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Interaction effects of dietary ginger *Zingiber officinale* and yeast *Sacharomyces cerevisiae* supplementation on performance, carcass yield and gut micro flora of broiler chickens

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Abstract

Consumer concern for drug residues in meat and eggs as well as ban imposed on the use of antibiotics in animal feed as growth promoter call for alternative search. A 56days feeding trial was conducted to investigate the effect of ginger inclusion with and without yeast supplementation on performance, carcass characteristics, gut micro flora of broiler chickens. A total of One hundred and eighty day, one old Arbor acre broiler chicks were allotted on weight equalization basis to 6 dietary treatments in a 3 × 2 factorial arrangements (3 levels of ginger (0%, 4% and 5%) with and without yeast (0%, 1% levels). The treatments were replicated thrice with ten birds per replicate. Feed and water were provided ad- libtum. Performance showed that birds on combination (5% ginger and 1% yeast) recorded highest weight (1527g) with better feed conversion while least weight (1202g) and least feed conversion were recorded with birds on ginger only. Highest eviscerated weight (1362.50g) and dressing percentage (72.79%) were recorded in broiler chicks on 1%Yeast + 5% Ginger while least values (1087.50g, 62.39%) were recorded with birds on yeast only. Total bacteria count increased from 1.20 x10^{6}cfu/ml (control) to 1.70 x10^{6}cfu/ml in diets supplemented 1% yeast and 5% ginger as well as Lactobacillus count increased with supplementation level Total anaerobic count decreased from1.10 x10^{6}cfu/ml in control diet to 0.68 x10^{6}cfu/ml in birds fed1% yeast and 5% ginger likewise coliform, clostridium and bacillus counts decreased with the additives (yeast and ginger) inclusion. It can be concluded that inclusion of ginger and yeast at 5% and 1% respectively in the diets improved performance and reduced pathogenic biota without detrimental effects in broiler chickens and might therefore serve as a natural substitute for synthetic growth promoters.

Keywords: broilers, ginger, yeast, performance, gut micro flora, carcass yield.

Introduction

In the past, growth-promoting antibiotics were used as feed additives; however, these were associated with residues in the meat and eggs by consumers, and have been banned or limited in many countries (Diarra *et al.,* 2011). As a result, natural alternatives to antibiotics, such as herbs and medicinal plants, have attracted attention due to their wide range of potential beneficial effects (Manesh *et al.,* 2012). Various feed additives are used in poultry to maximize net returns and carcass quality and to increase growth performance and control of disease (Chen *et al.,* 2009). Use of products such as probiotics, prebiotics and organic acids as replacements for antibiotics have increased in recent times. Ginger *Zingiber officinale* is a rhizomatous herbaceous plant, whose rhizome is used medicinally; it contains several compounds and enzymes including gingerdiol, gingerol, gingerdione and shogaols (Zhao *et al.,* 2011). These compounds have been reported to have antimicrobial, antioxidative and

pharmacological effects (Ali *et al*., 2008). The use of ginger as feed additives and substitute for antibiotic growth promoter is desirable for greater productivity in poultry as it increases palatability of feed, nutrient utilization, appetite stimulation, and increased gastric juice flow. It has also been found to increase secretion of gastrointestinal enzymes including lipase, disaccharidase and maltase (Zhang *et al*., 2009). Zhao *et al*.; (2011) reported that ginger enhances animals' nutrient digestion and absorption because of its positive effect on gastric secretion, enterokinesia and digestive enzyme activities. *Saccharomyces cerevisiae*, from malted grains fermentation also known as "baker's yeast" is one of the most widely commercialized types of yeast, has long been fed to animals (Rezaeipour *et al*., 2012). It*s* applications in animal production influence the normal microbial population within caecum to stimulate the growth, immune system and counteract aflatoxicosis in broiler chickens and duckling (Gheisari and Kholeghipour, 2014). The effects of yeast on animal production are currently based on the ability of yeast strains but this stimulatory characteristic may not be common to all strains of yeast. The mechanism of live yeast for improving performance is most probably supporting the growth of lactic acid bacteria and a competitive exclusion of pathogenic bacteria by yeast and its products especially the cell wall component (Onifade, 1998). Use of yeast and yeast products as natural growth promoters and immuno modulators is well documented as it may serve as alternatives to antibiotics for both growth promotion and disease resistance in poultry production. Several literatures referred that supplementation of yeast products improved immune response (Hooge, 2004; Shashidhara and Devegowda 2003; Zhang *et al*., 2011). Yeast could therefore be a performance enhancer through improvement in protein utilization and a significant retention of crude fibre thus confirms yeast as possessing the ability to degrade fibrous materials in poultry feeds. The present study seeks to investigate the effects of ginger inclusion with and without yeast supplementation on performance, carcass characteristics, gut micro flora of broiler chickens.

Materials and methods

Location of the experiment

The study was conducted at the Livestock Unit of Teaching and Research Farm of Agricultural Technology Department, Yaba College of Technology, Epe Campus, Lagos, Nigeria. The farm is located on (latitude $3^0 58^1$E and longitude $6^0 47^1$N (Goggle earth 2011).

Preparation of test ingredient

Fresh Ginger used in this study were grated and mixed with Yeast (*Saccharomyces cereviseae*)

Management of experimental birds

One hundred and eighty, one day old Arbor acre broiler chickens were purchased from a reputable commercial hatchery and used for this study. Brooding of the chicks was done under deep litter system, while appropriate vaccination and medication were administered. The chicks were allotted on weight equalization basis to 6 dietary treatments in a 3 × 2 factorial arrangements of 3 levels of ginger (0%, 4% and 5%) with and without yeast (0%, 1%) to have diets (D1-D3) with three levels of ginger without yeast and diets (D4-D6) with three levels of ginger with yeast. Each of the treatment was replicated three times with ten birds per replicate. Birds were managed intensively with feed and water given ad libitum for 56 days feeding trials. Feed ingredients were purchased from a reputable feed mill in Ijebu ode, Ogun State, Nigeria. The feeds

were balanced within the recommended range for broiler chickens (NRC, 1994), the experimental diets are shown in Tables 1 and 2.

Growth performance

The mean body weight, body weight gain, feed intake and mortality were recorded on replicate basis weekly. Feed conversion which is a ratio of feed consumed and the weight gained over a starter phase (0-4weeks) and finisher phase (5-8weeks) was also calculated.

Carcass yield

At the expiration of 56 days, two birds per replicate whose weights were similar or close to the average weight of the birds contained in each treatment were selected, fasted overnight, slaughtered, plucked and eviscerated. Evisceration of the carcass was done manually following standard commercial procedures (Jensen, 1984). The live weight, plucked weight and eviscerated weight were recorded while weights of wing, back, thigh, drumstick and breast were also recorded.

Gut microflora

Two birds were randomly selected from each replicate and slaughtered while the intestinal segments dissected. Caeca content was collected aseptically into sample bottles and stored in a refrigerator (-20°C) for microbiological analysis. Estimation of total bacteria counts, Coliform, Clostridium, Lactobacillus, Bacillus, Salmonella, Staphylococcus counts were done according to the method

Table 1: Composition of experimental broiler starter (0-4 weeks) diets containing graded levels of ginger and without dietary yeast

Ingredients %	T1 0%	T2 4%	T3 5%	T4 0%	T5 4%	T6 5%
Maize	54.00	54.00	54.00	54.00	54.00	54.00
Soybean meal	30.00	30.00	30.00	30.00	30.00	30.00
Fish meal (72%)	3.00	3.00	3.00	3.00	3.00	3.00
Vegetable oil	1.00	1.00	1.00	1.00	1.00	1.00
Wheat offal	6.00	2.00	1.00	6.00	2.00	1.00
Bone	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	2.00	2.00	2.00	2.00	2.00	2.00
Ginger	0.00	0.04	0.05	0.00	0.04	0.05
Yeast	0.00	0.00	0.00	0.01	0.01	0.01
Salt	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*
Premix*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*	*0.30*
Methionine	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*
Lysine	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*
Total	100.00	100.00	100.00	100.00	100.00	100.00
Determined analyses (%)						
Crude protein	22.43	22.43	22.43	22.43	22.43	22.43
Crude fibre	2.05	2.05	2.05	2.05	2.05	2.05
Ether extract	3.85	3.85	3.85	3.85	3.85	3.85
Calculated Analyses (%)						
Calcium	1.78	1.78	1.78	1.78	1.78	1.78
Phosphorus	0.46	0.46	0.46	0.46	0.46	0.46
Lysine	1.49	1.49	1.49	1.49	1.49	1.49
Methionine	0.56	0.56	0.56	0.56	0.56	0.56
ME *(Kcal/kg)*	2832	2832	2832	2832	2832	2832

**Starter premix: - Vit. A 10,000,000 (iu), Vit D3 2,000,000 (iu), Vit. E 23,000(mg), Vit K3(mg), Vit B1 1,800 (mg), Vit. B2 5,500 (mg), Niacin 27,500 mg, Pantothenic acid 7,500mg, Vit. B6 3,000mg, Vit.B12 15mg, Folic acid 750mg, Biotin H2 60mg, Chlorine chloride 300,000mg, Cobalt 200mg, Copper 3,000mg, Iodine 1,000mg, Iron 20,000mg, Manganese 40,000(mg), Selenium 200mg, Zinc 30,000mg, An ti-oxidant 1,250mg.*

Table 2: Composition of experimental broiler finisher (5-8 weeks) diets containing graded levels of ginger and without dietary yeast

Ingredients %	T1 0%	T2 4%	T3 5%	T4 0%	T5 4%	T6 5%
Maize	58.00	58.00	58.00	58.00	58.00	58.00
Soybean meal	25.00	25.00	25.00	25.00	25.00	25.00
Fish meal (72%)	2.00	2.00	2.00	2.00	2. 00	2.00
Vegetable oil	2.00	2.00	2..00	2.00	2.00	2.00
Wheat offal	7.00	7.00	7.00	7.00	7.00	7.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	3.00	3.00	3.00	3.00	3.00	3.00
Ginger	0.00	0.00	0.00	0.00	0.00	0.00
Yeast	0.00	0.00	0.00	0.00	0.00	0.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Premix*	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00	100.00
Determined analyses (%)						
Crude protein	20.33	20.33	20.33	20.33	20.33	20.33
Crude fibre	4.08	4.08	4.08	4.08	4.08	4.08
Ether extract	3.91	3.91	3.91	3.91	3.91	3.91
Calculated analyses (%)						
Calcium	1.77	1.77	1.77	1.77	1.77	1.77
Phosphorus	0.44	0.44	0.44	0.44	0.44	0.44
Lysine	1.31	1.31	1.31	1.31	1.31	1.31
Methionine.	0.54	0.54	0.54	0.54	0.54	0.54
ME(Kcal/kg)	3100	3100	3100	3100	3100	3100

**Starter premix: - Vit. A 10,000,000 (iu), Vit D3 2,000,000 (iu), Vit. E 23,000(mg), Vit K3(mg), Vit B1 1,800 (mg), Vit. B2 5,500 (mg),Niacin 27,500 mg, Pantothenic acid 7,500mg, Vit. B6 3,000mg, Vit.B12 15mg, Folic acid 750mg, Biotin H2 60mg, Chlorine chloride 300,000mg, Cobalt 200mg, Copper 3,000mg, Iodine 1,000mg, Iron 20,000mg, Manganese 40,000(mg), Selenium 200mg, Zinc 30,000mg, Anti-oxidant 1,250mg*

of Baker and Beach (1998).

Statistical analysis

Data collected were laid out in a 3 × 2 factorial arrangements of 3 levels of Ginger with and without (2 levels) Saccharomyces cerevisiae and analyzed using the SAS (2000) package. Analyses were done electronically to determine the main effects of Ginger levels, Saccharomyces cerevisiae inclusion) and their interaction (Ginger inclusion levels × Saccharomyces cerevisiae inclusion). Polynomial contrast (linear and quadratic) was applied to determine the effects of different supplemental levels of ginger (0%, 4%, and 5%) and 0% and1% levels yeast. A probability value of P-value less than the value of type I error (α=.05) will be considered to be statistically significant.

Results and discussion

Performance

Table 3 showed the main and interaction effects of graded levels of ginger and yeast as feed additives on performance of broiler chickens. From the Table significant differences existed between weights gained, Daily feed intake, Feed conversion ratio among broiler fed the dietary treatment. The result indicated that birds on combination 5% ginger and 1% yeast recorded highest weight (1527g) while least

weight (202g) was recorded with on 5% ginger only. Dietary inclusion of ginger and yeast influenced daily feed, feed conversion ratio as birds on treatment 6 consumed less feed but had best feed conversion among the treatment. However, birds on 0% ginger and; 0% yeast (74.80g) recorded highest feed intake followed by birds on 0% ginger and 1% yeast (74.26g). This could be attributed to the effect of oligosaccharides in yeast and accumulation of the active ingredients in ginger which gives rise to the formation of more stable intestinal flora and improved feed conversion efficiency as a consequence of better digestion, enhances gut health with improved performance (Park *et al*., 2001; Tekeli, 2007). Feed conversion ratio in ginger and yeast diets were significantly higher indicating better feed efficiency. These results agree with the work of Moorthy *et al*. (2009) and Onimisi *et al*. (2005) who reported significantly better feed conversion ratio in ginger fed broiler and also Ghasemi *et al*. (2006), who obtained improvement in body weight gain and feed conversion ratio in chicks fed live yeast (Raju *et al*.; 2006), reported that up to 200mg of yeast per kg diet improved feed efficiency of broilers. This could also be attributed to the effect of oligosaccharides in yeast that enhances gut health with improved performance. This result also agreeds with (Park *et al*., 2001); that diets with supplemental *Saccharomyces cerevisiae* at 0.025, 0.05 and 0.1% contain beta-glucans which has growth promoting and immune-enhancing effects in broiler chickens. Also, Paryad and Mahmoudi (2008) reported that the inclusion of 1.5% *S. cerevisiae* yeast in broilers ration improved body weight gain, feed intake and feed conversion ratio. Likewise, inclusion of ginger in diet of broiler chickens had a positive effect on feed consumption and weight gained (Zhang *et al*., 2009; Tekeli *et al.,* 2011; Zhao *et al*., 2011). The better performance of the broiler chicks fed the combination of ginger and yeast could be attributed to improvement in palatability and the quick digestive effect of this natural products. Ginger has been found to increase secretion of gastrointestinal enzymes including lipase, disaccharidase and maltase (Zhang *et al.,* 2009) While Yeast contains beta-glucans which has growth promoting and immune-enhancing effects. Zhao *et al*. (2011) reported that ginger enhances animals' nutrient digestion and absorption because of its positive effect on gastric secretion, enterokinesia and digestive enzyme activities likewise yeast in broilers ration improved body weight gain, feed intake and feed conversion ratio. It could be agreed that combination of the two resulted in better growth performance indices as probiotics contains microorganisms when fed along with the basal feed ingredients can inhibit growth of pathogenic microbes by increasing acidity of the intestinal contents. Thus, in turn may improve weigh gain and Feed conversion ratio Altaf *et al.* (2007).

Table 3a: Main effect of levels of ginger and yeast inclusion on performance of broiler chickens.

	Ginger effect					Yeast effect			
Parameters (g)	T1	T2	T3	SEM	P-Value	T4	T5	SEM	P-Value
Initial weight	40.06	40.06	40.06	0.00	0.00	40.06	40.06	0.00	0.00
Final weight	1342.97	1366.41	1404.59	37.00	0.49	1300.00^{b}	1442.13^{a}	25.66	0.00
Weight gain	1302.91	1326.35	1364.60	37.00	0.41	1260.44	1402.13^{a}	25.67	0.00
Daily feed intake	74.53^{a}	72.38^{b}	69.63^{c}	0.60	_	71.98	72.38	0.78	0.59
Total feed intake	3130.26^{a}	3039.80^{b}	2924.46^{c}	25.29	≤0.00	3023.20	3039.82	32.59	0.59
FCR %	2.40^{a}	2.29^{ab}	2.17^{b}	0.06	0.02	2.40^{a}	2.18^{b}	0.05	0.00

T1 0% ginger, T2 4%ginger, T3 5% ginger, T4 0% yeast, T5 1% yeast.

Table 3b: Interaction effect of levels of ginger and yeast inclusion on Performance of broiler chickens

Parameter (g)	T1	T2	T3	T4	T5	T6	SEM	P.value
Initial weight	40.06	40.06	40.06	40.06	40.06	40.06	0.00	0.00
Final weight	1342.19^{bc}	1317.19^{cd}	1242.19^{d}	1343.75^{bc}	1415.63^{b}	1567.00^{a}	23.36	≤0.00
Weight gain	1302.13^{bc}	1277.13^{cd}	1202.07^{d}	1203.69^{bc}	1375.57^{b}	1527.13^{a}	23.37	≤0.00
Daily feed intake	74.80^{a}	71.60^{bc}	69.54^{c}	74.26^{ab}	73.15^{ab}	69.54^{c}	0.54	0.00
Total feed intake	3141.60^{a}	3007.52^{bc}	2920.47^{c}	3118.92^{ab}	3072.09^{ab}	2928.45^{c}	22.60	0.00
FCR (%)	2.42^{a}	2.35^{ab}	2.43^{a}	2.39^{ab}	2.23^{b}	1.91^{c}	0.04	≤0.00

T1 0% ginger without yeast, T2 4%ginger without yeast, T3 5% ginger without yeast, T4 0% ginger with yeast, T5 4% ginger with yeast, T6 5% ginger with yeast.

Carcass yield

Table 4 showed the interaction effect of combination of yeast and ginger supplementation on carcass yield broiler chicken. A significant effect of supplemented additives was observed on the eviscerated weight and dressing percentage; However, overall significant of the additives did not reflect on all cut parts but wing weight while other retail cuts had numerical increase. The broiler chicken on (1%Yeast + 5% Ginger had 1362.50g eviscerated weight with 72.79% dressing percentage. While least value was recorded for diet supplemented only yeast with eviscerated weight of 1087.50g and 62.39% dressing percentage. Similarly, Zhang *et al*. (2009) observed significant increase in carcass yield, dressing percentage in broiler chickens offered an aqueous extract of a plant mixture and the observed result could be attributed to antioxidant effect of ginger which enhances protein and fat metabolism interpreting to higher weight. The higher carcass weight and carcass yield observed in this study could be attributed to the cumulative effect of the phytogenic properties in ginger and yeast microbial actions which enhanced digestive enzyme activity, beneficial microbial population thus neutralizing the effect of feed toxins for better carcass yield. These findings are in agreement with the reports of some authors (Shim *et al*., 2010; Chen *et al.,* 2013; Nawaz *et al.,* 2016) on higher body weight and better carcass yield in chickens fed diets containing *Lactobacillus* and *Saccharomyces* species. Similarly, Dieumou *et al*. (2012); Zomrawi (2013) also observed that carcass characteristics and dressing percentage improved in birds fed diet containing garlic and ginger.

Table 4a: Main effect of levels of ginger and yeast inclusion on Carcass yield of broiler chickens

	Ginger level					Yeast level			
Parameter (g)	T1	T2	T3	SEM	P.value	T4	T5	SEM	P.value
Live weight	1342.97	1366.41	1404.59	37.00	0.49	1300.00b	1442.13a	25.66	0.00
Eviscerated weight	1131.25	1200.00	1212.50	49.75	0.39	1170.83	1191.67	42.47	0.73
Dressing %	65.78	69.23	65.78	1.86	0.24	69.60	67.28	1.60	0.31
Thigh weight	14.60	10.80	10.30	44.97	0.39	10.72	9.74	44.88	0.33
Wing weight	9.225^{a}	8.66^{ab}	8.16^{b}	0.29	0.04	9.03	8.35	0.26	0.05
Drum stick	9.93^{b}	10.89^{a}	10.08^{ab}	0.29	0.07	10.45	10.15	0.26	0.39
Back weight	15.64	16.26	15.44	1.03	0.65	15.76	15.80	0.51	0.95
Breast weight	20.07	20.77	17.99	0.63	0.17	19.97	19.24	0.88	0.55

T1 0% ginger, T2 4%ginger, T3 5% ginger, T4 0% yeast, T5 1% yeast,

Table 4b: Interaction effect of levels of ginger and yeast inclusion on Carcass yield of broiler chickens

Parameters (g)	T1	T2	T3	T4	T5	T6	SEM	P. value
Eviscerated weight	1175.00^{bc}	1275.00^{ab}	1062.50^{c}	1087.50^{c}	1125.00^{bc}	1362.50^{a}	29.46	0.01
Dressing %	69.17^{ab}	71.78^{a}	67.86^{ab}	62.39^{b}	66.66^{ab}	72.79^{a}	1.13	0.08
Thigh weight	10.60	10.90	10.70	10.70	10.60	10.00	44.73	0.44
Wing weight	9.59^{a}	9.03^{ab}	8.46^{ab}	8.91^{ab}	8.29^{ab}	7.85^{b}	0.19	0.10
Drum stick	10.35	10.89	10.11	9.51	10.89	10.05	0.19	0.23
Back weight	16.58	16.82	14.31	15.14	15.69	16.58	0.36	0.33
Breast weight	20.84	20.01	19.08	19,30	21.54	16.90	0.62	0.35

T1 0% ginger without yeast, T2 4%ginger without yeast, T3 5% ginger without yeast, T4 0% ginger with yeast, T5 4% ginger with yeast, T6 5% ginger with yeast.

Gut micro flora

Table 5 showed the interaction effect of ginger and yeast supplementation on gut micro flora of broiler chickens. It was observed that Total bacteria count increased from 1.20 x10^{6}cfu/ml (control) to 1.70 x10^{6}cfu/ml in diets supplemented 1% yeast and 5% ginger). Total anaerobic count decreased from1.10 x10^{6}cfu/ml in control diet to 0.68 x10^{6}cfu/ml in birds fed1% yeast and 5% ginger). Lactobacillus count increased with supplementation level while coliform, clostridium and bacillus counts decreased with the additives (yeast and ginger) inclusion. It can be deduced that the constituents in the additives contributed to the colonization of *lactobacilli*. It has a number of mechanisms including competitive exclusion, to reduce the number of pathogens in the GIT, leading to improvement in bird performance (Jin *et al.,* 1998; Schneits and Hakkinen, 1998). Numerous reports indicated that addition of probiotics in feed, either solely or in combination with other feed additives like prebiotics, could regulate the intestinal microflora in order to increase the concentration of the beneficial bacteria such as *Lactobacillus ssp.* and *Streptococcus spp to* inhibit the reproduction of harmful bacteria in the gut (Li *et al.* 2014). Reduced population in the coliform counts agreed with Guo *et al.,* 2004a, 2004b, and 2004c) demonstrated that plants and their extracts could improve the growth performance, reduce the populations of coliforms species and enhance both cellular and humoral immune responses of chickens. Likewise, Cao *et al*., (2005) reported the antibiotic-like effects of the green tea polyphenols causing a decrease on all colonic floras in broilers. Based on observed results, reduced coliforms population could contribute to a balanced gut health. Some studies have confirmed the effects of yeast culture in increasing concentrations of commensal microbes or suppressing pathogenic bacteria (Stanley *et al*., 2004), promote growth of intestinal microflora (Spring *et al.,* 2000) and increase growth (Parks *et al*., 2001).

Table 5a: Main effect of levels of ginger and yeast inclusion on Gut microflora of broiler chickens

	Ginger level					Yeast level			
Parameter $X10^6$cfu/ml	T1	T2	T3	SEM	P.value	T4	T5	SEM	P.value
Total bacteria count	1.39^b	1.55^{ab}	1.65^a	0.07	0.00	1.43^b	1.63^a	0.05	0.01
Salmonella count	0.21	0.20	0.15	0.03	0.40	0.18	0.20	0.03	0.53
Lactobacillus	0.64	0.51	0.43	0.05	0.00	0.43^b	0.63^a	0.04	≤0.00
Coliform	0.68^a	0.55^{ab}	0.45^b	0.05	0.00	0.48^b	0.64^a	0.04	0.00
Total Anaerobic	1.04^a	0.71^b	0.73^b	0.06	0.00	0.87	0.78	0.07	0.27
Bacillus	0.73^a	0.58^b	0.50^b	0.05	0.00	0.53^b	0.68^a	0.05	0.01
Clostridium	0.73^a	0.50^b	0.54^b	0.05	0.00	0.63	0.55	0.05	0.17
Staphyloccocus	0.48	0.40	0.50	0.05	0.22	0.55	0.45	0.03	0.05

T1 0% ginger, T2 4%ginger, T3 5% gin ger, T4 0% yeast, T5 1% yeast.

Table 5b: Interaction effect of levels of ginger and yeast inclusion on gut microflora of broiler chickens

Parameters $X10^6$cfu/ml	T1	T2	T3	T4	T5	T6	SEM	P.value
Total bacteria count	1.20^b	1.48^a	1.60^c	1.58^c	1.63^a	1.70^a	0.04	0.00
Salmonella count	0.18	0.20	0.15	0.25	0.20	0.15	0.02	0.71
Lactobacillus	0.58^a	0.40^b	0.30^c	0.70^a	0.63^a	0.55^{ab}	0.03	0.00
Coliform	0.63^{ab}	0.45^b	0.35^c	0.73^a	0.65^{ab}	0.55^{abc}	0.02	0.01
Total Anaerobic	1.10^a	0.75^b	0.75^b	0.98^{ab}	0.70^b	0.68^b	0.05	0.02
Bacillus	0.63^{ab}	0.50^b	0.45^b	0.83^a	0.65^{ab}	0.55^b	0.02	0.01
Clostridium	0.80^a	0.55^b	0.53^b	0.65^{ab}	0.45^b	0.55^b	0.03	0.02
Staphyloccocus	0.40	0.35	0.45	0.55	0.45	0.55	0.03	0.00

T1 0% ginger without yeast, T2 4%ginger without yeast, T3 5% ginger without yeast, T4 0% ginger with yeast, T5 4% ginger with yeast, T6 5% ginger with yeast.

Conclusion

The combination of ginger and yeast as natural growth promoter can serve as alternatives to synthetic antibiotics in broiler chickens production is effective at inclusion levels for ginger at (5%) and yeast at (1%) had a beneficial effect on growth performance, carcass yield and better intestinal health without detrimental effect.

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