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GROWTH PERFORMANCE, CARCASS AND ORGAN YIELDS OF THREE STRAINS OF BROILER CHICKENS FED WITH AND WITHOUT GARLIC POWDER AS FEED ADDITIVE

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ABSTRACT

Use of natural plant materials like garlic in broiler production for enhanced performance, carcass quality and food safety are now widely advocated. This study examined growth performance and carcass yield of three strains of broiler chickens fed diet supplemented with conventional anti-coccidial (Ac) or garlic (G) powder as additive in a 3x2 factorial arrangement. Two hundred and eighty-eight, unsexed 4weeks old broiler chickens comprising 96 each of Ross 308 (R), Marshal (M), and Arbor Acre (A) strains were randomly allocated into six dietary treatments to make RAc for Ross on conventional anti-coccidial, MAc for Marshal on conventional anti-coccidial and AAc for Arbor Acre on conventional anti-coccidial at manufacturer's recommended level and RG for Ross on garlic, MG for Marshal on garlic and AG for Arbor Acre on garlic powder at 1.25g per kg feed. Data were collected on body weight gain, feed intake and feed conversion ratio. On day 26, two birds whose body weights were close to the group mean were selected per replicate and sacrificed for carcass analysis. The live, eviscerated, dressed, cut-parts, gizzard, liver, heart, proventriculus and offals weights were taken and analysed using ANOVA. Strain of broiler chickens and feed additive type did not influence growth performance. Arbor Acre had ($p<0.05$) the least dressed weight while Ross had the highest wing and shank weights. Marshal strain of

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broilers fed diet containing garlic recorded the highest ($p<0.05$) dressed weight. The study concluded that garlic can be used as natural anti-coccidial to optimize growth performance and carcass yield in broiler production.

Keywords: Broiler chicken, Growth performance, Carcass, Garlic.

1.0 INTRODUCTION

Broiler chickens are characterized by high growth rate, meat yield, efficient feed conversion, and short production cycle and therefore could serve as cheap, dependable animal protein source [1] for people in developing nations whose population are characterized with low animal protein intake [2]. According to [3], improvement in growth rate and the associated feed efficiency of broiler chickens could put immense pressure on the digestive system of the birds. This is because the gastrointestinal tract is a very diverse and dense microbial environment with large population of microbial organisms some of which are parasitic and could be detrimental to maximum production efficiency and animal health [4]. This calls for need to create a healthy intestinal environment to enhance optimal gut function. Hence, antimicrobial growth promoters such as antibiotics and anti-coccidial have been commonly used as additives in animal feeds to promote gut health and help animals digest feed and grow more efficiently [5]. Anti-coccidials are conventionally given to poultry for prophylactic or therapeutic measures because coccidiosis is known to be a major activator of enteritis with implications on performance [3]. However, there is now worldwide advocacy for antibiotic-free (ABF) poultry and poultry meat in response to the related negative effects of antibiotics in terms of drug resistance in microbes, drug residues in carcass, alteration of natural gut microflora, food security and safety issues in human health; and their consequent ban or restrictions [6]. Yet, in ABF production, prevention of coccidiosis and necrotic enteritis are major concerns [7]. Consequently, a paradigm shifts in advocacy and the evolvement of equally potent and safer alternatives to reduce or eliminate threats without compromising technical efficiency, birds' performance as well as products safety. Such alternatives are organic acids, enzymes and phytogenics [8].

Phytogenics, which are plant-based feed additives including herbs, spices, essential oils and their derivatives, are one of the most promising groups of feed additives that have proved effective in producing positive effects on immune response, performance and carcass of animals [8]. A wide range of activities of phytogenics including stimulation of feed intake, and antimicrobial, coccidiostatic and anthelmintic effects have been confirmed in poultry nutrition [9]. A phytogenic of interest is garlic (*Allium sativum*). It is a known spice or herb for the treatment and prevention of an array of diseases for both humans and animals [10]. According to [11], garlic contains at least 33 sulphur-containing compounds, several enzymes and 17 amino acids and minerals including selenium. The major bioactive components are allicin, ajoene, diakylpolysulphides, s–

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allylcysteine, diallylsulphide, s–methyl–cysteine sulphoxide and s–allyl cysteine sulphoxide, which may be responsible for its therapeutic properties [12].

Several studies have considered the performance enhancing potentials of garlic on animals [13, 14]. However, there is a need to investigate the potential of garlic as an anti-coccidial feed additive for broiler chickens to foster food security and improve future feeding of quality animal protein in developing countries. Thus, this study examined the performance and carcass yield of three strains of broiler chickens fed diets supplemented with garlic powder instead of conventional anti-coccidial.

2.0 MATERIALS AND METHOD

2.1 EXPERIEMENTAL SITE

The study was carried out at Ogun-Osun River Basin Development Authority Poultry unit along Alabata Road, Ogun State, Nigeria. The experimental site lies approximately on latitiude 7^{o} 3`N and longitude $3^{o}$ 54`E in South West, Nigeria's Derived Savannah Vegetation zone.

The housing type was a deep litter with concrete dwarf wall of about 1m high above soil level. Wood shavings were used as bedding material and were laid to about 5cm above floor surface.

2.2 EXPERIMENTAL TREATMENTS

Two hundred and eighty-eight (288) 3 weeks old unsexed broiler chickens comprising 96 each of Ross 308 (R), Marshal (M), and Arbor Acre (A) strains were used. They were randomly allocated into six (6) dietary treatments of bird strain with conventional anti-coccidial (Ac) or garlic powder (G) as an additive. Thus, treatments RAc, MAc and AAc for the conventional anti-coccidial and RG, MG and AG for the garlic powder additive. The conventional anti-coccidial was supplemented following manufacturer's recommendation at prophylactic level while garlic powder was supplemented at 1.25g per kg feed based on the findings of Javandel *et al*. (2008). Each treatment had six (6) replicates. The birds at 0-3 weeks were fed on a starter diet which had 22% crude protein and 2850Kcal metabolisable energy/kg. All recommended vaccinations were administered as required. Feeding and drinking troughs were adequately provided. Space allocation of $0.08m^2$/bird was maintained throughout the study. Birds on diet with garlic powder additive were not treated with any conventional antibiotic or anti-coccidial drug throughout the study period. The finisher diets contained 20% crude protein and 2997kcal/kg metabolisable energy. Feed and water were given *ad libitum* throughout the period of the trial which lasted 35 days. Growth performance data were collected on body weight, feed intake and feed conversion ratio.

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2.3 DATA COLLECTION

At day 33 of the study (when the birds were 54 days old), two birds whose body weights were close to the mean were selected from each replicate for carcass analysis. The birds were fasted for 24 hours after which they were slaughtered through neck dislocation and decapitation. Thereafter, the birds were scalded, de-feathered, eviscerated and cut into parts. Live, bled, plucked, eviscerated and dressed weights were measured using top-loading scale. The cut parts (breast, back, thigh, drum stick, head, neck and shank), organs (gizzard, proventriculus, spleen, kidney, liver, and heart), and offals (crop, small intestine, large intestine and caeca) were weighed using sensitive scale and expressed as a percentage of live weight.

2.4 DATA COLLECTION

All data obtained were subjected to ANOVA in a 3x2 factorial arrangement using SAS analytical package [15]. Significant means were separated using Duncan's Multiple Range Testas contained in [15].

3.0 RESULTS

Table 1 shows effect of strain on growth performance of broiler chickens fed diets containing conventional anti-coccidial or garlic powder. Strain had no significant ($p>0.05$) effects on final weight, total weight gain, daily weight gain, total feed consumed, daily feed intake, and feed conversion ratio of broiler chickens.

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Table 1: Main effect of strain on growth performance of three strains of broiler chickens fed diet supplemented with and without garlic.

Parameter	Strain			P-Value	SEM
	Ross	Marshal	Arbor Acre		
Initial weight (g/bird)	686.03	632.88	647.88	0.12	36.01
Final weight (g/bird)	2699.35	2485.80	2641.13	0.13	129.82
Total weight gain (g/bird)	2013.33	1852.93	1991.75	0.20	119.53
Daily weight gain (g/bird/day)	47.94	44.12	47.42	0.20	2.85
Total feed Intake (g/bird)	4735.30	4684.40	4731.30	0.97	307.02
Daily feed intake (g/bird/day)	112.75	115.65	112.65	0.75	6.19
Feed conversion ratio	2.37	2.45	2.38	0.84	0.22

Table 2 shows the effect of conventional anti-coccidial (Ac) or garlic powder (G) as feed additive on growth performance of three strains of broiler chickens. The Ac and G treatments had no influence ($p>0.05$) on final weight, total weight gain, daily weight gain, total feed intake, average daily feed intake, and feed conversion ratio of the birds.

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Table 2: Main effect of additive on growth performance of three strains of broiler chickens fed diet supplemented with garlic

Parameter	Additive		P - value	SEM
	Anti-coccidial	Garlic		
Initial weight (g/bird)	663.00	648.18	0.50	36.01
Final weight (g/bird)	2697.68	2519.83	0.05	129.82
Total weight gain (g/bird)	2134.68	1870.65	0.05	119.53
Daily weight gain (g/bird/day)	48.45	44.54	0.05	2.85
Total feed Intake(g/bird)	4869.00	4564.90	0.14	307.02
Average daily intake(g/bird/day)	115.93	111.43	0.25	6.19
Feed conversion efficiency	2.40	2.40	0.96	0.22

The effects of interaction between strains and conventional anti-coccidial or garlic powder as feed additive on growth performance of three strains of broiler chickens are presented in **Table3.** Interaction showed similar ($p>0.05$) performance of all groups in terms of final weight, weight gain, feed intake and feed conversion ratio of broiler chickens.

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Table 3: Interaction between strain and additive on growth performance of three strains of broiler chicken fed diet supplemented with and without garlic

Parameter	**Ross**		**Marshal**		**Abor Acre**		**P-value**	**SEM**
	Conventional Anticoccidial	Garlic	Conventional Anticoccidial	Garlic	Conventional Anticoccidial	Garlic		
Initial weight (g/bird)	698.75	673.30	620.75	645.00	669.50	626.26	0.44	11.31
Final weight (g/bird)	2748.60	2650.10	2569.85	2401.75	2774.60	2507.65	0.67	48.29
Total weight gain(g/bird)	2049.85	1976.80	1949.10	1756.75	2105.10	1878.40	0.66	42.65
Daily weight gain (g/bird/day)	48.81	47.07	46.41	41.83	50.12	44,72	0.65	1.02
Total feed Intake(g/bird)	4850.00	4620.54	4842.86	4525.90	4914.29	4548.22	0.95	80.67
Daily Feed Intake (g/bird/day)	115.48	110.02	115.31	115.99	117.01	108.30	0.58	1.65
Feed Conversion Efficiency	2.37	2.47	2.49	2.42	2.34	2.42	0.90	0.05

The main effect of strain on carcass traits of broiler chickens fed diet containing conventional anti-coccidial or garlic as an additive is shown in **Table 4**. Significant differences ($p<0.05$) were observed in relative dressed, wings and shank weights of the different strains of broiler chickens. Dressed weight was better ($p<0.05$) in Marshal strain (72.81%) compared to Arbor Acre strain (62.44%) while the value obtained for Ross strain (69.4%) was similar to that of Marshal. Similarly, strains of broiler chicken influenced ($p<0.05$) the relative weight of wings. Ross strain recorded superior ($p<0.05$) relative values for wings (8.99%) and shank (4.05%).

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Table 4: Main effect of strain on carcass yield of three strains of broiler chicken fed diet supplemented with and or without garlic

Parameter	Strain			P-value	SEM
	Ross	**Marshal**	**Arbor Acre**		
Killing out					
Live weight (g/bird)	2550.00	2535.00	2672.50	0.42	150.80
Bled (%)	93.32	90.90	89.40	0.29	3.18
Pluck (%)	87.01	84.10	83.79	0.60	4.76
Eviscerated (%)	79.24	78.71	74.67	0.32	4.23
Dress (%)	69.37[a]	72.81[a]	62.44[b]	0.02	3.67
Cut parts*(%)					
Breast	23.37	23.59	21.40	0.12	1.39
Wing	8.99[a]	8.15[b]	7.64[b]	0.01	0.39
Thigh	11.82	10.03	9.99	0.29	1.65
Drum stick	10.81	9.47	9.08	0.19	1.22
Back	13.23	11.35	10.85	0.13	1.46
Neck	3.56	3.93	3.34	0.28	0.48
Head	2.80[a]	2.31[b]	2.61[ab]	0.06	0.81
Shank	4.05	3.56	3.70	0.02	0.70

[ab] Means within the same row with different superscripts differ significantly ($p<0.05$).

*= Expressed as percentage relative to live weight

Table 5 shows main effect of feed additives on carcass traits of broiler chickens. Significant differences ($p<0.05$) were observed in the relative weights of breast and neck of birds fed diets containing Anti-coccidia and Garlic as additives. Relative breast weight was significantly ($p<0.05$) higher (24.0%) in the G group compared to the Ac group (21.6%) while neck relative weight was higher ($p<0.05$) in the Ac group. No differences ($p>0.05$) were obtained with other parameters that were measured.

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Table 5: Main effect of additive on carcass yield of three strains of broiler chicken fed diet supplemented with and without garlic

Measurement	Additive		P – value	SEM
	Anti- coccidial	Garlic		
Killing out				
Live weight (g/bird)	2611.67	2560.00	0.57	150.80
Bled (%)	91.14	91.27	0.95	3.18
Pluck (%)	83.55	86.38	0.34	4.76
Evisceration (%)	76.16	78.91	0.30	4.23
Dress (%)	66.08[b]	70.33[a]	0.09	3.67
Cut parts *(%)				
Breast	21.62	23.96	0.03	1.39
Wing	8.38	8.14	0.32	0.39
Thigh	10.47	10.76	0.77	1.65
Drum stick	10.29	9.28	0.20	1.22
Back	12.12	11.49	0.48	1.46
Neck	3.99[a]	3.23[b]	0.03	0.48
Head	2.54	2.61	0.65	0.81
Shank	3.92	3.63	0.50	0.70

[ab:] Means within the same row with different superscripts differ significantly ($p<0.05$)

*= Expressed as percentage of live weight

Effect of interaction between strain and conventional anti-coccidial or garlic powder feed additive on carcass traits of broiler chickens is shown in **Table 6.** Interaction between strain and feed additive type had a significant ($p<0.05$) influence on dressed and wing weights. The relative dressed weight recorded for MG (79.27%) was higher ($p<0.05$) than values for birds of other treatment groups. Relative dressed weights of RG (67.0%), MAc and AG were all similar and compared with AAc and RAc which recorded dressed weights of 60.20% and 71.70%, respectively.

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Table 6: Interaction between strain and additive on carcass yield of three strains of broiler chicken fed diet supplemented with and or without garlic

Parameter	Ross		Marshal		Arbor Acre		P-value	SEM
	Conventional Anticoccidial	Garlic	Conventional Anticoccidial	Garlic	Conventional Anticoccidial	Garlic		
Live weight (g/bird)	2580.00	2520.00	2560.00	2510.00	2695.00	2650.00	0.99	37.95
Bled (%)	94.98	91.65	90.19	91.62	88.26	90.54	0.45	0.91
Pluck (%)	87.50	86.52	82.56	85.64	80.58	86.99	0.58	1.27
Evisceration (%)	81.92	76.55	74.17	83.26	73.40	76.93	0.12	1.48
Dress (%)	71.70^{ab}	67.04^{bc}	66.35^{bc}	79.27^{a}	60.20^{c}	64.68^{bc}	0.04	1.97
Cut parts * (%)								
Breast	22.37	24.38	22.23	24.95	20.27	22.53	0.94	0.55
Wing	9.72^{a}	8.26^{b}	8.04^{b}	8.25^{b}	7.38^{b}	7.90^{b}	0.02	0.23
Thigh	11.39	12.24	9.95	10.12	10.05	9.94	0.92	0.44
Drum stick	12.32	9.30	10.28	8.67	8.28	9.88	0.09	0.48
Back	14.72	11.75	11.20	11.47	10.46	11.25	0.22	0.51
Neck	4.10	3.02	4.26	3.61	3.62	3.07	0.71	0.17
Head	2.89	2.72	2.34	2.27	2.40	2.83	0.23	0.09
Shank	4.70	3.41	3.66	3.47	3.40	3.99	0.24	0.20

$^{abc:}$ Means within the same row with different superscripts differ significantly ($p<0.05$).

*= Expressed as percentage relative to live weight.

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Effect of strain on organs and offals characteristics of broiler chickens fed diets containing conventional anti-coccidial or garlic powder feed additive is shown in **(Table 7).** The main effect of strain on organs and offals characteristics of broiler chickens fed diets containing Ac or G feed additive showed no influence ($p>0.05$) on the relative weights of gizzard, spleen, liver, lungs and proventriculus. Also, relative weight of offals (large intestine, small intestine and caeca) of broiler chickens of different strains were not influenced ($p>0.05$) by the treatments. However, significant ($p<0.05$) variations were observed for relative weights of heart and crop of the different strains of broiler chickens. Higher ($p <0.05$) relative value was obtained in Ross strain (0.49%) of broilers compared to Marshal (0.34%) but the value of 0.40% recorded for Arbor Acre was similar to these other two.

Table 7: Main effect of strain on organ yield of three strains of broiler chicken fed diet supplemented with and or without garlic

Measurement	Strain			P – value	SEM
	Ross	Marshal	Arbor Acre		
Live weight (g/bird)	2550.00	2535.00	2672.50	0.42	150.80
Organs (%)*					
Heart	0.49[a]	0.34[b]	0.40[ab]	0.04	0.66
Gizzard	1.81	1.83	1.73	0.61	0.14
Spleen	0.12	0.11	0.10	0.65	0.03
Liver	1.57	1.67	1.67	0.90	0.35
Lungs	0.50	0.53	0.38	0.18	0.10
Proventriculus	0.38	0.39	0.37	0.97	0.10
Offals (%)*					
Crop	0.50[ab]	0.46[b]	0.57[a]	0.05	0.05
Large intestine	0.45	0.34	0.53	0.30	0.17
Small intestine	2.97	3.10	3.43	0.84	1.08
Caeca	0.53	0.63	0.54	0.26	0.10

[ab:] Means within the same row with different superscripts differ significantly ($p<0.05$).

* Value expressed as percentage (%) of live weight

The main effect of feed additives on organs and offals characteristics of broiler chickens fed diet containing conventional anti-coccidial or garlic powder is presented in **Table 8**. Relative gizzard weight was heavier ($p<0.05$) in broiler chickens fed diet with Ac (1.90%) compared to those fed diet containing G (1.68%).

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Table 8: Main effect of additive on organs and yield characteristics of three strains of broiler chickens fed diet supplemented with and or without garlic

Measurement	Additive		P – value	SEM
	Anti-coccidial	Garlic		
Live weight (g/bird)	2611.67	2560.00	0.57	150.80
Organs (%) *				
Heart	0.40	0.42	0.77	0.06
Gizzard	1.90[a]	1.68[b]	0.05	0.14
Spleen	0.10	0.12	0.27	0.03
Liver	1.70	1.58	0.57	0.35
Lungs	0.49	0.46	0.61	0.10
Proventriculus	0.41	0.35	0.34	0.10
Offals (%) *				
Large intestine	0.46	0.42	0.72	0.17
Small intestine	3.05	3.28	0.73	1.08
Caeca	0.54	0.60	0.28	0.10

[ab] Means within the same row with different superscripts differ significantly ($p<0.05$)
*Values expressed as percentage of live weight.

Effect of interaction between strain and feed additive on organs and offals yield of broiler chickens is shown in **Table 9**. Interaction between strain and feed additive had no effect ($p>0.05$) on organs and offals, except the crop of broiler chickens. However, crop weight did not follow a particular trend across the treatment groups. Birds of the AG group had highest relative crop weight (0.61%) compared to birds in the RG (0.44%), RAc (0.57%) and MG (0.40%) groups.

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Table 9: Interaction between strain and additive on organs and offals yield of three strains of broiler chickens fed diet supplemented with and without garlic

Parameter	Ross		Marshal		Arbor Acre		P-value	SEM
	Conventional Anticoccidial	Garlic	Conventional Anticoccidial	Garlic	Conventional Anticoccidial	Garlic		
Live weight (g/bird)	2580.00	2520.00	2560.00	2510.00	2695.00	2650.00	0.99	37.95
Organs (%) *								
Spleen	0.10	0.14	0.10	0.12	0.10	0.10	0.65	0.01
Liver	1.71	1.43	1.73	1.61	1.66	1.69	0.84	0.08
Lungs	0.58	0.42	0.53	0.54	0.36	0.41	0.34	0.03
Proventriculus	0.43	0.32	0.39	0.38	0.40	0.34	0.78	0.02
Offals (%) *								
Crop	0.57^{a}	0.44^{bc}	0.53^{ab}	0.40^{c}	0.54^{ab}	0.61^{a}	0.04	0.02
Large intestine	0.62	0.28	0.31	0.36	0.44	0.63	0.14	0.05
Small intestine	3.13	2.82	3.08	3.13	3.95	3.90	0.71	0.25
Caeca	0.49	0.58	0.67	0.60	0.46	0.62	0.23	0.03

$^{abc:}$ Means within the same row with different superscript differ significantly ($p<0.05$)

*=Values expressed as percentage of live weight.

4.0 DISCUSSION

The non-significant effects of strain on growth performance of broiler chickens obtained in this study are in line with the findings of [16] who reported no major difference between final body weights of Cobb 500 and Shaver Starbro commercial broiler strains. The results obtained suggest that any of the commercial broiler strains can be selected for production as they all reflected good body weight and feed conversion ratio. Strain of broiler chickens had no influence on feed intake in this study. This result is at variance with the findings of [17] which reported differences in feed intake between strains of chickens. The disparity in the results may be caused by the differences in the appetite level as birds have innate capacity to adjust their feed intake to energy levels of diets [18]. [17] Worked on different strains of developed local Egyptian and Canadian chickens which were probably selected from different ecologies. Variations in breed and perhaps physiology and feeding programme may be responsible for the contrast observed in the feed intake in this study compared with that of [19] more so that layers are reared for their eggs while broilers are

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reared for their meat. Therefore, the opinion of [18] that feed intake differs due to birds' innate capacity gave credence to the findings of this study.

The Ac and G treatments had no influence ($p>0.05$) on final weight, total weight gain, daily weight gain, total feed intake, average daily feed intake, and feed conversion ratio of the birds. This result is at variance with that obtained by [20] who reported a positive influence of dietary garlic addition on growth performance of broiler chickens. It is also at variance with that of [20] who reported that the use of phytogenics enhanced broilers' live weight by 2.5% while feed efficiency was improved by 1.9%. Equally, [21] reported that when broilers were given daily doses of 25, 50 and 100mg of dissolved garlic powder, they had higher body weight gain at day 7, 14 and 21 than those in control while the feed intake and feed conversion ratio were not affected. However, [22] reported that addition of thyme and garlic powder into broiler diets had no major effect on performance. In the same vein, [24] reported that performance was not affected when broiler diets were supplemented with 1.5, 3.0 and 4.5% garlic powder. [25] reported that feeding garlic at 2g did not result in any difference in feed intake, FCR and weight gain of Ross strain of broiler chicken. Variations in results observed in the different studies could be attributed to the mode or level of administration, and or the basis of comparism. As indicated in this study, performance of broiler chickens on G additive compared with those on Ac additive. Similarity in this result could be due to the potency of the active ingredients contained in garlic to promote good gut health and equally support growth performance. Garlic contains bioactive components such as allicin, sulphur-containing compounds, several enzymes and 17 amino acids and minerals including selenium which help to engender growth and confer immunity and good health [12]. Furthermore, organic sulphur compounds could serve as active ingredients in many broad-spectrum natural antibiotics, anti-coccidial and anti-fungi preparations instead of the conventional commercial antibiotics and anti-parasitic preparations which have generally been blamed for drug residue, disease resistance and other deleterious phenomena.

The result for interactive effect of anti-coccidial or garlic powder suggested that garlic could serve as an effective organic feed additive in place of conventional anti-coccidial without negative effects on health and growth performance of broiler chickens. This finding is consistent with the earlier study by [22] in which broilers given daily doses of 25, 50 and 100mg of dissolved garlic powder observed higher body weight gain at days 7, 14 and 21 than those in control while the feed intake and feed conversion ratio were not affected.

The result of this study is in line with that of [26] who revealed that strain-influenced carcass characteristics of broilers give credence to the result obtained in this study. However, there were no significant ($p>0.05$) variations eviscerated, breast, thigh, drum stick among other major cuts of the birds. This finding is consistent with that of [27] who reported no differences in some carcass traits of different strains of broilers.

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According to [27] addition of garlic powder into broilers diets enhanced carcass yield while [28] and [28] reported that dressing percentage improved when broilers' diets were supplemented with extracts from medicinal plants including garlic. In this current study, improved carcass yield was mainly prominent in breast yield. This suggested that garlic enhances the yield of the primal choice cut of broiler chickens. This observation could probably be attributed to the amino acids, enzymes, and bioactive components contained in garlic which probably enhance tissue synthesis and good health as opined by [12].

The result of Interaction between strain and feed additive type was similar with [30] and [27] who stated that addition of garlic powder into broilers diets improved carcass yield. This was observed in Marshal strain of broiler chickens as the positive effect of garlic on dressed weight was more pronounced and probably more beneficial. Higher ($p<0.05$) relative wing weight was recorded for RAc. This could partly be because the Ross strain of broilers recorded heavier wings than the other two strains.

Relative weight of crop was found to be higher ($p<0.05$) in Arbor Acre Strain (0.57%) compared to Marshal (0.46%). This result is at variance with the findings of [27] who reported no significant ($p>0.05$) effect of strain on organs weight of broiler chickens.

Effect of conventional anti-coccidial or garlic feed additive on organs and offals characteristics of broiler chickens is in with the results of [30] reported significant reduction of gizzard weight in garlic-supplemented groups compared to control. This report supports the result obtained in the current study. However, there were no differences ($p>0.05$) in the values for heart, spleen, liver, lungs and proventriculus of the broiler chickens used in this study. This observation is consistent with the finding of [31] who reported that inclusion of multi-strain probiotics in diets did not influence organs weight of broiler chickens. Likewise, [32] reported no differences in histomorphology of broiler chickens on antibiotics, probiotics and symbiotic treatments. According to [12], garlic confers immunity and strong health. These opinions suggested that natural growth promoters like phytogenics could be used to substitute antibiotic growth promoters in chicken production in order to avoid the negative effects of antibiotics in the organs of broiler chickens.

This result of interaction between strain and feed additive on organs and offals yield of broiler chickens suggested that garlic powder as an additive could help maintain gut integrity particularly as there was no prominent variation in the feed intake as well as the weight of small and large intestines of birds in the different experimental groups yet there were selected enhanced meat yield. This finding is consistent with the reports of [30] who reported better carcass traits of broiler chickens fed diets containing garlic powder.

CONCLUSION

This study concluded that strain of broiler chickens did not affect growth performance of broiler chickens. Garlic powder as an additive increased the relative breast weight and had no detrimental effect on organs of broiler chickens. Garlic powder can be used as a natural anti-coccidial to promote gut health and optimize growth performance and carcass yield with safer and healthier carcasses in broiler production.

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