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## **Growth response and carcass characteristics of broiler chickens fed diets supplemented with garlic (*Allium sativum*)**

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**Target Audience:** Rural and Organic poultry farmers

### **Abstract**

*This study was conducted to determine the effects of garlic (*Allium sativum*) as a phytogetic feed additive (PFA) on growth and carcass characteristics of broiler chicken. One hundred and fifty day old Marshal Strains of broiler chicken were assigned to five dietary treatments with thirty birds in a Completely Randomized Design with the following inclusion levels of Treatment 1, 0.0% of garlic (without oral antibiotics medication for birds), Treatment 2, 0.0% garlic (with the use of antibiotics for the birds), T3 – 0.2% of garlic, T4 – 0.4% of garlic, T5 – 0.8% of garlic. The thirty chicks were subdivided into 3 replicates of 10 birds each. Feed and water were offered ad libitum and mortality was recorded as it occurred. Data were obtained on the growth performance parameters such as body weight, feed intake and liveability while feed conversion ratio was calculated. Carcass parameters measured were live weight, bled weight, eviscerated weight, dressed weight, primal cuts (thigh, drumstick, breast and wing) and internal organs (Gizzard, Liver, and Heart). The result of the growth performance showed that there were significant differences ( $P < 0.05$ ) in the average feed intake of the birds and the body weight gain of the birds, the values obtained for feed intake ranged from 4100.98g – 4907.31g. However, broilers fed with 0.4% inclusion level of *Allium Sativum* had the best liveability (96.67%). On carcass traits, there was significant difference ( $p < 0.05$ ) in the carcass parameters of the birds, however, no significant difference were observed ( $p > 0.05$ ) in the values of the organs (liver, heart and gizzard) and the primal cuts. This study revealed that the inclusion of garlic (*Allium sativum*) in the diets of broiler chicken has no detrimental effect on growth performance, organ weight and primal cut values of the experimental birds but improved the average body weight and liveability of the birds at the inclusion level of 0.4%/100kg of feed.*

**Keywords:** Broiler, Phytogetic, *Allium sativum*, marshal strain, growth performance, carcass characteristics,

### **Description of problem**

Feed additives are added to poultry feed to improve nutritive value of ingredients, enhance broiler performance by increasing growth rate and improving feed conversion efficiency. Chemical feed additives such as antibiotic growth promoters (AGP) have been intensively used in broiler chicken diets to improve productivity; however, they are notorious for bacterial resistance and their

negative impacts on the consumers' health (1). Since conventional supplements have been criticised for their potential negative impact on the food chain, poultry researchers and nutritionists have been searching for viable and natural alternative feed additives. Among numerous poultry feed additives that are available for poultry nutrition, natural herbs and plants have been widely advocated due to their reported widespread beneficial effects on

poultry health and productivity. Garlic (*Allium sativum*) is a recognized feed additive which belongs to the group of an herbaceous bulbous plant in the family *Alleaceae*. Garlic (*Allium sativum*) is one of such potential alternative feed additive which has recently been reported as having a wide range of beneficial effects on the production performance in livestock's.(2)

Garlic powder is a Phytogetic Feed Additive (PFA), which is a form of Natural Growth Promoter (NGP) frequently used in the Mediterranean region (3). Garlic (*Allium sativum*) contains about 15.33% protein, 0.8% fat, 3% minerals, with varying amounts of vitamins like thiamine, riboflavin, and niacin, and enzymes such as allinase, peroxidase, and myrosinase; in addition, it contains about 0.2% volatile oils, which are particularly released when the plant is processed into powder, which are used for various therapeutic purposes (2). Researches have proved that garlic has medicinal, antimicrobial properties, speeds up digestion and widely used as preservatives, spice and condiment in many homes (3). Garlic contains ascorbic acid and histidine as important anti-oxidative constituents. In most cases, chickens may however need some time to adapt to the powder in their diet before any beneficial effects are exhibited; this is mainly due to the oil fraction present in garlic powder which has a strong smell and unpleasant flavour (2)

Recent research works on phytogetic feed additives have shown promising results as regards weight gain, feed efficiency, lowered mortality and increased liveability in poultry birds (3). Phytogetic substances are known to increase performance of birds by stimulating secretion of digestive enzymes, leading to enhanced digestion and absorption (4). (5) reported that garlic has the potential of enhancing body weight gain and has antimicrobial activity when fed in mixture with ginger in broiler diets. Furthermore, garlic has been reported to be effective antibiotics,

antioxidant, antifungal and antiviral agent and improves the immune system (6, 7 8). Garlic is not widely used as human food because it gives a repulsive odour and the taste is pungent. Since monogastric animals are able to incorporate dietary components directly in their tissues, supplementary garlic for broilers could mediate in getting the bioactive compounds in garlic, through broiler meat into the human food chain, while avoiding the resentment due to its direct consumption. However, there is dearth of convincing information on quantity of supplementary garlic in broiler nutrition, hence the need to evaluate graded levels of garlic (*Allium sativum*) supplementation and the effects in the diets of broiler chickens in terms of growth performance and carcass characteristics.

## Materials and Methods

**Sourcing of Experimental Material** - Garlic bulbs were sourced and purchased from the local markets between Ilara-Remo and Ilishan-Remo, Ogun state, Nigeria. The bulbs were winnowed and the adhering fibre materials removed. The bulbs were splitted into cloves and macerated into smaller pieces using kitchen knife. The sliced garlic were air-dried under shade for five days to prevent volatilization of garlic clove nutrients which were ground using hammer mill and then air-dried again for three days at atmospheric temperature of 35-45° C. The air-dried samples were milled into fine particles size and bagged prior to use. The ground *Allium sativum* was used for the feed formulation at the rate of 0.0% of garlic without antibiotics (oral) medication for birds on this diet, 0.0% with the use of antibiotics for the birds on this treatment, T3 – 0.2% of garlic, T4 – 0.4% of garlic, T5 – 0.8% of garlic.

**Experimental site** - The experiment was conducted at the Teaching and Research Farm of Department of Agriculture and Industrial

Technology, Babcock University, Ilishan-Remo, Ogun State. Ilishan-Remo is in the rain forest of South Western Nigeria with mean rainfall of 2400mm. Ilishan is in the south west geo-political zone of Nigeria and falls on latitude of 6°54'N from the equator and longitude 3°42'E from the Greenwich Meridian and the mean annual temperature is about 27°C.

**Experimental birds and designs** - A total of one hundred and fifty (150) day old broiler chicks of Marshall Strain were procured from a reputable hatchery and bred for 7 weeks. On arrival, the birds were randomly assigned into five dietary treatments with three (3) replicates of 10 birds per replicate. Feed and water were provided ad-libitum. The experimental design used was Completely Randomised Design (CRD).

**Experimental Diets** – Five diets were formulated and compounded for the experiment with various inclusion levels of *Allium sativum*, except the positive control group (T1) with birds that were medicated with antibiotics (Enrofloxacin) at the manufacturer dose rate. They are as follows; T1 (+ Control) – 0.0% of garlic with antibiotics (oral), T2 (control) – 0.0% of garlic without antibiotics (oral), T3 – 0.2% of garlic, T4 – 0.4% of garlic, T5 – 0.8% of garlic.

**Management of Experimental Birds** - The cages were washed and disinfected using a disinfectant and left to rest for two weeks prior to the arrival of the chicks. Before the arrival of the birds, the brooding cages were ready and water was waiting for them upon arrival. The experimental birds were vaccinated but not medicated due to the nature of the study to prevent interruption of data, which might lead to experimental error.

**Data collection** - Data were collected on the performance parameters (Feed intake, Body weight gain, Feed conversion ratio (FCR) and Liveability) of broiler chicken.

**Feed intake** - The left-over of feed given were collected, weighed and the value recorded were subtracted from the initial feed given to ascertain the feed intake.

Feed intake (g) = feed given (g) - left-over feed (g)

**Body Weight Gain** - The weight of three identified birds in each replicate of each treatment were weighed at the beginning of the experiment and their weight recorded, this is to prevent error and ensure that same birds were weighed at all time. The weekly weight gain of experimental bird was recorded on weekly basis by subtracting the values of initial body weight in grams from final body weight.

**Feed Conversion Ratio** - This is the amount of feed consumed needed to produce 1kg of meat by the animals. This value was obtained by dividing the average feed intake by the average weight gain.

Feed Conversion Ratio (FCR) =  $\frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$

**Liveability** - Mortality was recorded against the respective replicates and when they occurred throughout the experimental period. Percentage liveability was calculated as;

Percentage liveability (%) =  $\frac{\text{Number of live birds} \times 100}{\text{Number of birds per treatment}}$

**Carcass Characteristics** - At the end of seven weeks experimental period, six birds were randomly selected from each treatment, two (2) per replicate for the carcass characteristics. The selected birds were starved overnight and their live weights were recorded. Birds were slaughtered by bleeding the left jugular vein according to (9). Afterwards, they were

defeathered, eviscerated and their respective weights were taken. The following parameters were recorded: thigh, wing, breast, drumstick and the organs (gizzard, liver and heart).

**Statistical Analysis** - Significant treatment means were subjected to analysis of variance (ANOVA) using statistical analysis system

package (10). Means were separated using Duncan multiple range test (11).

**Results and Discussions**

Tables 1 and 2 showed the gross and determined analysis of experimental starter and finisher diets.

**Table 1: Composition of garlic supplemented starter diets**

INGREDIENTS (%)	TREATMENTS				
	T1	T2	T3	T4	T5
	0.0%	0.0%	0.2%	0.4%	0.8%
Maize	57.50	57.50	57.50	57.50	57.50
Soybean Meal	34.00	34.00	34.00	34.00	34.00
Garlic	0.00	0.00	0.20	0.40	0.80
Wheat Offal	3.10	3.10	2.90	2.70	2.30
Vegetable Oil	1.00	1.00	1.00	1.00	1.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Limestone	1.50	1.50	1.50	1.50	1.50
Tox-nil	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Determined analysis					
Dry matter	89.36	89.36	89.48	90.80	88.26
Crude protein (%)	22.24	22.24	21.26	21.72	21.79
Crude fibre (%)	3.29	3.29	2.69	2.60	2.49
Ether extract (%)	2.70	2.70	3.60	3.70	3.85
Ash (%)	6.85	6.85	5.15	6.85	5.60
Metabolizable Energy(Kcal/Kg)	2788.54	2788.54	2749.40	2814.48	2865.63

**Table 2: Composition of garlic supplemented finisher diets**

INGREDIENTS (%)	TREATMENTS				
	T1 0.0%	T2 0.0%	T3 0.2%	T4 0.4%	T5 0.8%
Maize	53.00	53.00	53.00	53.00	53.00
Soybean Meal	29.00	29.00	29.00	29.00	29.00
Garlic	0.00	0.00	0.20	0.40	0.80
Wheat Offal	12.60	12.60	12.40	12.20	11.80
Vegetable Oil	1.00	1.00	1.00	1.00	1.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Limestone	1.50	1.50	1.50	1.50	1.50
Tox-nil	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Determined analysis					
Dry matter	90.60	90.60	91.13	91.24	91.66
Crude protein (%)	19.70	19.70	19.00	19.88	19.95
Crude fibre (%)	3.99	3.99	3.45	3.39	3.19
Ether extract (%)	3.60	3.60	3.62	3.70	3.75
Ash (%)	6.85	6.85	5.45	5.35	5.11
Metabolizable Energy(Kcal/Kg)	2949.48	2949.48	2998.09	2952.38	2874.78

In the starter diet, the dry matter percentage ranged from 89.36 - 90.80%. These indicate that the formulated diets can be stored for a period of one to two month due to low level of moisture content without been spoilt. The highest crude protein value (CP), crude fibre and ash were obtained from Treatment 1 and Treatment 2 (0.0% inclusion level of garlic) with and without antibiotics respectively while Treatment 5 (0.8% inclusion level of garlic) recorded the least value for Crude Fibre (CF), Ether Extract (EE) and ash. The highest value obtained for CP was obtained from the control diet while the value obtained for other diets did not follow a particular trend. This value were however lower than (23.0%) recommended by NRC (12). The metabolizable energy values obtained ranged from 2788.5 – 2865.6 Kcal/kg. The result obtained in the proximate analysis of the experimental diet could be linked to the fact that the test ingredient has

almost the same CP value with the wheat offal that was used in substituting for it in the gross composition of the diets therefore no significant difference were observed in the values of the proximate analysis.

In the finisher diet, the dry matter percentage ranged from 90.60 – 91.65%, this showed that the inclusion of the test ingredient did not influence the moisture content of the diets. While the least value of Crude Fibre of 3.19 was obtained from treatment 5 and ash value was obtained from treatment 5 (0.8% inclusion level of garlic), In contrast, it also recorded the highest value for Ether Extract (3.75) compared with control diets T1 and T2 (3.60). The metabolizable energy (ME) showed no significant difference and ranged from 2874.78 - 2998.09. The highest value obtained for CP was obtained from treatment 5 (0.8% inclusion level of garlic) while the value obtained for other diets did not follow a

particular trend. All the values of proximate analysis obtained from these experimental diets were not significantly different ( $P>0.05$ ).

The values obtained for the finisher diet were in line with recommendation of NRC (12) for broiler production.

**Table 3: Performance Characteristics of Broiler Chicken Fed Garlic Supplemented Diet**

PARAMETERS	TREATMENTS					SEM
	T1	T2	T3	T4	T5	
Average Feed Intake (g/bird)	4907.31 <sup>a</sup>	4100.98 <sup>bc</sup>	4249.10 <sup>ab</sup>	4323.45 <sup>c</sup>	4823.29 <sup>b</sup>	107.38
Body weight gain (g/bird)	2097.50 <sup>a</sup>	1780.00 <sup>c</sup>	1797.00 <sup>c</sup>	1965.33 <sup>b</sup>	2110.00 <sup>a</sup>	85.05
Feed Conversion Ratio	2.34	2.30	2.36	2.22	2.28	0.22
Liveability (%)	80.00 <sup>b</sup>	90.00 <sup>ab</sup>	90.00 <sup>ab</sup>	96.67 <sup>a</sup>	90.00 <sup>ab</sup>	1.66

<sup>a b c</sup> Means on the same row with different superscripts are significantly different ( $P<0.05$ ).

SEM: Standard Error of Means

There was significant difference in the average feed intake of the birds fed experimental diet supplemented with garlic ( $P<0.05$ ). The highest average feed intake of the birds was obtained from the control diet (4907.31g) while the least average feed intake (4100.98g) was obtained from birds on treatment 2. The result obtained showed that as the level of inclusion of garlic increases, the feed intake increases, this may be due to the benefits of the phytochemical substance in garlic which improves feed intake and feed efficiency. However this result was not in consonant with the findings of Imaseun *et al.* (13) who obtained a lower feed intake when ginger (*Zingiber officinale*) and black pepper (*Piper nigrum*) were included in the diet of broiler birds. However, the feed intake values were in the range recommended by (12, 15).

Significant differences were observed between the average body weight of the birds fed experimental diet ( $P<0.05$ ). Treatment 5 having the highest value (2110.0g) while the least value obtained was in treatment 2 (1780.0g), although treatment 5 and treatment 1 were not significantly different from each other. The average body weight also increases with increasing level of inclusion of garlic in the diet. This can also be attributed to benefits

of the phytochemical compound in the garlic i.e. allicin which helps to increase growth performance of experimental birds. This is in line with the report of (7) that reported that garlic, improved broiler growth and feed conversion ratio. The lower mortality rate obtained with birds on garlic diets could be due to the fact that garlic has potential as antibiotics, antioxidant, antifungal, antiviral agent and it improves the immune system (6), hence improve the liveability of birds.

The feed conversion ratio value ranges from 2.22–2.36 which falls within the recommended value for broiler birds, the values obtained were above the optimum value of 2.0 for broilers noted by (13). The variation observed in the FCR shows that inclusions of garlic in the diet of experimental birds do not have any harmful effect on feed consumption of birds. However, the FCR did not follow any particular trend, but the birds on diet T4 had better feed conversion ratio of 2.22 compared with the birds on the control diet (2.34). The result agrees with (14, 15) the reports that feed additives are generally used to improve feed intake and to increase growth rate in broilers. 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 (15, 16, and 17).

The survivability % obtained indicated that there was significant difference ( $P < 0.05$ ) between all the treatments although no specific trend was observed, all birds on garlic based

diets had lower mortality rate but birds on diet with 0.4% (T4) that had the best liveability percentage, therefore it can be said that inclusion of garlic in the diets reduced mortality and improve liveability due to improved immune system of the birds (6).

**Table 4: Carcass characteristics of broiler chicken fed garlic supplemented diet**

PARAMETERS	TREATMENTS					SEM
	T1	T2	T3	T4	T5	
Average Live weight (g)	1910.00 <sup>b</sup>	1830.00 <sup>ab</sup>	1780.00 <sup>ab</sup>	1750.00 <sup>a</sup>	1880.00 <sup>b</sup>	11.04
Bled weight (g)	1830.00 <sup>b</sup>	1790.00 <sup>ab</sup>	1710.00 <sup>ab</sup>	1650.00 <sup>a</sup>	1830.00 <sup>ab</sup>	9.05
Defeathered weight (g)	1740.00 <sup>b</sup>	1710.00 <sup>ab</sup>	1640.00 <sup>ab</sup>	1570.00 <sup>a</sup>	1740.00 <sup>b</sup>	6.04
Eviscerated weight (g)	1480.00 <sup>b</sup>	1450.00 <sup>ab</sup>	1360.00 <sup>ab</sup>	1460.00 <sup>a</sup>	1510.00 <sup>b</sup>	1.03
Dressed weight (g)	1337.05 <sup>b</sup>	1326.70 <sup>ab</sup>	1245.00 <sup>ab</sup>	1260.00 <sup>a</sup>	1325.00 <sup>b</sup>	0.83
Dressing out (%)	70.16	72.67	70.22	72.00	70.74	2.39
Cut parts (%DW)						
Breast (%)	27.50	25.36	25.88	26.97	25.41	3.29
Thigh (%)	14.92	14.30	15.27	14.30	14.26	2.45
Drumstick (%)	14.62	14.94	14.60	14.12	15.26	1.94
Wing (%)	11.59	11.7	11.86	11.54	11.87	1.86
Organ weight (%LW)						
Liver (%)	2.11	2.16	2.01	1.79	1.84	1.31
Heart (%)	0.51	0.47	0.50	0.39	0.45	0.40
Gizzard (%)	3.32	3.36	3.36	3.24	3.14	1.81

<sup>a b c</sup> Means on the same row with different superscripts are significantly different ( $P < 0.05$ ).

SEM: Standard Error of Means

The result on carcass characteristics showed that there were significant differences ( $P < 0.05$ ) in the live weight, bled weight, defeathered weight, eviscerated weight and dressed weight. Values obtained for primal cut showed non-significant differences for breast which ranged from 25.36 – 27.50%, thigh 14.26 – 15.27%, drumstick 14.12 – 15.26% and wings 11.54% – 11.87%. The liver, heart and gizzard also did not exhibit any significant variations among the dietary treatments. The result indicated that the test ingredient (*Allium sativum*) had no negative effects on the birds. (18)

Results obtained in this study on cut parts and organ weights were in line with findings of (19) and (20) who stated that garlic

supplementation had no significant effects on major carcass components and organ characteristics. No significant differences ( $P > 0.05$ ) were observed in the dressing out percentages of the experimental birds fed garlic supplemented diet, the value falls within the range 60.30 – 74.65% recommended for broiler chickens (21).

### Conclusion and applications

This study revealed that the inclusion of *Allium sativum* in broiler diet has been found to:

1. Maintain performance, carcass traits and improve liveability of broiler chicken when fed at 0.4% *Allium sativum* in their diets-

2. Use of *Allium sativum* will be useful in organic poultry production and poultry production in rural areas, where there is reduced accessibility to conventional medications.

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