

## **Performance and organoleptic qualities of broiler chickens fed and raised with varying levels of ginger and garlic mixture.**

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### **Abstract**

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*An experiment to assess the performance and organoleptic qualities of broiler chickens fed varying levels of ginger and garlic mixture was conducted in the Poultry Unit and Meat science and Technology laboratory of the Department of Animal Science Ambrose Alli University, Ekpoma, Edo State. A total of 120 day old (Anak 2000) broiler chickens were used for the experiment. Thirty chicks were randomly selected to each of the four treatment diets with diet 1 being the control and diet 2 contained 1% ginger and garlic mixture, diet 3 contained 1.5% ginger and garlic mixture while diet 4 contained 2% ginger and garlic mixture. Each treatment group contained three replicate with ten birds per replicate and were assigned to the four treatment diets in a completely randomized design (CRD). The result on the performance at the starter phase showed that weekly feed intake, weekly weight gain and feed conversion ratio were significantly ( $P < 0.05$ ) highest among birds fed the control (1.25 kg, 0.93 kg and 1.42) comparable to those on 2% ginger and garlic mixture on weekly weight gain alone (0.94 kg) while at finisher phase, final live weight, daily and weekly feed intake, weekly weight gain were significantly ( $P < 0.05$ ) highest among birds fed 2% ginger and garlic mixture 2.64 kg, 0.80 kg and 2.33 kg, 1.18 kg respectively. Feed conversion ratio was higher significantly ( $P < 0.05$ ) in those placed on 1% ginger and garlic mixture (2.24). No mortality was recorded in both phases. All the organoleptic qualities assayed in this study were significantly ( $P < 0.05$ ) higher among the chicken thighs processed with 1.5% ginger and garlic mixture. It is concluded therefore that the inclusion of ginger and garlic mixture (GGM) in the diet of broiler chickens up to 2.0% as supplement enhanced the growth performance of the birds and processing the primal cut with 1.5% of the mixture improved the organoleptic quality of the broiler chicken.*

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**Key words:** Broiler chickens, Ginger, Garlic, Performance, Organoleptic qualities

### **Description of Problem**

Feed additives are added in animal feed to improve their nutritive value, boost animal performance by increasing their growth rate, enhance feed conversion efficiency, greater livability and lowered mortality in poultry birds. Herbs could be expected to serve as feed additives due to their suitability and preference, reduced risk of toxicity and

minimum health hazards [1]. Moreover, there is a great phobia in using antibiotic as feed additives because of public concern about antibiotic residues in animal products and the potential evolving of antibiotic resistant bacteria. Recent research works on herbal formulations as feed additives have shown encouraging results as regards weight gain, feed efficiency, lowered mortality and

increased livability in poultry birds [2,3,4]. Ginger and garlic as natural growth promoters can be potential alternatives for common artificial growth promoters like antibiotics [5]. Ginger is the rhizome of the plant *Zingiber officinale*, consumed as a delicacy, medicine, or spice. Preliminary research indicates that nine compounds found in ginger may bind to serotonin receptor which may influence gastrointestinal function. Research conducted *in-vitro* shows that ginger extract might control the quantity of free radicals and the peroxidation of lipids [6] and have anti-diabetic properties [7]. Garlic (*Allium sativum*) has been used as a spice and a native medicine for many years. It has possessed antibacterial, antifungal, antiparasitic, antiviral, antioxidant, anticholesteremic, anti-cancerous, and vasodilator characteristics [8]. Ginger and garlic supplements in broiler chicken diets have been recognized for their strong stimulating effect on the immune and digestive systems in birds [9]. Recent research works on ginger and garlic formulations as feed additives have shown encouraging results in regards to weight gain, feed efficiency, lowered mortality and increased livability in poultry birds [10,11]. Different workers have tried at different levels of garlic and ginger in the diet of birds and but most consistent results were obtained at about 1% level [12,13] and supplementation of these products beyond 1% of ration may also have a negative effect on overall cost of feeding. As a result, they are incorporated at the level of 1% in the diet of broilers. On the other hand, studies on their use as mixtures in the diet of birds have produced inconsistent results. Ginger (*Zingiber officinale*) is a spice used for cooking and is also consumed whole as a delicacy or medicine. It have been reported to posse useful pharmacological potent chemical substances for use in poultry [14], this is due to its antioxidants, antibacterial, anti-inflammatory, antiseptic, anti-parasitic and

immunomodulatory properties. Positive effect of ginger on blood circulation, gastric secretion, and enterokinesia were reported by [15,16]. In addition, ginger has been found to enhance digestive enzyme activities [17]. All of these have favorable effects on animal productivity. So, using ginger and garlic as natural feed additives in broiler nutrition may be of great benefit and value. In processing broiler meat with Ginger and garlic a protein digesting enzyme (Zingibain and allicin) found in ginger and garlic is believed to improve digestion as well as kill parasites and their eggs. It was also reported to enhance antibacterial, anti protozoal, anti-inflammatory actions and supplement the use of other antibacterial, such as antibiotics. The nutrients found in ginger include carbohydrates, lipids, proteins, minerals and vitamins. Among these Phosphorus, potassium, riboflavin and vitamin C may be found. Ginger and garlic contains about 12 antioxidant constituents, the combined actions have been regarded as being more powerful than vitamin C[18]. Ginger and garlic are also extensively consumed as a flavoring agent; it is estimated that in India, that the average daily consumption is 8 -10 grams of fresh ginger root and garlic bulbs. Therefore, this study was set up to generate more information about the effect of using ginger and garlic mixture on growth performance and organoleptic qualities of broiler chickens.

### Materials and Methods

The experiment was conducted at the Poultry Unit and Meat Science and Technology laboratory of Ambrose Alli University Ekpoma, Edo State for the period of 10 weeks.

### Sourcing and Processing Of the Raw Materials

Ginger and garlic for the feeding trial and processing of the chicken meat were purchased

from local market within Ekpoma, Esan West Local Government Area of Edo State. It was sundried for about 7 to 14 days to reduce the moisture content to about 10%. The ginger and garlic were milled separately into powder form and mixed at the ratio of 1:1 to form the basal treatment material (ginger and garlic mixture

GGM). They were then stored in an air tight container till they were used for the feeding trial and processing of the chicken meat. Aliquot were taken from the milled ginger and garlic as well as the mixture mixed at the ratio of 1:1 before taken to the laboratory for proximate analysis.

**Table 1: Proximate composition of (%DM) Ginger and garlic**

Parameters	GRM	GBM	GGM
Dry matter	91.0	86.4	89.20
Crude protein	10.1	7.50	8.96
Crude fat	3.20	3.50	3.24
Crude fibre	18.3	12.4	16.02
Ether extract	4.90	5.20	5.60
NFE	54.50	57.80	55.20

GRM: Ginger root meal, GBM: Garlic bulb meal, GGM: Ginger and Garlic mixture (1:1)

### Experimental Diets

Commercially formulated diet was used for the experiment and the ginger and garlic mixture powder were added to basal diets at the levels (0, 1, 1.5 and 2%) resulting in four experimental diets (1, 2, 3 and 4) respectively. T<sub>1</sub> that serve as control contained (0% GGM), T<sub>2</sub> contained (1% GGM), T<sub>3</sub> contained (1.5% GGM) and T<sub>4</sub> contained (2% GGM). All the experimental diets were formulated to meet the nutrient requirements of broiler chicks according to (NRC, 1994) which was formulated from the local feed ingredients commonly used for poultry feeding in the Nigeria.

### Experimental Birds, Management and Design

A total of 120-day-old (Anak 2000) broiler chickens were used for the experiment. Thirty chicks were randomly selected based on their average initial weight to each of the four treatment diets. Each treatment group contained three replicates with ten birds per replicate and they were assigned to the four treatment diets in a completely randomized

design (CRD). The chicks were fed commercial starter diet for 2 weeks acclimatization period and then were also fed commercial diet (with the inclusion of ginger and garlic) for four weeks starter phase period and 4 weeks finisher phase period respectively. The birds had free access to the treatment diets and water *ad-libitum* throughout the duration of the experiment.

During the feeding trial, the broiler chickens were weighed at the beginning of the experiment (end of 2<sup>nd</sup> week) after the adjustment period and subsequently on a weekly basis. Weight changes and feed consumption was recorded weekly, while weight gain, feed intake, feed conversion ratio (FCR), protein efficiency ratio (PER) were estimated to assess the growth performance of the birds. Weight gain was calculated as final weight minus initial weight, feed conversion ratio (FCR) as feed intake divided by weight gain.

At the end of 8 weeks, thigh muscles from carcass of the birds (on treatment basis) were thawed, washed and trimmed off of fats before dry curing. Birds fed T<sub>1</sub> were cured with (curry

+ salt) serving as the control, birds on T<sub>2</sub> were cure with (1%GGM + salt), birds on T<sub>3</sub> were cured with (1.5%GGM + salt) and birds on T<sub>4</sub> were cured with (2%GGM + salt) respectively. The salt and spices were rubbed manually to give uniform blend to the thigh muscles from the broiler chickens and were allowed to cure before smoking in the drum kilns with charcoal. Ten selected panelists among the academic and non-academic staff of the Department of Animal science, Ambrose Alli University, Ekpoma, were used for the organoleptic quality assessment. A nine point hedonic scale (1= dislike extremely to 9=liked extremely) as described by [19] was used for the sensory evaluation.

### **Statistical Analysis**

All data were subjected to analysis of variance (ANOVA) and differences between treatments and means was determined using Duncan's Multiple Range Test at 5% level of probability. All statistical procedures were according to [20] using [21] package.

### **Results and Discussions**

Performance characteristics of the broiler chickens fed the dietary treatment (Table 2) at the starter phase revealed that the average weekly feed intake, weekly weight gain and feed conversion ratio were significantly ( $P<0.05$ ) affected by the treatment diets while at finisher phase, average final live weight, weekly feed intake, weekly weight gain and feed conversion ratio were significantly ( $P<0.05$ ) influenced by the treatment diets. Average final live weight (finisher phase) was higher among broiler chickens placed on 2% ginger and garlic mixture (GGM) with a mean value of 2.64kg/bird followed by 2.58kg/bird in those fed 0%GGM while least mean value of 2.49kg/bird among those fed T<sub>2</sub>. This is in consonance with the findings of [22] who recorded a significant difference in the values of broiler chickens fed ginger root meal.

weekly feed intake at starter and finisher phase were significantly highest among broilers fed the control diet with mean values of 1.250kg/bird and 2.37kg/bird comparable to 1.210 and 2.330 kg/bird respectively from those placed on 2% GGM. The high value recorded could be due to the synergetic effect of ginger and garlic and their properties as an appetizer, which enhances the activities of gut micro flora thereby increasing feed intake. This result agrees with the findings of [23] who reported higher feed intake of broilers on diet supplemented with ginger. The results were however at variance with the report of [24] who stated that broilers fed 2% dried supplementary ginger meal had significantly lower feed intake than those on the control diet. It also agreed with [25] who reported a significant difference in the feed intake of broilers fed ginger root powder. Average weekly weight gain was also significantly ( $P<0.05$ ) affected by the treatment diets with highest values (1.18kg/bird) from birds fed 2% GGM compared to those on the control diet with mean values of (1.15kg/bird). The highest weight gain recorded is a pointer to the fact that ginger and garlic mixture has a positive impact on the growth and tissue formation of the birds. This improvement is due to improved gut environment and micro flora achieved with ginger and garlic supplementation [23]. This effect is attributed to the fact that the susceptibility of pathogenic gram positive bacteria to the antibacterial components of ginger and garlic are higher than that of the physiological desirable intestinal bacteria [26,27]. This observation is in line with the findings of [28,29]. It is also backed up by the findings of [30] who observed that ginger acts as stimulant for feed digestion and conversion, which increase body weight gain. Further more, its active compounds such as zingiberene improves feed digestion and stimulates enzymes thereby enhancing the feed conversion ratio which

leads to an increase body weight gain. Feed conversion ratio was significantly ( $P<0.05$ ) influenced by the treatment diets. However lowest and best feed conversion ratio values of 1.26 and 1.81 (starter and finisher phase) were recorded among broiler chickens fed 2% GGM, while highest value of 1.42 (starter and finisher phase) were recorded among those fed the control diet and 2.24 from those fed 1% GGM at the finisher phase. The least and best-feed conversion ratio recorded in diet 4 indicates a better feed conversion efficiency compare to birds on other treatment diets. This

could be attributed to the accumulation of the active ingredients in ginger and garlic which gives rise to the formation of more stable intestinal flora and improved feed conversion efficiency as a consequence of better digestion [31]. These results agree with the work of [32] who reported that ginger and garlic supplementation enhanced the growth rate and feed conversion ratio of broiler chickens. However, there were no mortality during the period of the feeding trial and this further clarifies the phytobiotic potency of ginger and garlic mixture in broiler diets.

**Table 2: Performance characteristics of broiler starter fed varying levels of Ginger and Garlic mixture**

Parameters	Control	1% GGM	1.5%GGM	2% GGM
Weekly feed intake (kg/bird)	1.250 <sup>a</sup> ± 0.03	1.140 <sup>d</sup> ± 0.06	1.180 <sup>c</sup> ± 0.05	1.210 <sup>b</sup> ± 0.05
Weekly weight gain (kg/bird)	0.930 <sup>a</sup> ± 0.01	0.870 <sup>c</sup> ± 0.03	0.900 <sup>b</sup> ± 0.05	0.940 <sup>a</sup> ±0.02
Feed conversion ratio	1.420 <sup>a</sup> ± 0.08	1.270 <sup>b</sup> ± 0.08	1.270 <sup>b</sup> ± 0.03	1.260 <sup>c</sup> ± 0.06
Mortality (%)	0.000	0.000	0.000	0.000

*abcd*: means in the same row with varying super script differ significantly ( $P<0.05$ ), SEM±: Standard error of mean; GGM:Ginger and Garlic mixture.

**Table 3: Performance characteristics of broiler finisher fed and processed with varying levels of Ginger and Garlic mixture**

Parameters	Control	1% GGM	1.5%GGM	2% GGM
Final live weight (kg/bird)	2.580 <sup>b</sup> ±0.08	2.490 <sup>d</sup> ±0.08	2.530 <sup>c</sup> ±0.03	2.640 <sup>a</sup> ±0.06
Weekly feed intake (kg/bird)	2.370 <sup>a</sup> ±0.04	2.300 <sup>b</sup> ±0.03	2.190 <sup>c</sup> ±0.03	2.330 <sup>a</sup> ±0.06
Weekly weight gain (kg/bird)	1.150 <sup>ab</sup> ±0.05	1.040 <sup>b</sup> ±0.02	1.130 <sup>c</sup> ±0.04	1.180 <sup>a</sup> ±0.05
Feed conversion ratio	2.070 <sup>b</sup> ± 0.03	2.240 <sup>a</sup> ±0.05	1.970 <sup>c</sup> ±0.05	1.810 <sup>d</sup> ±0.03
Mortality (%)	0.000	0.000	0.000	0.000

*abcd*: means in the same row with varying super script differ significantly ( $P<0.05$ ), SEM±: Standard error of mean; GGM:Ginger and Garlic mixture.

**Organoleptic qualities of broiler chickens fed and processed with varying levels of Ginger and Garlic mixture**

The appearance score of the processed chicken thigh was significantly ( $P<0.05$ ) highest (8.870) among those processed with 1.5% GGM, followed by mean value of 8.370 recorded among those processed with the control while least appearance score of 7.59

was recorded from those cured with ( $T_4$ ).The higher preference given to chicken thighs processed with 1.5% ginger and garlic mixture could be due to the fact that the colour of the powdered mixture is brighter and attractive in its original state compared to only curry and this could have influenced the panelist judgment in recognizing the control ( $T_3$ ) as being the best with respect to appearance. This

takes credence from the report of [33] who observed a significant variation in the appearance score of meat product spiced with Dawadawa (*Parkia biglobosa*).

The tenderness score was also significantly ( $P<0.05$ ) influenced with the varying inclusion levels of ginger and garlic mixture with highest value (8.17) recorded from the chicken thighs processed with 1.5% GGM, followed by those with 1% GGM with the score of 8.08 while least score of 7.29 recorded from those processed with the control. This implies that these treatments have the ability to soften the meat due to the aromatic (organic) compound in ginger and garlic that aids the softening of the meat. This supports the findings of [34] who reported a significant variation in the tenderness of broiler chicken fed dietary inclusion levels of ginger root meal. Sensory score for juiciness showed significantly ( $P<0.05$ ) variation among the processed chicken products with highest (8.37) from chicken thighs spiced with 1.5% GGM, followed by 8.34 in those seasoned with 1.0% GGM and lowest 8.050 in chicken thighs processed with the control. The highest value recorded in chicken thighs spiced with 1.5%GGM could be due to the fact that the level of inclusion of the ginger and garlic is easily dissolvable in food when compared to other higher inclusion levels that might takes

time for them to blend in equal percentage in the minced meat product . This gets support from the report of [35], and also took credence from the report of [36] who reported a significant difference ( $P<0.05$ ) in the juiciness and flavour of broiler chicken fed diets containing varying levels of scent leaf meal a spice like ginger. The flavor score was significantly ( $P<0.05$ ) highest among chicken thighs processed using 1.5% GGM with a mean value of 9.04, followed by mean value of 8.26 in those processed with 1.0%GGM while least value of 7.23 in those seasoned with the control. The flavor of the chicken thighs seasoned with T<sub>3</sub> was more preferred than other treatment. Information on organoleptic quality of broilers fed ginger meal supplemented diets is scarce in literature. Overall acceptance score was also significantly ( $P<0.05$ ) highest 8.88 in chicken thighs processed with 1.5% GGM, followed by value (8.67) in chickens seasoned with 1.0% GGM and lowest numerical value of 7.85 recorded in those processed with the control. Highest overall acceptance score recorded among those processed with T<sub>3</sub> could be due to the highest score recorded in appearance, flavor and tenderness which are major sensory factors in determining the quality of the meat processed using foreign condiments or local spices. This finding lends support from the report of [37].

**Table 4: Organoleptic qualities of broiler chickens fed and processed with varying levels of Ginger and Garlic mixture**

Parameters	Control	1%GGM	1.5% GGM	2% GGM
Appearance	8.37 <sup>b</sup> ± 0.05	8.13 <sup>c</sup> ± 0.08	8.87 <sup>a</sup> ± 0.06	7.59 <sup>d</sup> ± 0.03
Tenderness	7.29 <sup>d</sup> ± 0.02	8.08 <sup>b</sup> ± 0.01	8.17 <sup>a</sup> ± 0.04	7.45 <sup>c</sup> ± 0.08
Juiciness	8.05 <sup>d</sup> ± 0.05	8.34 <sup>b</sup> ± 0.12	8.37 <sup>a</sup> ± 0.03	8.23 <sup>c</sup> ± 0.07
Flavour	8.13 <sup>d</sup> ± 0.12	8.26 <sup>b</sup> ± 0.05	9.04 <sup>a</sup> ± 0.02	8.18 <sup>c</sup> ± 0.04
overall acceptability	7.85 <sup>d</sup> ± 0.05	8.67 <sup>b</sup> ± 0.04	8.88 <sup>a</sup> ± 0.03	8.16 <sup>c</sup> ± 0.04

*abcd*: means in the same row with varying super script differ significantly ( $P<0.05$ ), SEM±: Standard error of mean; GGM: Ginger and Garlic mixture.

### Conclusion and Applications

1. It is concluded therefore that the inclusion of ginger and garlic mixture (GGM) in the diet of broiler chickens up to 2.0% as supplement enhanced the growth performance of the birds.
2. Processing the primal cut with 1.5% of the mixture improved the organoleptic quality of the broiler chicken.

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