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Dietary Intervention of Betaine Hydrochloride on Nutrient Utilization in Broilers

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A B S T R A C T

As broiler production is characterized by a very short life cycle. the aim of study to know the effect of dietary supplementation of betaine hydrochloride (betaine HCl) on nutrient utilization in broiler chicken for six weeks. One hundred – and – ninety two, day-old commercial (Vencobb 400) broiler chicks were allotted to four groups, with four replications of 12 chicks each, randomly. The four groups were allotted in to four dietary regimes and each replicate was randomly assigned to one of the four dietary treatments in this study. The experimental feed was formulated according to BIS (1992) specifications and the control ration - T_1 (without betaine) and feed grade betaine HCl at 250, 500, 750 ppm was added respectively to form different rations T_2, T_3 and T_4 groups. The result proven availability of crude protein, had significant difference ($P< 0.01$) among dietary supplementation of betaine HCl treatments but availability of other nutrients, minerals and nitrogen balance didnot show any significant difference ($P>0.05$). This is to conclude that apparent nutrient digestibility of crude protein was higher for ration with betaine HCl at 750 ppm.

Introduction

Betaine HCl the synthetic form of betaine was cheeper than that of anhydrous betaine and hence could be used in broiler nutrition effectively due to the increased availability throughout the year. Phillip (2012) noted that, in the gut, above pH 3 all added betaine HCl were present as anhydrous betaine and below pH 3 as betaine HCl and concluded that whichever form of betaine was added, in the gastro intestinal tract the forms will be interchanged depending on pH. Creswell and Srinongkote (2011) compared the effect of natural betaine and betaine HCl in broiler diet and concluded that both the sources of betaine had similar effects at equi-molar concentration.

Materials and Methods

The nutrient utilization of betaine HCl

supplemented broilers were evaluated based on their performance and assay of biological materials. Straight run commercial broiler chicks (Vencobb-400) were utilized in the biological trial, from day old to six weeks of age. One hundred – and – ninety two, day-old Vencobb – 400 strain commercial broiler chicks were used as the experimental birds. The birds were allotted to four dietary treatment groups, with four replications of 12 chicks each randomly in a Completely Randomized Design.

The experimental feed (in mash form) was formulated using corn and soyabean meal as per BIS (1992) specifications. To the control ration (T_1), feed grade betaine HCl was added at 250, 500, 750 ppm to formulate rations T_2, T_3 and T_4 respectively, taking special care for proper mixing of betaine HCl. No growth promoting antibiotics was added to any rations.

Broiler starter ration were fed up to four weeks of age and then switched over to broiler finisher ration for the last two weeks. Taking special care for proper mixing of betaine HCl. No growth promoting antibiotics was added to any rations. The birds were provided with feed and water *ad libitum*. Feed consumption by the birds in each replicate, was calculated weekly. The rations were subjected to proximate analysis as per A.O.A.C., 1990. The chemical composition of the experimental broiler starter and finisher rations are presented in Table.1. Gross energy of experimental rations were estimated using bomb calorimeter. (Plain jacket calorimeter, model: 1341, Parr instruments co., USA).

To assess the nutrient utilization and balance of nitrogen a metabolism study was conducted for three days duration after the feeding trial by using four randomly selected birds from each treatment. The first two days served as an adaptation period during which they were fed the same feed. Birds were housed in individual metabolism cages with facilities for feeding, watering and faces collection. Water was provided *ad libitum.* During trial feed intake was recorded for each bird and excreta from each bird was collected by placing plastic sheet in faces collection tray for each replicate. Total amount of droppings voided in 24 hour by the birds of each replicate was collected from the plastic sheets and measured. These samples were placed in double lined polyethylene bags, sealed, labeled and kept in deep freezer at -20^{o}C until further analysis. At the end of the metabolism trial the daily samples were pooled together and one part of the sample was used for estimation of faecal nitrogen (N) content. Rest of the faecal sample was dried at 65^{o}C for 48 h in a hot air oven, ground and stored in polyethylene sachets till analyzed further for proximate components.

The data collected on various parameters were statistically analyzed by Completely Randomized Design (CRD) as per the methods of Snedecor and Cochran (1994) and the means of different experimental groups were also tested by using Duncan's Multible Range Test (DMRT) using SPSS Ver. 20.0.

Results and Discussion

The chemical and mineral compositions of the droppings voided by experimental birds during the metabolic trial are given in Table 2.

The average DM per cent of droppings were 21.55, 22.19, 17.93 and 17.72 for the treatment groups belonging to T_1, T_2, T_3 and T_4 respectively. The CP and GE (kcal/ kg) contents of the droppings of birds belonging to groups fed with rations T_1, T_2, T_3 and T_4 were 27.00, 25.17, 26.55 and 26.68 per cent and 3962.70, 3977.56, 3924.30 and 3918.71 respectively.

The calcium content of the droppings of bird belonging to groups maintained on rations T_1, T_2, T_3 and T_4 were 2.08, 1.91, 2.11 and 2.22 per cent and phosphorus contents were 1.07, 0.99, 1.04 and 1.07 per cent respectively.

Data on nutrient digestibility percentage of experimental rations T_1, T_2, T_3 and T_4 are presented in Table 9. The percentage availability of the four experimental rations T_1, T_2, T_3 and T_4 were 68.04, 66.79, 68.55 and 68.82 for DM, 58.12, 59.34, 59.65 and 60.81 for CP, 81.97, 83.26, 84.16 and 85.46 for EE, 37.99, 37.15, 36.93 and 35.27 for CF, 78.76, 75.80, 79.52 and 79.28 for NFE and 68.29, 67.12, 68.47 and 69.33 for energy.

The nitrogen balance for the experimental birds fed four dietary treatments T_1, T_2, T_3 and T_4 were 1.96, 2.25, 2.38 and 1.86 g / day respectively data are given in Table 3.

The statistical analysis of data on availability of nutrients (DM, EE, CF, NFE and energy) not differ significantly between the treatment groups by inclusion of different levels of betaine HCl in broiler diets but the CP availability was higher ($p<0.01$) in all three betaine HCl supplemented rations than the control ration without betaine HCl.

The present data obtained for the betaine HCl supplemented group is in the agrement with the findings of Attia *et al.*, (2005) in broilers who observed that the addition of betaine had no significant influence on digestibility of DM, EE and CF except CP and Nguyen *et al.*, (2014) also observed that betaine supplementation did not have any impact on energy measures like apparent metabolisable energy (AME) and net energy (NE) in broilers.

Table.1a Chemical and mineral composition of broiler starter rations, %

Parameters	Treatments* (broiler starter rations)			
	T1	T2	T3	T4
Dry matter	91.34	91.12	91.43	91.84
Organic dry matter	92.05	92.3	92.07	92.71
Crude protein	23.18	23.12	23.08	23.35
Ether extract	3.16	3.14	3.21	3.36
Crude fibre	2.82	2.74	2.93	2.86
Total ash	7.95	7.70	7.93	7.29
Acid insoluble ash	1.15	1.12	1.17	1.12
Nitrogen free extract	62.89	63.30	62.85	63.14
GE, kcal/kg	3822.01	3838.02	3788.47	3805.99
Calcium	1.24	1.26	1.23	1.22
Total phosphorus	0.69	0.67	0.72	0.69
ME (kcal/kg)**	2800	2800	2800	2800

*On dry matter basis
** Calculated values.

Table.1b Chemical and mineral composition of broiler finisher rations, %

Parameters	Treatments* (broiler finisher rations)			
	T1	T2	T3	T4
Dry matter	91.04	91.07	91.31	91.20
Organic dry matter	92.53	92.3	92.39	92.44
Crude protein	20.51	20.46	20.53	20.48
Ether extract	3.86	3.76	3.87	3.87
Crude fibre	3.11	2.99	3.15	3.18
Total ash	7.47	7.70	7.61	7.56
Acid insoluble ash	1.30	1.14	1.34	1.39
Nitrogen free extract	65.05	65.09	64.84	64.91
GE, kcal/kg	3993.37	4015.66	3916.80	3981.59
Calcium	1.21	1.21	1.23	1.30
Total phosphorus	0.70	0.69	0.68	0.68
ME (kcal/kg)**	2900	2900	2900	2900

*On dry matter basis
** Calculated values.

Table.2 Chemical composition of the droppings voided by birds maintained on four experimental rations, %

Parameters[1]	Treatments*			
	T1	T2	T3	T4
Dry matter	21.55 ±1.69	22.19 ±1.62	17.93 ±1.66	17.72 ±1.87
Organic dry matter	78.27 ±0.34	80.06 ±0.28	76.77 ±0.75	76.98 ±1.37
Crude protein	27.00 ±1.04	25.17 ±0.95	26.55 ±1.31	26.68 ±3.01
Ether extract	2.18 ±0.09	1.90 ±0.10	1.92 ±0.21	1.79 ±0.04
Crude fibre	6.08 ±0.30	5.69 ±0.24	6.36 ±0.30	6.87 ±0.84
Total ash	21.73 ±0.34	19.94 ±0.28	23.23 ±0.75	23.02 ±1.37
Acid insoluble ash	3.92 ±0.05	4.03 ±0.30	4.51 ±0.37	4.63 ±0.39
Nitrogen free extract	43.01 ±1.73	47.30 ±1.08	41.95 ±1.92	41.64 ±4.90
GE of faeces, kcal/kg	3962.70 ±38.13	3977.56 ±22.92	3924.30 ±47.83	3918.71 ±19.27
Calcium	2.08 ±0.17	1.91 ±0.19	2.11 ±0.13	2.22 ±0.26
Phosphorus	1.07 ±0.02	0.99 ±0.03	1.04 ±0.03	1.07 ±0.03

*on dry matter basis
[1]Each value is a mean of 4 observations with SE

Table.3 Apparent Nutrient digestibility of four experimental rations (%) and nitrogen balance (g/day) of birds maintained on four experimental rations

Parameters	Treatments[1]				F Value	P Value
	T1	T2	T3	T4		
Dry matter	68.04 ±1.39	66.79 ±1.44	68.55 ±1.68	68.82 ±3.25	0.186 ns	0.904
Organic matter	72.95 ±1.29	71.20 ±1.22	73.85 ±1.54	73.93 ±3.05	0.431 ns	0.734
Crude protein	58.12[a] ±0.42	59.34[b] ±0.27	59.65[b] ±0.28	60.81[c] ±0.21	13.129**	0.001
Ether extract	81.97 ±0.52	83.26 ±1.10	84.16 ±2.65	85.46 ±1.81	0.737 ns	0.550
Crude fiber	37.99 ±0.76	37.15 ±1.38	36.93 ±0.83	35.27 ±0.73	1.392 ns	0.293
Nitrogen free extract	78.76 ±1.77	75.80 ±1.60	79.52 ±2.02	79.28 ±4.20	0.433 ns	0.733
Energy efficiency	68.29 ±1.31	67.12 ±1.34	68.47 ±1.86	69.33 ±3.14	0.196 ns	0.897
Nitrogen balance	1.96 ±0.13	2.25 ±0.06	2.38 ±0.08	1.86 ±0.39	1.325 ns	0.312

[1]Each value is a mean of 4 observations with SE
ns – non significant (P>0.05)
**Means bearing different superscripts within same column differ significantly (P≤ 0.01)

Table.4 Mineral availability of four experimental rations, %

Parameters	Treatments[1]				F value	P Value
	T1	T2	T3	T4		
Calcium	44.86 ±6.36	47.30 ±7.27	45.61 ±5.82	48.50 ±1.78	0.083[ns]	0.968
Phosphorus	51.28 ±1.75	52.42 ±2.02	51.99 ±1.33	50.83 ±4.92	0.061 ns	0.979

[1]Each value is a mean of 4 observations with SE
ns – non significant (P>0.05)

On contrary to this EI-Husseiny *et al*., (2007) observed improved digestibility of organic matter, crude protein, ether extract, crude fiber and nitrogen-free extract with increasing levels of dietary betaine supplementation in broiler rations.

The per cent availability of minerals of rations T_1, T_2, T_3 and T_4 were 44.86, 47.30, 45.61 and 48.50 for calcium, 51.28, 52.42, 51.99 and 50.83 for phosphorus. However, statistical analysis of data revealed that there was no significant difference in minerals availability among treatment rations for calcium and phosphorus. (Table 4)

Statistical analysis of data on availability of nutrients with inclusion of different levels of betaine HCl in broiler diet reveled increased the availability of CP (P<0.01%) than the

control group. The nitrogen balance (g/ day) of four treatment groups were 1.96, 2.25, 2.38 and 1.86, respectively and there was no significant difference (P >0.05) among the treatment groups.

In conclusion, this study found that supplementation of betaine HCl at 750 ppm improves nutrient digestability of crude protein, which in turn may increase the broiler production in short cycle. Hence inclusion of betaine in commercial ration may be recommended for better production.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical approval

The animal studies for the experiment have been approved by the ethics committee-COVAS, Mannuthy, Kerala and therefore have been performed in accordance with the ethics standards as applicable under institutional guidelines."

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