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Effect of Butyric Acid and Citric Acid as growth promoters and its effect on growth Performance and feed efficiency in Broiler Chicken

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ABSTRACT

An experiment was conducted to investigate the effect of dietary supplementation of butyric acid and citric acid as a growth promoter on feed intake, growth performance and feed efficiency in boilers. A total of 160 day-old broiler chicks were divided into four treatment groups. The control group (T4) was fed on basal diet without any supplementation and other three treatment groups were supplemented with 2% butyric acid, 1% citric acid and combination of 2% butyric acid and 1% citric acid in T1, T2 and T3 groups respectively. Statistical analysis of data revealed that both live body weight and weight gain significantly ($p<0.05$) improved in treatment groups fed on butyric acid, citric acid alone and in combination as compare to control group(T4). FCR and Performance index also significantly ($p<0.05$) improved in the same manner. Simultaneously, feed intake reduced significantly ($p<0.05$) in treatment groups fed on butyric acid, citric acid alone and in combination as compare to control group (T4). The present study revealed that dietary supplementation of butyric acid, citric acid alone and in combination improves growth performance, FCR and feed efficiency.

KEYWORD

Butyric acid, Citric acid, broiler, feed intake, growth performance, FCR

INTRODUCTION

Poultry farming is one of the most profitable businesses of agriculture in India. On one hand it increases farmer's income and on other hand provides nutritious meat and eggs for human consumption. Though it high feed efficiency and low mortality are the main factors for sustainable and economical broiler production, but presently chicks are stressed by various factors such as transportation, overcrowding, vaccination, chilling, over heating etc. These factors tend to create an imbalance in the intestinal micro flora and lowering the body defence mechanism, which affects the production performance of chicken.

To combat these adverse effects on growth rate, antimicrobial feed additives such as antibiotics and synthetic antimicrobial agents are often used to eliminate harmful organism in intestine and improve the growth rate and feed efficiency. However, most of these antibiotics have been banned in many countries, particularly the European Union, because of public health concern regarding their residues in the animal products and the development of antibiotic resistance in bacteria (Schwarz et al., 2001).

Scientist search for ideal compounds to minimise health related problems and among these compounds, organic acids are promising alternatives. Organic acids have also growth promoting properties that may be used as an alternative to antibiotics (Patten and Waldroup, 1988). The addition of organic acids to the broiler diet reduces the production of toxic components by bacteria and the colonization of pathogens in the GI Tract. Organic acids may affect the integrity of microbial cell membrane or cell macromolecules or interfere with nutrient transport and energy metabolism causing bactericidal effect (Ricke, 2003).Following organic acid feeding, reduction in gastric pH occurs which may increase the pepsin activity (Kirchgessner and Roth, 1982) and the peptides arising from pepsin proteolysis trigger the release of hormones, including gastrin and cholecystokinin, which regulate the digestion and absorption of protein. Considering the matter a study was conducted on organic acids like butyric acid and citric acid supplementation in diets due to their positive effect on health and growth of bird.

MATERIALS AND METHODS

The present investigation was carried out with day-old broiler chicks for a period of six weeks at Bihar Veterinary College, Patna. For this 170 day-old commercial broiler chicks were purchased and all chicks were of the same hatch in order to keep the genetic makeup uniform. The chicks were vaccinated against Gumboro and Ranikhet diseases and the weak and crippled chicks were discarded from the study. On 1st day 160 selected chicks were wing banded, weighed individually and randomly distributed to four different dietary treatment groups of 40 chicks in each group. The chicks were reared under the deep litter system with similar mangemental and environmental conditions. The commercial starter and finisher rations were fed to chicks from 0-3 weeks and 4-6 weeks, respectively. The dietary treatment group T_1 consisted of commercial broiler diets with supplementation of 2 % of butyric acid. Commercial broiler diets with 1% citric acid served as treatment group T_2, and commercial broiler ration with supplementation of combination of both 2 % butyric acid and 1% citric acid carry as treatment group T_3. The dietary treatments consisted of a commercial diet (both starter and finisher) without any organic acid supplementation served as control group (T_4). The birds were fed as per recommendation of BIS (1992) feeding standards to meet the energy and

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protein requirements during starter phase (0-21 days) and finisher phase (22-42 days). The chemical composition of commercial feed for starter and finisher phase of experimental birds is presented in Table 1.

Table 1: Chemical Composition of Experimental Ration

Values (%)	Starter Ration	Finisher Ration
Dry matter	89.22	89.35
Crude Protein	22.23	20.07
Ether extract	6.24	6.29
Crude fibre	3.61	3.56
Ash	6.17	5.73
Calcium	0.82	0.81
Phosphorus	0.62	0.67
ME* (Kcal/kg)	2800	2900

Samples of both starter and finisher commercial diets were analyzed for moisture, crude protein and crude fibre according to procedure laid down by AOAC (1995). A weekly record of the fresh feeds offered and weighed back was maintained for each group to calculate the feed consumption. The chicks were weighed individually at the start of the experiment and subsequently at weekly intervals. The weekly live weight gain was calculated from the difference in body weights attained at the end and at the start of the period. The feed conversion ratio was calculated by using this formula (FCR = Total amount of feed consumed (g) / Body weight gain(g)). Further, Performance index (PI) was developed by using ratio between average body weight gain (g) and feed consumption (g).

RESULTS AND DISCUSSION

Body weight and weight gain

The results reveal (Table 2) that supplementation of butyric acid and citric acid improved weekly body weight of chicken. The final body weight was significantly ($p<0.05$) highest in boiler having butyric acid (T_1) and combination of butyric acid and citric acid (T_3) supplemented diet, intermediate in citric acid (T_2) and lowest in control group (T_4). Significant difference in weight gain was also observed among the groups. The highest weight gain was found in combination of butyric acid and citric acid, followed by butyric acid, citric acid group and lowest in control group.

Table 2: Average weekly body weight (g) and Total weight gain (g) of broiler chicken as influenced by dietary supplementation of butyric acid and citric acid.

Age (week)	T_1	T_2	T_3	T_4	SEM
Day-old	41.81	41.57	42.17	41.55	0.48
1st	101.32^a	100.27^a	103.25^b	100.20^a	1.54
2nd	267.62^a	268.40^a	272.65^b	266.27^a	2.02
3rd	512.50^b	506.62^b	509.89^b	503.67^a	4.78
4th	824.47^b	818.20^b	829.42^b	803.02^a	6.91
5th	1268.95^b	1256.95^b	1282.62^b	1217.37^a	13.25
6th	1735.67^c	1716.67^b	1742.56^c	1671.32^a	18.49
Total wt. gain (g)	1693.87^c	1671.10^b	1700.39^c	1629.77^a	17.77

Means bearing different superscripts in a row differ significantly (P<0.05)

This result was in agreement with the finding of Taherpour *et al.*, (2009), who reported that body weight increased, when butyric acid were used in ration. Similarly Mansoub *et al.*, (2011) reported that powder form of Butyric acid improved body weight gain of chicks in comparison to control group. On contrary, Lesson *et al.*, (2005) revealed that dietary ration containing 0.5 % butyric acid had no effect on both total body weight and body weight gain.

The result of average body weight is also in consonance with the finding of Haque *et al.*, (2009) who reported that broiler fed the diet with citric acid alone and the diet with citric acid in combination with flavomycin attained significantly higher live weight compared to control and flavomycin treated birds. Similarly, Islam *et al.*, (2008) reported that 0.5 % citric acid improved the body weight gain of broiler as compared to control group and acetic acid in their experiment. On he contrary, the finding of experiment did not agree with report of Atapattu *et al.*, (2005), who found that live body weight and weight gain of broiler chicken were not significantly affected by the supplementation of citric acid in diets based on rice by-products. It might be due to different environmental condition.

Weekly feed intake

The result of this study (Table 3) revealed that feed intake did not vary significantly ($p<0.05$) till 2nd week of age. From 3rd week of age till the experiment, dietary supplementation with organic acid (T_1, T_2,T_3) group vary significantly from the control group(T_4). Further, cumulative feed intake (1st to 6th week of age) was significantly lower in all the organic acid supplemented groups as compared to control group. It means birds were eating lesser when organic acid were supplement in diets. However total body weights were higher in these groups. This might be due to better feed utilization and absorption.

In contrary, Taherpour *et al.*, (2009), who reported that the feed intake was improved when butyric acid used in the ration.

Table 3: Average weekly feed intake (g) of broiler chicken as influenced by dietary supplementation of butyric acid and citric acid.

Age(weeks)	T_1	T_2	T_3	T_4	SEM
1st	102.37	102.47	105.66	104.98	4.99
2nd	292.77	300.95	298.14	303.90	6.56
3rd	467.72^b	464.52^{bd}	455.55^{ad}	485.47^c	11.4
4th	614.58^a	626.27^b	632.66^b	661.56^c	16.35
5th	840.06^a	841.76^a	856.64^a	878.42^c	15.54
6th	854.09^{ad}	860.76^{bd}	846.19^a	975.42^c	15.82
Total feed intake (g)	3155.04^a	3195.91^a	3179.50^a	3409.4^b	28.21

Means bearing different superscripts in a row differ significantly (P<0.05)

Antongiovanni *et al*., (2007) using various level of butyric acid in the diet showed that at the end of experiment feed intake was not affected. This is also reported by Gunal *et al*., (2006) and Leeson *et al*., (2005).

Ao *et al*., (2009) reported that citric acid significantly decreased the feed intake of broiler chicks, this is in agreement with the present study. In contrary, Rafacz-Livingston *et al*., (2005) reported a linear ($p<0.05$) increase in feed intake in chick feed diets supplemented with citric acid. This might be due to the fact that mild dose of citric acid enhance the palatability of feed leading to increase feed intake.

Feed conversion ratio

The mean weekly feed conversion ratio of boilers having different dietary treatment group is shown in Table-4. There was significant ($p<0.05$) variation in FCR of broiler chicken found between different dietary treatment group. The highest FCR was recorded in butyric acid group (T_1), followed by combination of citric acid and butyric acid (T_3) then citric acid (T_2) and lowest in control group (T_4).

This result is similar to results found by Panda *et al*., (2009). They reported that feed conversion ratio is influenced by dietary supplementation of butyric acid among the treatment groups during both the starter and finisher period. Feed conversion ratio was better in 0.4% butyrate group compared to furazolidone or 0.05% butyrate group. In contrary Sayrafi *et al*., (2011) found significant improvement ($P<0.05$) in feed conversion ratio in antibiotic group compared to control and organic acid groups. Antongiovanni *et al*., (2007) using various levels of butyric acid in the diet showed that at end of the experiment feed conversion ratio was not affected.

Table 4: Average weekly Feed conversion ratio of broiler chicken as influenced by dietary supplementation of butyric acid and citric acid

Age (weeks)	T_1	T_2	T_3	T_4	SEM
1th	1.73	1.76	1.73	1.81	0.05
2th	1.75a	1.79b	1.75a	1.83c	0.08
3th	1.91a	1.96ac	1.93ac	2.09bc	0.05
4th	1.99a	2.02a	1.98a	2.23b	0.06
5th	1.90a	1.93a	1.91a	2.13b	0.06
6th	1.84a	1.87bd	1.85ad	2.16c	0.05
1-6th	1.85ad	1.88b	1.86bd	2.04c	0.06

Means bearing different superscripts in a row differ significantly (P<0.05).

Asgar *et al*., (2013) reported that there was significant ($P<0.05$) variation in feed conversion ratio. Highest feed conversion ratio was observed in citric acid than control, avilamycin and probiotic groups. Chaudhury *et al*., (2009) and Abdal-Fattah *et al*., (2008) observed profound effect of citric acid and feed conversion ratio differ significantly ($P<0.05$) among treatments at all ages. Better feed conversion ratio was found in treatment group fed on 0.5 % citric acid than birds fed on 0.5% acetic acid. In contrary to this finding influenced by citric acid, Wickramasinghe *et al*., (2014) report that feed conversion ratio was not significantly affected by dietary citric acid. This might be due to different climatic condition.

Weekly performance index

The data on average weekly performance index of broiler chicken as influenced by dietary supplementation of butyric acid and citric acid is given in Table 5.

Table 5: Average weekly performance index of broiler chicken as influenced by dietary supplementation of butyric acid and citric acid

Age(weeks)	T_1	T_2	T_3	T_4	SEM
1st	58.14	57.14	57.75	55.86	0.76
2nd	57.14c	55.89b	56.81c	54.64a	1.24
3rd	52.36b	51.28b	52.07b	48.07a	1.61
4th	50.78b	49.81b	50.50b	45.24a	1.67
5th	52.90b	52.08b	52.89b	47.16a	1.85
6th	54.64b	53.47b	54.34b	46.50a	1.61
1-6th	54.32b	53.27b	54.06b	49.57a	1.32

Means bearing different superscripts in a row differ significantly (P<0.05)

CONCLUSION

The result of this study indicated that supplementation of butyric acid and citric acid had influence on the performance index in broiler chicken throughout the experimental period and among all treatment groups. Performance index was significantly ($p<0.05$) higher in dietary groups supplemented with organic acid than control group. This result was in agreement with findings of Boling *et al*., (2000). They reported that 1 % of citric acid improved performance index in broiler chicken. Similar result was also found by Ao *et al*., (2000) and Rafacz *et al*., (2005). On the contrary, Atapattu and Nelligaswatta (2005) reported that performance index was not significantly affected by dietary 2-4 % citric acid supplementation. It might be due to higher percentage of citric acid used by Atapattu and Nelligaswatta as compare to present study.

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