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Antibiotic and Antihelminthic Effects of Garlic Bulbs (*Allium sativum*) and Ginger Rhizomes (*Zingiber officinale*) as Growth Promoters on Broiler Chickens in the Tropics

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Abstract | A hundred and fifty (150) day old Cobb strain broiler chicks were used in the study to evaluate the antibiotic and antihelminthic potentials and efficacies of ginger and garlic meals in their diets. On arrival the birds were weighed and allotted to five (5) treatments with three (3) replicates of ten (10) birds each. The test ingredients were grind into a meal separately before incorporated at the varying levels of 75% GBM (Garlic Bulb Meal) and 25% GRM (Ginger Rhizome Meal), 50% GBM and 50% GRM and 25% GBM and 75% GRM as treatments 3, 4 and 5 respectively. Treatments 1 and 2 serve as (control) and 10% antibiotics (Diaziprim – 48%S) both at various phases of production. Performance parameters, nutrient digestibility/retention, antiomicrobial analyses were investigated. Results from the starter and finisher phases show no significant ($p>0.05$) difference in initial weight, final weight, weight gain, feed intake, average daily weight gain, and feed conversion ratio. Percentage mortality showed significant ($p<0.05$) difference among the various treatment levels in both phases. However, treatment 5 had the highest value in final body weight gain, while treatment 3 had the lowest body weight gain. Mortality was highest in treatment 1 but none in treatments 4 and 5. Also crude fibre was significant ($p<0.05$) in the nutrient digestibility and protein retention. Results of this study showed that high performance was achieved at 25% (25g) GBM and 75% (75g) GRM inclusion in broiler chickens diet. Based on the performance and the microbial counts, GBM and GRM can be used to replace synthetic antibiotics in broiler chicken production without adverse effect.

Keywords | Broiler chickens, antibiotic, garlic bulbs, ginger rhizomes and antihelminthic

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INTRODUCTION

Over the past decades animal feeds producers and animal nutritionist have been faced with challenges due to ban of synthetic antibiotic in animal husbandry. Thus, because of the inhibition pose by the resistance bacteria, drug residual effects in carcass and alteration of gut micro flora posed by these synthetic antibiotic (Joshi et al., 2015; Patel et al., 2016; Belal et al., 2018). However, infections and diseases have been widely prevented in poultry for optimum production of quality meat and egg respectively. The deleterious side effects on both animals and human by its usage has make many countries to minimize or prohibit its usage.

Consequently, the of use of natural promoters of plants origins and extracts and other feed additives also helps to increase performance of broiler chickens has been established recently (Khan et al., 2012c; Patel et al., 2016; Belal et al., 2018).

Garlic bulbs (*Allium sativum)* and Ginger rhizomes

(*Zingiber officinale*) are underground stem modification that protect themselves against unfavourable condition of weather and the attacks of animals and serve as store houses of nutrients. They are propagated vegetatively. However, they are tagged functional food which has health benefit beyond the calories and nutrients they provide.

Furthermore, several researches have been conducted on the phytochemicals of these plants showing significant amount of Allicin, Allistatin, Ajoene, Gingerol, Gingerdiol and Gingerdione. These compounds are therapeutic which play vital roles in metabolism, antibiotic and are responsible for their health benefits (Karuppiah and Rajaram, 2012; Khan et al., 2012a, c; Patel et al., 2016; Belal et al., 2018).

These plants promote growth by stimulation which result from the suppression of micro-organisms that may cause adverse effects or encourage other micro- organisms that may have favourable effects on poultry performance (Karangiya et al., 2016; Umatiya et al., 2018). This study is posed to evaluate the efficacy of garlic and ginger as natural phytogenic growth promoters on the performance, antibiotic and antihelminthic in broiler chicken diets.

MATERIALS AND METHODS

Experimental site

The study was carried out between mid-January 2020–Feburary 2020 in the Department of Animal Science Teaching and Research Farm of Delta State University, Asaba Campus, Delta State, Nigeria.

Collection/preparation of the test ingredients

The test ingredients Garlic bulbs (*Allium sativum*) and ginger rhizomes (*Zingiber officinale*) were procured from a local market in Abraka Market in Delta State, Nigeria. The cloves of garlic bulbs were socked for 10minutes in warm water for the "papery pink shell" to cast off. It was sliced to form flakes of 3mm thick for easy drying up. In a similar manner, ginger rhizomes was soaked in water, washed and cut into required sizes and dried as well. These was peeled and sliced in 3mm thickness and dried under the sun rays for 6 hours. Both were stored prior to its usage.

Phytochemical and proximate composition of test ingredients

The experimental ingredients garlic (*Allium sativum*) and rhizomes of ginger (*Zingiber officinale*). The sun-dried experimental ingredients were grind separately to obtain Garlic Bulb Meal (GBM) and Ginger Rhizome Meal (GRM) before mixed with other feed ingredients for broiler chickens diets formulation. The test ingredient meals were analyzed for proximate compositions and Phytochemical substances using the (AOAC, 2012) procedures at the Animal Science Laboratory, Delta State University, Asaba Campus.

Experimental design and procedure

A hundred and fifty (150) day old cobb-500 strain were used for the experiment, on arrival, the birds were weighed and allocated randomly into five treatment groups with thirty (30) chicks per treatment in a Completely Randomized Design (CRD). Each treatment consists of three (3) replicates with Ten (10) chicks each. Five (5) dietary treatments designated as T1, T2, T3, T4 and T5 were formulate as: Treatment one (T1) was the control, T2 with 10% (10g) Antibiotics (Diaziprim–48% S) according to the manufacturer's recommendation. T3 contained 75% (75g) GBM and 25% (25g) GRM, T4 had 50% (50g) each of GBM and GRM while T5 contained 25% (25g) GBM and 75% (75g) GRM per 100kg at starter and finisher phases respectively. The experimental diet formulated according to (AOAC, 2012) procedures to supplied 23% and 20% crude protein and 2,900kcal/kg and 2,700kcal/kg metabolizable energy for starter and finisher phases as shown in Tables 1 and 2 respectively.

Phytochemicals analyses of test ingredients

Alkaloid, tannin, flavonoids, saponin and steroid were the phytochemicals determined using available procedures by (Evans, 2009).

Metabolic study

The last week of finisher phase, two birds each from treatment replicates were selected base don their average weight as represented in their respective pens/ replicates for metabolic trial. Droppings were collected for three (3) consecutive days using an aluminum foil which was placed under the birds in the cages. The collected excreta were bulked, dried and transported to the Animal Science Research Laboratory, Delta State University, Asaba Campus for proximate analysis.

Microscopic examination of faecal sample

Biological scientific microscope (Accu-scope; Model: 121-3) monocular, U.S.A was used for the visual observation of faecal sample to determine the appearance, colour and texture.

Microbial analysis of faecal sample

At the end of the 3th and 6th week performance study, microbial parameters were evaluated. Samples of the faeces were collected from each replicate treatment. Aluminum foil were placed in each pen for dropping collection between 7.30am-8.00am. Samples of the faeces were placed in labelled clean petri-dishes led according to treatment replicate. The representative samples were identified on microbial and population count in the Animal Science

Table 1: Percentage composition of experimental starter broiler chicken diets (0-21days).

Treatment					
Feed Ingredients (kg)	**T1 control**	**T2* 10% Antibiotic**	**T3 75% GBM 25% GRM**	**T4 50% GBM 50% GRM**	**T5 25% GBM 75% GRM**
Maize	50.00	50.00	50.00	50.00	50.00
Soya bean meal	20.00	20.00	20.00	20.00	20.00
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Wheat Offal	8.00	7.90	7.00	7.00	7.00
Palm Oil	2.50	2.50	2.50	2.50	2.50
Bone Meal	2.30	2.30	2.30	2.30	2.30
Limestone	1.20	1.20	1.20	1.20	1.20
Common Salt	0.25	0.25	0.25	0.25	0.25
Premix**	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25		0.25	0.25	0.25
Garlic bulb meal	----	----	0.75	0.50	0.25
Ginger rhizome meal	----	----	0.25	0.50	0.75
Total	100	100	100	100	100
%CP	23.13	23.03	22.97	22.97	22.97
MEKCal/kg	2,902.08	2,900.92	2,889.92	2,889.62	2,889.62

*Antibiotics (Diaziprim -48% S: Sulpfadiazine 400mg, Trimethoprim 80mg, Excipient 1g); GBM: Garlic Bulb Meal; GRM: Ginger Rhizome Meal; **Each of 2.5kg of starter vitamin– mineral premix provided the following vitamins and minerals. Vit. A: 10,000,000.00 I.U; Vit. D3: 2,000,000.00 I.U; Vit. E: 23,000.00 I.U; Vit. K3: 2,000.00 mg; Vit. B1: 1,800.00 mg; Vit. B2: 5,500.00 mg; Niacin: 27,500.00 mg; Pantothenic acid: 7,500.00 mg; Vit. B6: 3,000.00 mg; Vit. B12: 15.00 mg; Folic acid: 750.00 mg; Biotin: 60.00 mg; Choline chloride: 300,000.00 mg; Cobalt: 200.00 mg; Cu: 3,000.00 mg; Iodine: 1,000.00mg; Fe: 20.00 mg; Mg: 40,000.00 mg; Se: 200.00 mg; Zn: 30,000.00 mg; Antioxidant: 1,250.00 mg.

Table 2: Percentage composition of experimental finisher broiler chicken diets (22-42 days).

Treatments					
Feed Ingredients (kg)	**T1 Control**	**T2* 10% Antibiotic**	**T3 75%GBM 25%GRM**	**T4 50% GBM 50% GRM**	**T5 25% GBM 75% GRM**
Maize	55.00	55.00	55.00	55.00	55.00
Soya bean meal	17.30	17.30	17.30	17.30	17.30
Groundnut cake	9.00	9.00	9.00	9.00	9.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Wheat Offal	10.80	10.70	9.80	9.80	9.80
Bone Meal	3.50	3.50	3.50	3.50	3.50
Limestone	1.40	1.40	1.40	1.40	1.40
Common Salt	0.25	0.25	0.25	0.25	0.25
Premix**	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Garlic bulb meal	-----	-----	0.75	0.50	0.25
Ginger rhizome meal	-----	-----	0.25	0.50	0.75
Total	100	100	100	100	100
% CP	20.00	19.98	19.84	19.84	19.84
MEKCal /kg	2,727.25	2,726.00	2,714.69	2,714.69	2,714.69

*Antibiotics (Diaziprim -48% S: Sulpfadiazine 400mg, Trimethoprim 80mg, Excipient 1g); GBM: Garlic Bulb Meal; GRM: Ginger Rhizome Meal; **Each of 2.5kg of finisher vitamin – mineral premix provided the following vitamins and minerals; Vit. A: 8,500,000.00 I.U; Vit. D_3: 1,500,000.00 I.U: Vit. E: 10,000.00 I.U; Vit. K_3: 1,500.00 mg; Vit B_1: 1,600.00 mg; Vit. B_2: 4,000.00 mg; Niacin: 20,000.00 mg; Partothenic acid: 5,000.00 mg; Vit. B_6: 1,500.00 mg; Vit. B_{12}: 10.00 mg; Folic acid: 500.00 mg; Biotin: 750.00 mg; Choline chloride: 175,000.00 mg; Cobalt: 200.00 mg; Cu: 3,000.00 mg; Iodine: 1,000.00 mg; Fe: 20.00 mg; Mg: 40,000.00 mg; Se: 200.00 mg; Zn: 30,000.00 mg; Antioxidant: 1,250.00 mg.

Laboratory of Delta State University, Asaba Campus using routine laboratory procedure suggested by (Tuhin et al., 2007; Valarmanthy et al., 2010).

Data collection and stastical analysis

The parameters determined were: average feed intake, live weight gain, feed conversion ratio, percentage mortality, metabolic study and macro and microbial counts. All data collected during the period of study were subjected to analysis of variance (ANOVA) in completely Randomized Design. Statistical Package for Social Science (SPSS, 2019) version 23 was used while significant differences between the means were separated by Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS

Proximate composition of Garlic Bulb Meal (GBM) and Ginger Rhizome Meal (GRM)

It was observed that GRM had higher percentage values of parameters analyzed compared to GBM in all the parameter except nitrogen free extract which was higher in GBM than GRM as shown in Table 3.

Table 3: Proximate composition of GBM and GRM.

Parameters	GBM%	GRM%
Moisture content	10.64	12.51
Ash content	3.26	5.56
Crude fibre	10.27	15.94
Crude protein	17.8	18.81
Ether extract	7.55	12.05
Nitrogen free extract	50.47	45.13

Table 4 showed that carbohydrate is represented in percentages and saponins whose degree of presence was only visible. However, GBM showed higher values than GRM respectively. The other phytochemicals analyzed were represented in mg/g (milligram per gram).

Table 4: Phytochemical composition of GBM and GRM.

Phytochemical test	GBM(mg/100g)	GRM (mg/100g)
Alkaloid	0.56	0.81
Flavonoid	0.29	0.46
Saponin	++	+
Steroid	0.31	0.61
Tannin	0.58	0.64
Carbohydrate (%)	64.91	52.56

From the results in Tables 5 and 6, only percentage mortality among the performance characteristics showed significant ($p<0.05$) difference across the various treatments. However, numerical value differences existed among the dietary treatments. However, the broiler finisher fed treatment 5 and 3 had the highest and least values in final body weight gain while mortality was highest in treatment 1 but none in treatments 4 and 5 respectively.

Nutrient digestibility of broiler chickens fed experimental diets

Results obtained from the metabolic trial on the effect of dietary treatments on the nutrient digestibility and retention in Table 7 revealed significant ($p<0.05$) difference only in crude fibre among parameters analysed across dietary treatments. Broiler chickens fed experimental diets T2 and T4 showed higher Crude fibre digestibility compared to those fed treatment T1, T3 and T5 which were statistically similar.

Microscopic analysis of starter broiler faecal sample at 21 days old

The results in Table 8 revealed normal formed brown faeces with whitish particles. Uric acid crystals were present across all dietary treatments. Cyst of *Escherichia coli* was slightly present in treatment 4 and moderately present in treatment 1 and 2. *Isospora belli* was slightly present in treatment 1and 2; while *Ascaris lubricoides* was also slightly present in treatments 3 and 4. Ova of capillary worm and round worm were slightly present in treatments 2, 4 and 5 respectively.

Microscopic analysis of finisher broiler faecal sample at 42 days old

The results in Table 9 showed normal formed brown faeces with whitish particles in all treatments. Cyst of *Escherichia coli* was slightly present in treatment 1 and moderately present in treatment 2, while uric acid crystals were slightly present in treatment 1; moderately present in treatment 2, 5 and highly present in treatment 3.

Microbiological analysis of faecal sample of broilers chicken fed experimental starter diets at 21 days old

Results presented in Table 10 revealed significant quantities of microbial load of *Staphylococcus* spp., *Aspergillus niger* and *Escherichia coli* across treatment means but there were no significant differences ($p>0.05$) among the dietary treatments with respect to the microbial load of *Candida albicans,* and *Yeast.* Treatment (T1) had the highest microbial load value in *Aspergillus niger, Escherichia coli* and *Staphylococcus spp* (3.20, 3.30 and 18.70) respectively while Treatment (T5) had the least value of 1.20 for *Staphylococcus* spp.

Table 5: Performance of broiler chickens fed starter diets.

Parameters	T1 (control)	*T2 10%	Treatments T3 75% GBM 25% GRM	T4 50%GBM 50%GRM	T5 25%GBM 75%GRM	SEM±	SIG
Initial weight/bird(g)	0.40	0.40	0.40	0.40	0.40	00.39	NS
Final body weight/bird(g)	776	816	672	633	672	53.17	NS
Total weight gain/bird(g)	736	776	632	593	632	23.62	NS
Feed intake/bird(g)	840	848	842	841	819	17.54	NS
Average daily weight gain/bird(g)	26.30	28.00	23.00	21.00	23.00	03.37	NS
Feed conversion ratio	1.14	1.09	1.38	1.44	1.28	00.08	NS
Percentage mortality(%)	9.00^{a}	6.00^{b}	6.00^{b}	6.00^{b}	3.00^{c}	00.24	*

*Antibiotics (Diaziprim -48% S: Sulpfadiazine 400mg, Trimethoprim 80mg, Excipient 1g); GBM: Garlic Bulb Meal; GRM: Ginger Rhizome Meal; Treatment means with different superscripts within the same role are significantly (p>0.05) different; SEM: Standard Error of Mean; NS: Not significant.

Table 6: Performance of broiler chickens fed finisher diets.

Parameters	T1 (control)	*T2 10%	Treatments T3 75% GBM 25% GRM	T4 50%GBM 50%GRM	T5 25% GBM 75% GRM	SEM±	SIG
Initial weight /bird(g)	776	816	672	633	674	53.17	NS
Final body weight/bird(g)	1878	1962	1682	1793	2121	84.21	NS
Total weight gain/bird(g)	1102	1146	1008	1160	1449	19.07	NS
Feed intake/bird(g)	2604	2824	2824	2810	2900	57.75	NS
Average daily weight gain/bird(g)	93.00	100.86	88.14	111.21	123.57	02.73	NS
Feed conversion ratio	2.36	2.46	2.79	2.42	2.00	00.23	NS
Percentage mortality	6.00^{a}	3.00^{b}	3.00^{b}	0.00^{c}	0.00^{c}	00.12	*

*Antibiotics (Diaziprim-48% S: Sulpfadiazine 400mg, Trimethoprim 80mg, Excipient 1g); GBM: Garlic Bulb Meal; GRM: Ginger Rhizome Meal; a, b, c, d: Treatment means with different superscripts within the same role are significantly (p<0.05) different; SEM: Standard Error of Mean; NS: Not significant; **: highly significantly different; *: significantly different.

Table 7: Nutrient digestibility of broiler chickens fed experimental diets.

Parameters	T1 (control)	*T2 10%	T3 75%GBM 25%GRM	T4 50%GBM 50%GRM	T5 25%GBM 75%GRM	SEM±	SIG
Dry matter	89.02	89.55	90.18	90.43	90.28	0.66	NS
Ash content	60.45	57.95	54.90	54.85	57.50	1.16	NS
Crude fibre	61.00^{e}	70.50^{d}	79.00^{b}	82.50^{a}	76.00^{c}	2.57	**
Crude protein	83.15	89.65	83.10	91.85	83.05	1.73	NS
Ether extract	45.00	41.45	33.85	40.00	40.30	1.87	NS
Nitrogen free extract	64.06	63.60	65.09	63.51	64.54	5.01	NS

*Antibiotics (Diaziprim -48% S: Sulpfadiazine 400mg, Trimethoprim 80mg, Excipient 1g); GBM: Garlic Bulb Meal; GRM: Ginger Rhizome Meal; a, b, c, d: Treatment means with different superscripts within the same role are significantly (p<0.05) different; SEM: Standard Error of Mean; NS: Not significant; **: highly significantly different; *: significantly different.

Table 8: Microscopic analysis of starter broiler faecal samples.

Treatments	Appearance	Observation
T1 (Control)	Moist brown with whitish particles	Cyst of *Escherichia coli* ++, *Isospora belli* +, uric acid crystals +++, ova of round worm ++, *Escherichia coli* ++
*T2 (10%)Antibiotics	Firm brown dropping with white particles	Capillary worm ++, uric acid crystals +++, ova of round worm +
T3 75% GBM 25% GRM	Formed brown with white particles	Ova of round worm +, uric acid crystals ++, *Escherichia coli* ++, matured *Ascaris lubricoides* +
T4 50% GBM 50% GRM	Normal formed with white particles	Cyst of *Escherichia coli* +, uric acid crystals +, *Ascaris lubricoides* +
T5 25% GBM 75% GRM	Firm brown	Uric acid crystals +++, ova of *Isospora belli* +, ova of capillary worm + ova of round worm +

+: slightly present; ++: moderately present; +++: highly present; T1: control treatment (no antibiotics, no test ingredient); T2: Antibiotics (Diaziprim 48% S, sulpfadiazine 400mg, Trimethoprim 80mg, Excipient 1g); GBM: Garlic Bulb Meal, GRM: Ginger Rhizomes Meal.

Table 9: Microscopic analysis of finisher broiler faecal sample.

Treatments	Appearance	Observation
T1 (Control)	Formed brown with whitish particles	Cyst of *Escherichia coli* +, uric acid crystals ++
*T 2 (10%) Antibiotics	Most brown with whitish particles	Uric acid crystals ++, cyst of *Escherichia coli* ++, ova of round worm +
T3 75% GBM 25% GRM	Normal form with whitish particles.	Uric acid crystals +++, ova of round worm +
T4 50% GBM 50% GBM	Formed brown	Uric acid crystals +
T5 25% GBM 75% GRM	Normal form	Ova of round worm +, uric acid crystals ++

+: slightly present; ++: moderately present; +++: highly present; T1: control treatment (no antibiotics, no test ingredient); T2: Antibiotics (Diaziprim 48% S, sulpfadiazine 400mg, Trimethoprim 80mg, Excipient 1g); GBM: Garlic Bulb Meal, GRM: Ginger Rhizomes Meal.

Table 10: Microscopic analysis of broilers faecal sample for starter phase.

Parameters (X 10^5CFU/ML)	T1 (control)	*T2 0.10%	T3 0.75% GBM 0.25% GRM	T4 0.50 GBM 0.50 GRM	T5 0.25 GBM 0.75 GRM	SEM±	SIG
Aspergillus niger	3.20^a	0.00^b	0.00^b	0.00^b	0.00^b	0.32	**
Candida albicans	0.00	0.00	1.20	0.75	0.00	0.13	NS
Escherichia coli	3.30^a	0.00^b	0.00^b	0.00^b	0.00^b	0.33	**
Staphylococcus spp	18.70^a	$1.50b^c$	4.70^b	$1.35b^c$	1.20^d	1.57	**
Yeast	0.00	0.00	0.00	0.60	0.00	0.3	NS

*Antibiotics: Diaziprim –48% S. Sulfadazine 400mg, Trinethoprim 80mg, Excipient 1g; GBM: Garlic Bulb Meal; GRM: Ginger Rhizome Meal; a, b, c, d: treatment mean with different superscript within the same row are significantly (P<0.05) different; SEM: Standard Error of Mean; NS: No significant difference; *: Significantly different; **: Highly significantly different.

Table 11: Microscopic analysis of broilers faecal sample for finisher phase.

Parameters (X 10^5 CFU/ML)	T1 0% GBM 0% GRM	*T2 0.10%	T3 0.75% GBM 0.25% GRM	T4 0.50 GBM 0.50 GRM	T5 0.25GBM 0.75GRM	SEM±	SIG
Aspergillus niger	4.00^a	0.00^b	0.00^b	0.00^b	0.00^b	0.40	**
Candida albicans	0.00	0.00	0.00	0.00	0.00	0.00	NS
Escherichia coli	3.75^a	0.00^b	0.00^b	0.00^b	0.00^b	0.38	**
Staphylococcus spp.	20.50^a	0.00^c	1.00^b	0.00^c	0.00^c	2.01	**
Yeast	0.00	0.00	0.00	0.00	0.00	0.00	NS

*Antibiotics: Diaziprim –48% S. Sulfadazine 400mg, Trinethoprim 80mg, Excipient 1g; GBM: Garlic Bulb Meal; GRM: Ginger Rhizome Meal; a, b, c, d: treatment mean with different superscript within the same row are significantly (P>0.05) different; SEM: Standard Error of Mean; NS: No significant difference; *: Significantly different; **: Highly significantly different.

Microbiological analysis of faecal sample of broilers chicken fed experimental finisher diets at 42 days old

The results of microbial counts as presented in Table 11 showed that the test ingredients had no effects on *Candida albicans, Escherichia coli*, and *Yeast* counts while the microbial loads of *Aspergillus niger, Escherichia coli* and *Staphylococcus* spp. significantly (p<0.05) affects all the treatments. For *Staphylococcus* spp. counts, the highest value (20.50) was recorded in T1, followed by T3 (1.00), while lowest values were recorded in T2, T4 and T5 respectively.

DISCUSSION

Perforamance characteristics of the broiler chickens at 21days old of the experiment were not significantly (p>0.05) different, but percentage mortality differed significantly (p<0.05). The final body weight in treatment 4 (50% each of GBM and GRM) showed lower value of 633g compared to the control diet. Several studies have reported that test ingredients had no significant effect on the body weight gain and feed conversion ratio of birds (Onibi et al., 2009; Karangiya et al., 2016). The poor growth of broilers chickens starter fed experimental test ingredients may be attributed to the present of phytochemicals in their test diets (Patel et al., 2017)

Similar result as observed in broiler chickens starter was also recorded at the finisher phase of birds fed experimental diets. The final body weight in treatment 5

had the highest value of 2.12kg compared to the control diet and other treatments respectively. Inclusion of 25% GBM and 75% GRM mixture in the diet increased the body weight gain of broilers in treatment 5. Broilers fed 75% GBM and 25% GRM had the lowest body weight gain. The significant body weight recorded is in agreement with several studies that suggested that active compounds such as allicin in garlic promotes the gut health which aid digestion, enhanced energy utilization and conversion to yield optimum growth performance (Karangiya et al., 2016; Belal et al., 2018; Umatiya et al., 2018).

The reduced weight gains of broilers fed treatments 3 and 4 could be partly ascribed to the higher crude fibre content of experimental test ingredients and may have impaired nutrient digestion and absorption (Onu and Otuma, 2008; Onu, 2010; Oleforuh-Okoleh et al., 2014). Feed intake of birds in treatment 5 (2.90kg) showed the highest value compared to other treatments.

This is in alignment with reports of several reports that ginger enhances feed intake in broilers, which reflects on the body weight of birds and mixtures of garlic and ginger enhances performance of pullet growers, final live weight, hen day production and egg weight of laying hens (Ademola et al., 2012; Saiyed, et al., 2015; Karangiya et al., 2016). The different responses of broilers chickens to the test diets with respect to feed intake might be as a result of the availability of micro nutrients inherent in the test ingredients (Hossain et al., 2014; Kidane et al., 2017; Sudipta et al., 2017)

The differences observed in crude fibre among the nutrient digestibility and retention of broiler chickens fed experimental diets might be connected to stage of maturity and methods of processing of the test ingredients (Patel et al., 2017).

Microscopic analysis of starter broiler faecal samples showed that all treatments had normal formed, firm brown faeces with white particles and uric acid. Treatments 1, 3 and 4 revealed ova of round worm and crystal of *Escherichia coli*. Furthermore, treatments 2 and 5 had capillary worm and ova of round worms while treatments 3 and 4 had *Ascaris lubricoides*.

It has been opined by researchers that younger birds are more sensitive to antinutritional factors than older ones (Abdel-Wareth et al., 2012; Patel et al., 2017). At 42 days of age, the microscopy of the faeces of finisher broilers fed the experimental diets showed acceptability of the test ingredients in the diet. All treatments had normally formed firm brown faeces with white particles. The absence of *Ascaris lubricoides* and capillary worms in the faeces of broilers in treatments 3 and 4 is a good indication of their antihelminthic properties (Patel et al., 2017; Kidane et al., 2017).

The virtual absence of *Isospora belli* in the faeces of birds fed experimental diet that contained 25% GBM and 75% GRM suggest that it is the most potent combination of the test ingredients for gut freedom from helminthes. This is in consonance with the findings of Karuppiah and Rajaram, (2012) that chicks fed diets containing essential oil blend from a mixture of herbs, showed a reduced oocyte excretion compared to those fed the non-supplemented diet.

The microbiological count in the faecal samples of broilers fed experimental diet at 21 days of age showed the efficacies of antibacterial contents in the test ingredients is quite significant. This is in agreement with the reported use of herbs and spices as well as their products in ratios, aimed primarily at harnessing their antimicrobial potentials to boost performance in farm animals (Abdel-Wareth et al., 2012; Karuppiah and Rajaram 2012; Karthik et al., 2014; Kuldeep et al., 2015).

The population counts of microbes in faecal samples of the broilers at 42 days of age recorded a drastically reduce microbial loads. Each of the microbial loads did not differ significantly in loading density among the treatment groups. All microbes were totally absent in the test treatments while treatment I recorded the highest of all microbial loads. This observation is similar to what was reported by (Sudrashan et al., 2010; Adeshina et al., 2011) who obtained significant reduction in the bacterial counts of *Staphylococcus* spp., *Escherchia coli* and *Salmonella* spp., when essential oil isolated from ginger was used as a decontaminating agent in chicken meat.

More so, (Jacob and Pescatore, 2011) documented that the aqueous extract of the seeds of *Carica papaya* showed 90% efficacy towards other helminthes because of the activity of papain and subsequent addition of garlic into drinking water is an effective control measure for intestinal worms and coccidiosis.

CONCLUSIONS

The results of this study evaluated and established the importance of using naturally occurring phytochemical substances of plant origin significantly promote growth, feed utilization, antimicrobial properties in broiler chickens. Although, growth performance was slow at the starter phase for the test ingredients due to treatment factor but there was a rapid increase in feed consumed and growth performance at the finisher phase, especially in treatment 5 (25% GBM and 75% GRM mixture). It also revealed that garlic bulbs and ginger rhizomes can be source locally,

cheaper and easy to use with no adverse effects compared to synthetic antibiotics. Birds on treatment 5 (25% GBM and 75% GRM) had a better growth performance, antibiotic and antihelminthes potentials at the finishers phase compared to the commercial antibiotics.

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AUTHORS CONTRIBUTION

Okondu Nneka Helen:- worked on the performance of the birds, proximate analysis composition of the test ingredients and microbial counts. Akpodiete Orienru Job: experimental designed of the project, senior supervisor, and Obakanurhe Oghenebrorhie English writer and Editor, junior supervisor, Microbial counts and identification.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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