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Evaluation of Optimum Inclusion Levels of Biostrong® 510 as Replacement for Antibiotic Growth Promoters in Broiler Chickens Production under Field Conditions in Nigeria

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Target Audience: Poultry farmers, Poultry Researchers, Feed millers.

Abstract

A feeding trial was conducted to evaluate the response of broiler chickens fed diets supplemented with Biostrong® 510 as replacement for antibiotic growth promoters (AGPs). A total of 396 day old Ross broiler chicks were allotted randomly to six dietary treatments each replicated thrice, with 22 chicks per replicate. Biostrong® 510 was included at 0g, 15g, 17.5g and 20g/100 Kg diet for T1-T4 respectively while T5 and T6 had Oxytetracyclineand water-grade Neocyril plus respectively. Data was collected ongrowth performance indices, haematological parameters, liver function indices, ileum and ceacum microbial contents, tibia bone quality indices, and litter quality indices. All data collected were subjected to analysis of variance and significant differences among treatment means were compared using the Dunnett test of significance. The result for the starter phase showedbirds on the AGPs had significantly ($P<0.05$) higher final weight and weight gain than birds on Biostrong® 510 and control. Feed consumption was significantly ($P < 0.05$) higher for the controlthan for birds on antimicrobials. Haematological indices was not significantly ($P>0.05$) different, while liver function indices showed decreased concentration for Alanine-amino transferase (ALT) (24.33-12.67 µL) and Alkaline phosphatase (ALP) (140.67-81.33 µL respectively) for the Biostrong® 510 diets compared to control treatment values of 34.00µL and 294.00µL for ALT and ALP respectively. Feed consumption was significantly highest for finisher birds on control diet as birds fed growth promoters utilized significantly less feed, to gain similar weights with the control. Biostrong® 510 significantly improved feed conversion similar to the antibiotics. There was significantly ($P<0.05$) higher values for dry matter content of litter for birds fed Biostrong® 510 above the control and AGPs. Bone density was significantly ($P<0.05$) higher for Biostrong® 510 diets. Potential pathogenic bacteria species identified were mainly in treatments with no Biostrong® 510. It is concluded that Biostrong® 510 though did not significantly improve growth of broiler chickens, but however improved feed conversion, similar *to the antibiotics; significantly lowered cost of production even more than the AGPS; improved bone strength, and litter quality and consequently the health of birds.Biostrong® 510is therefore a potential replacement for antibiotic growth promoters*.

Key words: Biostrong® 510, Antibiotic growth promoter, Performance, broiler chickens.

Description of problems

The feeding of antibiotics to livestock creates an ever-increasing number of antibiotic-resistant bacteria, including many that cause disease in humans (1). The widespread use of antibiotics therefore worries public health authorities. The World Health Organization called antibiotic resistance "a problem so serious it threatens the achievements of modern medicine" (2). By January 2006, the EU placed a total ban on the use of feed antibiotics. This total ban on the use of antibiotics as growth promoters has been integrated into a new EU regulation concerning feed additives (3).A simple way to help overcome the health problems caused by antibiotic resistance is to stop adding antibiotics to animal feed. A study from the Maryland School of Public Health found that when poultry and beef are produced without these antibiotics, bacterial resistance quickly declines (1).Essential oil compounds are a group of feed additives showing a potential for the replacement of antibiotics growth promoters (AGPs). They are active ingredients present in various plants and spices (e.g. thymol, carvacrol, eugenol). Due to their antibacterial activity they might be able to modify the composition of intestinal microbiota and to exert beneficial effects on performance of poultry (4,5, 3).Biostrong® 510 is a phytogenic eubiotic formulation from Delacon Nutrional Company, containing essential oils and plant extracts (6).

The aim of this work therefore is to evaluate the efficacy of Biostrong® 510 as alternative to the conventional antibiotics used as growth promoters in poultry production. The specific objective was the Evaluation of the optimum level of Biostrong® 510 in broiler diets under field conditions which are largely different from the product test conditions, and the effect on growth performance, haematology, liver function, intestinal microbiota, bone and litter quality characteristics.

Materials and Methods.

Experimental site

The experiment was conducted at the Poultry Unit of Animal Science Departmental Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Zaria is located in the Northern Guinea Savannah Ecological zone on longitude 11° 09Ɛ 01.78ƐN and latitude 7°39Ɛ14.79ƐE, 671m above sea level. The climate is characterized by a well-defined dry and wet seasons and relatively dry with annual rainfall ranging from 700-1400mm (7).

Experimental Design and management of birds

Three hundred and ninety six (396) day-old Ross broiler chicks were allocated to six (6) dietary treatments, each replicated three times with 22 chicks per replicate each in a completely randomized design (CRD). The birds were housed in deep litter pens and managed with all necessary routine management practicesand routine vaccinations.

Experimental diets

Six maize-soya beans cake based diets were formulated at both the starter and finisher phases of the feeding trial to meet standard requirements of broiler chickens as recommend by (8) and modified for tropical conditions by (9). Diets had 2900 ME Kcals/Kg DM and 23% CP at starter phase and 3000 ME Kcals/Kg DM and 20 % CP at finisher phase. Biostrong® 510 was added as non-inclusive part of the diets as shown below.

Diet 1: 0 g of Biostrong® 510/100Kg diet (Control)

Diet 2: 15g ofBiostrong® 510/100 Kg diet

Diet 3: 17.5gofBiostrong® 510/100 Kg diet

Diet 4: 20gofBiostrong® 510/100 Kg diet

Diet 5: Oxytetracycline at manufacturer's recommendation.

Diet 6: Control diet but birds were routinely given water-grade Neocyril® plus at recommended levels

The manufacturer's recommendation for Biostrong® 510 is 150g/ton of feed.

Growth Study

Initial and final weights of birds were taken at the beginning and at the end of both starter and finisher phases. Feed intake was measured weekly while, weight gain feed/gain ratio and cost per Kg gain were computed for both phases. Mortality was recorded as they occur.

Haematological and Blood Serum Biochemical Investigation

At the end of the starter phase trial, 2ml of blood samples was collected from each of three birds per replicate via the wing veins into sterile tubes containing an anticoagulant (ethylene diamine tetra acetic acid, EDTA) for the determination haematological parameters like Packed Cell Volume (PVC) which was determined by the microhaematocrit method, haemoglobin concentration (HB) which was determined photometrically at the wavelength of 540nm, the erythtocyte (RBC) and leucocytes (WBC) were done using the improved Neubauer haemocytometer. Differential leucocyte counts were determined by the thin slide method (10).

Liver Function Test

At the end of the starter phase, 2 mls of blood samples were taken from 1 chicken per replicate that is three birds per treatment into sterilised sample bottles containing no anticoagulant and were allowed to cloth and then centrifuged and serum was separated and stored at -20°C at the Clinical Pathology laboratory of the Ahmadu Bello University Teaching Hospital for determination of parameters related to liver function; blood glucose, blood urea nitrogen, alanine aminotransferase (ALT), albumen(ALB), aspartate aminotransferase (AST) and alkaline phosphatise (ALP),according to the methods described by (10)

Bone Quality determination

The tibia bones of the birds used for the carcass analysis were removed carefully. They were weighed in grammes using a top loading digital scale to obtain fresh weight of bones. The length of the tibia bones was measured in cm using a graduated ruler. The fresh bones were oven dried at 100 ^{0}C until a constant weight was obtained. Dry weights of bones were taken.The dry bones were ashed at 550 ^{0}C in a muffle furnace for 6 hours to obtain the percent ash content of the bone. Bone density was calculated as bone weight/bone length.

Intestinal Microbiota Study

At the end of the starter phase, bacterial cell species and numbers in the ileum and caecum were determined using 1 chicken per replicate that is three chickens treatment. This was carried out at theDepartment of Veterinary Microbiology Ahmadu Bello University, Zaria. Total aerobic plate and the total coliform counts of samples were undertaken. The total bacteria load, and Isolation of *Salmonella, Staphylococcus* and *Escherichia coli* from the samples were done using different selective media for isolation of bacteria groups and characterization based on sugars fermentation using Microbact 12E kit and conventional biochemical methods. The media used were Eosin Methylene Blue Agar (11), Mannitol Salt Agar (12) and Salmonella Shigella Agar. (13).

Litter Quality Analysis

At four weeks, the litter from each pen was mixed and representative samples were taken for laboratory analysis. The dry matter, nitrogen and pH were determined. The process was repeated at week 8. The average values for the two were taken.

Data Analysis

All data obtained from the two feeding trials were each statistically analysed using the General Linear Model Procedure of Statistical Analysis Systems and Significant difference between treatments means were separated using Dunnets Test (14).

Results and Discussions

Table 1 shows the performance characteristics of broiler chicks fed different levels of Biostrong® 510 as a natural growth promoter. There were significant ($P<0.05$) differences in final weight, total weight gain and feed consumption. Birds on the AGPs had significantly ($P<0.05$) high final weight and total weight gain than birds on the different levels of Biostrong® 510 and the control. Feed consumption was significantly ($P<0.05$) higher for the control than for birds on antimicrobials. Feed conversion ratio did not differ significantly ($P>0.05$). Feed cost/kg gain was also significantly lowest for the birds on the antimicrobials. No mortality was recorded for all treatments in this phase.

The observed results for the growth performance show that AGPs increased performance in chickens. Chlortetracycline, oxytetracycline and penicillin have been reported to improve growth rate when supplemented in animal feed (15). The performance by birds on of Biostrong® 510 showed no particular trend. Some experiments with broilers (16, 17, 18, 19, 20) also did not find statistical differences in the performance parameters of birds fed diets supplemented with different types, concentrations, or combinations of plant extracts. According to (19), the absence of effect on bird performance may be related to the composition of the basal diet and/or to the environmental conditions of the experiment.

Table 1: Growth Performance of Broiler chicks ed different levels of Biostrong ® 510 in Starter diet

Parameters	Levels of Biostrong® 510				Oxytet[1]	Neocyr[2]	SEM
	0g	15g	17.5g	20g			
Initial Weight (g/bird)	41.8	40.9	40.7	41.7	41.5	41.3	0.87
Final Weight (g/bird)	845.6[b]	851.7[b]	853.7[b]	852.8[b]	924.4[a]	907.9[a]	26.87
TWG (g/bird)	803.8[b]	810.8 [b]	813.1[b]	811.2[b]	882.9[a]	866.6[a]	26.33
DWG (g/bird/day)	28.7	28.9	29.0	28.9	31.5	30.9	5.96
TFC. (g/bird)	1729.6[a]	1613.9[b]	1575.7[b]	1611.8[b]	1593.8[b]	1639.4[b]	83.96
DFC (g/bird/day)	61.8	57.6	56.3	57.6	56.9	58.6	1.21
FCR	2.15	1.99	1.94	1.99	1.81	1.90	0.55
Feed cost/Kg gain (₦/Kg)	223.8[b]	207.5[a]	202.4[a]	208.1[a]	199.3[a]	209.3[a]	5.52
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

a,b, Means with different superscript differ significantly across the row ($P < 0.05$) SEM: Standard error of means. Oxytet [1]: Oxytetracycline. Neocyr [2]: Neocyril plus TWG= Total Weight. Gain DWG= Daily Weight Gain DFC= Daily feed consumed FCR= Feed conversion ratio TFC= Total Feed Consumed

Similarly, (21) did not find any significant effect of feeds containing different Oregano levels on the performance parameters of broilers up to 42 days of age.

In contrast however, (22) have demonstrated that herbs and herbal products as natural feed additive have a positive effect on broiler growth performance. (23) also reported that broilers fed the XT a blend of capsicum, cinnamaldehyde and carvacrol) diets had significantly greater live weight, better weight gains and feed efficiency than broilers fed a control diet with avilamycin during the experimental period.The observation in the current work may also be due to adequate hygienic conditions in the poultry house which made the chicks unexposed to health challenges. This is particularly obvious in the birds fed control diet which performed well, similar to other treatments fed antimicrobial substances. Additionally, birds showed no sign of ill health and there was no mortality recorded at the starter phase.

Table 2 shows the performance characteristics of finisher broiler chickens fed different levels of Biostrong® 510 as a natural growth promoter. There was no significant ($P>0.05$) difference in final weight and weight gain of birds across all treatments. However, feed consumption, feed conversion ratio and mortality differed significantly ($P < 0.05$) among the treatment.

The observed non-significant difference in final weight and weight gain may mean that the antibiotics (Oxytetracycline) and essential oils blend (Biostrong® 510) used as growth promoters in the work have no significant effect on tissue accumulation by birds. This agrees with earlier research reports that growth promoters may not significantly affect weight gain in situations where birds are not exposed

Table 2 Growth Performance of Broiler chickens fed different levels of Biostrong® 510 in finisher diets

	Level of Biostrong® 510						
Parameters	**0g**	**15g**	**17.5g**	**20g**	**Oxytet[1]**	**Neocyr[2]**	SEM
Initial weight (g/bird)	937.70	863.50	894.10	853.90	930.90	892.80	43.28
Final weight (g/bird)	2822.60	2776.90	2688.50	2650.70	2700.00	2706.40	86.72
TWG (g/bird)	1884.90	1913.5 0	1794.40	1796.80	1769.00	1813.50	76.04
DWG (g/bird/day)	89.80	91.10	85.50	85.60	84.20	86.40	4.19
TFC (g/bird)	3574.20^{a}	3397.50^{b}	3221.00^{b}	3269.20^{b}	3286.20^{b}	3392.50^{b}	74.78
DFC (g/bird/day)	170.20^{a}	161.80^{b}	153.40^{b}	155.70^{b}	156.50^{b}	161.60^{b}	3.56
FCR	1.90^{b}	1.78^{a}	1.80^{a}	1.82^{a}	1.86^{b}	1.87^{b}	0.03
Feed cost/Kg gain (₦/Kg)	194.45^{ab}	184.93^{a}	188.99^{ab}	190.50^{ab}	205.12^{b}	206.31^{b}	3.57
Mortality (%)	1.59^{b}	0.00^{a}	1.17^{b}	0.00^{a}	1.59^{b}	0.00^{a}	0.06

a,b, Means with different superscript differ significantly across the row ($P < 0.05$) SEM: Standard error of means. Oxytet[1]: Oxytetracycline. Neocyr[2]: Neocyril plus FCR= Feed conversion ratio DFC=daily feed consumed TFC= Total Feed Consumed DWG= Daily weight gain TWG= Total weight Gain

to pathogenic microbial infection (16, 17, 18, 19, 20) did not find statistical differences in the weight gain of birds fed diets supplemented with different types, concentrations, or combinations of plant extracts.Feed consumption was significantly highest for the birds on control diet above all levels of Biostrong® 510 and the antibiotics. Birds fed growth promoters though did not gain higher weights than the control diet, they utilized significantly less feed to gain similar weights with the control diet. The feed conversion ratio of birds reflected this to some extent as the control diet had significantly higher value than the three levels of Biostrong®510 but was however similar to those on antibiotics. Biostrong® 510 therefore appear to improve feed conversion in finisher birds. This result agrees with the observation (22), who reported that herbs and herbal products as natural feed additive have a positive effect on broiler growth parameters. (23) also reported that broilers fed the XT (a blend of Capsicum, Cinnamaldehyde and Carvacrol) diets had significantly better feed efficiency than broilers fed a control diet with Avilamycin during the experimental period. Biostrong® 510 improves feed utilization and therefore has a potential to improve growth performance. Birds fed 15g Biostrong® 510/ 100Kg diet had the lowest cost of production per Kilogram meat but was however, similar to those of the other levels and the control. Birds fed the two types of antibiotic growth promoters had significantly ($P<0.05$) higher cost of production than other treatments. The trend is related to the feed conversion ratio of the birds. The mortalities recorded for this phase across the treatments can be described as very low and showed no particular trend. The mortalities recorded for treatments 1, 3 and 5 may therefore not be as a result of treatment effect.

Table 3 shows the Haematological indices of broiler chickens fed different levels of Biostrong® 510. All parameters measured were not significantly (P>0.05) influenced by the dietary treatment. The observed PCV values in this trial across the treatment groups which ranged from 24.0- 28.3% fell within the normal range of 24.9-45.2% for healthy chickens as reported by (24).This indicate that the diets were suitable and adequate for broiler chickens, and the birds were not anaemic. The haemoglobin count of 8.00-9.40 g/dl in this trial fell within the normal range of 7-15g/dl recommended for healthy chickens indicating that the birds had sufficient blood pigment for proper transportation of oxygen, thus healthy living. The aim of estimating haemoglobin content is to determine the oxygen carrying capacity of the birds' circulatory system. Birds with low oxygen carrying capacity can easily succumb to any form of respiratory diseases while birds with high haemoglobin concentration can be regarded as having high oxygen capacity and such birds are likely to withstand some level of respiratory stress. The non-significant (P>0.05) differences in the values of heterophils, lymphocytes, monocytes, eosinophil and basophils indicate the absence of active infections.

Table 3 Haematological indices of Broilerchickens fed different levels of Biostrong® 510

Parameters	Level of Biostrong® 510				Oxytet[1]	Neocyr[2]	SEM
	0g	15g	17.5g	20g			
PCV (%)	28.3	26.7	27.7	26.3	24.0	27.3	1.81
Hb (g/dl)	9.40	8.20	9.20	8.27	8.00	9.07	1.39
Tp ((g/dl)	2.73	2.2 7	2.20	2.40	2.27	2.40	0.16
RBC (x10^{12} /L)	4.70	4.2 7	4.87	4.47	4.00	4.60	0.20
WBC (x10^{9} /L)	11.53	10.60	7.67	5.07	8.77	11.00	3.17
Heterophils (%)	4.00	4.33	6.00	6.33	5.67	8.67	1.69
Lymphocytes (%)	95.33	91.67	92.00	88.67	85.33	91.00	2.58
Monocytes (%)	0.67	1.67	1.33	2.67	3.33	2.33	1.03
Eosinophils (%)	0.00	0.33	0.00	2.00	2.67	0.00	0.69
Basophils (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Band cell (%)	0.00	2.00	0.67	0.33	2.33	0.33	0.59

Oxytet[1]: OxytetracyclineNeocyr[2]: Neocyril plus SEM: Standard error of means

Table 4 shows the results of liver function tests of broiler chicks fed levels of Biostrong® 510. Significant (P<0.05) difference was observed for alanine-amino transferase (ALT) aspartate amino tranferase (AST) and Alkaline phosphatase (ALP). The inclusion of Biostrong® 510 resulted into a decrease in the amounts of these enzymes which were produced by the liver and the amounts present in the blood is indicative of the integrity of the liver. It is reported that if alanine amino tranferase(ALT) and Aspartate-amino tranferase (AST) are found together in elevated amounts in the blood, liver damage is most likely present (**25)**.

Thus, the reduced amount of these liver enzymes (AST, ALT, ALP) in the blood of birds fed levels of Biostrong® 510 may indicate an improvement in the health of the liver and showed that the material does not impair the liver in its function. Such impairment or damage to the liver would have caused a leakage of these enzymes, leading to high levels in the blood. Also the reduced level of ALP indicated that the food used in this work provided high digestible protein as high value of ALP is an indication of poor quality protein (26). Thus this material (Biostrong® 510) has no toxic or damage-causing effect on the liver.

Table 4 Liver function indices of broiler chickens fed different levels of Biostrong ® 510

Parameters	Level of Biostrong® 510						SEM
	0g	15g	17.5g	20g	Oxytet[1]	Neocyr[2]	
Glucose (mmol/L)	13.80	13.50	12.70	13.73	13.93	14.00	0.79
Albumin (g/L)	36.67	36.67	35.67	36.33	35.67	34.67	4.76
BUN (mmol/L)	4.00	4.13	4.23	4.10	5.43	4.67	0.51
AST (µL)	38.33^{a}	23.00^{b}	22.00^{b}	26.00^{b}	29.00^{a}	37.00^{a}	5.01
ALT (µL)	34.00^{a}	24.33^{a}	23.00^{a}	12.67^{b}	24.33^{a}	36.67^{a}	10.92
Alkaline phosphatase (µ/L)	294.00^{a}	140.67^{b}	114.00^{b}	81.33^{b}	120.33^{b}	165.33^{b}	59.41

a,b, Means with different superscripts differ significantly across the row (P<0.05) Oxytet[1]: OxytetracyclineNeocyr[2]: Neocyril plus BUN= Blood urea nitrogen AST= Alanine-amino tranferase ALT = Alanine-amino tranferase SEM: Standard error of means

Table 5 shows the result of tibia bone characteristics of broiler chickens fed different levels of Biostrong® 510. There was significance difference (P<0.05) across the treatments for tibia bone density and Birds fed levels of Biostrong® 510 had significantly higher bone density than birds on control and AGPs. Bone dry matter and bone ash were also numerically higher for birds on Biostrong® 510 compared to birds on the control group and on antibiotics.

The higher values for bone density, bone dry matter and bone ash observed for the birds fed levels of Biostrong® 510 show that the material increased bone strength of the birds. (27) reported that tibia is the fastest growing bone in the chicks while, (28) stated that the tibia ash is a very sensitive tool used to evaluate calcium and phosphorus requirement based on the degree of mineralization. Increased bone strength is a critical need in modern day broiler breeds that have been developed for very rapid growth and high weight gain and need strong bones to bear the weight. Bones must also grow fast and with improved rate of mineral deposition to forestall leg deformities and the associated poor performance and degraded chicken meat.

Table 5 Tibia bone characteristics of Broiler chickens fed levels of Biostrong® 510

Parameters	Level of Biostrong® 510				Oxytet[1]	Neocyr[2]	SEM
	0g	15g	17.5g	20g			
Bone length (cm)	10.73	11.43	11.33	10.57	10.86	11.17	0.18
Bone weight (g)	18.33	20.67	20.33	20.33	19.33	19.67	0.94
Bone density (g/cm)	1.71^{b}	1.80^{ab}	1.79^{ab}	1.92^{a}	1.72^{b}	1.73^{b}	0.09
Bone dry matter (%)	46.91	48.49	48.63	48.25	45.89	45.91	3.03
Bone ash (%)	30.93	31.94	31.74	35.36	31.64	31.19	2.46

a,b, Means with different superscript differ s ignificantly across the row (P < 0.05) SEM: Standard error of meansOxytet [1]: OxytetracyclineNeocyr[2]: Neocyril plus

Table 6 shows the litter quality parameters of broiler chickens fed different levels of Biostrong® 510. There was significant (P<0.05) difference for dry matter content of litter for birds fed Biostrong® 510. pH and Nitrogen concentration were not significantly different (p>0.05).

During the experiment it was observed that the litters for birds fed Biostrong® 510 was generally of better physical/visual qualities as samples appear drier, lighter in colour and powdery without caking, unlike the darker, caked litter observed in birds on antibiotics as well as those in the control group. Biostrong® 510 has potential to improve the quality of litter and by implication the health of birds.

The pH of sawdust or wood shaving litter has been reported to be 5 - 6.5 (29) and the values obtained in this present study fall within this range.

Table 6 Litter quality of Broiler chickensfed different le vels of Biostrong® 510

Parameters	Level of Biostrong® 510				Oxytet[1]	Neocyr[2]	SEM
	0g	15g	17.5g	20g			
Dry matter (%)	81.89[b]	83.98[a]	86.04[a]	85.69[a]	82.60[b]	82.62[b]	1.54
pH	6.30	6.27	6.23	6.20	6.20	6.27	0.05
Nitrogen concentration (%)	2.66	2.53	2.56	2.52	2.53	2.45	0.19

a,b, Means with different superscript differ significantly across the row (P < 0.05) Oxytet[1]: OxytetracyclineNeocyr[2]: Neocyril plus SEM: Standard error of means

The potential pathogenic bacteria species identified as shown in table 7, were mainly in treatments not containingBiostrong® 510. *Citrobacterfreundi, Yersinia enterocolitica and Proteus vulgaris* were identified in the control diet. *Citrobacterfreundi, Yersinia enterocolitica, and Proteusrettgeri*was identified in treatment 5 with Oxytetracycline. *Yersinia enterocolitica, Proteusrettgeri and Klebsiellaoxytoca*were identified in treatment 6 that had Neocyril plus in their drinking water. Virtually all these bacteria species were not identified at the certainty level in all levels of Biostrong® 510. It may be that the colonisation by the beneficial bacteria has supressed the activity and habitation of potentially pathogenic species.The role of the commensal intestinal microbiota in suppressing pathogen colonization is likely to be multifactorial. In addition to the production of a wide variety of short chain fatty acids, which are bacteriostatic for a subset of bacterial species either directly or by reducing pH of the intestinal environment, the commensal microbiota contribute to the colonization resistance against pathogenic microbes. Moreover, some members of the microbiota also generate bacteriocins, small peptide molecules with microbiocidal or microbiostatic properties (30).

Table 7 Potential bacteria species identified in ileum and caecum

Bacterial specie	Levels of Biostrong® 510				Oxytet[1]	Neocyr[2]
	0g	15g	17.5g	20g		
Citrobacterfreundi	+	-	-	-	+	-
Yersinia enterocolitica	+	-	-	-	+	+
Proteus vulgaris	+	-	-	-	-	-
Proteusrettgeri	-	-	-	-	+	+
Klebsiellaoxytoca	-	-	-	-	-	+

Oxytet[1] = OxytetracyclineNeocyr[2]= Neocyril plus-= Absent+ = Present

Conclusion and Applications

It can be conclude that:

1. Biostrong® 510 used as a natural growth promoter did not significantly improve growth of broiler chickens, but however improved feed conversion ability of broiler finishers above the control and the AGPs used.
2. Significantly lowered the cost of production than AGPs by finisher broilers. Biostrong®510 also improved liver health and function, bone strength and litter quality.

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