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Effect of Supplementing Betaine on Productive Performance of Broiler Chickens Fed Diets Containing Different Levels of Choline

Sanaa A. M. AL-Hameed*[1], Abbas. S.H. AL- Machi[2] and Jassim K.M. Al-Gharawi[2]

[1]College of Agricultural Engineering Science, University of Baghdad, Iraq
[2]College of Agriculture, University of Al-Muthanna, Iraq
Corresponding Author: Sanaa A. M. AL-Hameed **Email**: Sanaa.a@coagri.uobaghdad.edu.iq

ABSTRACT

The objective of this study was to determine the effects of supplemental betaine and choline on productive performance of broiler chickens. A total of 240 one-day old of Ross strain unsexed chicks were randomly distributed into four treated groups: T1control group (basal diet without any addition)،T2, T3and T4 were content basal diet plus 6000 *PPM* betain and 0.5,1.0,1.5 gm choline / kg feed respectively. The results showed that the diet with 6000 *PPM* betaine supplementation plus 1.5gm choline/ kg feed increased (P <0.05)live body weight ،body weight gain ,and the feed conversion ratio at (2-5) week of age, however feed consumption during the 3rd to the 5th weeks of age. Meanwhile an improving in dressing percentage and reducing in mortality rate of birds were seen during the completely rearing period.

Keywords: Broiler, Betaine, Choline, Performance

Correspondence:
Sanaa A. M. AL-Hameed
College of Agricultural Engineering Science, University of Baghdad, Iraq.
Email: Sanaa.a@coagri.uobaghdad.edu.iq

INTRODUCTION

Betaine and choline are considered the most important donor compounds for methyl group (CH_3) that live body needs in its metabolic reactions, especially when subjected to any challenge. The biosynthesis of betaine is made by choline oxidation (Klasing *et al*., 2002), In chicks, betaine donates a methyl group (CH3) to homocysteine for the synthesis of methionine three times more than choline, it can replace part of methionine depending on the concentration of the cysteine in the diet (Waldroup, *et al*., 2006 and Rama *et al*, 2011). Betaine plays main role in metabolism, it acts as an osmolyte to help maintain cell water homeostasis, Kettunen *et al*. (2001) and Eklund *et al*. (2005) reported that the addition of betaine in poultry diets has reduced the risk of body dehydration and facilitated the process of water retention inside the living cell, especially intestinal cells. The osmo-protective property of betaine is due to the dipolar zwitterions and its high solubility in water (Shakeri *et al*., 2018). In broiler chicken's supplementation at various levels of betaine indicates some improvement on performance and carcass quality (Waldroup *et al*.,2006; Dilger *et al*.2007; Rama *et al*., 2011; Sakomura *et al*.2013; Nofal *et al*.2015; Shakeri *et al*.2018; Mahoudi *et al*,2018; Wenchao *et al*.2019; Hosam *et al*.,2019 and Park and Kim,2019). It is well known that choline is a water soluble vitamin, it is an important source of methyl group for the methylation of homocysteine or functions as organic osmolyte (Pillai et.al, 2006.) It used for the synthesis of acetylcholine which is responsible for the transmission of nerve impulses and phosphatidil, choline is responsible for the integrity of cell membranes, and plays an important role in the metabolism of fat in the liver its deficiency is associated with fatty liver. Supplementation of choline in broiler diet improves feed intake, feed efficiency and weight gain (Waldroup *et al*., 2006; Dilger *et al*., 2007; Hossain *et al*. 2014; Farina *et al*.2017; and Chandharil *et al*.,2017)

The present study conducted to determine the effect of supplementing broiler chickens' diet with betaine and choline on broiler performance.

MATERIALS AND METHODS

A total of 240 unsexed one- day old Ross strain chicks were randomly distributed into four treated groups: T1(control group) consist of basal diet without any addition ،T2,T3and T4 were considered the treated diets which content basal diet plus 6000*PPM* betain and 0.5,1.0,1.5 gm choline / kg feed respectively. The chicks were fed starter ration for the first 21 days of age and grower ration for 22-42 days of age according to the strain catalog recommendation (table1) .Lighting regime was provided constantly during experimental period, the live body weight ، body weight gain ,feed consumption and the feed conversion ratio calculated weekly ،mortality rate ،dressing percentage and the productive index were calculated at the end of the experiment . A completely randomized design (CRD) within the statical analysis system (SAS,2001) was used to analyse the data for the effect of difference factors between the values of the studied parameters.

Table1. Composition and chemical calculated analysis of the experimental diets.

Ingredient	Starter ration% (1-21) days	Grower ration% (22-35) days
yellow corn	591	630
Soybean meal	360	318
Broiler premix*	25	25

Sunflower oil	6	12
DCP	7	4
Limestone	10	10
Vitamins and minerals	1	1
Total	1000	1000
Calculated analysis**		
Crude Protein	22	20
Metabolizable energy kcal / kg of feed	2960	3040
Lysine	1.47	1.36
Methionin	0.53	0.48
Methionin + cysteine	0.96	0.92
Calcium	0.96	0.90
Avialable phosphorus	0.47	0.45
Crude fat	2.7	2.9
Crude fiber	2.8	2.8
C/P ratio	134.5	152

* Broiler premix: DUFAMIX 964 ABAZ BROILER PREMI INCLSION 2.5%:
Moisture:1.36, Crude Protein:18.46, Metabolizeble Energy:2075Kcal/Kg, Crude Ash:7.33, Crude Fiber:0.81, Crude Fat:0.40, Calcium:18.23, Available Phosphorus:9.6, Magnesium:0.2, Potassium:0.15, Sulpher:2.12, Sodium:6.40, Lysine:8.23, Methionine:8.30, Meth.+Cyst.:9.15, Tryptophan:0.16, Threnine:1.28, Valine:1.13, Arginine:0.83, Histden:0.54, Glutamic:2.4, Aspartic:2.08, Tyrosine:0.53, Phenyle Alanine:0.76, Alanine:0.78, Leusine:1.37 and all the Necessary Vitamins and Minerals
**NRC (1994)

RESULTS AND DISCUSSION

The effects of supplementation of betaine and choline to broiler diets on the live body weight are presented in table 2. The data showed that the addition treatments (T2, T3and T4) resulted to significant increase (P<0.05) in live body weight as compared to T1(control) at the 2nd week. Treatment 4 which contained (6000 *PPM* of betaine and 1.5mg choline / kg feed) gave the highest rate of live body weight at 3rd,4th and 5th weeks of age as well as in calculating the whole mean of this trait as compared to T1, T2, T3. The data of table 3 revealed also that the addition treatments (T2, T3and T4) resulted significant increases (P<0.05) in the means of weight gain at the 2nd week of age. Meanwhile during 3rd, 4th and 5th weeks of age and in calculated the final weight gain of birds gave T4 the highest weight gain in comparing to those produced in T2, T3 and T1. No significant differences between all treatments in the means of feed consumption during the 1st and 2nd weeks of age (table 4) meanwhile the differences became significant (P<0.05) at the 3rd, 4th, 5th and the whole mean of this trait. The highest feed consumption recorded in T4 as compared to other supplemented groups while the less feed consumption was noticed in birds of group T1(table 4). It can be seen also from table 5 that during (3-5) weeks of age, T4 and T3 recorded significantly (P<0.05) best feed conversion ratio as compared to T2 and T1, as well as in calculating the whole mean of this trait.

Table 2. The effect of dietary supplementation of betaine and different levels of choline on live body weight of birds (gm) (±se)

Treatments	Age in weeks				
	1	2	3	4	5
T 1	160.47 ±0.82	354.14 ±1.26b	632.27 ±3.79d	1042.18 ±8.29d	1623.74 ±11.68d
T 2	159.92 ±0.58	367.37 ±1.18 a	651.56 ±4.02c	1086.32 ±7.86c	1711.65 ±10.83c
T 3	161.22 ±0.63	370.33 ±1.33a	663.48 ±3.42b	1113.36 ±7.17b	1769.17 ±11.26b
T 4	160.79 ±1.01	373.15 ±1.21a	682.03 ±3.63a	1160.52 ±8.06a	1874.22 ±9.93a
Significance Level	NS	*	*	*	*

T1: control treatment without any addition T2,T3and T4 basal diet plus 6000*PPM* betain and 0.5,1.0,1.5 gm choline / kg feed respectively NS:no significant *different letters in the same raw are significantly different(p<0.05)

Table 3. The effect of dietary supplementation of betaine and different levels of choline on weight gain of birds(gm)(±se)

Treatments	Age in weeks					Total weight gain
	1	2	3	4	5	
T 1	128.66 ±0.42	193.67 ±2.03b	278.13 ±2.94c	409.91 ±4.17d	581.56 ±4.62d	1591.93 ±13.39d
T 2	128.83 ±0.56	207.45 ±2.11a	284.19 ±3.11bc	434.76 ±3.62c	625.33 ±3.90c	1680.56 ±11.22c
T 3	130.66 ±0.39	209.11 ±1.98a	293.15 ±2.73b	449.88 ±3.18b	655.81 ±4.11b	1738.61 ±13.18b
T 4	131.00 ±0.42	212.36 ±1.85a	308. 88 ±0.04a	478.49 ±3.80a	713.70 ±4.07a	1844.73 ±10.85a
Significance Level	NS	*	*	*	*	*

T1: control treatment without any addition T2, T3and T4 basal diet plus 6000*PPM* betain and 0.5,1.0,1.5 gm choline / kg feed respectively NS:no significant *different letters in the same raw are significantly different($p<0.05$)

Table 4. The effect of dietary supplementation of betaine and different levels of choline on feed consumption ((gm\ bird \day) (±se)

Treatments	Age in weeks					feed consumption
	1	2	3	4	5	
T 1	136.80 ±0.78	360.69 ±2.87	4 55. 17 ±4. 6 8c	702.72 ±6.35c	1140.36 ±9.72d	2795.74 15.66d
T 2	137.41 ±0.88	370.11 ±2. 36	4 60.31 ±3. 76 bc	726.44 ±5.87b	1184.69 ±8.99c	2878.96 18.18c
T 3	137.70 ±0.75	373.47 ±2. 44	469. 48 ±4.12b	740.78 ±5.68b	1215.44 ±8.72b	2936.87 11.95b
T 4	139.60 ±0.83	374.12 ±2. 25	484. 35 ±2.84a	776.42 ±6.16a	1284.87 ±6.87a	3059.36 16.29a
Significance Level	**NS**	**NS**	*	*	*	*

T1: control treatment without any addition T2,T3and T4 basal diet plus 6000*PPM* betain and 0.5,1.0,1.5 gm choline / kg feed respectively NS:no significant *different letters in the same raw are significantly different($p<0.05$)

Table 5. The effect of dietary supplementation of betaine and different levels of choline on feed conversion ratio (gm feed\gm weight gain) (±se)

Treatments	Age in weeks					Feed conversion ratio
	1	2	3	4	5	
T 1	1.06 ±0.007	1.95 ±0.009 b	1.64 ±0.014b	1.7 1 ±0.010c	1.96 ±0.011c	1.75 ±0.011b
T 2	1.07 ±0.006	1.87 ±0.004 a	1.62 ±0.011b	1.67 ±0.003b	1.89 ±0.011b	1.62 ±0.008a
T 3	1.05 ±0.006	1.87 ±0.006a	1.60 ±0.012ab	1.65 ±0.003b	1.85 ±0.008ab	1.60 ±0.009a
T 4	1.07 ±0.005	1.85 ±0.003a	1.57 ±0.010a	1.62 ±0.002a	1.80 ±0.006a	1.67 ±0.005a
Significance Level	**NS**	*	*	*	*	*

T1: control treatment without any addition T2, T3and T4 basal diet plus 6000 *ppm* betain and 0.5,1.0,1.5 gm choline / kg feed respectively NS:no significant *different letters in the same raw are significantly different($p<0.05$)

The improvement of broiler performance in this study could be due to the nutritional effects of betaine and choline as that they considered the most important donor compounds for methyl group (CH_3) which the body needs in its metabolic reactions,especially when subjected to any challenge(Rama,2008). Betaine which donates methyl groups for methylation of homocysteine to methionine which is a prerequisite for the formation of protein in the body and thus improve the performance of birds(Zarei, *et al*, 2008; Rama et.al, 2011; Igwe, 2015 and Chandhari et.al, 2017). Honarbakhsh and Somero (2007) refared that the absorption of nutrients depends on intestinal epithelium and betaine contributes to protecting the intestinal epithelium as well as improving the digestion of nutrients.

These results agree with that recorded by (Hossain *et.al*, 2014; Igwe *et.al*,2015 and Alagawany *et.al*,2015)that the addition of betaine to broiler diets has improved the feed consumption and enhanced feed conversion ratio and with (Waldroup *et al*., 2006; Dilger *et al*., 2007; Hossain *et al*. 2014 and Chandharil *et al*.,2017; Wang,2018) by the role of choline inside the body as it is used to synthesize phosphatidylcholine which is responsible for the integrity of cell membranes and thus improve the production performance of poultry, and due to its role in fat metabolism, it is metabolized to different compounds in including phosphatidyl choline essential for cell membrane integrity and acetylcholine involved in neurotransmission ((Pillai et.al, 2006).

The mortility percentage recorded significant increase($P<0.05$) (Table 5) in the comparative birds group(8.33%)compared with T2, T3, T4 which did not differ significantly with each other (3.33,3.33,1.66) due to the role of choline in preventing the accumulation of fat in the liver as well as its role in the prevention of deformation and curvature of the legs(Ryu et.al, 1995).

Table 6: The effect of dietary supplementation of betaine and different levels of choline on the mortality percentage and productive index of birds (±se)

Treatments	(%)mortality rate	productive index
T 1	8.33 ±1.66a	241.64 ±1.45c
T 2	3.33 ±1.66b	274.86 ±1.11b
T 3	3.33 ±1.66b	287.44 ±0.71b
T 4	1.66 ±1.00b	317.23 ±1.16a
Significance Level	*	*

T1: control treatment without any addition T2, T3and T4 basal diet plus 6000*Ppm* betain and 0.5,1.0,1.5 gm choline / kg feed respectively *different letters in the same raw are significantly different($p<0.05$)

It is noted from Table (6) also that the treatment T4 gave the highest mean of the production index ($p<0.05$) compared with T2and T3 that did not morally differ with each other and with T1. The improvement of the index of the production index may be attributed to the improvement in the production performance of the experimental factors, indicating the high weight of the marketed bird, the decrease in the rate of destruction and the improvement of the feed conversion ratio.

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