Original Research Article

Growth Performance Characteristics of Cockerel Chicken Fed Diets containing Ginger rhizome and Garlic Bulb powder

Abstract: The use of antibiotics in poultry production has raised global concern due to health risk associated with its residues in poultry products. A study was conducted to assess the growth performance characteristics of cockerel fed ginger and garlic based diets for a period of 12 weeks. A total of 180 day old Isa white cockerels were randomly allotted to 4 experimental treatment diets. Each dietary treatment was replicated 3 times with 15 chicks per replicate in a completely randomized design. Diet one had 0% ginger rhizome and garlic bulb powder (T_1), diet 2 had 2% ginger rhizome powder (T_2), diet 3 had 2% garlic bulb powder (T_3) while diet 4 had 2% mixture (1:1) of ginger rhizome powder and garlic bulb powder (T_4). The weights were measured and weight gain calculated on weekly basis. In addition, the feed intake and feed conversion ratio were measured and calculated on weekly basis. At starter phase, average initial weight, average final weight, average weekly feed intake and average daily feed intake were not significantly ($P>0.05$) affected by the dietary treatments. However, Feed conversion ratio (FCR) was significantly ($P<0.05$) highest (2.09) among birds placed on T_2 while the lowest mean value of 1.30 was recorded in T_3. At finisher phase, the average initial weight, average weekly feed intake, average daily feed intake and FCR were not significantly ($p>0.05$) affected by the experimental diets. However, birds fed T_4 had the highest ($P<0.05$) mean value of average final live weight (1796.67g) while the least value (1553.33g) was obtained in birds fed T_3. The average daily weight gain were significantly ($p<0.05$) highest 37.14 g T_2. It was concluded that ginger and garlic powder can be used successfully in cockerel diets at 2 % level of inclusion to enhance growth performance characteristics especially at finisher phase.

Key words: Growth Performance, Cockerel, Finisher phase, starter phase, Ginger, Garlic

INTRODUCTION

The extensive use of antibiotic as growth promoters in poultry industry has resulted in rapid appearance of resistant form of microorganisms less sensitive to antibiotics. Over the years, there has been need for the use of alternative form of antibiotics. Spices and some plant leaves have been found to be phytobiotic and various researchers have reported their success stories. Otoikhian *et al.* (2007) reported that ginger can successfully be used as a phytobiotic substance in poultry production. Natural products of plant origin like spices, herbs and many plant extracts can be considered as alternative to antibiotics as well as growth promoters in improving broiler performance (Fenelli *et al.*, 1998). Garlic is active against microorganisms that are resistant to synthetic antibiotics and the combination of garlic extracts with antibiotics has been reported to lead to partial and total synergism (Didry *et al.*, 1992).

On the other hand, in traditional medicine, ginger is believed to have weight- loss properties in humans; described as a root that stimulates digestion and speeds up the body metabolic processes

(Maharlouei *et al.*, 2019). Spices such as ginger, turmeric and pepper are able to act at various levels of the digestive processes from the food intake to nutrient absorption in the gut. At the level of the taste buds they activate the heat receptors, which in turn stimulate salivation (increased synthesis of amylases), secretion of digestive juices in the stomach, secretion of gastric juices and mucus by the stomach epithelium, secretion of bile and increase in the level of biliary acids in the gastric juices. At the stomach level, it brings about increased gastric motility and at the gut level, there is increased permeability of the gut mucosa to improve nutrient absorption. Ginger has been found to enhance pancreatic lipase activity (Platel and Srinivasan, 2000). This study therefore assessed the performance characteristics of cockerel fed ginger and garlic based diets

MATERIALS AND METHODS

Experimental Site

This experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma, Edo State. The farm lies between Latitude 6.44 ^{0}N and Longitude 6.8 ^{0}E in Esan West Local Government Area of Edo State, Nigeria. Ekpoma is within the South-geo-political zone of Nigeria, experiencing tropical climate with a mean annual rainfall of about 1556 mm. The mean ambient temperature ranges from 26 ^{o}C in December to 34 ^{o}C in February, relative humidity ranges from 61 % in January to 92 % in August with yearly average of about 82 %. The vegetation represents an interface between the tropical rain forest and the derived savanna.

Sourcing, Collection and Preparation of Ginger rhizome and Garlic Bulb powders for the Experimental Diets

Chopped dry ginger rhizomes and garlic bulbs were purchased from Kaduna, Kaduna State, Nigeria. The chopped ginger rhizomes and garlic bulbs were sun dried for 21 days, and later milled using milling machine with particle of 0.15mm sieve powder size. The ginger and garlic powder were stored in air tight clean and dry plastic containers until used. About 50 g of the processed ginger and garlic powders were taken to laboratory for proximate analysis using the methods according to AOAC (2002). The proximate analysis showed the percentage crude protein of the ginger and garlic used for feed formulation to be 9.10 and 16.28 % respectively. Four treatment diets were prepared. Diet one had 0 % ginger rhizome and garlic bulb powder (the control diet), diet 2 had 2 % ginger rhizome powder (2 % GRP), diet 3 had 2 % garlic bulb powder (2 % GBP) while diet 4 had 2 % mixture (1:1) of ginger rhizome powder and garlic bulb powder (2 % G/G).

Experimental Design and Management of Experimental Birds

A total of two hundred (200) day – old Isa white cockerel chicks purchased from a reputable hatchery in South/West, Nigeria were used for the experiment. They were brooded and fed commercial broiler starter mash for four weeks acclimatization period before allotting them to different treatment diets. The Design of the experiment was completely Randomized Design (CRD). After brooding a total of 180 birds were selected from the four weeks old cockerels and randomly allotted into four experimental treatment diets. Each dietary treatment was replicated 3 times with 15 chicks per replicate. The birds were allowed access to feed and water *ad-libitum* throughout the duration of the experiment. The experiment lasted for 12 weeks (excluding the

brooding and acclimatization period of four weeks) with the first 6 weeks being the starter phase and the last 6 weeks finisher phase.

Table 1: Percentage Composition of Cockerel Starter Diets

Ingredients	**Inclusion levels of spices**			
	Control (0%)	**GRP (2%)**	**GBP (2%)**	**G/G (1:1%)**
	T_1	T_2	T_3	T_4
Maize	50.00	50.00	50.00	50.00
Soya bean meal	20.00	20.00	19.00	20.00
Groundnut Cake	7.00	7.00	7.00	7.00
Wheat offal	15.20	13.20	14.20	13.20
Ginger rhizome Powder	0.00	2.00	0.00	1.00
Garlic Bulb Powder	0.00	0.00	2.00	1.00
Fish Meal (foreign)	2.00	2.00	2.00	2.00
Bone Meal	2.00	2.00	2.00	2.00
Lime stone	3.25	3.25	3.25	3.25
Premix	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00
Calculated Analysis:				
Crude Protein (%)	20.33	20.28	20.06	20.35
Metabolizable energy(kcal/kg)	2894.69	2848.25	2841.82	2841.65

The Crude Protein and Metabolizable of the diets are calculated based on the recommended nutrient composition of feed ingredients by NRC, (1994).

T_1 = Control
T_2= GRP = Ginger rhizome Powder
T_3= GBP = Garlic Bulb Powder
T_4= G/G = Mixture of Ginger rhizome Powder and Garlic Bulb Powder.

Table 2: Percentage Composition of Cockerel Finisher Diets

Ingredients	**Inclusion levels of spices**			
	Control (%)	**GRP (2%)**	**GBP (2%)**	**G/G (1:1%)**
	T_1	T_2	T_3	T_4
Maize	38.00	38.00	38.00	38.00
Maize offal	20.00	20.00	19.00	20.00
Groundnut Cake	10.00	10.00	10.00	10.00
Wheat offal	13.00	11.00	12.00	11.00
PKC	7.45	7.45	7.45	7.45
Ginger rhizome Powder	0.00	2.00	0.00	1
Garlic Bulb Powder	0.00	0.00	2.00	1
Fish Meal (Foreign)	4.00	4.00	4.00	4.00
Bone Meal	3.00	3.00	3.00	3.00
Lime stone	4.00	4.00	4.00	4.00

Premix	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00
Calculated Analysis:				
Crude Protein (0%)	15.13	15.08	15.26	15.40
Metabolizable energy(kcal/kg)	2694.47	2648.03	2642.55	2641.43

The Crude Protein and Metabolizable of the diets are calculated based on the recommended nutrient composition of feed ingredients by NRC, (1994).

$T_{1=}$ Control
$T_{2=}$ GRP = Ginger rhizome Powder
$T_{3=}$ GBP = Garlic Bulb Powder
$T_{4=}$ G/G = Mixture of Ginger rhizome Powder and Garlic Bulb Powder.

Growth Characteristics

The growth parameters assessed were: the weight and feed intake of the birds. Initial weights of the birds (cockerel) were measured at the point of arrival using ATOM-A 120 weighing scale of 0.5 g sensitivity and thereafter their weights were measured on weekly basis for 12 weeks. The feed offered to the birds and the leftover were measured using 20 kg top-pan CAMERY weighing scale and recorded to the nearest 0.01 kg. The daily feed intake was determined by subtracting the weight of the feed leftover from the weight of the feed offered in previous day. The recorded feed intakes (kg) were converted to grams and used to compute the average weekly feed intake. The weekly weight gain was determined as the difference between the body weight (kg) at the beginning of the week and the weight at the end of the week. Feed Conversion Ratio (FCR) was calculated from the relationship between the feed intake and weight gain of the birds. The following formulae were used.

Feed intake = feed offered (previous day) – left over

Weight gain = final weight of the bird (at end of the week) - initial weight of the bird (at the beginning of the week)

The feed conversion ratio was calculated using the formula below:

$$\text{Feed conversion ratio} = \frac{\text{feed intake}}{\text{weight gain}}$$

The data obtained were subjected to general linear model of SAS, 2002, software. The differences among means were separated using Duncan Multiple Range Test of the same software

RESULTS

Growth Performance Characteristics of Cockerel Starter Fed Ginger, Garlic and Mixture of Ginger and Garlic Powder.

The performance characteristics of the experimental birds (cockerel) as influenced by the dietary treatments are shown in Table 3. The dietary treatment at starter phase significantly ($P<0.05$) affected the average weekly weight gain, average daily weight gain and feed conversion ratio. Average final weight, average weekly feed intake and average daily feed intake were however not significantly ($P>0.05$) affected by the dietary treatments. At starter phase, Average initial weight was statistically ($P>0.05$) similar with mean values of 168.33, 170.00, 175.00 and 175.00

g/bird recorded among birds on T_1, T_2, T_3 and T_4 respectively. In addition, the average final weight was highest in birds fed T_3, followed by those fed T_2, and T_4 while those on T_1 had the least. The average weekly feed intake ranged from 272.33 g in birds fed T_3 (the highest) to 254.00 g in birds fed T_1. The average daily feed intake followed the same trend as the average weekly feed intake. Average weekly weight gain ranged from 220.00 g in birds fed T_3 (the highest) to 130.00 g in birds fed T_2 which had the least. Moreover, average daily weight gain ranged from 31.43 in birds fed T_3 (the highest) to 18.57 in birds fed T_2 which had the least. The Feed conversion ratio showed significant ($P<0.05$) difference with highest value of 2.09 among birds placed on T_2, followed by comparable value of 1.84 among birds maintained on T_4, 1.73 from those on T_1 while the lowest mean value of 1.30 was recorded among birds fed T_3.

Table 3: Growth Performance Characteristics of Cockerel Starter Fed Ginger, Garlic and Mixture of Ginger and Garlic Powder.

Parameters	T_1 Control (0%)	T_2 GRP (2%)	T_3 GBP (2%)	T_4 G/G (1:1%)
Average initial weight (g)	168.33±0.011	170.00±0.008	175.00±0.014	175.00±0.013
Average final weight (g)	600.00±0.029	626.67±0.037	690.00±0.173	616.67±0.148
Average weekly feed intake (g)	254.00±0.005	270.67±0.008	272.33±0.003	263.33±0.014
Average daily feed intake (g)	36.29±0.001	38.67±0.001	38.90±0.004	37.61±0.002
Average weekly weight gain (g)	153.33±0.023^{b}	130.00±0.006^{b}	220.00±0.032^{a}	143.33±0.003^{b}
Average daily weight gain (g)	21.90±0.003^{b}	18.57±0.009^{b}	31.43±0.005^{a}	20.47±0.001^{b}
Feed conversion ratio	1.73±0.253^{ab}	2.09±0.145^{a}	1.30±0.223^{b}	1.84±0.091^{ab}

Mean on the same row with different superscripts (a, b) are significantly different ($P<0.05$)
T_1 = Control
T_2= GRP = Ginger rhizome Powder
T_3= GBP = Garlic Bulb Powder
T_4= G/G = Mixture of Ginger rhizome Powder and Garlic Bulb Powder.

Growth Performance Characteristics of Cockerel Finisher Fed Ginger, Garlic and Mixture of Ginger and Garlic Powder.

The growth performance of cockerel fed the experimental diets at finisher phase is shown in Table 4. The average initial weight, average weekly feed intake, average daily feed intake and feed conversion ratio were not significantly ($p>0.05$) affected by the experimental diets. However, the Average final live weight, average weekly weight gain and average daily weight gain were significantly ($P<0.05$) affected by the experimental diets. Birds fed T_4 had the highest mean value of average final live weight (1796.67g) followed with a comparable value

(1780.00g) from birds fed T_1 and 1676.67g from birds fed T_2 while the least value (1553.33g) was obtained in birds fed T_3. Average daily and weekly feed intake though not significantly ($p>0.05$) different, were highest in birds fed T_4 (650.00 and 92.86 g) followed by those on T_2 (642.00 and 91.71g), T_3 (628.00 and 89.71g) while the least values (607.33 and 86.76g) were obtained in birds fed T_1. Average weekly weight gain ranged from 260.00 g in birds fed T_2 (the highest) to 236.67 g in birds fed T_1 which had the least. The average daily weight gain were significantly ($p<0.05$) highest 37.14 g in birds fed T_2 while 33.81 g was the least in T_1. Birds placed on diet T_4 had the highest value (2.60) of feed conversion ratio followed by those on T_3 (2.58), T_1 (2.57) while the least (2.49) was obtained from birds fed T_2.

Table 4: Growth Performance Characteristics of Cockerel Finisher Fed Ginger, Garlic and Mixture of Ginger and Garlic Powder.

Parameters	T_1 Control (0%)	T_2 GRP (2%)	T_3 GBP (2%)	T_4 G/G (1:1%)
Average initial weight(g)	690.00±0.173	626.67±0.037	600.00±0.029	616.67±0.148
Average final weight (g)	1780.00±0.035^{a}	1676.67±0.022^{b}	1553.33±0.029^{c}	1796.67±0.035^{a}
Average weekly feed intake (g)	607.33±0.034	642.00±0.002	628.00±0.005	650.00±0.002
Average daily feed intake (g)	86.76±0.005	91.71±0.000	89.71±0.001	92.86±0.000
Average weekly weight gain (g)	236.67±0.003^{b}	260.00±0.015^{a}	243.33±0.003^{ab}	250.00±0.000^{a}
Average daily weight gain (g)	33.81±0.000^{b}	37.14±0.002^{a}	34.76±0.001^{ab}	35.71±0.000^{a}
Feed conversion ratio	2.57±0.163	2.49±0.145	2.58±0.032	2.60±0.006

Mean on the same row with different superscripts are significantly different ($P<0.05$)
T_1 = Control
T_2= GRP = Ginger rhizome Powder
T_3= GBP = Garlic Bulb Powder
T_4= G/G = Mixture of Ginger rhizome Powder and Garlic Bulb Powder.

DISCUSSIONS

Growth Performance Characteristics of Cockerel at Starter phase fed with Ginger, Garlic and Mixture of Ginger and Garlic Powder.

Average daily feed intakes of cockerel fed experimental diets were similar and did not differ significantly. This suggests that, the feeds are equally acceptable and may also indicate lack of adverse effect of smell and taste of ginger, garlic or its mixture on the palatability of feed in the diets of the cockerel chickens. This result confirms the findings of Onu (2010); Raji *et al.* (2011) and Rahimi *et al*. (2011) who reported that ginger and garlic powder in the broiler's diets had no negative effect on feed consumption.

Average daily weight gain was significantly highest in birds fed T_3 (garlic supplemented diet) which is in agreement with the findings of Dieumou *et al*., (2009) who observed higher daily weight gain in broiler chickens fed varying dietary levels of Ginger and Garlic. This translated to the highest average weekly weight gain recorded among birds fed T_3. Garlic is known to contain compounds like allicin and oregano sulfur compounds responsible for inhibition of pathogenic bacteria and fungi resulting in improved gut environment and higher weight gain of experimental birds (Cullen *et al.*, 2005). However, the cockerel placed on T_2 (ginger supplemented diet) had the least average weekly and daily weight gains which is in contrast with the findings from Arshad *et al.* (2012), who mentioned that use of ginger in broilers' feed had a significant positive effect on the body weight gain as compared to the control. Experimental birds in T_2 group showed significantly higher average feed conversion ratio as compared to T_1, T_3 and T_4 groups. Although, better feed conversion ratio was observed in T_3 group followed by T_1 and T_4 groups. These results is in variance with the findings of Aji *et al*.,(2011); Mansoub and Nezhady, (2011) who has reported non-significant effect of garlic on feed conversion ratio of broiler chickens. These results also disagree to the reports of Ademola *et al*. (2009); Thayalini *et al*. (2011) who did not observe any significant improvements in the feed conversion ratio of broilers fed diet containing ginger powder as compared to the control group. The discrepancies may be due to breed difference and method used in processing ginger and garlic.

Growth performance Characteristics of Cockerel at Finisher Phase fed with Ginger, Garlic and Mixture of Ginger and Garlic Powder.

Final live weight of cockerel showed significant variation with higher value recorded among birds fed 2% mixture of ginger and garlic (T_4). The significant increase in the weight of cockerel fed diet T_4 could be as a result of the synergetic effects of ginger and garlic which led to the highest feed intakes and consequently the highest final live weight recorded among the cockerel fed T_4. This agrees with earlier reports by Demir *et al.* (2003); Ademola *et al.* (2005); Javendel *et al*. (2008) who fed medicinal plants (ginger and garlic) as growth promoters in broiler diets and observed a pronounced improvement in their final live weights. This may probably be attributed to the health benefits that the birds derived from ginger and garlic supplementation in their diets (Reuter, 1995). Additionally, the higher values (although not significant) of average daily and weekly feed intakes among birds fed T_4, T_2 and T_3, show that the smell and taste of ginger, garlic and the mixture had positive effect on the palatability of feed in the diets of the cockerel chickens. This agrees with different researchers who reported that ginger and garlic powder in the broiler's diets had a significant positive effect on feed consumption (Herawati and Markuji, 2011; Mohammed *et al.*, 2012). In addition, the higher average daily and weekly weight gains recorded among birds fed diets containing ginger, garlic and mixture of ginger and garlic could be due to the phytobiotic properties of ginger and garlic. For instance, garlic contains sulfur compounds (such as allicin and oregano) responsible for inhibition of pathogenic bacteria and fungi resulting in improved gut environment and higher weight gain of experimental birds while the presence of ginger in the diets stimulate lactic acid bacteria and decreases pathogenic bacteria such as mesophilic aerobic, *coliform* and *E. coli*, and thus improves absorption of nutrients for better weight gain of the birds (Kshirsagar *et al.*, 2018). The results are consistent with Arshad *et al.* (2012) who stated that use of ginger in broilers had a significant positive effect on the body weight gain as compared to the control. In contrast, Onibi *et al.* (2009) and Fadlalla *et al.* (2010) reported that garlic powder had no significant effect on the body weight gain and feed

conversion ratio of birds. Although, no significant variation was observed in feed conversion ratios among the birds in all the dietary groups, however, experimental birds in T_2 group had the best feed conversion ratio, followed by those on T_1 and T_3, while those on T_4 had the least. These results agrees with the findings of Aji *et al*. (2011); Mansoub and Nezhady (2011) who reported non-significant effects of garlic on feed conversion ratio of broiler chickens and also Ademola *et al*. (2009) and Thayalini *et al*. (2011) observed no significant improvements in the feed conversion ratio of broilers fed on a diet containing ginger powder as compared to the control group.

CONCLUSION

The growth performance characteristics of cockerel were positively influenced by the dietary treatments especially at finisher phase. The mixture of ginger rhizome and garlic bulb powder at 2 % level of inclusion could help to improve the growth performance of cockerel chicken. Therefore, the use of ginger and garlic bulb powder at 2 % level of inclusion in cockerel diets is safe and can be used to improve the growth performance of cockerel at finisher phase. This result may also serve as baseline for further experiments on the use of ginger rhizome and garlic bulb powders in place of synthetic antibiotic growth promoters in meat-type poultry production.

NOTE:

The study highlights the efficacy of " traditional medicine" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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