



Growth Performance and Intestinal Bacterial Count of Broiler Chickens Fed Diets Containing Graded Levels of Clove (*Syzygium aromaticum*) as Natural Growth Promoter

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Abstract

*The study evaluated clove (*Syzygium aromaticum*) as an alternative to synthetic antibiotic growth promoters. A total of 300, day-old Ross 308 broiler chicks were allotted to five dietary treatments replicated thrice with 20 chicks in a completely randomized design. Clove powder was included in the diet at 0, 100, 200 and 300 g while oxytetracycline was used as positive control. All data collected were subjected to analysis of variance and significant differences amongst treatment means were compared using Tukey procedure. Growth performance results showed that final weight (FW) and body weight gain (BWG) of birds fed 100 g (1008.33 and 968.07 g/bird) and 300 g (1008.19 and 967.86g/bird) of clove powder per 100 kg diet were significantly ($P<0.05$) higher than those fed diet with oxytetracycline (957.22 and 917.22 g/bird) with an improved feed conversion ratio (FCR) of 1.86 compared to those fed diet containing oxytetracycline (1.94). At the finisher phase, birds fed 200 and 300 g of clove inclusion had higher ($P<0.05$) FW, BWG, total feed intake (TFI) and FCR compared to the control groups. *Bacillus* and *Lactobacillus* spp populations in the ileum and caecum significantly ($P<0.05$) increased in birds fed 300 g compared to those fed the control diet while the population of pathogenic bacterial species (*E.coli*, *Salmonella* spp. and *Clostridium* spp.) significantly reduced with clove inclusion in diet. Inclusion of clove in the diets of broiler chickens at 100 g/100kg diet at the starter phase, improved BWG and FCR by 5.50 and 4.12%, respectively while at the finisher phase, clove inclusion in diets of broiler chickens at 200 and 300 g/100kg diet improved BWG by 15.65 and 21.22%; this resulted in improved FCR by 11.08 and 13.29%, respectively. Clove inclusion at 100 and 300 g/100kg diet during the starter and finisher phases, respectively are recommended for improved performance.*

Keywords: Antibiotic Growth Promoter, Antimicrobial, Clove, Feed Additives, Phytobiotic

Introduction

The use of feed additives as growth promoters in poultry nutrition is one of the ways to accomplish the goal of increasing animal protein intake through increased animal production (Mammo, 2012). Additives are substances that are added to a nutritionally balanced diet which provoke response towards the exploitation of maximum genetic potential of the host in terms of growth and feed conversion efficiency. Amongst growth promoters, the most commonly used are antibiotic growth promoters (AGPs) which have been reported to effect increased feed efficiency and body weight gain (Moses *et al.*, 2017). However, the ban on the use of AGPs

due to their deleterious side effects on both animals and humans has increased over the years in many countries arising from indiscriminate use. Hence, natural growth promoters (NGPs) have been identified as effective alternative to antibiotic growth promoters (AGPs) in poultry diets for improved growth performance and safer meat production for human population (Demir *et al.*, 2003; Moses *et al.*, 2017). The use of phytobiotics as NGPs in animal diets is still an interesting approach.

The herbs and some compounds in them could act like antibiotics thereby reducing the growth of some harmful bacteria in the

gastrointestinal tract of animals while increasing the beneficial ones (Salihu *et al.*, 2020; Reuben *et al.*, 2021). This results in higher weight gain and better feed efficiency (Salihu *et al.*, 2020). Phytogetic substances are expected to increase performance of birds by stimulating secretion of digestive enzymes, leading to enhanced digestion and absorption (Geier and Oster, 2001; Recoquillay, 2006). Among the various herbs that can be used as Phytoiotics is clove buds (*Syzygium aromaticum*).

Clove buds contain approximately 15 to 20% volatile essential oils dominated by eugenol (70-85%) (Pino *et al.*, 2001; Lutterodt *et al.*, 2010; Ramadan *et al.*, 2013; El-Maati *et al.*, 2016) and has been reported to improve growth performance in poultry by enhancing the intestinal population of microbiota (Mohammadi *et al.*, 2014). In addition, clove has valuable nutrients such as vitamins, minerals, essential amino acids and essential fatty acids (Cortes-Rojas *et al.*, 2014). Natural foods are generally believed to be safer, healthier and less hazardous than foods containing artificial additives. Hence, the study evaluated the growth performance and intestinal bacterial counts of broiler chickens fed diets containing graded levels of *Syzygium aromaticum* as natural growth promoters.

Materials and Methods

Experimental site

The study was conducted at the Poultry unit of the Research and Experimental Farm, Department of Animal Science, Ahmadu Bello University, Zaria. Zaria is located between latitude 11° 14'44"N and longitude 7°38'65"E, at an altitude of 610m above sea level (Ovimaps, 2023). The area falls within the Northern Guinea Savanna zone having an average annual rainfall of 700-1400mm occurring between the months of April-October, the maximum temperature varies from 26°C to 35°C depending on the season while the mean relative humidity during

harmattan period and the wet season are 21% and 72%, respectively (IARMS, 2023).

Source and processing of experimental materials

The feed ingredients used were obtained from Samaru, Zaria. Cloves was purchased from Samaru market in Sabon-Gari Local Government Area of Kaduna State, crushed by grinding using hammer mill and included as part of the experimental diets.

Experimental materials and management

A total of three hundred (300) day-old Ross 308 broiler chicks were obtained from Agrited Ibadan and raised in a deep litter system under the same environment. The birds were placed on five (5) experimental diets containing graded levels of cloves with 3 replicates of 20 chicks in a completely randomized design (CRD). Throughout the experimental period, feed and clean water were provided *ad-libitum*. All necessary vaccinations and medication were administered as at when due.

Experimental diets

Five (5) standard experimental diets were formulated containing graded levels of cloves as phytogetic source at the starter and finisher phases to meet the requirement of broiler chickens as recommended by NRC (1994) and shown in Tables 1 and 2.

Diet 1: Control diet

Diet 2: Diet containing cloves at 100 g/100kg diet

Diet 3: Diet containing cloves at 200 g/100kg diet

Diet 4: Diet containing cloves at 300 g/100kg diet

Diet 5: Diet containing Oxytetracycline (at 110 g/100kg sub-therapeutic level)

Data Collection

Growth study

The growth performance characteristics measured include: body weight and total feed intake (TFI). Body weight gain (BWG), average daily body weight gained (ADBWG), average daily feed intake (ADFI) were derived while feed conversion ratio (FCR) were calculated as the ratio of feed intake to body weight gain. Mortality rate (MR) were calculated and expressed in percentage.

Intestinal microbial study

At the end of the experimental period, bacterial cell species and numbers in the ileum and caecum were assessed using three chickens per replicate that is nine chickens per treatment. This was carried out at the Department of Veterinary Microbiology, Ahmadu Bello University, Zaria. Total aerobic plate and the total coliform counts of samples were taken. The total bacteria load, and isolation of pathogenic bacteria (*Salmonella*, *Staphylococcus* and *Escherichia coli*) and beneficial lactogenic bacteria (*Lactobacillus* and *bacillus spp*) from the samples was done using different selective media for isolation of bacteria groups and characterization based on sugars fermentation using Microbact 12E kit and conventional biochemical methods. Eosin Methylene Blue Agar, Mannitol Salt Agar and Salmonella Shigella Agar media was used (OMP, 2015).

Data analysis

All data collected were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS (SAS, 2003). Significant means were compared with the control using Tukey procedure.

Results and Discussion

Growth Performance of Broiler Chickens Fed Graded levels of Cloves (0-4weeks)

Table 3 shows growth performance of birds fed graded levels of cloves at the starter phase. Birds fed 100 g and 300 g of cloves in diet were significantly ($P<0.05$) higher than birds'

fed Oxytetracycline (Oxytet) in final weight, body weight gain and average daily body weight gain (ADBWG) having 100 g (1008.33, 968.07 and 34.57 g/bird), 300 g (1008.19, 967.86 and 34.57 g/bird) compared with birds fed Oxytetracycline (957.22, 912.22 and 32.76 g/bird). FCR was better ($P<0.05$) in birds fed 100 and 300 g of clove in diet having 1.86 each. TFI and ADFI were significantly higher in birds fed the control diet (1272.66 and 45.28 g/bird) compared to birds fed 300 g of cloves (1179.67 and 42.13 g/bird), they were however statistically similar with those fed 100 g of spring onions (1236.83 and 44.17 g/bird).

The results of this study indicated that inclusion of cloves in the diets of broiler chickens have positive effect on growth performance parameters measured. Final weight of birds fed diets treated with cloves were significantly higher than those fed diets with oxytetracycline. FCR was also better in birds fed diets with clove inclusion, this improvement in growth parameters is expected as reported in several studies (Mukhtar, 2011, Azedegen *et al.*, 2014 and Mohammadi *et al.*, 2014).

The findings of this study are in line with those of Mukhtar (2011) who indicated that chickens fed diet with several clove oil concentrations 200, 400 and 600 mg/kg diet) improved body weight gain, feed intake and FCR. This improvement in growth parameters in birds fed 100 g and 300 g clove inclusion could be attributed to cloves ability to improve bird's overall efficiency. Cloves as phytobiotics is reported to have some antimicrobial and antibacterial activity by reducing population of pathogenic microbes and improving the population and activities of beneficial ones hence improving digestibility, growth and health status of chickens (Chami *et al.*, 2004). This is possible due to the presence bioactive compounds (eugenol and carvacrol) and essential oils which helps in

improving nutrient digestibility and utilization. By improving nutrient utilization; his beneficial effect of cloves in turns improved BWG and FCR in broiler chickens.

Growth performance of broiler chickens fed graded levels of cloves (5-8weeks)

Table 4 shows growth performance of birds fed graded levels of cloves at the finisher phase. Birds fed oxytetracycline treated diet were significantly ($P<0.05$) higher in final weight, BWG, ADBWG, TFI and ADFI compared with those fed the control diet. FCR was significantly ($P<0.05$) better in the birds fed oxytetracycline in diet compared to those fed the control diet. Birds fed diets with oxytetracycline had 2614.81, 1617.40, 59.90, 4243.52 and 157.17 for final weight, body weight gain, average daily body weight gain, total feed intake and average daily feed intake, respectively, compared with those fed the control diet which had 2285.88g/bird, 1294.59 g/bird, 47.95 g/bird, 4052.78 g/bird and 150.11 g/bird. Similarly, Birds fed diets with oxytetracycline also had better FCR (2.64) compared with those fed the control diet which had 3.16. Birds fed 200g and 300g of cloves in diet were statistically similar with those fed oxytetracycline treated diets in all the growth parameters measured. Mortality was significantly higher in the control group indicating low survivability.

The results revealed that inclusion of both oxytetracycline and cloves in diet improved growth performance parameters measured. It also improved the survivability of birds at the finisher phase. This is an important function of feed additives, which is to protect and enhance the immunity of the birds to fight against pathogenic microbes as well as enhance the activity of the lactogenic microbes for better performance. The higher weights and better FCR observed in birds fed cloves and oxytetracycline compared to birds fed the control diet could be due to increased proliferation of higher absorptive surfaces

which resulted in improved feed utilization and growth performance. The antimicrobial, antiviral and antifungal properties of clove as a PFA might have triggered exclusion elimination mechanism which has been reported in many literature (Ouwehand *et al.*, 2010; Pandey *et al.*, 2015; Salihu *et al.*, 2020).

The findings of this study is in line with those of Mohammadi *et al.* (2014) who reported that broiler chicken diets fortified with 100 and 300mg/kg clove oil enhanced the performance and feed conversion ratio via increased gastrointestinal villus height and crypt depth. Similarly, the improvement in growth parameters measured in this study by cloves and oxytetracycline inclusion in diet of broiler chickens agrees with the findings of Mukhtar (2011) who reported that chickens fed diet with several clove oil concentrations (200, 400 and 600 mg/kg diet) improved body weight gain, feed intake, feed conversion ratio and carcass yield as well as reduced mortality rate. Azedegen *et al.* (2014) in a similar study reported that besides the significant improvement in body weight gain, total feed intake and feed conversion ratio measured; decrease in total cholesterol level was observed in the chicken group fed 450 mg/kg clove oil compared to other treated groups. The improvement in FCR and survivability of birds across the treatment indicates efficiency of feed additives in reducing incidence of mortality in poultry, hence, improving performance of broiler chickens, this agrees with the reports of Mukhtar (2011). Similarly, a 5% improvement in FCR against the control group was recorded also by Ulfah (2006) by feeding broilers with a combination of the essential oils of oregano, thyme, cinnamon and eucalyptus.

Effect of graded levels of cloves on ileal microbial population of broiler chickens

Table 5 shows the Ileal bacterial count of broiler chickens fed graded levels of cloves during the finisher phase. Birds fed 300 g of

cloves inclusion in diet were significantly ($P < 0.05$) higher than birds fed the control diet in *Bacillus* and *Lactobacillus spp* counts. A numerical increase in population was observed across the treatments, an increase in beneficial bacterial population (*Bacillus* and *Lactobacillus spp*) was generally observed with increase in clove inclusion in diet. Birds fed 300 g of clove inclusion had 5.27 and 12.77×10^3 CFU/g which amounted to 39.39% and 8.31% increment compared to birds fed the control diet which had 3.77 and 11.79×10^3 CFU/g. However, a significant reduction was observed for pathogenic bacterial species (*E. coli*, *Salmonella spp* and *Clostridium spp*) with increase in clove inclusion in diets. The population of harmful bacterial species (*E. coli*, *Salmonella spp*, and *Clostridium spp*) in the ileum reduced as the quantity of cloves included in diet of broiler chickens increased. Population of *E. coli* reduced from 0.13, 0.06 to 0.00×10^3 CFU/g for birds fed the control diet, 100 g and 200 g of clove in diet, this indicates reduction in bacterial population with increase in clove inclusion in diet. Similar, trend was observed for *Salmonella spp*, *clostridium spp* and *pseudomonas spp*.

The results revealed that clove inclusion in the diet of broiler chickens significantly reduced the population of ileal pathogenic/harmful bacterial species (*E. Coli*, *Salmonella spp*, *Pseudomonas spp* and *Clostridium spp*) at 8 weeks of age consequently increasing the population of ileal lactogenic/beneficial bacterial species (*Bacillus* and *Lactobacillus spp*). The significant reduction in pathogenic bacterial species with clove inclusion observed in this study is in line with the reports of Sofia *et al.* (2007). Sofia *et al.* (2007) tested the antimicrobial activity of different Indian spice plants such as mint, cinnamon, mustard, ginger, garlic and clove. The only sample that showed complete bactericidal effect against all the food-borne pathogens tested *Escherichia coli* (*E. coli*, *Staphylococcus aureus* and *Bacillus cereus*) was the aqueous extract of

clove at 3%. At the concentration of 1% clove extract also showed good inhibitory action. Similarly, Fu *et al.* (2007) pure clove oil or mixes with rosemary (*Rosmarinus officinalis spp.*) oil were tested against *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Bacillus subtilis*, *E. coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa* and results showed minimum inhibitory concentrations between 0.062% and 0.500% (v/v) which is promising as anti-infectious agents or as food preservative. The increase in ileal lactogenic/beneficial bacterial species reported in this study is supported by the reports of Salihu *et al.* (2020) who observed increase in the population of *Bacillus* and *Lactobacillus spp* with inclusion of *Ocimum gratissimum* and *Ocimum canum* in the diet of broiler chickens.

Effect of graded levels of cloves on caecal bacterial population of broiler chickens

Table 6 shows the effect of graded levels of cloves on caecal bacterial population. The bacterial population of *Bacillus spp*, *Lactobacillus spp*, *E. coli*, *Salmonella spp* and *Clostridium spp* observed in this study were all significantly affected by inclusion levels of cloves in diet of broiler chickens. The lactogenic/beneficial bacterial specie (*Bacillus spp*) and were observed to significantly increase across the treatments while, *Lactobacillus spp* increased numerically compared to those fed the control diet. Birds fed 100, 200 and 300 g of cloves were significantly ($P < 0.05$) higher in *Bacillus spp* by 21.46%, 25.51% and 41.16% than birds fed the control diet. Birds fed 300 g of cloves were significantly ($P < 0.05$) higher in *Lactobacillus spp* compared to those fed the control diets. Birds fed oxytetracycline were also significantly higher in both *Bacillus spp* and *Lactobacillus spp* compared to those fed the control diet. The pathogenic/harmful bacterial species (*E. coli*, *Salmonella spp*, and *Clostridium spp*) population significantly ($P < 0.05$) reduced with 200 and 300 g of clove

inclusion compared to the control group. The caecal *E. coli* and *Salmonella spp* pathogenic bacterial population significantly ($P < 0.05$) reduced with 100, 200 and 300 g of clove inclusion in broiler chicken diets compared to those fed the control.

The trend of reduction in pathogenic harmful bacterial species and the consequent increment in beneficial bacterial species both in the ileum and the cecum of the small intestine observed and reported in this study validates the improved performance in growth parameters measured and it is also in line with the reports of Chami *et al.* (2004) who reported that cloves as a phytobiotic is reported to have some antimicrobial and antibacterial activity by reducing population of pathogenic microbes also improving the population and activities of beneficial ones hence improving digestibility, growth and health status of birds. Similarly, Abdel-Moneim *et al.* (2007) reported that clove oil has potent antimicrobial activity against *Escherichia coli*, *Salmonella typhimurium*, *Staphylococcus aureus*, *Bacillus subtilis*, *Candida albicans*, *Aspergillus niger* and *Rhizopus nigricans*.

Conclusion

From the results obtained, the following conclusions were made:

1. Clove (*Syzygium aromaticum*) inclusion in diets of broiler chickens at 100 g/100kg during the starter phase, improved BWG and FCR by 5.5 and 4.12%, respectively. At the finisher phase, clove inclusion in diets of broiler chickens at 200 and 300 g/100kg diet improved BWG by 15.65 and 21.22%, and FCR by 11.08 and 13.29%, respectively.
2. Clove (*Syzygium aromaticum*) inclusion in diets of broiler chickens at 300 g/100kg at 8 weeks of age reduced population harmful pathogenic bacterial species (*E. coli*, *Salmonella spp.* and *Clostridium spp.*) in the ileum. While inclusion of clove at 300g/100kg diet increased the population of beneficial bacterial species (*Bacillus* and *Lactobacillus spp*) in the ileum. Similar trend was observed in the cecum..

Recommendations

1. Poultry farmers and feed manufacturers can use clove (*Syzygium aromaticum*) at 100 g/100kg diet as an alternative to synthetic antibiotic growth promoters during the starter phase while, in the finisher phase at 300 g/100kg diet for improved growth performance, safer and healthier poultry product for consumption.
2. Further researches should be conducted using clove (*Syzygium aromaticum*) on other poultry species for validation and confirmation of the beneficial effects of this phyto-genic source.

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Table 1: Composition of broiler starter diets containing graded levels of cloves

Ingredients (kg)	Graded Level of clove inclusion				
	Control	100g	200g	300g	Oxytet
Maize	57.00	57.00	57.00	57.00	57.00
SBC	30.00	30.00	30.00	30.00	30.00
GNC	9.00	9.00	9.00	9.00	9.00
Bonemeal	3.00	3.00	3.00	3.00	3.00
Limestone	0.25	0.25	0.25	0.25	0.25
Common Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.05	0.05	0.05	0.05	0.05
Methionine	0.20	0.20	0.20	0.20	0.20
Vit-Min Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
ME (Kcal/Kg)	2901	2901	2901	2901	2901
Crude Protein (%)	23.00	23.00	23.00	23.00	23.00
Crude Fibre (%)	4.28	4.28	4.28	4.28	4.28
Ether Extract (%)	4.70	4.70	4.70	4.70	4.70
Calcium (%)	1.23	1.23	1.23	1.23	1.23
Phosphorus (%)	0.80	0.80	0.80	0.80	0.80
Methionine (%)	0.52	0.52	0.52	0.52	0.52
Lysine (%)	1.20	1.20	1.20	1.20	1.20
Feed Cost (₦/kg)	267.88	272.88	271.08	275.08	279.08

^A Biomix Vitamin- mineral premix provide per kg of diet: vit. A, 13,340 i.u; vit. D₃, 2680 i.u;vit. E, 10 i.u; vit. K, 2.68 mg; calcium pantothenate, 10.68mg; vit. B₁₂, 0.022mg; folic acid, 0.668mg; choline chloride, 400mg; 26.68mg; manganese, 13mg; iron, 66.68mg; zinc, 53.34mg; copper, 3.2mg; iodine, 1.86mg; cobalt, 0.268mg; selenium, 0.108mg, oxytet: oxytetracycline

Table 2: Composition of broiler finisher diets containing graded levels of cloves

Ingredients (kg)	Level of clove inclusion				
	Control	100g	200g	300g	Oxytet
Maize	58.00	58.00	58.00	58.00	58.00
Maize offal	6.80	6.80	6.80	6.80	6.80
SBC	24.00	24.00	24.00	24.00	24.00
GNC	7.00	7.00	7.00	7.00	7.00
Bonemeal	3.00	3.00	3.00	3.00	3.00
Limestone	0.40	0.40	0.40	0.40	0.40
Common Salt	0.30	0.30	0.30	0.30	0.30
Lysine	0.05	0.05	0.05	0.05	0.05
Methionine	0.20	0.20	0.20	0.20	0.20
Vit-Min Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
ME (Kcals/Kg)	2965	2965	2965	2965	2965
Crude Protein (%)	20.02	20.02	20.02	20.02	20.02
Crude Fibre (%)	4.40	4.40	4.40	4.40	4.40
Ether Extract (%)	4.50	4.50	4.50	4.50	4.50
Calcium (%)	1.08	1.08	1.08	1.08	1.08
Phosphorus (%)	0.51	0.51	0.51	0.51	0.51
Methionine (%)	0.51	0.51	0.51	0.51	0.51
Lysine (%)	1.11	1.11	1.11	1.11	1.11
Feed Cost (₦/kg)	261.15	266.15	265.04	269.04	273.04

^A Biomix Vitamin- mineral premix provide per kg of diet: vit. A, 13,340 i.u; vit. D₃, 2680 i.u;vit. E, 10 i.u; vit. K, 2.68 mg; calcium pantothenate, 10.68mg; vit. B₁₂, 0.022mg; folic acid, 0.668mg; choline chloride, 400mg; 26.68mg; manganese, 13mg; iron, 66.68mg; zinc, 53.34mg; copper, 3.2mg; iodine, 1.86mg; cobalt, 0.268mg; selenium, 0.108mg and oxytet: oxytetracycline

Table 3: Growth performance of broiler chickens fed graded levels of cloves (0-4weeks)

Parameters	Control	100	200	300	Oxytet	SEM
Initial Weight (g/bird)	40.33	40.27	40.00	40.33	40.00	0.24
Final Weight (g/bird)	968.83 ^{ab}	1008.33 ^a	986.52 ^{ab}	1008.19 ^a	957.22 ^b	23.85
Body weight gain (g/b)	928.50 ^{ab}	968.07 ^a	946.52 ^{ab}	967.86 ^a	917.22 ^b	23.50
ADBWG (g/bird)	33.16 ^{ab}	34.57 ^a	33.80 ^{ab}	34.57 ^a	32.76 ^b	0.85
Total feed intake (g/bird)	1740.65 ^b	1797.22 ^a	1787.01 ^{ab}	1800.34 ^a	1780.96 ^{ab}	33.56
ADFI (g/bird)	61.93 ^b	64.18 ^a	63.82 ^{ab}	64.30 ^a	63.61 ^{ab}	1.19
Feed conversion ratio	1.88 ^{ab}	1.86 ^a	1.89 ^{ab}	1.86 ^a	1.94 ^b	0.04
Mortality (%)	0.00	0.33	0.67	0.33	0.67	0.47

^{abc} Means with the same superscripts along the rows are not significantly different ($p>0.05$), SEM: standard error mean, ADFI: average daily feed intake, ADBWG: average daily weight gain and oxytet: oxytetracycline.

Table 4: Growth performance of broiler chickens fed graded levels of cloves (5-8weeks)

Parameters	Control	100	200	300	Oxytet	SEM
Initial Weight (g/bird)	991.30	995.37	1010.19	997.41	997.41	78.58
Final Weight (g/bird)	2285.88 ^c	2417.04 ^{bc}	2507.41 ^{ab}	2566.66 ^{ab}	2614.81 ^a	79.21
Body weight gain (g/bird)	1294.59 ^c	1421.67 ^{bc}	1497.22 ^{ab}	1569.26 ^{ab}	1617.40 ^a	70.01
ADBWG (g/bird)	47.95 ^b	52.65 ^b	55.45 ^{ab}	58.12 ^{ab}	59.90 ^a	2.92
Total Feed Intake (g/bird)	4052.78 ^c	4061.48 ^{bc}	4199.25 ^{ab}	4294.26 ^a	4243.52 ^a	69.69
ADFI (g/b)	150.11 ^b	150.43 ^b	155.53 ^a	159.04 ^a	157.17 ^a	2.50
Feed conversion ratio	3.16 ^b	2.87 ^a	2.81 ^a	2.74 ^a	2.64 ^a	0.13
Mortality (%)	1.67 ^b	0.00 ^a	0.00 ^a	0.00 ^a	0.00 ^a	0.74

^{abc} Means with the same superscripts along the rows are not significantly different ($p>0.05$), SEM: standard error mean, ADFI: average daily feed intake, ADBWG: average daily weight gain and oxytet: oxytetracycline.

Table 5: Ileal bacterial count of broiler chickens fed graded levels of cloves (8wks)

Parameters (x10 ³ CFU/g)	Control	100	200	300	Oxytet	SEM
<i>Bacillus spp</i>	3.77 ^b	4.23 ^{ab}	4.93 ^{ab}	5.27 ^a	4.83 ^{ab}	0.60
<i>Lactobacillus spp</i>	11.79 ^c	12.21 ^{bc}	12.15 ^{bc}	12.77 ^{ab}	13.22 ^a	0.44
<i>E. coli</i>	0.07 ^b	0.03 ^a	0.00 ^a	0.00 ^a	0.00 ^a	0.02
<i>Salmonella spp</i>	0.03 ^b	0.00 ^a	0.00 ^a	0.00 ^a	0.00 ^a	0.01
<i>Clostridium spp</i>	0.10 ^c	0.03 ^b	0.00 ^a	0.00 ^a	0.03 ^b	0.01
<i>Pseudomonas spp</i>	0.13 ^b	0.03 ^{ab}	0.00 ^a	0.00 ^a	0.00 ^a	0.06

^{abc} Means with the same superscripts along the rows are not significantly different ($p>0.05$), SEM: standard error mean, oxytet: oxytetracycline.

Table 6: Caecal bacterial count of broiler chickens fed graded levels of cloves (8weeks)

Parameters (x10 ³ CFU/g)	Control	100	200	300	Oxytet	SEM
<i>Bacillus spp</i>	3.96 ^c	4.81 ^b	4.97 ^b	5.59 ^a	5.51 ^a	0.23
<i>Lactobacillus spp</i>	12.00 ^b	12.21 ^b	12.68 ^{ab}	13.07 ^a	13.22 ^a	0.36
<i>E. coli</i>	0.13 ^c	0.06 ^b	0.00 ^a	0.00 ^a	0.00 ^a	0.01
<i>Salmonella spp</i>	0.03 ^b	0.00 ^a	0.00 ^a	0.00 ^a	0.00 ^a	0.01
<i>Clostridium spp</i>	0.03 ^b	0.03 ^b	0.00 ^a	0.00 ^a	0.00 ^a	0.01
<i>Pseudomonas spp</i>	0.03	0.03	0.03	0.00	0.00	0.02

^{abc} Means with the same superscripts along the rows are not significantly different ($p>0.05$), SEM: standard error mean, oxytet: oxytetracycline.