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Evaluation of dietary supplementary betaine hydrochloride on growth in broilers

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Abstract
This study was conducted to investigate the effect of dietary supplementation of betaine hydrochloride (betaine HCl) on growth in broiler chicken. The study was carried out for a period of six weeks in Vencobb 400 broiler chicks. One hundred – and – ninety two, ay-old commercial broiler chicks were allotted to four groups, with four replications of 12 chicks each, randomly. The four groups were allotted 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 to the control ration (T_1), feed grade betaine HCl at 250, 500, 750 ppm was added respectively to form different rations T_2, T_3 and T_4 for different treatment groups. Results indicated significant ($P \leq 0.01$) effect of betaine HCl supplementation on weekly body weight, weekly body weight gain, and cumulative FCR. There was no significant difference ($P > 0.05$) for cumulative feed intake of birds on 42nd day. It is concluded that effect of betaine HCl was found to have significant effect in increasing body weight in broilers.

Keywords: Broiler birds, betaine hydrochloride, growth

Introduction
Betaine can function as osmoregulator as well as methyl donor in transmethylation reactions inside the body, it can protect the cell enzymes and membranes against ionic inactivation, maintaining water and ion balance in living cells at the cellular level. Betaine also donates essential methyl groups in a number of biochemical reactions such as synthesis of DNA/RNA and carnitine. Betaine is a more efficient methyl donor than either methionine or choline and can reduce feed cost by "sparing" some added methionine and choline in poultry feeds Haldar *et al*. (2011) [5].
Cretton and Aa (2012) [3] noted that betaine at the rate of 500 gram per ton of broiler feed, with deficient in 750 gram choline choloride, 200 gram methionine as well as 750 gram of betaine in the broiler diet deficient in 1000 gram choline choloride, 300 gram methionine and birds supplemented betaine at with 1 g / kg of feed fed groups recorded higher body weight gain were compared to the control group fed without betaine. Vasanthakumar (2013) [8] also concluded that betaine hydrocholoride supplementation at the rate of 0.2 and 0.3 per cent in broiler diet resulted in no significant difference in feed consumption. On perusal of literature, studies on the effect of dietary supplementation of betaine HCl on growth in broilers are scanty. Hence the objective of study to investigate the growth performance in broilers during the supplementation of betaine hydrochloride (betaine HCl) as feed additive.

Materials and Methods
The growth of betaine HCl supplemented broilers were evaluated based on their performance. One hundred – and – ninety two, day-old Vencobb – 400 strain commercial broiler chicks were used as the experimental birds. All the birds were identified with wing bands placed in the wing web of the right wing on each bird on day old, and were weighed individually. The birds were allotted to four dietary treatment groups, with four replications of 12 chicks each randomly in a Completely Randomized Design. An experiment was designed and conducted at the University Poultry and Duck Farm, College of Veterinary and animal sciences, Mannuthy, Kerala.
The experimental feed (in mash form) was formulated using corn and soyabean meal as per BIS (1992) [2] specifications and data is presented in Table 1. 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. The ingredient composition of the experimental broiler starter and finisher rations are presented in Table.1.

Broiler starter ration were fed up to four weeks of age and then switched over to broiler finisher ration for the last two weeks. The birds were provided with feed and water *ad libitum*. Feed consumption by the birds in each replicate, was calculated weekly.

The birds in each replicate were weighed at the beginning of the trial and subsequently at the end of every week at morning hours. Birds were individually weighed and mean live weight per replicate was obtained. From these data mean weekly weight gain of birds in each replicate was calculated. Mean weekly feed conversion ratio was calculated by dividing the feed consumed by the live weight gain during the same period. Mortality was recorded at occurrence and livability was calculated.

The data collected on various parameters were statistically analyzed as per the methods of Snedecor and Cochran (1994) [7] and the means of different experimental groups were also tested by using Duncan's Multible Range Test (DMRT) in SPSS Version 20.0.

Results and Discussion

The weekly body weight of birds belonging to the groups T_1, T_2, T_3 and T_4 at six weeks of age were 2078.38, 2145.83, 2249.19 and 2215.44 g respectively and the data is presented in Table 2.

The results revealed that the initial body weights were similar for all the treatments and there was significant difference in body weight between treatments throughout the study due to dietary inclusion of betaine HCl. On day 7, all the birds fed rations T_2, T_3 and T_4 recorded higher ($P\leq0.01$) body weights than those fed ration T1. Similar trend was noticed up to 21st day. On day 28, birds fed rations T_3 had higher body weight than other treatment groups fed rations T_1 and T_4 but birds fed rations (T_1 and T_4) and (T_2 and T_4) as well as (T_2 and T_3) were having similar body weights. On day 35, the betaine HCl (500 ppm) supplemented birds fed rations (T_3) had significantly higher body weight than other treatment groups fed rations T_1 and T_4 but at the same time those fed (T_1, T_2 and T_4) as well as (T_2, and T_3) were similar. On day 42, dietary inclusion of betaine HCl at 500 ppm (T_3) ration fed birds recorded significantly higher ($P\leq0.01$) body weight than those fed rations T_1 and T_2 but at the same time birds fed rations (T_1 and T_2) and (T_2 and T_4) as well as (T_3 and T_4) were having similar body weights.

This is in accordance with the findings of Enting *et al.,* (2007) [4], Mailfert and Driver (2008) [6] and Vasanthakumar (2013) [8] who found significant ($P\leq0.05$) influence/increase in weight gain by betaine supplementation in broilers. Statistical analysis of mean body weight gain and average daily gain during the study period revealed significant difference in body weight gain of broilers between treatments throughout the experiment due to dietary inclusion of betaine HCl. On day 7 and 14 the betaine HCl supplemented birds fed rations T2, T3 and T4 recorded significantly higher body weight gain than those fed control ration T1. On day 21, 28, 35 and 42, dietary inclusion of betaine HCl at 500 ppm (T_3) resulted in higher body weight gain ($P\leq0.001$), ($P\leq0.01$), ($P\leq0.05$) and ($P\leq0.01$) respectively. In the present study betaine supplementation resulted in better body weight gain which is an agreement with the findings of Attia *et al.,* (2005) [1] in broilers.

The data on mean cumulative weight gain and average daily gain of birds upto six weeks of age fed four dietary treatments are presented in Table 3. The mean cumulative body weight gain and average daily gain of birds belonging to the groups T_1, T_2, T_3 and T_4 at six weeks of age were 2030.92, 2098.83, 2202.27 and 2167.79 and 48.36, 49.97, 52.44 and 51.61 g respectively. The cumulative feed intake of birds on dietary treatments of groups T_1, T_2, T_3 and T_4 were 3853.50, 3836.54, 3989.52 and 3875.04 g respectively and presented in Table 4.

Statistical analysis of cumulative feed consumption (g/bird) revealed significant difference in feed consumption of broilers between treatments throughout the experiment due to dietary inclusion of betaine HCl except on day 35 and 42. On day 7 and 14 in betaine HCl supplemented birds fed rations T_2, T_3 and T_4 feed consumption was significantly higher ($P\leq0.01$) and ($P\leq0.05$) respectively. On day 21, betaine HCl supplemented rations fed birds T_2 and T_3 recorded higher feed consumption than those fed T_1 and T_4 rations ($P\leq0.05$). On day 28, birds fed ration T_3 recorded higher ($P\leq0.05$) feed consumption than those fed T_1, T_2 and T_4). On day 35 and 42 there was no significant difference among treatment groups in feed intake.

This is in agreement with the results of Haldar *et al*. (2011) [5] who reported that the feed intake improved with dietary betaine supplementation when compared to the positive control group.

The data on cumulative feed conversion ratio (FCR) of experimental birds maintained on four dietary treatments at weekly intervals are represented in Table 5. The mean cumulative FCR of experimental birds maintained on T_1, T_2, T_3 and T_4 at the sixth week of age were 1.90, 1.83, 1.81 and 1.79.

There was no significant difference in feed conversion efficiency from 0 to 4 weeks of age. However, statistical analysis of cumulative feed conversion ratio data revealed that there was significant difference among treatment groups on fifth and sixth week. On day 35, birds fed treatment rations T_2, T_3, T_4 had highest ($P\leq0.05$) feed efficiency than those fed control ration (T_1). On day 42, dietary inclusion of betaine HCl at 750 ppm (T_4) resulted in highest ($P\leq0.01$) feed efficiency followed by betaine HCl at 500 ppm and 250 ppm (T_2 and T_3) than the control (T_1) group fed without betaine HCl. Similar to the results obtained in this study, better feed efficiency in broilers was reported with betaine supplementation by Attia *et al.,* (2005) [1]. The per cent livability from 0 to 42nd day age of broilers as influenced by dietary inclusion of betaine HCl was 100 per cent in all the treatment groups. The result clearly implies that dietary betaine HCl has no adverse effect on livability.

The per cent livability from 0 to 42nd day age of broilers as influenced by dietary inclusion of Betaine HCL was 100 per cent in all the treatment groups.

Table 1a: Ingredient composition of broiler starter rations, %

Ingredients	Broiler starter rations, %			
	T1	T2	T3	T4
Yellow maize	53.00	53.00	53.00	53.00
Soyabean meal	41.70	41.70	41.70	41.70
Vegetable fat	1.00	1.00	1.00	1.00
Dicalcium phosphate	2.30	2.30	2.30	2.30
Calcite	1.10	1.10	1.10	1.10
Salt	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Vitamin B-complex[1]	0.01	0.01	0.01	0.01
Vitamin AB_2D_3K mix[2]	0.0125	0.0125	0.0125	0.0125
Toxin binder[3]	0.10	0.10	0.10	0.10
Anticoccidial [4]	0.02	0.02	0.02	0.02
Choline chloride[5]	0.1	0.1	0.1	0.1
Trace mineral mixture[6]	0.1	0.1	0.1	0.1
Total	100	100	100	100
To 100 kg of the above mixture the betaine HCL added as below				
Betaine HCl	Nil	250 ppm	500 ppm	750 ppm
Cost per kg feed[7], Rs.	32.07	32.10	32.13	32.16

Table 1b: Ingredient composition of broiler finisher rations, %

Ingredients	Broiler finisher rations, %			
	T1	T2	T3	T4
Yellow maize	61.00	61.00	61.00	61.00
Soyabean meal	33.20	33.20	33.20	33.20
Vegetable fat	1.35	1.35	1.35	1.35
Dicalcium phosphate	2.40	2.40	2.40	2.40
Calcite	1.13	1.13	1.13	1.13
Salt	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20
Vitamin B-complex[1]	0.01	0.01	0.01	0.01
Vitamin AB_2D_3K mix[2]	0.0125	0.0125	0.0125	0.0125
Toxin binder[3]	0.10	0.10	0.10	0.10
Anticoccidial [4]	0.02	0.02	0.02	0.02
Choline chloride[5]	0.1	0.1	0.1	0.1
Trace mineral mixture[6]	0.1	0.1	0.1	0.1
Total	100	100	100	100
To 100 kg of the above mixture the betaine HCL added as below				
Betaine HCl	Nil	250 ppm	500 ppm	750 ppm
Cost per kg feed[7], Rs.	29.45	29.48	29.51	29.54

Note:

[1]Vitamin B-complex (Meriplex-Vesper Pharmaceuticals Group Pvt., Ltd. Bangalore) containing Vitamin B_1-8 mg, Vitamin B_6-16 mg, Vitamin B_{12}-80 mg, Niacin-120 mg, Calcium pantothenate- 80 mg and Vitamin E_{50}-80 mg per gram, Folic acid-8mg and Calcium-86mg.

[2]Rovimix A, B_2, D_3, K (DSM Nutritional Products) containing Vitamin A- 82,500 IU, Vitamin B_2-50 mg, Vitamin D_3-12,000 IU and Vitamin K-10 mg per gram.

[3]UTPP- 5 Powder contains treated Aluminosilicates, Propionates, Formates and Acetates. (Bio-Tech, Bangalore)

[4]ZURICOX, Composition per kg- Equivalent to 0.5% Diclazuril. (Alembic Limited, Vadodara, Gujarat.)

[5]ANICHOL 60%. (Jubilant Life Sciences, Noida, Uttar Pradesh)

[6]Supplimin-TM, each kg contains- manganese sulphate equivalent to elemental manganese 54 g, zinc sulphate equivalent to elemental Zinc 52 g, ferrous sulphate equivalent to elemental Iron 30 g, copper sulphate equivalent to elemental copper 4 g, potassium iodide equivalent to elemental iodine 1 g, cobalt sulphate equivalent to elemental cobalt 0.1 g, chromium chloride equivalent to elemental chromium 0.2 g, Selenomethionine 100 ppm.

[7]Cost calculated as per the rate contract for ingredients fixed by the College of Veterinary and Animal Sciences Mannuthy for the year 2014-2015.

Table 2: Weekly body weight of birds maintained on four experimental rations, g

Treatment[1]	Day one	7th day	14th day	21st day	28th day	35th day	42nd day
T1 (Control)	47.46 ±0.51	151.19 a ±3.23	392.67 a ±7.92	748.63 a ±11.43	1182.50 a ±16.61	1684.44 a ±23.87	2078.38 a ±28.03
T2 (250 ppm betaine HCl)	47.00 ±0.59	171.92 b ±2.83	430.85 b ±7.13	803.79 b ±12.25	1247.10 bc ±17.56	1741.08 ab ±26.50	2145.83 ab ±35.05
T3 (500 ppm betaine HCl)	46.92 ±0.56	164.65 b ±2.74	432.69 b ±6.08	819.79 b ±12.10	1291.21 c ±19.42	1792.46 b ±29.14	2249.19 c ±39.75
T4 (750 ppm betaine HCl)	47.65 ±0.55	168.94 b ±2.67	438.19 b ±5.50	786.25 b ±11.32	1222.38 ab ±17.20	1714.81 a ±23.07	2215.44 bc ±33.44
F value	0.403ns	10.139**	9.623**	6.731**	6.595**	3.161*	4.893**
P value	0.751	0.001	0.001	0.001	0.001	0.026	0.003

[1]Each value is a mean of 48 observations
ns – non significant (*P*>0.05), **significant at 0.01 level
*Means bearing different superscripts within same column differ significantly (*P*≤0.05)

Table 3: Cumulative body weight gain and average daily gain of birds maintained on four experimental rations, g

Treatment[1]	7th day	14th day	21st day	28th day	35th day	42nd day	ADG
T1 (Control)	103.73 a ±3.16	345.21 a ±7.88	701.17 a ±11.39	1135.04 a ±16.57	1636.98 a ±23.82	2030.92 a ±28.00	48.36 a ±0.67
T2 (250 ppm betaine HCl)	124.92 b ±2.54	383.85 b ±6.92	756.79 bc ±12.11	1200.10 bc ±17.42	1694.08 ab ±26.40	2098.83 ab ±34.93	49.97 ab ±0.83
T3 (500 ppm betaine HCl)	117.73 b ±2.53	385.77 b ±5.93	772.88 c ±12.01	1244.29 c ±19.33	1745.54 b ±29.08	2202.27 c ±39.68	52.44 c ±0.94
T4 (750 ppm betaine HCl)	121.29 b ±2.51	390.54 b ±5.40	738.60 b ±11.14	1174.54 ab ±17.04	1677.17 a ±22.92	2167.79 bc ±33.27	51.61 bc ±0.79
F value	11.792**	10.065**	6.979**	6.758**	3.222*	4.934**	4.934*
P value	0.001	0.001	0.001	0.001	0.024	0.003	0.03

[1]Each value is a mean of 48 observations
*Means bearing different superscripts within same column differ significantly (*P*≤0.05)
ADG- Average daily gain, **significant at 0.01 level

Table 4: Cumulative feed intake of birds maintained on four experimental rations, g

Treatment[1]	7th day	14th day	21st day	28th day	35th day	42nd day
T1 (Control)	136.23 a ± 2.48	499.65 a ± 6.46	1089.44 a ± 3.93	1897.60 a ± 19.90	2870.33 ± 27.43	3853.50 ± 32.39
T2 (250 ppm betaine HCl)	160.10 b ± 2.71	544.04 b ±7.98	1141.02 b ± 17.96	1948.63 ab ± 38.80	2870.92 ± 35.48	3836.54 ± 71.72
T3 (500 ppm betaine HCl)	160.94 b ± 3.25	554.98 b ±11.92	1166.00 b ± 13.42	2033.29 b ± 18.53	2953.13 ± 25.74	3989.52 ± 36.66
T4 (750 ppm betaine HCl)	163.33 b ± 5.93	544.04 b ± 4.90	1125.52 ab ± 15.97	1909.73 a ± 39.35	2807.42 ± 42.91	3875.04 ± 90.34
F value	10.873**	8.890*	5.314*	3.964*	3.162 ns	1.215ns
P value	0.01	0.02	0.015	0.035	0.064	0.346

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

Table 5: Cumulative feed conversion ratio of birds maintained on four experimental rations

Treatment[1]	7th day	14th day	21st day	28th day	35th day	42nd day
T1 (Control)	1.31 ±0.01	1.45 ±0.03	1.55 ±0.01	1.67 ± 0.01	1.75 a ±0.01	1.90 a ±0.02
T2 (250 ppm betaine HCl)	1.28 ±0.02	1.42 ±0.01	1.51 ±0.01	1.62 ±0.02	1.69 b ±0.01	1.83 b ±0.01
T3 (500 ppm betaine HCl)	1.35 ±0.01	1.43 ±0.02	1.51 ±0.02	1.63 ±0.02	1.69 b ±0.01	1.81 b ±0.02
T4 (750 ppm betaine HCl)	1.35 ±0.04	1.39 ±0.01	1.52 ±0.01	1.63 ±0.01	1.68 b ±0.01	1.79 b ±0.01
F value	1.962ns	1.575 ns	2.320 ns	3.008 ns	5.417*	8.206**
P value	0.174	0.247	0.127	0.072	0.014	0.003

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

Conclusion

The effect of betaine HCl was found to be significantly increasing in case of body weight from 7th day to 42nd day of age. The birds fed with betaine HCl supplemented 500 ppm had highest body weight gain compared with other groups. The effect of betaine HCl was found to be significant

(P<0.01) for body weight at 42nd days of age. The effect of betaine HCl found to be significantly increasing (P<0.05) for cumulative body weight gain at 42nd days of age. The effect of betaine HCl was found to be significant (P<0.01) for average daily gain at 42nd days of age. The cumulative feed intake did not show any significant difference (P>0.05) among different dietary treatment groups on 42nd day. The effect of betaine HCl supplementation was found to be significant (P<0.01) for cumulative FCR at 42nd days of age. Livability was 100 per cent in all the treatment groups throughout the experimental period.

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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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