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Effect of Garlic Supplementation in the Diets of Cockerel Chicks on Performance and Economy of Production

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Authors' contributions

This work was carried out in collaboration among all authors. Author KAS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author BTO managed the analyses of the study. Author KOJ managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A feeding trial was conducted to determine the effect of garlic supplementation (0,1.5,3.0 and 4.5%) in the diet of 240 day old cockerel chicks on growth performance, economy of production, nutrients digestibility, hematological and serum indices, four treatments with 3 replicates each of 20 birds each were adopted in a complete randomized design. The four diets used were almost isocaloric and isonitrogenous,while data collected were subjected to ANOVA. The diets had comparable levels of nutrients, initial body weight (90.0 g), daily weight gain per bird (6.02 ± 0.39 g), and fuel conversion ratio (5.43 ± 0.5 g), while the daily fuel intake per board was significantly ($P<0.05$) varied and least at 4.5% inclusion level, with corresponding highest (#25,489) profitability and best

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(P<0.05) digestibility of crude protein, NFE and ether extract. Highest (P<0.05) PCV, Hb, RBC, WBC and lymphocyte was obtained at 4.5% level of inclusion, with corresponding high level of plateles and significantly (P<0.05) depressed urea (3.13 g/dl). The use of garlic in cockerel chicks' nutrition up to 4.5% is beneficial, for the enhancement of growth, digestibility wellbeing and profitability.

Keywords: Garlic; growth performance; cockerel chicks; economy of production.

1. INTRODUCTION

Animal production is dynamic and has moved from primitive and subsistence to commercial and more productive level, with resultant more yield of meat, egg, milk and productivity [1,2]. The potential of animals can be maximized by the provision of the right environment, feed inclusive and a functional physiology, that has been adapted to produce hormones, digestive enzymes and other precursors required such as co-enzymes and catalysts [3,4].

The body system is not 100% efficient in the discharge of its metabolic functions, there is therefore need for external intervention by enzymes, hormones and antibiotics. An in efficient metabolic process will result to wastage of resources, due to improper digestion respiration, blood circulation and endocrine and nervous system functioning [5,6].

There is no controversy that the use of food supplement, hormones, antibiotics and other drugs, to enhances animal well being had been age long [7,8]. Substances added to animal feed are chemical or biological in nature and they are used in small quantity [9]. However the use of inorganic additives has resulted to antimicrobial resistance, which has under mined and endangered human and veterinary medicine staggering human and animal death has been recorded and may increase in an alarming proportion, if any pro-active step is not taken [9].

The global growing interest in organic agriculture and reduction of reliance on antibiotics and other non organic additives is due to the growing occurrence of antimicrobial resistance related diseases [10,11].

Recent clinical and preclinical trials in animal production have revealed an increasing trend in the use of biological sources like Ginger (*Zingiber officinale*), Garlic (*Allium sativum*), Bitter leaf (*Vernonia amygdalina*) and scent leaf (*Ocimum gratissimum*) as feed additives [10, 12]. They are utilized, because of their multivarious functions and potency in the

treatment of respiratory diseases, ulcers, diarrhea, cancer, inflammation [13].

Poultry farmers have systematically adopted garlic in poultry feed, to improve digestion, feed utilization, economy of production and animal well being [10,14]. Outcomes of many research on poultry nutrition have revealed poor performance in growth, egg production and feed utilization, when garlic is used at high level. [10], adopted 0.125 to 2.0% Garlic in the diet of broilers, [15] incorporated garlic powder at 1.5-3.0% in broilers diet, with a favorable performance at 1.5%.

Olobatoke and Mulugeta [16] added garlic to the diet of laying hen, up to 5%, with resultant improvement in egg quality; however, there was reduced egg production. In pursuit of increased and improved poultry production, this study tried to evaluate the effect of garlic powder addition at 0, 1.5, 3.0 and 4.5% in the diet of cockerel chicks on growth performance nutrients digestibility, hematological and serum indices. The choice of cockrel chicks is because is easy to raise by subsistence chick is because it can be easily raised by subsistence farmers [17] and has a high survival rate without an intensive medication programme. This is complemented with the medicinal importance of Garlic, due to its content of bioactive organosulfor compound [18,19]. It also contain Allicin and its derivatives, which are potent for the treatment of bacteria, virus and also inhibitory to organisms causing dental carries [20,21]. Any improvement in feed utilization will enhance economic returns and cost of feeding poultry, since feed accounts for about 60-70% of the total cost of animal production [5]. This trial will be used to assess the utilization of diets with graded levels (0,1.5, 3.0,4.5%) of garlic by cockerel chicks.

2. MATERIALS AND METHODS

2.1 Experimental Site

The trial to investigate the effect of Garlic supplementation in the diets of Cockerel was carried out in the poultry unit of the Teaching and

Research farm of Federal College of Wildlife, New Bussa Niger State, Nigeria. The poultry pen was properly cleaned and made conducive before chicks arrival.

2.2 Experimental Birds

Two hundred and forty day old cockerel chicks Hacco black hybrid were sourced from a reputable hatchery, with good history of supply of good chicks. The chicks were randomly allotted to four treatments (0%, 1.5%, 3.0% and 4.5%) inclusion of garlic. Each treatment had 60 chicks at 20 birds per replicate, while each treatment was replicated thrice.

2.3 Managements of Birds

The chicks were raised in pens with short wall and well ventilated upper parts, covered with wire net to prevent rodents. They were managed on deep litter system. Feeders and drinkers were well laid out on the floor. Feed and water were offered to the birds based on their age requirement and need.

2.4 Feeding and Digestibility Trial

Four diets with crude protein and metabolizable energy conforming with the recommendation of [22] for cockerel chicks were adopted. The diets were supplemented with 0-4.5% levels of garlic at graded levels of (0, 1.5, 3.0 and 4.5%). The trial lasted for eight weeks. Four birds from each replicate were moved to metabolic cage at the seventh week for excreta collection and subsequent nutrient digestibility determination to Profile crude protein, crude fiber, ether extract and nitrogen free extract, using [23] method.

2.5 Hematological and Serum Metabolite Determination

On the seventh week, four birds per replicate were selected and bled through the jugular vein into two vaccutiner tubes, one containing ethylene diamine tetra acetic acid (EDTA) for hematological study and the other sterile plasticvaccutiner tubes without EDTA for serum biochemical analyses. Hematological parameters determined were Pcv, Hb, RBC, WBC and lymphocyte and the serum metabolites were platelets, urea and creatinine.

2.6 Growth Response Determination

Value of feed intake in gram per bird is taken on a daily basis and the weight gain was determined

as the difference in the weight of the chicks at the beginning and end of the week.

Feed intake value is the difference between the feed offered and feed residue, and the feed conversion ratio was determined by dividing feed intake by weight gain, this will help to ascertain the quantity of feed consumed for a gram weight gain.

2.7 Economy of Cockerel Chicks Production

This was done to determine if there is any economic benefit from the incorporation of garlic (0,1.5,3.0,4.5%) into the diets of cockrel chicks by finding the cost and returns. The following total variable cost, total fixed cost, total revenue and profit margin were determined.

2.8 Statistical Analysis

All data collected were subjected to analysis of variance in a complete randomized design of (SAS 2003) significant means were separated using the Duncan multiple range test of the same package.

3. RESULTS

3.1 Gross Composition of Garlic Supplemented Diets Fed to Conserve Cockerel Chicks (Starter Phase)

Table 1 shows four diets, with garlic supplementation (0, 1.5, 3.0 and 4.5%). The diets were almost isonitrogenous 20% crude protein and isocaloric.

3.2 Proximate Composition of Garlic Supplemented Diets Fed to Cockerel Chicks (Starter Phase)

The proximate composition of the diets elicited the dry mater (90.29 – 90.44), crude protein (20.15 – 20.89%), ether extract (3.66 – 3.77%), crude fiber (5.67 – 6.21%), ash (9.29 -9.45%), and NFE (50.18 – 51.11%). The diets had comparative proximate values.

3.3 Performance Characteristics of Cockerel Chicks Fed Garlic Supplemented Diets

All chicks in the four treatments had comparable (90.0 g) initial body weight; their final body weight over the period of the trial was significantly varied

(p<0.05), 440 g (0% GARLIC), 450 g (1.5% GARLIC), 439 g (3.0% GARLIC) and 430 g (4.5% GARLIC), with corresponding comparable daily weight gain of 6.23 g (0% GARLIC), 6.41 g (1.5% GARLIC), 6.23 g (3.0% GARLIC) and 6.02 g (4.5% GARLIC). Daily feed intake of 38.00 g/bird was highest (p<0.05) in 1.5% GARLIC. All treatments however had comparable feed conversion ratio. The economy of production analysis was computed based on total variable cost, total fixed cost and total revenue, which were used to determine profitability in all the treatments. Highest profit of ₦25,489 was realized at 4.5% level of garlic supplementation.

3.4 Nutrient Digestibility of Cockerel Chicks Fed Garlic Supplemented Diets

This elicited the nutrient digestibility of cockerel chicks fed garlic supplemented diets. The digestibility of crude protein, crude fiber, ether extract and nitrogen free extract varied (p<0.05). (4.5% GARLIC) had highest digestibility of crude protein (72.95%), NFE (70.00%) and ether

extract (68.70%), with a resultant least (p<0.05) crude fiber digestibility (60.60%).

3.5 Hematological Components of Cockerel Chicks Fed Garlic Supplemented Diets

This shows hematological indices like PCV (%), Hb (g/dl), RBC ($10^9/l$), WBC and lymphocyte ($10^9/l$). all values obtained were significantly (p<0.05) varied and highest in T₄ (4.50% garlic supplementation). The range of values obtained was (28.00 – 31.00%), (8.90 – 9.70 g/dl) (2.10 – 2.38 $10^9/l$), (225.30 – 235.60 10 (l) and (2115-2.29 $10^9/l$) for PCV, HB, RBC, WBC, and lymphocyte respectively.

Table 6 Serum metabolites of cockerel chicks fed garlic supplement diets. This shows the concentration of platelets (g/dl), level of urea (mmol/dl) and creatinine (mg/dl). Platelets increased from 5.00 (g/dl) in control treatment to 19.00 g/dl in (4.50% GARLIC) inclusion least (P<0.05) urea ($3.13\text{mmol}^{-1}/l$) was recorded for (4.5% GARLIC), while creatinine level increased (P<0.05) with garlic inclusion levels.

Table 1. Gross composition of garlic supplemented diets fed to conserve cockerel chicks

Ingredients	Garlic (0%)	Garlic (1.5%)	Garlic (3.0%)	Garlic (4.5%)
Garlic	0.00	1.50	3.00	4.50
Maize	32.00	30.50	29.00	27.50
Maize offal	06.00	0.6	0.6	0.6
Wheat bran	26	26	26	26
Groundnut cake	14	14	14	14
Soy bean	8.00	8.00	8.00	8.00
Fish meal	6.00	6.00	6.00	6.00
Bone meal	3.00	3.00	3.00	3.00
Oyster shell	4.00	4.00	4.00	4.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
CP	20.74	20.59	20.44	20.29
ME	2644	2600	2589	2580

Table 2. Proximate composition of garlic supplemented diet feed to cockerel chicks (Starter phase)

Composition	Garlic (0%)	Garlic (1.5%)	Garlic (3%)	Garlic (4.5%)
Dry matter	90.26	90.37	90.29	90.44
Crude protein	20.63	20.15	20.89	20.37
Ether extract	3.66	3.71	3.77	3.69
Crude fiber	5.87	5.95	6.13	6.21
Ash	9.37	9.45	9.32	9.29
NFE	50.73	51.11	50.18	50.88

Table 3. Performances characteristics of cockerel chicks fed with garlic supplemented diets

Growth parameters	Garlic (0%)	Garlic (1.5%)	Garlic (3.00%)	Garlic (4.50%)	SEM \pm
Initial weight (g/bird)	90.0	90.0	90.0	90.0	
Final weight (g/birds)	440 ^{ab}	450 ^a	439.0 ^b	439.0 ^b	10.0
Daily weight (g/birds)	6.23	6.41	6.23	6.02	1.5
Daily feed intake (g/birds)	36.00 ^{ab}	38.00 ^a	37.00	33.0 ^b	3.00
Feed conversion ratio (FCR)	5.77	5.92	5.93	5.43	0.5
Total variable cost of product	13,574	13,527	13,910	11,491	
Total Fixed cost	10,000	10,000	10,000	10,000	
Total Cost	23,574	23,527	23,910	21,491	
Total Revenue	48,000	47,500	47,000	46,980	
Profit	24,426	23,973	23,090	25,489	

abc: mean value along the same horizontal row with different superscripts are significantly ($p<0.05$) different

Table 4. Nutrient digestibility of cockerel chicks fed garlic supplemented diets

Growth parameters	Garlic (0%)	Garlic (1.5%)	Garlic (3.00%)	Garlic (4.50%)	SEM \pm
Crude Protein	68.45 ^b	68.25 ^b	69.50 ^b	72.75 ^a	2.0
Crude Fiber	63.50 ^a	62.00 ^b	64.00 ^a	60.60 ^c	1.2
Nitrogenfree extract	64.00	66.00 ^c	67.50 ^c	70.00 ^a	1.0
Ether Extract	63.00 ^c	63.20 ^b	64.75 ^b	68.70 ^a	1.6

abc - Mean values along the same horizontal row with different superscripts are significantly ($P<0.05$) different

Table 5. Hematological components of cockerel chicks fed garlic supplemented diets

Parameter	Garlic (0%)	Garlic (1.5%)	Garlic (3%)	Garlic (4.5%)	SEM
PCV(%)	28 ^c	28 ^b	29 ^b	31 ^a	± 0.50
Hb(g/dl)	8.90 ^c	8.90 ^c	9.40 ^b	9.70 ^a	± 0.15
RBC($^{10^6}_{\mu l}$)	2.10 ^b	2.14 ^c	2.19 ^c	2.38 ^a	± 0.15
WBC($^{10^{12}/l}$)	225.30 ^c	226.90 ^b	230.30 ^b	235.60 ^a	± 0.42
Lymphocyte($10^9/L$)	2.15 ^c	2.26 ^b	2.27 ^{ab}	2.29 ^a	± 0.02

abc - Mean values along the same horizontal row with different superscripts are significantly ($P<0.05$) different

Table 6. The serum metabolites of cockerel chicks fed garlic supplemented diets

Parameter	Garlic (0%)	Garlic (1.5%)	Garlic (3%)	Garlic (4.5%)	SEM
Platelets (g/dl)	5.00 ^c	8.00 ^b	13 ^b	19.00 ^a	± 2.00
Urea (mmol/l)	4.00 ^a	3.60 ^d	3.60 ^a	3.13 ^c	± 0.35
Creatinine(mg/dl)	114.00 ^d	119.00 ^b	126.00 ^a	116.80 ^c	± 1.71

abc - Mean values along the same horizontal row with different superscripts are significantly ($P<0.05$) different

4. DISCUSSION

The gross composition of the diets showed adequate level of nutrients in conformity with the recommendation [22] that cockerel chicks of shorter phase requires 19-20% crude protein and metabolizable energy of 2700 kcal/kg. The levels of dietary fixed ingredients, such as bone meal limestone, lysine, methionine, and salt were adequate and in conformity with the recommendation [17].

The low level of garlic dietary inclusion was supported by [10], when they adopted garlic inclusion at (1.25-2.00% in broiler diet, while [15]

added garlic at 1.50-3.00% in broilers nutrition, [24] also staged they limited impact was recorded when feed additive was added to broiler chicks diets of high level, he however obtained a good performance in broiler chicks fed dietary supplementation of garlic at 1.50%, thus forming the basis for this investigation in cockerel chicks nutrition recorded in tropics.

The proximate composition of the diets revealed comparable dry matter, crude protein, ether extract, crude fiber, ash and NFE, this help to remove bias or error due to variation in diet composition. The dietary nutrients composition aligned with recommendation of [17,8].

The performance of the cockerel chicks considered, such as feed intake, weight gain, feed conversion and economics of production were favorable and impressive with increased level of garlic. Daily feed intake values were significantly ($P<0.05$) varied, it was highest in (1.5% GARLIC) inclusion and least at (4.5% GARLIC) inclusion. This confirms the finding [25], when they detected depressed feed intake in cockerel chicks fed diets containing sweet orange peel at 0-10%, [26], further buttressed that feed supplement must be systematically adopted to obtain optimum performance, good immune response and growth for broiler chicks. Feed intake and growth rate are directly related [3], in this instance, daily weight gain in the treatments compared, this could be due to the presence of Allicin, which is in aromatic oil in garlic, which enhances digestion and positively influence the respiratory system and food combustion for energy generation [1]. Improved ($p<0.05$) PVC ($28.00\pm3.0\%$), Hb(8.9 ± 0.8)g/dl, RBC($2.10\pm0.28\times10^6/\mu\text{l}$), WBC($225.30\pm10.30\times10^3/\mu\text{l}$) and Lymphocyte ($2.15\pm0.14\times10^2/\mu\text{l}$) were recorded for good well being and defence mechanism, this reflected in high rate of survival of the chicks, this corroborated the findings of [5,26], that garlic is a form of organic antibiotics that boosts animal performance. This treatment also significantly enhanced the level of blood platelets, with highest value of (GARLIC 4.5%). Urea level reduced ($p<0.05$) as the level of garlic inclusion increased, which is an indication of good urea excretion, the level of creatine did not follow any pattern. The significantly reduced level of urea corroborated the view of [3] that garlic and most feed additives have medicinal value and some are regarded as system purifiers.

This trial shows that garlic was effectively utilized up to 4.5% inclusion level, this view was also expressed by Karangya et al. [7], when he asserted that garlic inclusion in livestock feed improved growth and boost immunity, due to its content of bio active compounds. Feed conversion ratio in the treatments compared, an indication that cockerel chicks can effectively utilize diets with 4.50% inclusion level of garlic. Profitability in the treatments compared (50.47-54.25%) and were above 25% obtained in broiler chicks production by Oluyemi and Robert [17].

5. CONCLUSION

Garlic as feed additive in the diets of cockerel chicks:

- Can be used up to 4.5% inclusion level to enhance feed intake and significantly ($P<0.05$) improve the digestibility of crude protein, Nitrogen Free Extract (NFE) and ether extract.
- Improved livability, serum and hematological indices.

6. RECOMMENDATION

The adoption of garlic in the feed of cockerel chicks up to 4.5% is beneficial, because it promotes survival, growth, nutrients digestibility and improved serum and hematological values.

ETHICAL APPROVAL

Animal ethic Committee approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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