEY: SEM - Standard Error Mean

WBC - White blood cells

PCV - Packed cell volume

Ref. value* - Merck's Manual, 1998

Conclusion

It can be concluded that the chickens in all the dietary treatments had good nutritional status and therefore were able to fight pathological and other stressful conditions that they encountered. This could be the reason why there was no mortality during the experiment because the birds produce more of WBC and lymphocytes to fight foreign bodies. Garlic can be added in drinking water of birds (broiler chicken) up to 9g per litre without any adverse effect in the haematological response of the broiler birds.

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