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RESEARCH ARTICLE

Evaluation of Dietary Supplementation of Broiler Chicks with Different Levels of Aloe Vera as a Replacement for Antibiotic Growth Promoter on Broiler Production in the Humid Tropics

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ABSTRACT

An experiment was conducted to evaluate the effects of dietary inclusion of Aloe Vera to substitute antibiotic growth promoter (Enramycin) on performance, carcass characteristics and intestinal micro flora of broiler chicks. The experiment involved one hundred and five Anak '2000' broilers which were used on complete randomized design in 5 groups with 3replicates, each consisting of 7 broilers. The groups included the control group (basal diet) and three groups with basal diets mixed with different levels of Aloe Vera powder (0.5, 1.0 and 1.5%). Finally, there was a group with basal diet plus antibiotic Enramycin. The experiment lasted for 56 days (8 weeks) during which the following parameters were collected: body weight gain, feed intake, feed conversion ratio, carcass and organ characteristics and microbial loads. At the end of the experiment, 8 broiler chicks were randomly collected from each experimental group for the evaluation. All the data collected were subjected to analysis of variance (ANOVA). The results obtained showed that Aloe Vera powder groups and antibiotic group brought about higher body weight gain and feed intake compared to the control group. However, significant differences ($P<0.05$) were observed in feed conversion ratio between the groups treated by Aloe Vera powder, antibiotic Enramycin and the control group. Although the antibiotic group showed better dressing weight than the Aloe Vera powder and the control groups. There was no significant difference ($P>0.05$) seen between the group treated with 1.5% Aloe Vera powder and the antibiotic group regarding body weight gain and dressing weight. Dietary Enramycin significantly ($P<0.05$) decreased *Escherichia coli* but have no effect on Staphylococcus and Salmonella counts. In conclusion, Aloe Vera powder when used at 1.5% are more efficient than antibiotic growth promoter (Enramycin) in improving broiler performance and decreasing intestinal *Escherichia coli* and *Salmonella spp.* and could be successfully used to substitute antibiotic growth promoters in broiler diets.

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INTRODUCTION

The poultry production as practiced today is a specialized one and concentrating more on the use of high performance birds. The major factors for successful poultry production are high genetic potential, balanced nutrition and health maintenance. On the other hand, there is a major demand to produce high quality poultry meat and egg at low price without rely on antibiotics and other medicines in poultry feed and water.

Antibiotic Growth Promoters (AGPs) in poultry feed have increased feed efficiency and growth (Dibner and Richards, 2005). The uses of AGPs have been under scrutiny for years (Retcliff, 2000). With the declining use of antibiotic growth promoters due to the development of antibiotic resistant strains, use of antibiotics in poultry is banned (Owens *et al*., 2008; Alcicek *et al*., 2004). Many studies have been carried out on using additives, including organic acids, as alternatives to antibiotics, with direct or indirect effects on intestinal micro flora on poultry

products (Amaechi and Amaeze, 2012). Several studies have shown antimicrobial properties of herb extracts (Cowan, 1999; Hammer *et al*., 1999) which can improve intestinal micro flora population and enhance health in birds' digestive systems through reduction in number of disease-making bacteria (Mitsch *et al*., 2004).

Aloe Vera is among the most well-known herbs. Previous studies discovered different properties of Aloe Vera, including wound healing, anti-parasitic, anti-viral, anti-fungal and anti-bacterial properties (Boudreu and Beland, 2006; Reynolds and Dweck, 1999). An important Aloe Vera property which has received attention from researchers is the polysaccharide acemannan-a manno polymer (Reynolds and Dweck, 1999). Several studies revealed that properties of Aloe Vera, including wound healing, immunomodulatory and antibacterial properties, may stem from acemannan (Mascolo *et al*., 2004). Studies performed on the effects of Aloe Vera and of polysaccharide contained in Aloe Vera (acemannan) on the broilers have shown that Aloe vera can improve the immune response in broilers (Chinnah *et al*., 1992; Valle-paraso *et al*., 2005). In addition, Lin *et al*. (2005) reported improved intestinal micro flora in broilers as a result of acemannan treatment. This process reduced *E.coli* and increased Lactobacillus counts. Based on the result obtained in previous studies on Aloe Vera, here we try to study the effects Aloe Vera mixed with broilers' feed on performance and to find out whether Aloe Vera can be a suitable replacement for antibiotic growth promoters.

MATERIALS AND METHODS

Birds and Diets

The study was conducted at the poultry unit of Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State of Nigeria. A total of one hundred and five (105) day old chicks of Anak (2000) broiler were used for the experiment. Chicks were brooded in a warmed fumigated brooder deep Liter house and feed on a commercial broiler starter Top Feed for four weeks divided into five diet groups with three replicates (7 chickens each) on a completely randomized design. The control group was treated with basal diet without additives mixed with feed. For the next three groups, the diets were mixed with 0.5, 1.0 and 1.5% Aloe Vera powder, respectively.

Finally, the diet for the last group was mixed with Enramycin (growth promoter). Enramycin is a polypeptide antibiotic produced by *Streptomyces fungicides*. It was purchased from a reputable veterinary store. The raw Aloe Vera was purchased from a reputable dealer. The whole

Fresh and matured Aloe Vera leaf was over dried and grinded using manual grinder into finer particles. The powder was submitted to the laboratory to determine the nutrient and chemical contents.

Housing and Management

The broiler chicks were housed in pens which were cleaned properly. The birds were weighed at day old to determine the initial body weight and subsequently weighed weekly to determine the body weights and body weight gains. The birds were vaccinated against New Castle disease and Infectious Bursal disease, likewise all other medications were given.

The experiment lasted for 8 weeks. Body weight gain, feed conversion ratios and feed intake were obtained by calculation.

Carcass Measurements

On day 56, eight birds per treatment were randomly taken to study carcass characteristics. Chicks were fasted over night and then individually weighed, slaughtered, defeathered and eviscerated. The percentage of carcass and organs (% of live body weight) was calculated.

Determination of Bacterial Loads

The cloacae samples of the chicks were collected every 2 weeks intervals for 3 times using swab sticks. The faecal samples collected were subjected to total viable count (TVC) as described by Cheesbrough (2000), expressed as the number of Colony Farming Unit (CFU) per unit measure of the test sample. Identification of bacteria flora was based on Collins and Lyne, (1984) guidelines.

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) as described by Steel and Torrie (1980). Significant differences among treatment means were separated by Duncan's new multiple range test (Duncan, 1955) with a 5% level of probability.

RESULTS

Table 2 shows the effect of dietary treatments on the productive performance (body weight gain, feed intake, and feed conversion ratio (FCR) recorded weekly and for the entire period. The results of weight gain showed that broiler chicks fed Aloe Vera supplemented diet exhibited more body weight gain than the control. Broiler chicks fed the Enramycin supplemented diets recorded more weight gain than the others.

As seen in the Table, the largest body weight was observed in the antibiotic group. However, there was no significant difference among the antibiotic group and Aloe vera powder groups.

Feed intake did not differ significantly between the control group and those feed Aloe Vera powder or Enramycin supplemented diets during the entire period. However, there was a numerical increase in the feed intake with highest daily feed intake recorded in Enramycin supplemented diets.

The results of FCR showed that addition of Aloe Vera powder or Enramycin did significantly ($P<0.05$) improve FCR. Broiler chicks fed Aloe Vera powder or Enramycin supplemented diets gave almost the same values of FCR during the entire period. Broiler chicks fed Enramycin supplemented diets showed significant ($P<0.05$) posterior value of FCR compared to the control and other supplemented diets. Addition of either Aloe Vera powder or Enramycin improved the performance of growing broilers expressed as weight gain or FCR. Birds fed such supplemented diets utilized feed more efficient than the control diets.

Table 1: Percentage composition of experimental diets

Ingredients %	Starter diet	Finisher diet
Crude protein	21.00	18.00
Fats/oil	6.00	6.00
Crude fibre	5.00	5.00
Calcium	1.00	-
Phosphorous	0.45	0.40
Lysine	1.00	0.85
Methionine	0.55	0.35
Salt	0.30	0.33
Metabolizable energy	2800ckal/kg	2800kcal/kg

The effects of dietary treatments on carcass characteristics are shown in Table 3. Aloe Vera and Enramycin significantly (P<0.05) increased dressing percentage. There was a significant difference (P<0.05) in slaughter weight when 1.5% Aloe Vera was supplemented in the broiler chicks diets than other treatments. Significant difference (P<0.05) existed in the breast cut, shank and back cut when the broiler chicks diets were supplemented with Aloe Vera and Enramycin. No significant differences were detected on wing cut, drum stick, thing, neck and head (% body weight) among treatments. However, there were minor increases in the relative weight of wing cut, drum stick, thigh, neck and head of broiler chicks fed Aloe Vera or Enramycin supplemented diets compared to those fed the control diets.

The effects of dietary treatments on organ characteristics of broiler chicks fed the different dietary treatments are shown in Table 4. No significant difference was detected in the organs (% body weight) among treatment except the heart. However, there were minor increases in the relative weight of gizzard, intestine, liver and spleen of broiler chicks fed Aloe Vera supplemented diets compared to those fed the control or Enramycin supplemented diets. Significant difference (P<0.05) existed in the heart when the broiler chicks were supplemented with Aloe Vera and Enramycin.

The effects of dietary treatments on intestinal micro flora (*Escherichia coli*, *Staphylococcus* and *Salmonella*) of chicks fed the different dietary treatments are shown in Table 5. The results showed that dietary Enramycin significantly (P<0.05) decreased *Escherichia coli*, but had no effect on Salmonella. Dietary Enramycin and Aloe Vera significantly (P<0.05) increased Staphylococcus. The total microbial load were not statistically significant (P>0.05) among broiler chicks fed dietary Enramycin and Aloe Vera, although there were numerical variation among the treatments. However, the total intestinal bacteria in broiler chicks fed control diet were significantly (P<0.05) lower than those fed dietary feed supplementation.

DISCUSSION

The analysis of data on mean cumulative feed consumption revealed no significant difference between treatment groups due to dietary inclusion of Aloe Vera. This might be due to the consumption of isocaloric and isonitrogenous feed in all the treatment groups throughout the experimental period.

According to the results obtained on feed intake, it can be seen that the Aloe Vera powder groups have the highest level of feed intake compared to the control group and this leads to increased body weight in these groups in comparison to the control group. Olupona *et al*; (2010) reported increased feed intake in groups which were treated by Aloe Vera gel dissolved in water (15, 20, 25 and 30cm^3/dm^3) as body weight gain. Similarly, the present study shows increased feed intake in the 1.5% Aloe Vera powdered group with raised level of body weight gain. Increased feed intake in the 1.5% Aloe Vera powdered groups can be attributed to changes in feed taste and stimulation of appetite since, as reported by Windisch *et al*; (2008), phytogenic substances (as additives to birds' feed) can improve taste of diet. Furthermore, Wenk (2002) argued that herbs can stimulate appetite and endogenous secretions which, in turn improve performance. The result further showed that as a growth promoter, Aloe vera compared favourably very well with antibiotic growth promoter. These results are in agreement with the observation made by Mehala and Moorthy

Table 2: Effect of dietary treatments on growth performance of broiler chicks

Parameter	T_1 (0%)	T_2 (0.5%)	T_3 (1.0%)	T_4 (1.5%)	T_5 (Enramycin)	SEM
Initial weight(g)	356.66	361.66	367.66	361.00	364.00	1.81
Final weight (g)	2432.70	2513.96	2551.96	2558.30	2571.00	36.13
Weight gain (g)	2075.30	2152.30	2184.30	2197.30	2207.00	35.68
Daily weight gain (g)	49.37	53.99	54.14	54.37	54.28	0.84
Daily feed intake (g)	80.61	81.90	82.97	84.64	82.83	1.03
Feed conversion ratio (FCR)	1.62^b	1.79^{ab}	1.73^{ab}	1.77^{ab}	1.8^a	0.03

[a-b] treatment means with different superscripts are significantly different (P<0.05).

Table 3: Effect of dietary treatment on carcass characteristics of broiler chicks

Parameter	T_1 (0%)	T_2 (0.5%)	T_3 (1.0%)	T_4 (1.5%)	T_5 (Enramycin)	SEM
Slaughter weight (g)	1883.30^a	1866.70^a	1876.70^a	1900.00^b	1888.80	50.58
Dressing weight (%)	55.43^a	60.73^b	61.23^b	62.16^b	62.73^b	1.14
Breast cut (%)	19.10^b	22.83^{ab}	22.23^{ab}	22.46^{ab}	24.33^a	0.71
Wings cut (%)	8.30	8.83	8.53	8.30	8.10	0.4
Drum stick (%)	10.63	11.16	10.23	10.60	11.23	0.22
Thigh (%)	9.36	10.03	9.50	10.23	10.40	0.19
Neck (%)	4.00	4.53	4.63	4.56	4.50	0.13
Shanks (%)	5.30^a	4.96^{ab}	2.86^b	4.50^{ab}	4.63^{ab}	0.35
Head (%)	2.66	2.50	2.20	2.46	2.30	0.07
Back cut (%)	13.06^b	15.46^{ab}	14.56^{ab}	14.26^{ab}	17.10^a	0.50

[a-b] treatment means with different superscripts are significantly difference (P<0.05) within each column.

Table 4: Effect of dietary treatment on organ characteristics of broiler chicks

Parameters	T_1 (0%)	T_2 (0.5%)	T_3 (1.0%)	T_4 (1.5%)	T_5 (Enramycin)	SEM
Liver (%)	2.26	2.36	2.40	2.36	2.33	0.10
Kidney (%)	0.73	0.83	0.73	0.80	0.83	0.03
Heart (%)	0.46^b	0.50^b	0.46^b	0.46^b	0.63^a	0.02
Lungs (%)	0.60	0.53	0.40	0.46	0.53	0.03
Spleen (%)	0.10	0.13	0.13	0.11	0.08	0.01
Gizzard (%)	1.80	2.60	2.13	2.30	2.13	0.12
Preventriculus (%)	0.86	0.43	0.56	0.46	0.46	0.03
Intestine (%)	4.53	6.66	6.06	5.63	4.76	0.56
Crop (%)	0.43	0.40	0.40	0.26	0.33	0.03

$^{a-b}$ mean within each column with no common superscript differ significantly (P<0.05).

Table 5: Effect of dietary treatments on intestinal bacteria of broiler chicks

Parameters	T_1 (0%)	T_2 (0.5%)	T_3 (1.0%)	T_4 (1.5%)	T_5 (Enramycin)	SEM
E.coli (cfu/mg)	4.73^b	4.63^b	3.90^{ab}	3.10^{ab}	2.84^a	0.03
Staphylococcus (cfu/mg)	41.44^b	48.33^a	48.66^a	50.77^a	49.88^a	2.59
Salmonella (cfu/mg)	5.96^a	5.68^a	3.69^b	3.80^b	6.02^a	0.21
Total microbial load	88.33^b	97.55^a	102.33^a	95.22^a	104.88^a	3.8

$^{a-b}$ mean within each column with no common superscript differ significantly (P<0.05).

(2008). Kumer *et al*. (2005) also obtained similar results when they compared the body weights and weight gains of birds fed on diets containing Aloe Vera feed supplement and those fed on diets containing antibiotic growth promoters.

The analysis of data on mean cumulative feed intake revealed no significant difference between treatments groups due to dietary inclusion of Aloe Vera and Enramycin and the control. This might be due to the consumption of isocaloric and isonitrogenous feed in all the treatment groups and the control throughout the experimental period.

Statistical analysis of data on weight grain and daily weight gain revealed no significant difference among the treatment groups due to dietary inclusion of Aloe Vera and Enramycin. However, numerically higher body weight gain was observed in the treatment groups compared to control (Kumari *et al*., 1994; Changkang *et al*., 2007). It was consistent with Sinurat *et al*. (2002) who reported that broiler chickens fed with fresh Aloe Vera gel (0.25 g/kg) and dry Aloe Vera gel (0.25 and 1.0 g/kg) had no significant effect on body weight of broiler chicks. Moreover, findings obtained in studies on treatments of broilers with virginiamycin and other antibiotic growth promoters suggested that antibiotic growth promoters (AGPs) can increase broilers' body weight gain compared to control group (Bafundo *et al*., 2003; Miles *et al*., 2006), which is in line with the findings of the present study. In addition, Aloe vera groups showed higher feed conversion ratio than the control group, but they showed no significant difference from each other. Reports from other studies on herbs revealed that supplementary feed with essential oils, plant extracts and herbs powders did not improve feed conversion ratio compared to control group or the group treated by antibiotic growth promoters (Toghyani *et al*., 2010; Buzkurt *et al*., 2009; Jang *et al*., 2007; Sarica, *et al*., 2005). However, broiler fed with 600mg Aloe Vera gel water extract presented higher feed conversion ratio compared to broilers treated by 150ppm chlortetracycline. The improved feed conversion ratio seen in these findings may be explained as follows: antibiotic growth promoters reduce level of competition between nutritional substances and the host. They also increase absorption and consumption of nutritional compounds by thinning intestinal wall (Amaechi and Anueyiagu, 2012). Moreover, expulsion of pathogenic organisms from the gut by the beneficial ones most likely conferred better absorption of nutrients on the birds and hence enhanced the bird's ability to convert feed.

More significantly, the present study suggests that the antibiotic group has not only higher level of body weight gain and higher feed conversion, but also it exhibit heavier dressing percentage compared to the control. It should be mentioned however, that while studying the effects of herbal medicine as broiler's feed supplements on performance, different parameters such as plant parts, physical properties, genetic variation, age, different dosage used, extraction method, harvest time and compatibility with the other ingredients, can influence performance differently (Yang *et al*., 2009).

Since the main polysaccharide contained in Aloe Vera is acemannan, the enhanced body weight gain in groups treated by Aloe Vera powdered compared to the control group may be attributed to anti-bacterial properties of Aloe Vera which can improve intestinal micro flora. Furthermore, the acemannan contained in Aloe Vera can stimulate immune system and improve body resistance against bacteria and viruses. This in turn, improves growth performance. This is in agreement with Rangasamy and Kabiarasil (2007); Mehala and Moorthy (2008) who concluded that herbal growth promoters not only improved the growth rate of birds but also had immunomodulatory effects on the broilers. The microbial loads of the faecal samples were significantly influenced by the dietary inclusion of Aloe Vera and Enramycin in the broilers diets. This could be attributed to the ability of some bacteria to thrive well in the presence of Aloe Vera and others unable to cope with the condition. This shows that Aloe Vera is made of different constituents which posses antibacterial, antifungal and antiviral properties with direct or indirect effect on intestinal micro flora population. This antimicrobial activity according to Cowan (1999) enhances birds' digestive system through reduction in number of disease making bacteria (Mitsch *et al*., 2004). Broiler chicks on dietary treatment have a significant difference higher than the control in the total

microbial load and *staphylococcus aureus*. This implies that dietary treatment with Aloe Vera and Enramycin have little or no effect on *Staphylococcus aureus* (Gram positive bacteria) due to their thick cell wall preventing the active ingredients of Aloe vera and Enramycin from affecting the organism.

Conclusion

It could be concluded that, under the condition of the present study, Aloe Vera powder at 1.5% dietary inclusion are more efficient than antibiotic growth promoter (Enramycin) on improving broiler performance and decreasing intestinal *Escherichia coli* and *Salmonella spp*. Therefore, dietary inclusion of Aloe Vera in broiler diets is highly recommended, it will be interesting to try different inclusion levels of Aloe Vera since there was no detrimental effect recorded both health wise and performance.

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