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Performance of Broilers Fed Vegetable Based Diets Supplemented with Organic Acids and Methionine as Growth Promoter Source and Antibiotics

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MMR and MSA designed and carried out the study. Author MNH wrote the protocol and first draft of the manuscript. Authors MKR and MSKS managed the literature searches, analyses of the study performances. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aims/Objectives: The investigation assessed and compared the performance of broilers fed on a vegetable based (VB) diet supplementation of antibiotic growth promoter (AGP) and organic acids (OA) either independently or in combination.
Study Design: Cross-sectional study.
Place and Duration of Study: The experiment was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh with 72 as hatched day old (Cobb 500) broilers and continued for 35 days during the period of 22 October to 25 November, 2012.
Methodology: Broilers were equally and randomly distributed into four treatment groups. Vegetable based (control), VB+AGP, VB+OA and VB+AGP+OA respectively. Each group of birds had three replications and 6 broilers constituted a replication. In all replication

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body weight and feed consumption were recorded at day old chick (DOC) and seven days interval.

Results: It was found that the live weight on VB (control) diet was lower (P<0.01) (855.33g/b) and that on other groups (VB+AGP, VB+OA, VB+AGP+OA) were 978.67g/b, 1008.67g/b and 982.33g/b respectively at 35 days of age. The feed consumption during the experimental period was 1692.01g/b, 1805.65g/b, 1702.00g/b and 1774.34g/b respectively. The feed conversion efficiency were also lower in VB (control) diet than those of VB+AGP, VB+OA and VB+AGP+OA diets throughout the experimental period. At 35 days of age, feed conversions were 2.53, 2.37, 2.33 and 2.41 on VB (control), VB+AGP, VB+OA and VB+AGP+OA diets respectively. It was also found that the total cost of production per kg live broilers was Tk. 107.77, 97.91, 91.39 and 96.73 on VB, VB+AGP, VB+OA and VB+AGP+OA diets respectively. Significant differences were obtained for live weight and breast meat among all dietary groups.

Conclusion: The results of the study revealed that organic acids might be used as a substitute of antibiotic in vegetable based diet for safe meat production from broiler.

Keywords: Antibiotic; broiler fed; methionine; organic acids; vegetable based diet; cost of production.

1. INTRODUCTION

Bangladesh is a small country (56,000 square miles) burdened with large number of gradually increasing population (more than 16 crore). Everybody requires 120g meat per day but availability is only 16.5 g/day which is quite inadequate for normal growth and development of the body [1]. Poultry meat especially chicken meat is the most desirable animal protein and is acceptable for most of the people regardless of caste and religions. Broiler raisers are always interested to different approaches for better growth and economic production. The poultry industry is playing an important role in its growth and it creates numerous employment opportunities [2]. Short life cycle of broiler requires less capital for broiler rising. Poultry feeding incurring 65-75% total cost of production. Nearly 30% costs are attributable to supplying protein in diets [3]. Among the protein sources, Animal Protein i.e. fish meal, meat meal, bone meal and conventional protein concentrates are usually used in the broiler diets. On the other hand, different oil cakes and soybean meal (SM) are the traditional sources of plant protein. Use of antibiotic growth promoter (AGP) as a therapeutic agent in poultry is one of the important issues, now a day and establishes a beneficial effect in the gastro-intestinal tract is in practice in many farms. Entering the chemical drugs to human food chain and development of antibiotics resistances are serious concern in food safety point of view [4,5]. The rate of increased resistance to antibiotics is a major public health hazard [6]. Antibiotics are often used to suppress or eliminate harmful organisms in intestine and improved growth and feed conversion [7]. Application of non-antibiotic is going to a challenge [8]. In consequence, all feed antibiotics and chemotherapeutics already banned by European Union in 2006. Therefore, additives acceptable to consumers and alternative to antibiotics are needed to be incorporated. Numerous products are considered and among these, organic acids appear to offer the best additive for improving poultry production. From the use of organic acids in poultry one can accept performance similar or better than the antibiotic growth promoters, without affecting public health and preventive to *Necrotic enteritis* in chickens. It also reduces carrier state of *Salmonella* spp. and *Campylobacter* spp. As the uses of organic acids are becoming more acceptable to feed manufacturers, poultry producers and consumers, there is a growing interest in substituting them for antibiotic as growth promoters [9]. Organic acids also improve the digestibility and

absorption of proteins, minerals and other nutrients in the diet. Among organic acids, short chain fatty acids (SCFA) are considered as potential alternative to AGP [10]. In case of amino acids among the vegetable proteins; soybean meal is the good source of lysine [11]. Soybean meal is widely used as protein source in poultry diet; the requirement of lysine is normally meet up. Methionine is the first limiting essential amino acid in maize and soybean-based diets for poultry. It plays a significant role in energy production and protein synthesis. It enhances production and size of the eggs, overall growth of the bird, feed conversion ratio (FCR) and livability of broilers and layers [12,13]. As it could not be synthesized in chickens, manufactured methionine must be added to the dietary mixture to ensure that the birds receive an adequate amount. All quality poultry feeds are designed to contain adequate methionine and prevent reduced body growth and feather development. Synthetic methionine is metabolized into a highly toxic compound such as methyl propionate, which adversely affects the performance of the birds [14]. Supplementing feed grade methionine sources to broiler diets in order to balance the dietary protein in accordance to the broilers demand or the economic optimum is a common practice, nowadays. Presently, food safety is a great international concerned. It is at risk in Asia and the Pacific. Consumers today are conscious on not to include AGP for the sake of food safety for the various food scares; created on Bovine *Spongiform Encephalopathy* and *Dioxin scares* [15]. They expected meat, eggs, milk and other products are nutritious consistent and free from contamination. Many researchers suggested feeding chicken, fed on vegetable based (VB) diet without animal proteins (AP). In Bangladesh, producing safe poultry is still a major concern to consumers [16]. Vegetable based (VB) diets in broiler farming is regarded as an efficient tool for a sustainable agricultural development. VB diets in broiler characterized by production of safer meat and meat products, devoid of any chemical residues; antibiotics and toxin binder etc. So far author knowledge goes, there is no vegetable based diet broiler farm in Bangladesh. But it is fact that some farms are avoiding feed additives, vaccines and antibiotic in rearing poultry. Broiler products from VB diet may have a good prospect in domestic market. Transparency, traceability and accountability are required for food safety and to produce safe food to protect public health. Organic acids as a substitute of antibiotic growth promoter in vegetable based diet and compare performance of vegetable based diet on broiler such as body weight, feed conversion and meat yield with or without supplementation of antibiotic as well. Considering the above points and poor status of safe food production in Bangladesh and possible effects to find out the alternatives of using antibiotics with vegetable based diet, the current study was undertaken.

2. MATERIALS AND METHODS

2.1 Collection of Broilers and Experimental Materials

The broilers were purchased from the sale centre of Nourish Poultry and Hatchery Ltd., Sreepur, Gazipur, Bangladesh. Antibiotic growth promoter (AGP); Ciprofloxacin (Trade name: CIPRO-A VET, Manufacturer: The ACME Laboratories Ltd., Chemical composition: Ciprofloxacin 10%) and organic acid mixture (Trade named Hameco-pH marketed by Square pharmaceuticals Limited) were collected from local market of Mymensingh.

2.2 Layout of the Experiment

Chicks were equally and randomly divided and distributed in 4 dietary treatments which were shown in Table 2.1. Vegetables based (VB) diet; VB+AGP, VB+OA, VB+AGP+OA diets respectively and having 3 replications in each. DL-Methionine is the most commonly used

methionine source in poultry. It can be added to premixes, mineral and compound feeds. Each dietary group consists of 18 chicks distributed in three replicated pans with 6 chicks in each.

Table 2.1. Layout of the experiment showing the distribution of broilers to different diets and their replication

Replication	Diet				Total
	1	2	3	4	
1	06	06	06	06	24
2	06	06	06	06	24
3	06	06	06	06	24
Total	**18**	**18**	**18**	**18**	**72**

2.3 Collection, Drying, Processing and Storage of Full Fat Soybean

Full fat soybean (FFS) were collected from BAU Poultry Farm required amount of raw FFS was sun dried and stored in polythene bags until processing. Raw FFS (without dehulling) was washed with tap water and then boiled using a large pan. The grains were taken in a pan with preboiled water (100ºC) and the pan was covered with a lid. The grains were boiled for 15 minutes at 110ºC and then sun dried, and kept in polythene bags, which was covered by gunny bags until grinding and used for further diet formulation. All other feed ingredients used in the experiment were purchased from a feed shop in Mymensingh Town.

2.4 Formulation of Vegetable Based (VB) Broiler Feed

The broiler diets were formulated for two phases' starter and grower with locally available feed ingredients (Table 2.2). Starter diet was provided between day old and 17 days and grower diet was provided between 18 and 35 days of age. The nutrient requirements (CP, ME, Ca, P, Lysine, Methionine and tryptophan) were satisfied as per requirement (Table 2.3) and four diets were prepared as per requirement of the experiments. After weighing according to requirement maize, full fat soybean, soybean meal was ground by a grinding machine and mixed thoroughly. All the diets were prepared weekly and stored in plastic bags.

Table 2.2. Composition of the vegetable based (VB) broiler diet

Feed Ingredients	Amount in 100kg	
	Starter (0-17 days)	Grower (18-35 days)
Maize (Crushed)	47.00	50.00
Rice polish	5.85	5.85
Soybean meal	25.00	20.50
Full fat soybean	17.00	18.00
Soybean Oil	1.50	2.00
Oyster shell	2.00	2.00
DCP	1.00	1.00
Vitamin-mineral premix	0.25	0.25
Common salt	0.30	0.30
DL-Methionine	0.10	0.10
Total	**100**	**100**

Table 2.3. Calculated composition of broiler starter and grower ration

Chemical composition		
Nutrient	**Starter (0-17 days)**	**Grower (18-35 days)**
ME (kcal/kg)	2960	3055
CP (%)	21.53	19.90
Ca (%)	1.00	0.98
Av.P (%)	0.45	0.38
Methionine (%)	0.44	0.44
Lysine (%)	1.22	1.12

2.5 The Technique Used in Providing Antibiotic and Hameco-pH in the Drinking Water

Antibiotic and Hameco-pH were supplied through drinking water. The purpose was to observe the interaction of antibiotic and organic acids in the growth, carcass quality and economic feasibility of broilers. One group of water was kept control; without supplementation of AGP or OA. The other drinkers of different treatments groups were provided with 0.1% Ciprofloxacin + 0% Hameco-pH, 0.1% Hameco-pH + 0% Ciprofloxacin, 0.1% Ciprofloxacin + 0.1% Hameco-pH respectively.

2.6 Management Practices

2.6.1 Housing

The experimental room was cleaned and disinfected first by bleaching powder solution prepared at the rate of 3g per 5 liters of water and later with Vircon S (Antec International Limited, USA). After drying, the whole room was divided into 12 separate pans of equal sized using wire net and bamboo materials. The height of wire net was 85 cm. Floor space provided for each broiler was 900 cm^2. Fresh dried rice husk litter was spread on floor of the pans at a depth of about 4cm, before placing chicks on the floor pens. For light and temperature controls, bulbs were used in each pan. Electric light was provided in the trial house for 24 hours in the whole production period. The house temperature was maintained at 34ºC for the first week. In the course of trial period the brooding temperature was gradually reduced from 34ºC to 31ºC at the end of first week, 31ºC to 28ºC in second week, 28ºC to 25ºC in third week and 25ºC to 23ºC in fourth week and it was 23ºC in fifth week to end of trial. The brooding temperature and humidity was measured by an automatic digital thermo-hygrometer.

2.6.2 Feed and water management

For the first 3 days feeds was given on newspapers simultaneously a little amount of feed was supplied in the feeder, so that the chicks were habituated to eat in the feeder. Water was supplied in a round drinker. One feeder and one drinker were provided each pan (6 chicks). The feeders were thoroughly washed cleaned at the end of each week and drinkers were washed twice daily.

2.6.3 Vaccination

The chicks were vaccinated against Infectious Bursal Disease (Gumboro) and for Newcastle Disease. Vaccines were administrated as per recommendation of manufacturer. The vaccination schedule followed during the experimental period is given in Table 2.4.

Table 2.4. Vaccination schedule followed for the chicks

Age of chicks (day)	Name of Disease	Name of Vaccine	Route of administration and Dose
3	Ranikhet	BCRDV[a]	One drop in each eye
14	Gumboro	Cevac[b]	One drop in each eye

2.6.4 Data collection and record keeping

The recorded parameters during the experimental period are Chick weight initially and weekly replication wise for each diet, Feed intake weekly replication wise for each diet, Mortality when occurred. The data which were obtained by calculation are Body weight gain, Feed intake, Feed conversion ratio and Production cost. The cost of broiler production for each treatment group was calculated based on the market price of feed ingredients, cost of chicks, cost of antibiotic and organic acids, management cost (labor, medicine, electricity and litter cost) to produce per kg of live broiler.

2.7 Methods of Broiler Processing

At the end of the experiment, 12 representative samples of birds, weighing near pan average weight of broilers were selected from each replication. Feeder and drinker were withdrawn from the pans 12 hours prior to slaughtering to facilitate proper bleeding. They were fasted, slaughtered, bleed, scalded, de-feathered, rescaled and dissected following the procedure and meat were stripped out from the carcass.

2.8 Statistical Analysis

All recorded and calculated data were analyzed using a Completely Randomized design (CRD). Analysis of variance (ANOVA) was performed with the help of computer [17] program to compare all parameters among diets. Least significant difference (LSD) was calculated to know the difference between the treatments means when significant difference was observed.

3. RESULTS AND DISCUSSION

The performance of broilers is presented under following sub-heading to compare the effects of different diets on broiler.

3.1 Body Weight

The body weight of broilers was significantly influenced by the diets (Table 3.1). The initial (day old) body weight of broilers was almost similar ($P>0.05$) in all dietary groups. At 7 days of age, body weight of broilers was non-significant ($p>0.05$) among all dietary groups. At 14, 21, 28 and 35 days of age, differences in body weight of broilers among dietary groups were

highly significant (P<0.01). Same result also found (P<0.01) using organic acid diet [18]. At 14, 21, and 35 days of age, differences in body weight of broilers was significantly higher on VB+AGP, VB+OA and VB+AGP+OA dietary groups than that of VB (control) diet. At the 28 days of age, body weight of broilers was significantly higher in VB+OA, VB+AGP and VB+AGP+OA diet but among them VB+OA receiving group showed always highest weight respectively. At 35 days of age, body weight of broilers was significantly higher on VB+OA diet than that of other diets. Highest live weight of broilers was found on VB+OA diet which was similar to the findings [19,20,21,22,23,24]; Significant difference was found in using VB (control) diet than other diet which agreed with the findings [25,26,27] as also found in this study.

Table 3.1. Effect of supplementing vegetable based (VB) diet; AGP, OA and AGP+OA in drinking water on live weight at different age (g/b)

Age(day)	Diets				Level of significance[+]
	VB	VB+AGP	VB+OA	VB+AGP+OA	
Initial	41.16	41.50	41.33	41.33	NS
7	124.33	130.33	133.66	129.50	NS
14	233.66b	278.66[a]	292.33[a]	279.66[a]	**
21	413.33[b]	482.67[a]	512.67[a]	478.33[a]	**
28	638.66[c]	715.33[b]	785.67[a]	726.66[b]	**
35	855.33[b]	978.67[a]	1008.67[a]	982.33[a]	**

*VB: Vegetable Based, AGP: Antibiotic Growth Promoter, OA: Organic Acids. NS: P>0.05, **: P<0.01, [abc] means with different superscripts within the same row differ significantly*

3.2 Feed Intake (FI)

The feed consumption of broilers during different stages of growth in drinking water application is given in Table 3.2. At 7, 14, 21 and 28 days of age, feed consumption were similar (P>0.05) among all dietary groups. During 35 days of age, it was highly significant (P<0.01) among all dietary groups. The feed consumption of broilers on VB+AGP and VB+ AGP+OA diet was more or less similar than other diets. Lowest feed intake of broilers was observed on VB+OA diet which did not differ from VB diet group and that was supported by [21,24,28]. Comparatively increase in feed intake of birds of VB group also observed by [25,29], similar to the finding of this study.

Table 3.2. Effect of supplementing vegetable based (VB) diet; AGP, OA and AGP+OA in drinking water to broilers diet on feed intake (g/b) at different age

Age (day)	Diet				Level of significance[+]
	VB	VB+AGP	VB+OA	VB+AGP+OA	
7	121.67	124.33	117.33	123.33	NS
14	203.67	223.33	230.00	220.00	NS
21	347.67	378.33	385.33	353.67	NS
28	478.33	455.33	449.67	465.67	NS
35	540.67[b]	624.33[a]	519.67[b]	611.67[a]	**

*VB: Vegetable Based, AGP: Antibiotic Growth Promoter, OA: Organic Acids. NS: P>0.05, **: P<0.01, [abc] means with different superscripts within the same row differ significantly*

3.3 Feed Conversion (FC)

The FCR (feed intake: live weight gain) of broilers during different stages of growth of birds receiving different application is given in Table 3.3. At 7, 21 and 35 days of age FCR did not differ among all dietary groups. At the age of 14 days FCR in all treated groups showed a highly significant (P<0.01) difference from the control (VB). However, the FCR value was more or less similar on VB+AGP, VB+OA and VB+AGP+OA dietary groups, although found better in VB+OA receiving birds. At 28 days of age, FCR value only VB+OA group differed significantly (P<0.05) from VB group. Lowest feed conversion (FCR) value of broilers was found on VB+OA diet, same result also found using organic acid diet which was similar with [24,30,31,32]. FCR of broilers found (2.53) in VB (control) diet and it was similar (2.51) with [33,34].

Table 3.3. Effect of supplementing vegetable based (VB) diet; AGP, OA and AGP+OA in drinking water to broilers diet on feed conversion at different age

Age (day)	Diet				Level of significance+
	VB	VB+AGP	VB+OA	VB+AGP+OA	
7	1.47	1.40	1.27	1.40	NS
14	1.86[a]	1.50[b]	1.45[b]	1.46[b]	**
21	1.93	1.87	1.75	1.78	NS
28	2.12[a]	1.95[ab]	1.66[b]	1.87[ab]	*
35	2.53	2.37	2.33	2.41	NS

*VB: Vegetable Based, AGP: Antibiotic Growth Promoter, OA: Organic Acid. NS: P>0.05, *: P<0.05, **: P<0.01, [abc] means with different superscripts within the same row differ significantly*

3.4 Carcass Characteristics of Dietary Treatment

Meat yield of broilers receiving different water treatments are presented in Table 3.4. Significant (P<0.01) differences were obtained in live weight and breast meat among all dietary groups. On the other hand, no significant differences were observed for feather, thigh, drumstick, wing, heart, liver and dressing yield. Non significant (P>0.05) differences of dressing yield on dietary organic acids was found by [20,35].

Table 3.4. Effect of supplementing vegetable based (VB) diet; AGP, OA and AGP+OA in drinking water to broilers on carcass characteristics at 35 days of age

Variable	Diet				Level of significance+
	VB	VB+AGP	VB+OA	VB+AGP+OA	
Live weight (g/b)	851.67[c]	972.67[b]	993.67[a]	979.7[b]	**
Blood weight (%)	5.55	5.89	5.56	6.05	NS
Feather weight (%)	7.12	6.95	6.27	6.97	NS
Breast meat (%)	16.95[a]	14.49[b]	15.63[ab]	15.50[ab]	*
Thigh meat (%)	5.01	5.17	6.46	5.82	NS
Thigh bone (%)	1.22	1.27	1.08	1.16	NS
Drumstick meat (%)	2.77	3.02	2.84	2.97	NS
Drumstick bone (%)	1.47	1.40	1.55	1.50	NS
Wing meat (%)	2.07	2.03	2.09	1.99	NS
Wing bone (%)	1.38	1.27	1.50	1.44	NS
Abd. Fat (%)	0.63	0.78	1.03	1.12	NS

Table 3.4 Continued…

Gizzard (%)	2.03	2.03	1.82	2.10	NS
Head (%)	2.40	2.58	2.73	3.18	NS
Heart (%)	0.40	0.47	0.48	0.58	NS
Liver (%)	2.59	2.14	2.41	2.42	NS
Neck (%)	2.77	2.22	2.69	2.86	NS
Viscera (%)	7.64	8.77	9.44	7.68	NS
Spleen (%)	0.01	0.01	0.01	0.01	NS
Shank (%)	4.38	4.33	4.49	4.85	NS
Dressing (%)	54.95	55.24	55.56	55.34	NS

*VB: Vegetable Based, AGP: Antibiotic Growth Promoter, OA: Organic Acid. NS: P>0.05, *: P<0.05, **: P<0.01, ^{abc} means with different superscripts within the same row differ significantly*

3.5 Cost of Production

It was found that the total cost of production per kg live broiler produced were Tk. 107.77, 97.91, 91.39 and 96.73 on different diets; VB, VB+AGP, VB+OA and VB+AGP+OA respectively (Table 3.5). The profit per kg live broiler was highest with VB+OA diet, intermediate on VB+AGP, VB+AGP+OA diets and lowest on VB diet.

Table 3.5 Cost and Return of Different Water Treatment of Broilers

Variable	Diet				Level of significance^{+}
	VB	VB+AGP	VB+OA	VB+AGP+OA	
Cost per kg diet (TK)	32.70	33.20	33.45	33.28	-
Feed cost (Tk/b)	55.33	59.00	55.37	58.23	-
Total cost (TK/b)	92.13	95.80	92.17	95.03	-
Total cost (Tk/kg.b)	107.77	97.91	91.39	96.73	NS
Sale (Tk/b)	106.92	122.33	126.08	122.79	-
Profit (Tk/b)	14.79	26.54	33.91	27.76	NS
Profit (Tk/kg.b)	17.22	27.08	33.61	28.26	NS

VB: Vegetable Based, AGP: Antibiotic Growth Promoter, OA: Organic Acid. NS: P>0.05

4. SUMMARIES AND CONCLUSION

A total of 72 day old Cobb 500 broiler chicks were randomly selected and used in the experiment to evaluate the effects of antibiotic and organic acids either alone or in combination on growth of broiler fed a vegetable based (VB) diet supplemented with methionine. The broilers were divided into 4 groups and 3 replications. Feed was supplied *adlibitum* and fresh drinking water was supplied at all times. The experiment carried out for a period of 35 days. During the experimental period identical care and management were followed for all dietary groups. At the 35 days of age, average body weight of broilers were 855.33g, 978.67g, 1008.67g and 982.33g on VB, VB+AGP, VB+OA and VB+AGP+OA diets respectively. At the 14, 21, 28 and 35 days of age, difference body weight of broilers were highly significant (P<0.01) on all diets. During 14, 21 and 35 days of age, differences in body weight of broilers was significantly higher on VB+AGP, VB+OA and VB+AGP+OA receiving groups than that of VB (control). At the 28 days of age, body weight of broilers was significantly higher in birds who received VB +OA than that of VB, VB+AGP and VB+AGP+OA groups respectively. At 7, 14, 21 and 28 days of age, feed consumption were similar among all treatments groups. During 35 days of age, the feed consumption of broilers

differed significantly (P<0.01) among all treatment groups. The feed consumption of broilers on VB+AGP and VB+AGP+OA diet was more or less similar. At 14 days of age, feed conversion efficiency was 1.86 for VB (control) diet and it was improved by 19.35%, 22.04% & 21.50% in VB+AGP, VB+OA and VB+AGP+OA groups respectively. However, the FCR values were more or less similar on VB+AGP, VB+OA and VB+AGP+OA receiving groups. But FCR values were better in birds receiving VB+OA. During 28 days of age, FCR value significantly (P>0.05) differed among all dietary groups. Significant differences were obtained for live weight and breast meat among all treatment groups. So it may be concluded that use of OA in VB diet can be cost effective, safe to uphold productivity and ensure food safety for human consumption.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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