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EFFECT OF SUPPLEMENTATION OF METHIONINE, BETAINE AND CHOLINE ON THE PERFORMANCE OF BROILER CHICKEN IN EARLY LIFE FED METHIONINE DEFICIENT RATION

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ABSTRACT

The experiment was designed and conducted to evaluate the effect of methionine, betaine and choline in the broiler chicks given low methionine starter ration. Day old broiler chicks (n=250), were randomly divided into five treatment groups (n=5) with five replicates of ten chicks. A low methionine (LM) starter ration was formulated and the treatment groups were (A) LM supplemented with methionine @ 0.14%, (B) LM, (C) LM supplemented with choline @ 0.17%, (D) LM supplemented with betaine @ 0.14% and (E) LM with Betaine @ 0.07% in the starter ration. Choline was added @ 700 mg/kg to treatment groups (A and B). Data of weight gain (WG) and feed intake (FI) were collected from 0-28 days and feed conversion ratio (FCR) was calculated. Statistical analysis of data revealed significant differences among the treatment groups in FI, WG and FCR ($P<0.05$). Supplementation of Choline and betaine to treatment groups C, D and E respectively did not show results as per treatment group (A) supplemented with methionine. However, betaine supplementation showed better WG and FCR as compared to treatment B and C ($P<0.05$); but the inclusion rate of betaine had no significant effect on the performance of broiler chicken ($P>0.05$).

Key words: betaine, broiler, choline, methionine, performance.

INTRODUCTION

Methionine is the second limiting amino acid after lysine. According to NRC (1994) the concentration of methionine in the starter ration should not be less than 0.5%. It is required in metabolic functions such as protein synthesis and as a methyl donor. As a methyl donor methionine is activated to S-Adenosyl methionine (SAM), utilized in number of body reaction, such as maintenance of DNA, formation of epinephrine and choline. The amount of methionine needed by the body to provide SAM is far in excess than dietary intake of methionine (Sylvia, 2009). Choline and folic acid are methyl donors; folic acid has to take methyl group before liberating methyl group; while, choline first has to be activated and then converted to betaine before methyl groups are liberated to fulfill the methylation function (McKeever *et al*., 1991). Dietary choline is preferentially used for biosynthesis of acetylcholine (i.e. neurotransmission) and phosphatidylcholine (i.e. cell membrane integrity) (Dilger *et al*., 2007).

The Basic metabolic role of betaine as a methyl donor and osmoprotectant has been recognized (Barak *et al*., 1993). Recent research findings regarding the methylation function of betaine have demonstrated that, when one of the two biochemical pathways (Vit. B_{12} dependant and independent) in the conversion of homocysteine to methionine is inhibited, betaine can be used to convert homocysteine to methionine in the transmethylation pathway in the liver (Barak *et al*., 1996). Betaine needs not any activation, once in the cystol regardless of its origin is used to methylate Homocysteine to methionine through the action of the enzyme betaine homocysteine methyl transferase (BHMT) (McKeever *et al*., 1991, Dilger *et al*., 2007). The metabolic product of betaine (dimethyl glycine and sarcosine) contributes methyl groups used for the formation of the activated folic acid (Devlin, 1982) and conversion of homocysteine to methionine (Barak *et al*., 1996). The objective of the present study was to find out the effect of low methionine diet and replacement of methionine with betaine and choline on the performance of broiler chicken during early life and to assess the capacity of betaine to support chick growth when included in a choline-free diet.

MATERIALS AND METHODS

Two hundred and fifty (n=250), day old Hubbard male chicks were reared in the battery brooder. Chicks were randomly divided into five treatments groups, fifty chicks in each treatment group with five replicates of ten chicks under completely randomized designed. A low methionine (LM) feed @ 0.36% (28% less than NRC) was formulated. The Five treatment groups were (A) LM supplemented with methionine @ 0.14% (B) LM (C) LM with choline chloride @ 0.17% (D) LM with betaine supplemented @ 0.14% and (E) LM with betaine supplemented @ 0.07% in starter diets respectively. Treatment group A, B and C were supplemented with choline as choline chloride 50% @ 700 mg/ kg of basal diet. Carefully weighed feed and water offered ad libitum. Vaccination against New castle disease and Infectious bursal disease was carried out as per schedule. Data on weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) were collected from 0-28 days on weekly intervals. The data thus collected were analyzed through analysis of and comparison of mean, was carried out with least significant difference (LSD) test using computer soft ware "MSTAT-C" (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Results of average weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) of the respective treatments are given in table 1. The feed was formulated as methionine deficient (0.36%) and the estimated cumulative quantity of sulfur amino acid (methionine + cysteine) was 0.66% in basal starter diet. The results revealed that limiting methionine had negative impact on growth performance. Supplementation of methionine @ 0.14% to the LM feed to treatment group (A) for the 28 days of experimental period revealed a statistically significant effect ($P<0.05$) as compared to group (B) given LM feed. The WG was 16.87% more than the methionine deficient treatment group (B). The addition of methionine to LM feed exhibited a better FI (4.34%) and FCR (12.93%). For the optimal growth the requirement of sulfur amino acids is 0.8% and for maximum weight gain it is suggested to be 0.93% (Pack and Schutte, 1992). Takahashi *et al*., (1994) and Vogt, (1994) reported that LM diet depressed growth; limiting the methionine had a negative effect on growth, feed intake and efficiency to utilize the nutrients. However Ohta and Ishibashi, (1995) recommended that for optimal growth, 0.30% of methionine is required irrespective of total sulfur amino acids and exceeding dietary methionine level to 0.70 % reduced growth performance and Takahashi *et al*. (1994) suggested that limiting the sulfur amino acid had no effect on carcass yield. Gorman and Balnav, (1996) reported that increasing concentration of all indispensable amino acids improve weight gain. Choline in typical feedstuffs is not completely available for absorption; however choline chloride, the common form of supplemental choline considered 100% bio-available (Emmert and Baker, 1997) and 722 mg/kg diet is optimal for normal growth (Dilger *et al*., 2007). In the present study choline as choline chloride (50 %) was added @ 700 mg/kg basal diet and treatment group (C) further supplemented @ 0.17% with choline; inclusion of choline to LM feed did not improve WG or FCR as compare to Group (A, D and E) rather had a negative effect on FI (- 6.52%) and WG (-16.88%) than treatment group A ($P<0.05$). Choline is preferentially used for biosynthesis of acetylcholine and can only supply methyl groups after it has been oxidized to betaine to convert homocysteine to methionine (Garrow *et al*., 2007). The supplementation rate of choline as choline chloride might have disturbed the ion balance resulted in lower FI and WG. Choline and methionine supplementation together improved growth, but only choline supplementation at the expense of methionine to LM feed did not improve performance of the broiler (Vogt, 1994). However, Baranova (1993) suggested that inclusion of choline to the feed mixture improved growth with the inclusion rate of 500-700 g/ton of feed. Supplementation of betaine in the present study was @ 0.14% and 0.07% to treatment group (D) and (E) respectively and inclusion rate in treatment group (D) and (E) had non-significant effect on the WG and FCR ($P>0.05$); however, group (D) consumed more feed ($P<0.05$), while in both treatment groups (D & E) significantly higher WG, FI and FCR is observed over the treatment group (B) respectively ($P<0.05$). The effect of adding betaine to the feed at the expense of methionine and choline showed 6.66% and 5.64% improvement in growth by group (D) and (E) respectively as compare to treatment group (B). Virtanen and Rosi (1995) concluded that both betaine and methionine supplementation had equal improvement in growth and feed conversion as well as better carcass yield. However, Sun *et al*. (2008) and Rafique *et al*. (2000) reported that supplementation of betaine to replace 25% of total dietary methionine did not

Table-1: Mean Weight Gain (gms), Feed Intake (gms) and Feed Conversion Ratio with SEM (0-28 Days)

Parameters	Treatment Groups				
	A	B	C	D	E
WEIGHT. GAIN± SE (gms)	977.49^{a} ± 27.40	836.32^{c} ± 13.98	868.30^{bc} ±10.47	892.02^{b} ±5.25	883.56^{b} ±3.89
FEED INTAKE ± SEM (gms)	1735.30^{a} ±37.48	1659.90^{b} ±23.26	1629.01^{b} ±19.18	1683.36^{ab} ±22.17	1627.66^{b} ±12.56
FCR± SEM	1.77^{c} ±0.017	2.00^{a} ±0.018	1.87^{b} ±0.020	1.87^{b} ±0.015	1.83^{b} ±0.015

* Mean presented in a row with different superscript indicate significant difference ($P<0.05$).

improve the growth performance of the broilers. Similarly, negative effect of betaine has been reported by Rostagno and Pack, (1996). While, Dilger *et al*. (2007) suggested that betaine can spare choline but still 150mg/diet has to be supplied as supplement. Waldroup *et al*. (2006) suggested that either choline or betaine supplementation had marginal methionine sparing effect. The findings of the present study revealed that treatment group (D) supplemented with betaine had 6.66% higher WG as per treatment group (B).

In conclusion, it is suggested that betaine can partially spare methionine and choline in broiler chicks, but the over all performance of the methionine supplementation along with choline might have resulted in additive effect on the growth performance. Further experimentation on the subject may be carried out to establish the fact that methionine can be partly provided by other available analogue.

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