Effect of a commercial blend of essential oils and organic acids on the performance of broiler chickens

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Abstract

An experiment was conducted to evaluate the effects of Biostrong® Forte (BF) on the performance of broiler chickens. The BF is a commercial blend of essential oils and organic acids. Five hundred and forty (540) day old Ross broiler chicks were used in the feeding trial. The birds were randomly distributed into five treatments, each replicated thrice with 36 chicks per replicate. T1 is the control; T2, T3 and T4 had 50, 75 and 100g BF per 100kg feed, respectively while T5 had Oxytetracycline (AGP) 60g/100kg of feed. The five diets were supplied ad libitum to birds for 42 days. Parameters collected were growth performance indices, haematological parameters, liver function indices, and carcass quality. All data were subjected to analysis of variance and significant ($P < 0.05$) differences among treatment means were compared using the Tukey test of significance. Significant ($P < 0.05$) difference was observed for growth performance indices as final weight and weight gain were best for the 50g BF per 100 Kg diet which compared favourably with the antibiotic group. The cost of producing meat was similarly best for 50g BF per 100 Kg diet, while the highest cost of production was observed for the antibiotic group. No significant ($p > 0.05$) differences were observed for all haematological parameters, although the packed cell volume and haemoglobin count fell within the normal range for healthy chickens. Significant ($p < 0.05$) difference was observed for aspartate amino transferase (AST). Higher AST values were however observed for birds on the control, while 50g BF and 100g BF were similar but higher than the values observed for 75g BF and AGP groups. There was however no significant ($p > 0.05$) difference for alanine amino transferase (ALT) and alkaline phosphatase (ALP). The carcass analysis showed significant ($p < 0.05$) difference in dressed weight across treatments, with the AGP group having the highest value while the control, alongside 50g BF and 75g BF were at par statistically. From the results of this study it may be concluded that BF significantly improved the growth performance of broiler chickens, had no impairment to the liver with the treatment with 50g per 100kg diet having the best cost of production when compared with the antibiotic group and the control group. This shows that BF at 50g per 100kg diet can effectively replace antibiotics in broiler diets.

Keywords: Essential oils, Organic Acids, Broiler Chickens, Growth performance, Liver Functions, Antibiotics

Introduction

An antibiotic is any substance that can destroy or inhibit the growth of bacteria and similar microorganisms, also antibiotics is widely known chemotherapeutic agents used for the clinical management of infectious diseases in humans, plants and animals. However a matter of interest is the fact that a sizeable fraction of antibiotics produced every year all over the world is

used for non-therapeutic purposes. In US alone, about 24.6 million pounds of antibiotics are used in animal agriculture annually and as stated earlier a substantial portion of this is used as growth promoters and not for the treatment of infections (Oliver *et al.*, 2011). The benefits of antibiotics in animal feed include increasing efficiency and growth rate, and preventing or reducing the incidence of infectious disease.

However use of antibiotics as growth promoters rather than for therapeutic use increases emergence of antibiotic resistant strains in these livestock and the challenge of residual antibiotics in animal products is serious public health threat. In a 2014 study by Center for Science and Environment (CSE) found residues of multiple medically important antibiotics in chicken meat samples from Delhi. Also The CSE report estimates that by 2050, antimicrobial resistance – which includes resistance to antibiotics as well as anti-fungals, anti-virals etc, can lead to 10 million deaths per year and lost outputs worth \$100 trillion globally (CSE, 2017). It is therefore important to find a way to solve this challenge and save the livestock industry as a whole and that solution is to stop the use of antibiotics as growth promoters in animal feed.

Some promising alternatives to antibiotics that are already available commercially include Eubiotics. Eubiotics as used in the feed industry refers to agents that ensure a healthy balance of the micro-flora in the gastrointestinal tract. Feed additives such as probiotics, prebiotics, essential oils and organic acids are often referred to as Eubiotics (Jacob, 2015; Ravindran, 2016). Biostrong Forte is a phytogenic eubiotic formulation which is a blend of essential oils and organic acids. This work was aimed at evaluating the graded levels of commercial essential oils and organic acids blend as alternative to the conventional antibiotics used as growth promoters in broilers raised under field conditions.

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° 09' 01.78" N and latitude 7° 39' 14.79" E 671m above sea level. The climate is characterized by a well-defined dry and wet seasons and relatively dry with a range annual rainfall of 700-1400mm (IAR Meteorological Unit, 2017).

Experimental design and management of birds

Five hundred and forty (540) day old Ross broiler chicks were allocated to five (5) dietary treatments, each replicated three times with 36 chicks each in a completely randomized design (CRD). The birds were housed in deep litter pens and managed with all necessary routine management practices. Feed and water were provided *ad libitum* for the 42 days period of the experiment.

Experimental diets

Five diets were formulated at both the starter and finisher phases of the feeding trial and Biostrong® Forte was added as non-inclusive part of the diets as shown below.

Diet 1: 0 g Biostrong® Forte per 100 Kg diet (Control)

Diet 2: 50g Biostrong® Forte per 100 Kg diet

Diet 3: 75g Biostrong® Forte per 100 Kg diet

Diet 4: 100g Biostrong® Forte per 100 Kg diet

Diet 5: Oxytetracycline at 60g/100Kg diet (a sub-therapeutic level).

Growth study

Initial and final weights of birds were taken at the beginning and at the end of the study. Weight gain and feed intake were measured weekly while feed/gain ratio and cost per Kg gain were computed. Mortality was recorded as they occur.

Haematological study

At the end of the starter phase (28 days), 2 ml blood samples were taken from three birds per treatment into sterilised sample bottles containing EDTA and taken to the laboratory for haematological study. The samples were analyzed for packed cell

volume (PCV), Haemoglobin (Hb) count and total proteins (TP). The RBC and WBC were counted. Differential counts of the WBC was done for the various cell types including lymphocytes, monocytes mean corpuscular haemoglobin concentration , mean corpuscular haemoglobin and band Cells.

Liver function test

At the end of the starter phase, 2 ml blood samples were taken from three birds per treatment into sterilised sample bottles containing no anticoagulant and taken to the Clinical Pathology Laboratory of the Ahmadu Bello University Teaching Hospital for determination of liver function enzymes; Alanine aminotransferase (ALT), Aspartate aminotransferase (AST) and Alkaline Phosphatase (ALP) according to the methods described by Lamb (1991).

Carcass analysis

At the end of the finisher phase (49 days), 3 chickens were randomly selected from each treatment, which represented the average weight of the group for carcass evaluation. The selected birds were starved of feed overnight, bled by severing the jugular vein and then scalding in hot water to remove the feathers. Live weight for each chicken was taken before slaughter. Dressing percentage, weight of organs and

the standard cut parts were measured. The organs were expressed as a percent of live weight while the cut parts were expressed as percentage of dressed weight.

Statistical analysis

All data obtained from the feeding trial were each statistically analysed using the General Linear Model Procedure of Statistical Analysis systems software package. Significant differences between treatments means were separated using Tukey Test (SAS, 2002).

Results and discussion

Growth performance of broiler chicks

Table 1 shows the growth performance of broiler chicks fed different levels of commercial blend of essential oils and organic acids. There was significant ($p<0.05$) difference in the final weight, weight gain, and feed intake .The birds fed with antibiotics and birds fed with the 50g BF had higher final weight , weight gain and better feed intake than those of the other levels of BF and the control diet. There was also significant difference in the feed cost/kg weight gain with the antibiotic having the highest feed cost/kg weight gain while the 50g BF had the best/lowest cost of production.

Table 1: Growth performance of Broiler chicks fed different levels of commercial essential oil and organic acid blend

Parameters	T1 0g BF	T2 50g BF	T3 75g BF	T4 100g BF	T5 60g OXY	SEM
Initial weight (g/bird)	44.7	45.6	44.5	44.4	44.7	0.54
Final weight (g/bird)	1172.3 ^c	1301.0 ^a	1227.0 ^b	1199.3 ^b	1282.3 ^a	23.57
Weight gain (g/bird)	1127.6 ^c	1255.4 ^a	1182.5 ^b	1154.9 ^b	1237.7 ^a	23.76
Feed intake (g/bird)	1988.8 ^b	2061.0 ^a	1939.9 ^b	1899.1 ^c	2028.4 ^a	33.72
Feed/gain ratio	1.70	1.60	1.60	1.60	1.60	0.04
Feed cost (₦/Kg)	112.6	116.7	118.8	120.8	152.7	---
Feed cost/Kg weight gain (₦/Kg gain)	198.7 ^b	191.6 ^b	194.8 ^b	198.8 ^b	250.8 ^a	5.03
Mortality (%)	0.9	0.9	1.9	0.0	0.0	0.72

a,b,c, Means with different superscripts on the same row are significantly different ($P<0.05$)
SEM: Standard error of means. BF-Biostrong® Forte. OXY-Oxytetracycline

The result showed that 50g BF increases growth performance in broiler similar to the antibiotics. Antimicrobials may control and limit the growth and colonization of a variety of pathogenic and non-pathogenic species of bacteria in chicks gut (Ferket, 2004) and a more balanced biota population in gut could lead to a greater efficiency in digestibility and utilization of food, resulting in an enhanced growth and improved FCR (Bedford, 2000). The 50g BF has a positive effect on the gut flora environment which enables the birds to digest feed efficiently, which culminates into better growth performance. This agrees with Helander *et al.*, (1998) who investigated how two isomeric phenols, carvacrol and thymol exert their antibacterial effects on *E. coli* O157 and *S. typhimurium*. Both carvacrol and thymol disintegrated the membrane of bacteria, leading to the release of membrane-associated materials from the cells to the external medium. This observation also agrees with the findings of Jamroz and Kamel,(2002) who reported that broilers fed XT(a blend of capsicum cinnamaldehyde and carvacrol) had significantly greater live weight better weight gain and feed efficiency than broilers fed a control diet with avilamycin . The observation in the current research however disagrees with the report of some other authors who conducted experiments with broilers and did not find statistical differences in the growth performance parameters of birds fed diets supplemented with different types, concentrations, or combinations of plant extracts as reported by (Onimisi *et al.*, 2017). Mortality rates were very low and did not follow any particular trend. Therefore the mortality may not be attributed to the diet fed to the

animals as the control diet also had mortalities just as seen in diets with 50g and 75g of the blend of organic acid and essential oils.

Growth performance of finisher broiler chickens

Table 2 shows the growth performance of broiler chickens fed different levels of commercial essential oil and organic acid blend at the finisher stage. There was significant ($p<0.05$) differences in final weight, weight gain feed intake, and feed cost/kg weight gain. Birds fed 50g BF and AGP had significantly high final weight and feed intake. However, birds in the control group are at par with 50g BF and AGP in feed intake. The feed cost/kg weight gain is also highest in the antibiotic group and lowest in birds fed 50g BF. The observed result shows that antibiotics increases growth performance in broiler. Antibiotics may control and limit the growth and colonization of a variety of pathogenic and non-pathogenic species of bacteria in chicks gut (Ferket, 2004) and a more balanced biota population in gut could lead to a greater efficiency in digestibility and utilization of food, resulting in an enhanced growth and improved FCR (Bedford, 2000). The 50g BF has a positive effect on the gut flora environment which enables the birds to digest feed efficiently which culminates into better growth performance, which agrees with (Helander *et al.*, 1998) who investigated how two isomeric phenols, carvacrol and thymol exert their antibacterial effects on *E. coli* O157 and *S. typhimurium*. Both carvacrol and thymol disintegrated the membrane of bacteria, leading to the release of membrane-associated materials from the cells to the external medium.

Table 2: G rowth performance of broiler chickens fed different levels of commercial essential oil and organic acid blend

Parameters	T1 0 BF	T2 50g BF	T3 75g BF	T4 100g BF	T5 60g OXY	SEM
Initial weight (g/bird)	1205.7	1301.0	1193.7	1166.0	1282.3	123.29
Final weight (g/bird)	2113.3 ^b	2229.1 ^a	2083.5 ^b	2018.2 ^c	2231.4 ^a	37.34
Weight gain (g/bird)	907.6 ^a	928.1 ^a	889.8 ^a	852.2 ^b	949.1 ^a	32.66
Feed intake(g/bird)	2037.0 ^a	2019.6 ^a	1960.2 ^b	1829.6 ^c	2071.2 ^a	39.08
Feed/gain ratio	2.40	2.20	2.20	2.20	2.20	0.08
Feed cost (₦/Kg)	105.7 ^b	109.5 ^b	109.5 ^b	109.5 ^b	152.7 ^a	2.61
Feed cost/Kg weight gain (₦/Kg gain)	253.68 ^b	238.70 ^a	242.00 ^a	235.40 ^a	333.80 ^c	8.88
Mortality (%)	0.0	0.0	0.0	0.9	0.0	0.43

a, b, c Means with different superscripts on the same row are significantly different (P<0.05)

SEM: Standard error of means. BF-Biostrong® Forte. OXY-oxytetracycline

This observation also agrees with the findings of Jamroz and Kamel (2002) who reported that broilers fed XT a blend of capsicum cinnamaldehyde and carvacrol) had significantly greater live weight better weight gain and feed efficiency than broilers fed a control diet with avilamycin. The observation in the current research however disagrees with the report of some other authors who conducted experiments with broilers and did not find statistical differences in the growth performance parameters of birds fed diets supplemented with different types, concentrations, or combinations of plant extracts as reported by Onimisi *et al.* (2017). Demir *et al.* (2005) indicated no differences in body weight gain, feed intake and feed efficiency of broilers fed diets supplemented with antibiotic growth promoter and five herbal natural feed additives from day 0 to 42 days of age. No significant differences in body weight gain of broilers were observed when thyme powder (Sarica *et al.*, 2005) and a blend of extracts of sage, thyme and rosemary (Hernandez *et al.*, 2004) were added to diets. The result from this observation could be attributed to the fact that this blend may be a superior formulation as observed also by Fallah and Rezaei (2013) who recognized that, blend of prebiotic and organic acids is suitable for

broiler performance than prebiotic or organic acids as alone feed additive for each. The Synergistic effects of supplementing essential oils combined with organic acids have been reported. For instance, (Jang *et al.*, 2007) reported that the use of CRINA® Poultry and lactic acid together in broiler feeds improved the final body weight and FCR, when compared to birds fed diets with Antimicrobial Growth Promoters. They also tested a phytogetic feed additive and a blend of organic acids and their interactions. The phytogetic additive or organic acids improved body weight at 21 days and also the cumulative FCR (period of 1 to 42 days) was improved. The mortality observed was generally minimal across the treatment as no particular tend was observed and may not be as a result of treatment effect

Haematological indices of broiler chickens

Table 3 shows the Haematological indices of broiler chicks fed essential oil and organic acids. There were no significant differences for all parameters. It was observed that the PCV values obtained from all treatments (36.5-41.0 %) fell within the normal range of 24.9-45.2% for healthy chickens as reported by (Mitraka and Rawnsley, 1997) this indicate that the diets were suitable and adequate for broiler chickens, and the birds were not anaemic.

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Table 3: Haematological indices of Broiler chicks fed different levels of commercial essential oil and organic acid blend

Parameters	T1 0 BF	T2 50g BF	T3 75g BF	T4 100g BF	T5 60g OXY	SEM
PCV (%)	40.02	38.5	37.6	36.5	41.0	1.65
RBC (10 ⁶ /uL)	2.8	2.8	2.7	2.6	2.9	0.14
Hb (g/dL)	12.2	11.9	11.4	11.1	12.2	0.55
WBC (10 ³ /uL)	111.8	109.4	108.4	112.2	109.7	5.16
Heterophils (%)	7.0	4.3	3.6	3.0	6.8	1.36
Lymphocytes (%)	81.3	85.3	88.1	89.96	88.4	2.69
MCV (fl)	143.3	136.2	142.0	138.8	141.8	2.28
MCH (pg)	43.4	41.9	43.1	42.2	42.2	0.52
MCHC (g/dL)	30.3	30.8	30.3	30.4	29.8	0.51

Means with different superscripts on the same row are significantly different (P<0.05)

SEM: Standard error of means. BF:Biostrong® Forte. OXY-Oxytetracycline

Mhonzya (2002) reported that haemoglobin and packed cell volume levels are normally higher in a well-nourished than poorly fed animal. Although when they go below normal ranges then it shows an anaemic case. Anaemia exists when the PCV (%) falls below the normal range for the species in question (Jain, 1986). But since all the levels of the essential oil and organic acid did not fall below the range then it implies there was no case of anaemia but rather better feed conversion efficiency. The haemoglobin count observed in this study varied from 11.1-12.2g/dL which fell within the normal range of 7-15g/dL recommended for healthy chickens (Mitruka and Rawnsley, 1997) indicating that birds had sufficient blood pigment for proper transportation of oxygen thus healthy living while for the parameters of the red blood cells which was almost the same with that of the control diet indicates also that the red blood cells was not reduced by the blend of essential oils and organic acids which indicates that the product also allows for proper oxygen and carbon dioxide transport as reported by Isaac *et al.* (2013) that red blood cell is involved in the transport of oxygen and carbon dioxide in the body. Thus, a reduced red blood cell count implies a reduction in the level of oxygen that would be carried to the tissues as well as the level of carbon dioxide

returned to the lungs (Ugwuene, 2011; Soetan *et al.*, 2013; Isaac *et al.*, 2013).

The non-significant differences also observed in other parameters indicate that the condition of the blood of the chickens was very normal as indicated in the ranges as given by Jain, (1986), and also it indicated that there were no active infections.

Liver function indices of broiler chickens

Table 4 shows the liver function test of broiler chicken fed different levels of commercial essential oil and organic acid blend .significant(p<0.05) difference was observed for aspartate amino transferase (AST). Higher values were observed for the control, T2 and T4 and were all significantly same but above the values observed for T3 and T5. These differences may not be related to the growth promoters used because the control group was among the highest value observed. There was however no significant difference for alanine amino transferase (ALT) and alkaline phosphatase (ALP). The inclusion of this blend however led to the reduction of the amounts of this enzyme produced in the liver. The amounts present in the blood are indicative of the integrity of the liver and so the reduced state of these enzymes indicates that there was no impairment of the liver.

A reduction in the alanine amino transferase also indicate that this blend provides a high

digestible protein as high value of ALP is an indicator of low quality protein

(Ologhobo *et al.*, 1993).the inference therefore is that this blend has no damage-causing effect to the liver.

Table 4 : Liver function indices of Broiler chickens fed different levels of commercial essential oil and organic acid blend

Parameters	T1 0 BF	T2 50g BF	T3 75g BF	T4 100g BF	T5 60g OXY	SEM
Aspartae-amino transferase (U/L)	36.7 ^a	35.7 ^a	34.3 ^b	40.0 ^a	30.0 ^b	2.18
Alanine-amino transferase (U/L)	49.3	51.3	48.7	50.0	42.3	2.83
Alkaline Phosphatase (U/L)	69.7	62.7	62.3	67.7	66.3	3.68
Total Protein (g/dL)	3.8	4.2	3.96	4.1	3.9	0.39
Albumin (g/dL)	2.0	2.4	2.0	2.6	2.5	0.34
Globulin (g/dL)	1.8	1.7	2.0	1.5	1.4	0.27

a,b,c Means with different superscripts on the same row are significantly different (P<0.05)

SEM: Standard error of means. BF:Biostrong®Forte. OXY: Oxytetracycline

Carcass characteristics of broiler chickens

Table 5 shows the carcass characteristics of chickens fed different levels of commercial essential oil and organic acid blend. There were no significant (p>0.05) differences in all parameters measured except for final weight and dressed weight. Birds on AGP had significantly (p<0.05) higher value than the birds on BF and the control. The result showed that carcass yield was improved with birds on AGP. Biostrong® Forte showed no significant effect on carcass characteristics parameters

measured as no particular trend was observed. This result is in agreement with the findings of Zhang *et al.* 2005 who tested the feeding of EO and organic acids in broilers and found no effect on carcass characteristics such as dressing percentage and breast percentage In contrast, research with rosemary oil in broiler diets by Yesilbag *et al.* (2011) has found that performance and carcass yield was improved with treatment, while sensory quality scores and acceptability of the meat by panelists was lowest in the rosemary oil treatments.

Table 5: Carcass of broiler chicks fed different levels of commercial essential oil and organic acid blend

Parameters	T1 0g BF	T2 50g BF	T3 75g BF	T4 100g BF	T5 60g OXY	SEM
Live weight (g)	2250.0 ^b	2250.0 ^b	2183.3 ^b	2166.7 ^c	2333.3 ^a	36.56
Dressed weight (g)	1674.3 ^b	1675.3 ^b	1679.7 ^b	1631.0 ^c	1781.3 ^a	35.17
Dressing % (%)	74.4	74.4	76.9	75.3	76.3	1.16
Breast cut (%)	30.9	31.1	32.3	30.5	31.8	0.76
Thigh (%)	14.4	14.7	14.1	114.9	13.8	0.60
Drumstick (%)	13.6	13.3	12.9	14.0	14.1	0.40
Back (%)	20.0	20.1	20.6	20.5	20.5	0.54
Liver (%)	2.0	2.0	2.2	2.2	2.0	0.14
Heart (%)	0.5	0.5	0.5	0.6	0.6	0.03

a, b, c Means with different superscripts on the same row are significantly different (P<0.05)

SEM: Standard error of means. BF: Biostrong® Forte. OXY-oxytetracycline

These contradictory findings on carcass characteristics and sensory quality may be explained by differences in the chemical structure and properties of Essential oils. The results observed for the organ weights were consistent with those observed by

Hernández *et al.* (2004), who did not find differences among the control treatment and those containing antibiotic or mixtures of plant extracts for organ weights of 42-day-old broilers

Conclusion

From the results of this study, it may be concluded that Biostrong® Forte, a natural growth promoter which is a blend of essential oils and organic acids have positive and growth promoting effect on broiler chickens

at an inclusion level of 50g per 100kg of feed. It significantly improved growth performance without impairment to liver function and blood quality. Biostrong® Forte can therefore effectively replace antibiotics as growth promoter in broiler diets.

Recommendation

Farmers and feed millers can include 50g of Biostrong® Forte in 100 Kg of the diets of broiler chickens for optimal performance and to completely replace antibiotics as growth promoter.

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