INTERNATIONAL JOURNAL ON ORANGE TECHNOLOGIES
www.journalsresearchparks.org/index.php/IJOT e- ISSN: 2615-8140|p-ISSN: 2615-7071
Volume: 02 Issue: 11 | November 2020

Effect of Dietary supplementation of Garlic (*Allium sativum*) oil on the Growth Performance, Carcass Quality and Cost Implication of Broiler Chickens.

Oluwafemi R.A[1], Bamigboye Samson. O[2]
[1,2]Department of Animal Science, University of Abuja. Nigeria
Agbonika D.A[3]., Maduekwe, Innocent. M[4]
[3.4]Department of Agricultural Economics, University of Abuja. Nigeria.

Abstract: *This experiment was carried to evaluate the "Effect of dietary supplementation of Garlic (Allium sativum) oil on carcass quality, growth performance and cost implication of broiler chickens". A total of 180 day–old- (Arboacre) broiler chicks of mixed sex was used in this study which lasted for eight (8) weeks. The birds were divided into four experimental groups; each group was further subdivided into three replicates of fifteen birds per each in a Complete Randomized Design (CRD). The birds were fed on two basal diets (Starter and finisher) throughout the experimental period. The garlic oil (Allum sativum) was added to the basal diet at (0.00, 0.1, 0.2, 0.3%) level respectively. The treatments were T1, T2, T3, and T4 with T1 serving as control. Growth performance, carcass characteristics, and cost implication were recorded. At the end of the experiment, the birds were slaughtered, dressed to estimate the different parameters. The result showed that the diet with 0.3% garlic oil inclusion had significantly (P<0.5) higher body weight and best dressing percentage compared with the control treatment (0. 0%).Garlic oil inclusion reduced the mortality rate of the birds as well as productivity. The results on cost implication of the experiment diets indicated that, the diet with 0.3% level of garlic oil has the highest profitability ratio as compared to other treatment groups. This is be due to the higher weight gains recorded by the group of chicken.*

Keywords: *Garlic oil; broiler chicks; performance; profitability.*

1.0 Introduction

Phytobiotics, also called phytogenic feed additives (PFA) are plant derived products added to feed in order to enhance the performance of livestock through the improvement of digestibility, nutrient absorption and elimination of pathogens residents in the animal gut (Balunas and Kinghorn, 2005; Athanasiadou *et al*., 2007). Recent consumers' expectations in relation to food quality, have led to increasing use PFAs by poultry producers (Gardzielewska *et al*., 2003; Alagbe, 2019; Olafadehan *et al.,* 2020). The positive effects of these feed supplements on broiler performance, carcass characteristics and meat quality have been demonstrated (Schleicher *et al*., 1998). Evidence also showed that gram positive and gram-negative food-borne bacteria, yeast and mould could be inhibited by garlic, onion, cinnamon, cloves, thyme and other spices (Smith-Palmer *et al*., 1998). PFA, such as garlic (*Allium sativum*) oil has been reported to prevent accumulation of lipids including neutral fats and cholesterol (Bamidele and Adejumo, 2012).

Antimicrobial compounds produced by microorganisms have been used in animal rations as growth promoters for many years (Barragry and Powers, 1994). Antibiotics have been used widely to prevent infections and poultry diseases and for the improvement of meat and egg production. However, use of antibiotics is restricted due to drug resistance in bacteria, drug residue in carcass and also alteration of natural gut micro flora (Botsoglou *et al.,*2002). Recently many countries tend to minimize or prohibit the use of antibiotics because of their deleterious side effects on both animals and human.

Consequently, the of use of natural promoters such as probiotics, prebiotics, symbiotics, enzymes, toxic binders, organic acids, oligosaccharides, phytogenics, and other feed additives, to enhance the growth and performance of broiler chickens have been advocated (Borazjanizadeh *et al.,* 2011). Garlic as natural growth promoters can be potential alternatives for common artificial growth promoters like antibiotics (Demir*et al.,* 2003). Garlic *(Allium sativum)* has been used as a spice and a native medicine for many years. It has been indicated to possess antibacterial, antifungal, antiparasitic, antiviral, antioxidant, anti-cholesteremic, anticancerous and vasodilator characteristics (Khan *et al.,* 2007; Hanieh *et al.,* 2010). The key active ingredient in garlic is the plant chemical, allicin, which rapidly decompose to several volatile organosulphur compounds with bioactivities (Chang and Cheong, 2008; Alagbe, 2018). Garlic oil addictive in broiler chicken diets has been recognized for their strong stimulating effect on the immune and digestive systems in birds (Horton *et al.,* 1991; Gardzielewska *et al.,* 2003).

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The objective of the present study was to evaluate the growth performance, carcass characteristics and cost implication of broiler chicken fed graded level of garlic oil inclusion.

2.0 MATERIALS AND METHODS

2.1 Site of the Experiment

The experiment was undertaken at the University of Abuja Teaching and Research farm, Animal pavilion section of the Faculty of Agriculture, University of Abuja, Nigeria. The site has latitude 8.55^0 and 90^{0}N, longitude 7^0 00^{0}N and 7^{0}05^{0}E. It covers land mass total of 655qkm (6,500 hectare.

2.2 Collection of Test material and preparation

Fresh garlic cloves were purchased from a local market in Gwagwalada, it was peeled. Olive oil was poured into a small saucepan and adds the peeled garlic cloves; it was placed over the lowest heat at 4^{0}C for about 3-5minutes. And later allowed it to cool then transferred it to sterilized bottle and stored in the fridge for up to two weeks.

2.3 Design and Managements of Experimental Birds

One hundred and eighty-day old white marshal broiler starter chicks were purchased from a reputable hatchery. The chicks on arrival at the experiment site were housed in a deep litter system. The pen was disinfected and cleared two weeks before the birds were housed in it. At arrival, the birds were given anti-stress. Feeders and drinkers were provided, and hutch, were also cleaned at intervals. The performance of the chicks was monitored and the initial weights of the chick were recorded at the commencement of the experiment. Weekly body weight gained and weekly feed intake were recorded.

All data were subjected to Complete Randomized Design (CRD) model by (Steel and Torrie, 1980). The significant difference between mean were compared using Duncan Multiple Range test (Duncan, 1955). The birds were allotted into four dietary treatments designated T1, T2, T3, and T4 with three replicates per treatment. Each replicate has 15birds making a total of 45 birds per treatment. The birds were managed in a battery cage system. Heat and light were provided throughout the brooding period using kerosene lamps and electricity.

2.4 Feed intake

Feed intake and body weight was recorded weekly; feed conversion ratio was calculated by dividing the total feed intake by weight gain. Mortality was also recorded as it occurs and experiment lasted for 8 weeks.

2.5 Data collection

Data were collected on growth performance traits (such as daily feed intake, daily body weight gain, final body weight and feed conversion ratio). On the last day of study, two birds from each replicate were live weighed and slaughtered. The head, shank, and all internal viscerals were removed and then the carcass was weighed. The carcass weight was expressed in terms of dressing percentage as follows:

Dressing percentage = (Carcass weight/Live weight) x100.

2.6 Statistical Analysis

All data collected was subjected to one-way analysis of variance (ANOVA) using SPSS (25.0) and significant means will be separated using Duncan multiple range tests (Duncan, 1955) significant will be declared if P ≤ 0.05.

Table 1: Percentage composition of the experimental diet (Starter: 0-4 weeks)

INGREDIENTS	T1	T2	T3	T4
Maize	53.00	53.00	53.00	53.00
Wheat offal	1.6	1.6	1.6	1.6
GNC	10.00	10.00	10.00	10.00
Soya beancake	30.00	30.00	30.00	30.00
Bone meal	3.00	3.00	3.00	3.00
Methionine	0.20	0.20	0.20	0.20
Premix	0.25	0.25	0.25	0.25
Limestone	1.50	1.50	1.50	1.50
Salt	0.30	0.30	0.30	0.30
Lysine	1.50	1.50	1.50	1.50
Garlic Oil (%)	-	0.10	0.20	0.30
Calculated Analysis:				
Crude Protein	23.01	23.18	22.20	22.22
Crude Fibre (%)	3.65	3.67	3.65	3.65
Phosphorus (%)	0.54	0.54	0.54	0.54
Ether Extract (%)	3.73	3.84	3.85	3.86
Metabolizable Energy (Kcal/kg)	2902.0	2918.2	2922.7	2927.4

Table 2: Percentage composition of experimental diet (Finisher: 4-8 weeks)

INGREDIENTS	T1	T2	T3	T4
Maize	62.00	62.00	62.00	62.00
Wheat offal	1.00	1.00	1.00	1.00
GNC	6.00	6.00	6.00	6.00
Soya beancake	26.1	26.1	26.1	26.1
Bone meal	3.00	3.00	3.00	3.00
Methionine	0.15	0.15	0.15	0.15
Premix	0.25	0.25	0.25	0.25
Limestone	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25
Lysine	0.15	0.15	0.15	0.15
Garlic Oil (%)	**0.0**	**0.1**	**0.2**	**0.3**
Calculated Analysis:				
Crude Protein	20.97	21.00	21.03	21.06
Crude Fibre (%)	3.32	3.32	3.32	3.32
Phosphorus (%)	0.54	0.54	0.54	0.54
Ether Extract (%)	1.13	1.13	1.13	1.13
Metabolizable Energy (Kcal/kg)	3000.2	3003.6	3009.3	3010.4

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Table: 3 Effect of graded oil levels of garlic on the performance of broiler chickens

PARAMETERS	T1	T2	T3	T4	SEM
Initial body weight (g/bird)	45.04	45.00	45.03	45.01	-
Final body weight (g/bird)	1600.2^{c}	1804.5^{b}	1944.8^{a}	2005.8^{a}	8.75
Weight gain (g/bird)	1555.2^{c}	1759.5^{b}	1899.8^{a}	1960.8^{a}	8.06
Total feed intake (g/bird)	3803.1	3801.9	3800.8	3800.2	9.03
Feed conversion ratio	2.45^{c}	2.16^{b}	2.00^{b}	1.94^{a}	0.02
Mortality (%)	1.34	0.00	0.00	0.00	0.01

^{a,b,c} means with same superscript are significantly different ($p<0.05$), T1: Control (without Garlic oil), T2: 0.1% Garlic oil, T3:0.2% Garlic oil, T4: 0.3% Garlic oil, SEM = standard error of mean

Table: 4 Effect of Garlic oil on carcass characteristics of Broiler Chickens.

PARAMETERS	T1	T2	T3	T4	SEM
Live weight (g)	1704.3^{c}	1900.6^{b}	1970.1^{b}	2101.8^{a}	12.31
Dress weight (g)	1284.3^{c}	1440.2^{b}	1549.0^{b}	1710.7^{a}	19.35
Dressed weight	75.40^{c}	76.00^{c}	78.63^{b}	81.4^{a}	0.17
Thigh	9.55^{c}	10.22^{b}	10.34^{b}	11.22^{a}	1.22
Drum stick	10.88^{b}	10.21^{b}	10.08^{b}	13.49^{a}	0.95
Breast cut	17.22^{c}	19.22^{b}	22.08^{a}	23.17^{a}	2.04
Back cut	19.22^{b}	18.45^{b}	19.21^{b}	22.17^{a}	1.93
Wing	11.22^{a}	10.88^{a}	8.77^{b}	9.92^{b}	0.05
Heart	0.94^{b}	0.91^{b}	0.87^{c}	1.16^{a}	0.02
Liver	2.39^{a}	2.41^{a}	1.88^{b}	2.08^{a}	0.01
Kidney	0.77^{b}	1.12^{a}	1.08^{a}	1.18^{a}	0.18
Spleen	0.10^{b}	0.18^{a}	0.16^{a}	0.15^{a}	0.09
Gizzard	6.59^{a}	5.07^{b}	5.78^{b}	6.03^{a}	1.01
Proventriculus	1.44^{a}	0.94^{b}	1.34^{a}	1.28^{a}	0.03

^{a,b,c} means with same superscript are significantly different ($p<0.05$), T1: Control (without Garlic oil), T2: 0.1% Garlic oil, T3:0.2% Garlic oil, T4: 0.3% Garlic oil, SEM = standard error of mean

TABLE 5: Cost Implication of broiler chicks fed diet supplemented with Garlic oil

PARAMETERS	T1	T2	T3	T4
Total cost production (₦)/bird	450	450	450	450
Total feed consumed (g)/bird	3803.1	3801.9	3800.8	3800.2
Total cost of feed (₦)/bird	844	955	1067	1178
Total body weight gain (kg)/bird	1.60	1.80	1.94	2.01
Revenue (₦)/bird	326.1	444	876.7	1053.7
Cost-benefit ratio	0.16	0.20	0.32	0.34

Results and Discussion

The results obtained from this experiment "The Effect of Garlic oil inclusion on carcass quality, growth performance and cost implication of Broiler Chickens is discussed below. **Table 3**Shows the results of effect of graded levels of garlic oil on the performance of the experimental birds in (1-8th weeks) phase. There was significant *(P < 0.05)* difference in the final body weight, weight gain, feed intake, feed to gain ratio, and mortality across dietary treatment. The result of the study showed that birds fed 0.3% garlic oil had the highest weight gain of 2005.8g, while birds on 0.0% garlic had the least weight gain of 1600.2g. The result is in agreement with the report of Aporn *et al.*, (2008); Olatunji et al (2015) who suggested that replacing garlic oil up to 1.3% for antibiotic as growth promoter could maintain productive performance of broilers and had no effect on sensory quality. There was significant *(P < 0.05)* difference in feed intake. Feed intake decreased as the level of garlic oil inclusion in the diets increased. This could be as a result of the harsh, pepperish taste and smell of garlic. Feed conversion ratio of the various Diets means are as follows, 2.45, 2.16, 2.00 and 1.94 in Diets 1-4 respectively. The observed increase in body weight and weight gain of chicks with garlic oil addition is similar to the findings of Shittu et al. (2020); Horton and Prasad (1991); Oluwafemi and Alagbe (2019) that reported that garlic oil as a natural feed addition, improved broiler growth, Feed Conversion Ratio (FCR) and decreased mortality rate. The highest mortality was recorded in Diet. There was no particular trend in the mortality pattern across the treatments.

The results on **Table 4**reveal the Carcass characteristics of broilers. There were significant *(P<0.05)* differences in the

liveweight, dressed weight, percentages of wings, back, kidney, gizzard and abdominal fat. There were no significant differences *(P>0.05)* in the dressing percentage, percentages of the breast, drum stick and length of the intestine.

The significant increase in daily body weight gain and final body weight of birds fed garlic oil confirms the findings of Demir *et al.*, 2003; Ademola *et al.*, 2005; Oluwafemi et al., 2020; Shittu et al., 2020; Javendel *et al.*, 2008) who fed herbal plants (garlic) as growth promoters in broiler diets and observed a pronounced improvement in their body weight gain and feed conversion ratio. These results might be due to the good health status of the birds, which may be caused by the addition of garlic, and might also be due to the chemical composition of garlic (Reuter, 1995), Windisch *et al.*(2009); Alagbe (2019) work on the proven effects of phytobiotic feed additives in different poultry species, indicated a reduced feed intake, and improved feed conversion ratio. Pourali *et al.* (2010) suggested that allicin in garlic promotes the performance of the intestinal flora thereby improving digestion and enhancing the utilization of energy, leading to improved growth. Similar, observations were made (Onu and Aja, 2011; Musa et al., 2020), in their study on weaned rabbits, they noted that these herbs may have controlled and limited the growth and colonization of numerous pathogenic and nonpathogenic species of bacteria in the gut leading to improved translation of feed to meat. Ramakrishna *et al.* (2003) also suggested that garlic supplementation enhances the activity of pancreatic enzymes and provides an environment for better absorption of nutrients.

The result on **Table 5** reveal the cost implication which showed the economical evaluation of the experimental diets indicated that, the diet with 0.3% level of garlic oil showed the highest profitability ratio as compared to the control group. This might be due to the highest return of the weight gains recorded by this group of chicken. This is in line with the observation of Agbonika and Folorunsho (2020) that farmers having full control of birds kept under intensive system help in feed quality and quantity intake. Well-fed birds gain weight easily and result in the increase of their prices at point of sale. The cost-ratio of 0.16, 0.20, 0.32 and 0.34 was obtained for T1, T2, T3, and T4 respectively. The revenue was 326.1, 444, 876.7 and 1053.7 with T4 having the highest. The body weight gained (Kg) for T4 was also the highest (2.01).

CONCLUSION AND RECOMMENDATION

Four experiments were conducted to determine the best level of Garlic oil addiction in broiler diets with 0.0%, 0.1%, 0.2% and 0.3% inclusion level. The results showed that 0.03% Garlic oil addiction level compared favourably with highest growth rate. The best graded level of Garlic inclusion that gave optimum performance was at 0.03% inclusion rate.

The garlic oil inclusion reduced the mortality rate of the birds, increases productivity and food safety. Further studies using different inclusion levels is recommended

ACKNOWLEDGEMENT

This research was funded by Central Bank of Nigeria. The authors appreciate CBN for the financial support under the corporate Social responsibility initiative.

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