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Effects of Oral Administration of Garlic *(Allium sativum)* Extract on the Growth Performance and Caecal Microbial Load of Broiler Chickens.

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Abstract

The study was conducted to determine the effect of garlic extract on the growth performance and caecal microbial load of broiler chickens. One hundred and twenty (120) day-old broiler chickens were distributed to four (4) treatment groups with three (3) replicates of ten (10) birds each in a Completely Randomized Design. The Control birds on 0% garlic were administered broad spectrum antibiotics for first 3 days from day-old and for another three days at four weeks of age. The garlic extract obtained by soaking 50g of crushed garlic bulbs in 1 litre of water at room temperature for 12 hours and sieved, was given at varying levels of 5%, 10% and 15% through drinking water. The 15% inclusion level of garlic significantly ($p<0.05$) reduced mortality percent in broilers. The 15% garlic extract level significantly ($p<0.05$) increased the live weight and dress weight similar to result obtained for control birds. Garlic extracts had no significant ($p>0.05$) effect on the caecal microbial load of broiler chickens at finisher phase. The study concluded that 15% garlic extract aqueous inclusion significantly reduced mortality and improved liveability of broiler chickens.

Keywords: Broiler Chicken, Garlic Extract, Weight-Gain, Livability, Ceacal Microbial Load

Description of problem

In the past few decades, poultry industries have developed in several areas including nutrition, genetics, management for maximum efficiency in growth performance and meat yield [0]. For many years, antibiotics have been used in broiler diets to promote growth while restricting or eliminating particular pathogenic organisms [0]. However, intensive use of antibiotics in poultry farming leads to development of antibiotic resistant bacteria which is a potential threat to animals and human health. Antibiotic resistance develops as a result of the unrestricted utilization of antibiotics in response to increased demand for animal products, creating a global concern for animal and human health [0] and presence of antibiotics residues in poultry products [0].

The use of natural feed additives and growth promoters from different sources in animal feeds is an effective way to enhance nutrient utilization and to reduce the antibiotic residues. Phytogenic supplements are plant derived products used in feeding poultry to maintain performance [0]. Among a large number of natural feed additives , garlic has been considered as an effective plant having antioxidant and antimicrobial activities along with multiple beneficial uses [0].

Rahman *et al.,* [0] reported that garlic has many beneficial properties such as antimicrobial, antioxidative, antithrombotic, antiplatelet aggregator, and antihypertensive in broilers. So, garlic has been utilized to promote growth by improving poultry performance [0]. Garlic supplemented broiler chicken diets have been recognized for their strong stimulating effect on the body weight gain [0], ability to eliminate pathogenic microbes and improve body health which can finally increase the feed intake and growth [0]. It has a great impact on haematological parameters, which affect the physiological, pathological and nutritional status of poultry [0].

Research has been conducted on its use in poultry production, its employment as a natural feed supplement and acceptance would serve as a phytochemical source for better growth, health, and production performance. It is important to ascertain these claims and also investigate the effects of oral Garlic extract administration on the growth performance and caecal microbial load of broiler chickens.

Materials and methods

Experimental Site

The experiment was carried out at the Livelihood Support and Development Centre, SLIDEN Africa, near Federal University of Agriculture Abeokuta, Ogun State, Nigeria. It is located in the derived savannah vegetation zone of South-Western, Nigeria. Annual rainfall average is about 1100 mm and peak rainfall occurs in the period of June to September. The mean temperature is 25°C and average relative humidity of about 80% (Google Earth, 2020).

Preparation of Garlic (*Allium sativum*)

The Garlic *(Allium sativum)* used in this experiment were bought from a market in Abeokuta. The Garlic was peeled and grinded, and 50g of grinded garlic was added to a litre of water at room temperature and kept for 12 hours. It was then sieved and the extract obtained was added to the birds drinking water. Treatment one (T1) which is the control treatment contained no garlic extract while Treatments 2,3 and 4 birds were given water containing 5%, 10% and 15% garlic extract respectively, of the water volume.

Experimental Animals and Management

One hundred and twenty (120) broiler chickens (Arbor acre) were collected from a reputable hatchery at day-old. The birds were fed compounded broiler starter (for four weeks) and finisher (3 weeks) as presented in Table 1. Clean and cool water containing the garlic extracts at various inclusion levels were provided *ad libitum*. Adequate sanitation was observed. The vaccination guide from the hatchery was strictly adhered to.

Experimental Design

One hundred and twenty (120) broiler chicks were distributed into four (4) treatment groups with each treatment having three (3) replicates of ten (10) birds. Treatment 1 (T1) birds were on water that contains no garlic extract but was administered broad spectrum antibiotics at monthly intervals and it served as the control. Treatments 2, 3 and 4 birds were on water that contain Garlic extracts at 5%, 10% and 15% respectively in a Completely Randomized Design. The birds were fed *ad-libitum* on the compounded finisher diet in Table 1.

Data Collection

Growth Performance Parameters

The body weight of birds per replicate were weighed at the commencement of the experiment and subsequently on weekly basis to estimate average weight gain. Weekly feed intake were measured as the difference between the feed given and leftovers. Feed conversion ratio (FCR) were also computed. Record of mortality was taken as it occurred in order to estimate livability.

Daily Water Intake: This was calculated as volume of water left over subtracted from the total water supplied.

a) $$\text{Daily Water intake} = \frac{\text{Total water supplied (ml)} - \text{Total water Left over (ml)}}{\text{Total number of birds}}$$

b) $$\text{Daily Feed intake (g)} = \frac{\text{Total feed supply - Total feed left over}}{\text{Total number of birds}}$$

c) $$\text{Weight Gain (g)} = \frac{\text{Final weight (g) - Initial weight (g)}}{\text{Total number of birds}}$$

d) $$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Average feed intake (g)}}{\text{Average body weight gain (g)}}$$

e) $$\text{Mortality percent} = \frac{\text{Number of mortality}}{\text{Total number of birds}} \text{ X } 100$$

Caecal microbial load

Two birds per replicates were used for caecal microbial load evaluation. The caeca were collected and taken to the laboratory for further analysis on the microbial load.

Statistical analysis

Data collected during the experiment was subjected to one-way analysis of variance (ANOVA) in a Completely Randomized Design using SAS (2002) and the means were separated using Duncan multiple range test of the same software at 5% level of significance.

$Y_{ijk} = \mu + T_j + ?_{ij}$

Where, Y_{ijk}= individual observation

μ = population mean

T_j= the effect of Garlic

$?_{ij}$ = random residual error

Results

Effects of Oral Garlic Extract Administration on the Growth Performance Characteristics of Broiler Chickens at Starter Phase

The growth performance characteristics of broiler chickens on oral administration of garlic extract at the starter phase are presented in Table 2. Feed Conversion Ratio (FCR) significantly ($p<0.05$) reduced with an increase in garlic extract percentage. The best ($P<0.05$) FCR was recorded in birds on a 15% inclusion level. Mortality percentage reduced significantly ($p<0.05$) in birds on 10% garlic inclusion. The highest ($p<0.05$) mortality percentage occurred in the group of birds with 5% garlic inclusion.

Effects of Oral Garlic Extract Administration on the Growth Performance Characteristics of Broiler Chickens at Finisher Phase

The effect of oral administration of garlic extract on the growth performance characteristics of broiler chickens at the finisher phase is presented in Table 3. The results showed that the initial weight, final weight, weight gain and FCR were not significantly different ($p>0.05$) among treatments. Significantly ($p< 0.05$) higher feed intake and water intake were recorded for birds on 10% inclusion compared with all other treatments. Mortality percentage was significantly ($p< 0.05$) higher in treatments with 5% and 10% garlic extract administration compared with control treatment and 15% inclusion.

Effects of Oral Garlic Extract Administration on the Caecal Microbial Counts of Broiler Chicken at Finisher Phase

The effect of oral garlic extract administration at various inclusion levels on the caecal microbial load of broiler chickens at the finisher phase is presented in Table 5. There were no significant ($p>0.05$) differences observed in the values of all the parameters. The mean values of TBC ranged from 0.77 to 2.10, E-coli ranged from 0.30 to 0.87, Strepto faecolis ranged from 0.00 to 0.77, Staphylococcus aerus ranged from 0.13 to 0.50, Proteus spp ranged from 0.00 to 0.13, Enterobacter ranged from 0.03 to 0.33 and Pseudomonas ranged from 0.00 to 0.07.

Discussion

The results of the present study showed that during the starter period (0-21 days), the garlic extract orally administered at the levels of 5%, 10% and 15% although did not significantly increase body weight, it significantly affected the FCR and mortality. Over the entire starter phase, broilers from the 15% group gave the best FCR. The ratio is however comparable with that of the control and 10% groups. These results are consistent with the previous literature, since dietary supplementation with garlic used in different forms results in a significant increase in body weight ( ), who fed broilers with diets containing 0 to 20% crushed garlic bulbs, found no significant differences between the groups in body weight and decreased plasma cholesterol.

Also, addition of garlic to experimental diets showed very little influence on body weight and body weight gain as compared to the control group at the finisher phase. This finding was in agreement with ( ) who found no effect of garlic on the body weight and body weight gain in broiler. On the other hand ( ) found higher body weight through the addition of garlic compared to the chicken in control group. ( ) showed that herbal plant could stimulate the digestion system of birds, improve the function of liver and increase the pancreatic digestive enzymes and thus enhancing the metabolism. Garlic extract contains different bioactive components. It has been proved that garlic significantly enhanced villus and goblet cell numbers in the duodenum, jejunum and ileum of birds ( ). As a result of these intestinal morphological changes, the entire absorptive process in the birds is better activated.

In this way nutrient absorption is enhanced with the resultant growth promoting effect (,). But in this study, we found no impact of garlic on body weight and body weight gain except for the group with garlic extract at

15% that showed a considerable low FCR compared to the 5% group.

Significant improvement was noticed in feed intake of broilers fed with garlic at 10% inclusion rate compared with birds on other treatments at the finisher phase. This finding is similar to previous observations of ( ) who reported that feed consumption was significantly higher in birds fed diets with lower concentration of garlic. In this experiment, the feed conversion ratio value ranges from 2.70-4.42 which were above the optimum value of 2.0 for broilers noted by ( ). The variation observed in the FCR may be due to the finisher phase treated in isolation. For many years feed additives have been widely used to increase animals' performance and recently it is used in poultry industry to improve growth, feed efficiency and layers performance (, ,). The mortality% obtained indicated that increased percentage of garlic support livability similar to what obtains for the control birds which were on antibiotics. The mortality rate varied significantly among garlic groups, with the highest mortality rate in the 5% garlic group at the starter phase. The 10% and 15% garlic groups showed significantly lower mortality, suggesting improved immunity due to antimicrobial and antioxidant properties of garlic. These findings indicate that garlic inclusion level must be optimized to balance growth performance, feed efficiency, and bird health. ( ).

There are multiple interactions between the host cells, the intestinal environment, bacterial cells and digesta ( ). These interactions emphasize the extremely important role of intestinal microbiota in the health and wellbeing of the host; the way this is achieved is multifactorial and not yet fully

Table 1: Composition of experimental diet for starter (0-4weeks) and finisher (5-6) phases

Ingredient	Starter	Finisher
Maize	58.0	53.5
Soya bean meal	29.4	20.2
Fish meal	1.6	0.4
Groundnut cake	6.0	10.0
Wheat offal	0	10.8
Bone meal	2.5	3.0
Oyster shell	1.5	1.0
Salt	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.25
Premix	0.25	0.25
Total	100	100
Determined analysis		
Crude Protein (%)	23.29	22.11
Crude Fibre (%)	3.27	4.03
Metabolizable Energy (Kcal/kg)	3176.11	3170.43

understood. The intestinal microbiota dominates the mucosa along the GI tract, forming a protective barrier competing against pathogenic bacteria for adhesion ( ). This principle has a variety of names but is most known as competitive exclusion and has been exploited successfully in human nutrition by including commensal bacteria as probiotic agents in foodstuffs. Similar commensal agents have been used as competitive exclusion agents for serious enteric pathogens.

Conclusion

Based on the results of this present study, it could be concluded that the oral administration of garlic extract at various levels (5%, 10% and 15%) significantly influenced the FCR and livability of broiler chickens with no significant effect on the caecal microbial counts of broiler chickens. Garlic extract can therefore be administered up to 15% level of inclusion in the drinking water for comparable results to antibiotic group (0%) of broiler chickens without any deleterious effect.

Table 2: Effect of inclusion levels of garlic extract on growth performance of broiler chicks

Parameters	0%	5%	10%	15%	SEM
Initial weight (g)	40.73	40.40	40.60	41.83	0.43
Final weight (g)	950.33	892.67	933.33	973.00	18.02
Weight gain (g)	909.60	852.2	892.73	930.97	17.92
Feed intake (g)	1573.83	1572.57	1507.23	1470.80	20.18
Feed conversion ratio	1.74^{ab}	1.86^{a}	1.69^{ab}	1.58^{b}	0.05
Mortality (%)	3.33^{ab}	10.00^{a}	0.00^{b}	3.33^{ab}	1.47
Water intake (ml)	3107.43	2659.27	2968.83	3049.77	76.04

$^{a,b;}$ Means bearing different superscript in a row differ significantly (P<0.05)
SEM = Standard Error of Mean

Table 3: Effect of inclusion levels of garlic extract on growth performance of broiler finisher (5-6 week)

Parameters	0%	5%	10%	15%	SEM
Initial weight (g)	950.33	892.67	933.33	973.00	18.02
Final weight (g)	1615.33	1308.23	1433.67	1562.17	59.23
Weight gain (g)	698.67	576.47	587.53	662.63	50.78
Feed intake (g)	1880.53^{b}	1856.48^{b}	2310.74^{a}	1796.94^{b}	72.36
Feed conversion ratio	2.70	3.50	4.42	2.93	0.36
Mortality (%)	0.00^{b}	10.00^{ab}	16.67^{a}	0.00^{b}	2.84
Water intake (ml)	4062.75^{b}	3956.45^{b}	4585.51^{a}	3969.22^{b}	102.43

$^{a,b;}$ Means bearing different superscript in a row differ significantly (P<0.05)
SEM = Standard Error of Mean

Table 5: Effects of Oral Garlic Extract Administration on the Caecal Microbial Count of Broiler Chickens

Parameters	0%	5%	10%	15%	SEM
TBC	0.77	2.10	0.97	1.07	0.29
E-coli	0.33	0.87	0.33	0.30	0.14
Strepto-faecolis	0.07	0.77	0.00	0.13	0.17
Staphy-aerus	0.23	0.13	0.50	0.47	0.12
Proteus spp	0.03	0.00	0.13	0.07	0.03
Enterobacter	0.07	0.33	0.27	0.03	0.08
Pseudomonas	0.03	0.00	0.03	0.07	0.01

TBC- Total Bacterial Count, E-coli: *Escherichia coli*

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