Original Research Article

Effect of garlic supplementation in the diets of cockerel chicks on performance and economy of production

Abstract: A feeding trail 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 allotted to four experimental diets, in a Complete Randomize Design (CRD). 60 chicks each were allotted to the four treatments, while each treatment was replicated thrice at 20 chicks per replicate; to determine growth performance, economy of production, digestibility, hematological and serum malice. Data collected were subjected to ANOVA. The diets had comparable levels of nutrients, initial body weight (90.0g), daily weight gain per bird (6.02 ± 0.39g), and fuel conversion ratio (5.43 ± 0.5), 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 (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 platelet, significantly (P<0.05) depressed urea (3.13g/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".

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 (Fadlalla et al., 2010). 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.

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 (Horrigen et al., 2002).

There is no controversy that the use of food supplement, hormones, antibiotics and other drugs, to enhances animal well being had been age long (Karangiya et al., 2016). Substances added to animal feed are chemical or biological in nature and they are used in small quantity (FAO, 2019). 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 (FAO 2019).

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 (Javanandel et al., 2008).

Recent clinical and preclinical trials in animal production have revealed an increasing trend in the use of biological sources like Ginger (Zingiber officinale), Garlic (Allum sativum), Bitter leaf (Vernonia amygdalina) and scent leaf (Ocimum grattisissimum) as feed additives (Javandel et al.,2008, Simon and Jenderek., 2003). They are utilized, because of their multivarious functions and potency in the treatment of respiratory diseases, ulcers, diarrhea, cancer, inflamation (Gardzielewska et al., 2003).

Poultry farmers have systematically adopted garlic in poultry feed, to improve digestion, feed utilization, economy of production and animal well being (Javandal et al., 2008). 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. Javandel et al., 2008, adopted 0.125 to 2.0% Garlic in the diet of broilers, Mitosevic et al., 2013 incorporated garlic powder at 1.5-3.0% in broilers diet, with a favourable performance at 1.5%.

Olobatoke and Mulugeta (2010) 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 choices of cockerel chick is because it can be easily raised by subsistence farmers for backyard poultry (Oluyemi and Roberts 1988) and it 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 (Iwalokun et al., 2004). It also contain Allicin and its deriviatives, which are potent for the treatment of bacteria, virus and also inhibitory to organisms causing dental carries (Chang and Cheong 2008).

Materials and methods

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 condusive before chicks arrival.

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 20birds per replicate, while each treatment was replicated thrice.

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 liter 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.

Feeding and digestibility trial

Four diets with crude protein and metabolizable energy conforming with the recommendation of NRC, 1994 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 the A.O.A.C(2002) method.

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..

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.

Economy of of cockerel chicks production.

This was determined by computing the variable cost, fixed cost, total cost and total revenue to arrive at the profit margin.

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.

RESULTS

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.

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	06	06
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

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.

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	9037	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 fibre	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

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.

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±
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 prodct	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.

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%).

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±
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.

Hematological components of cockerel chicks fed garlic supplemented diets

This shows hematological indices like PCV (%), Hb (g/d), RBC (10^9/l), WBC and lymphocyte (10^9/l). all values obtained were significantly ($p<0.05$) varied and highest in T_4 (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 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($10^9$$_{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: Serum metabolizes of cockerel chicks fed garlic supplement diets.This shows that 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 (3.13mmol^{-1}/l) was recorded for(4.5%GARLIC), while creatinine level increased ($P<0.05$) with garlic inclusion levels.

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

Discussions

The gross composition of the diets showed adequate level of nutrients in conformity with the recommendation of NRC (1994), that cockerel chicks of shorter phase requires 19-20% curde protein and metabolizable energy of 2700 kcol 1kg. the levels of dietary fixed ingredients, such as bone meat, limestone, lysine, methinonine, and salt were adequate and in conformity with the recommend action of attach (2004) . And Oluyemi and Robert (2000).

The law level of garlic dietary inclusion was supported by Javende *et al,* (2008), when they adopted garlic inclusion at 0<125-2.00% in broiler diet, while Mitosevic *et al,* (2013) added garlic at 1.50-3.00% in broilers nutrition, suriya *et al* (2012) also staged they limited impact was recorded when feed additive as 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 infestation in cockerel chicks nutrition recorded in tropics.

The proximate composition of the diets revealed comparable dry matter, crude protein, either extract, crude fiber, ash and NFE, this help to remove bias or error due to variation in diet composition and also establishment the fuel that the crude protein of 20% as adequate for cockerel starter chicks as recommended by Oluyemi and Robert (2008).

The performance of the cockerel chicks considered feed intake, weight gain, feed conversion and economics of production, most of which were favorable and impressive with increased level of garlic inclusion. Daily feed intake values were significantly (P<0.05) varied, highest in (1.5% GARLIC)inclusion and least at (4.5%GARLIC) inclusion which was (33.0g/brrd). This confirms the findings of Ojabo and Adenkola (2013), when they detected depressed feed intake in cockerel chicks fed diets containing sweet orange peel at 0-10%, Tekeli *et al,* 2008, 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 (Tewe, 1997), 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 (Fadlalla *et al,,* 2010).

These trial shows that garlic was effectively utilized up to 4.5% inclusion level, this view was also expressed by Karangiya et al, (2016), 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 2000).

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.

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.

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