International Scholars Journals

African Journal of Poultry Farming ISSN 2375-0863 Vol. 7 (7), pp. 001-003, July, 2019. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Short Communication

Performance of broiler chicken in early life on methionine deficient feed with added choline and betaine

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Accepted 22 December, 2018

The experiment was designed and conducted to evaluate the availability of betaine (betaine anhydrous 97%) as methionine sparing for broilers. Two hundred and fifty day-old chicks were randomly divided into five treatment groups which were divided into five replicates of ten chicks each. Primarily, a single starter ration deficient in methionine was formulated using NRC standards. The five treatment groups were; (A) Positive control supplemented with methionine, (B) Low Methionine (LM), (C) LM supplemented with choline at 0.17%, (D) LM supplemented with Betaine (0.14%) and (E) LM with Betaine at 0.07% in the starter ration. Choline was added at 700 mg/kg to Treatments A and B. Weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) data was collected on a weekly basis from 0 to 28 days. Statistical analyses 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 B, C, D and E respectively did not show results as per Treatment A supplemented with methionine. However, betaine supplementation showed better WG and FCR to Treatments B and C (P<0.05). Inclusion rate of betaine had no significant effect (P>0.05).

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

INTRODUCTION

Methionine (MET) is the second limiting amino acid after lysine. According to NRC (1994), the concentration of MET in the starter ration should not be less than 0.5%. It is required in a number of metabolic functions such as protein synthesis and as a methyl donor. As a methyl donor, MET is activated to S-Adenosyl Methionine (SAM), utilized in a number of body reactions such as the maintenance of DNA, formation of epinephrine and choline. The amount of MET needed by the body to provide SAM is far in excess than the dietary intake of MET. Thus the remethylation of homocysteine allows the conversion to methionine. Choline and folic acid are methyl donors; folic acid has to take a methyl group before liberating a methyl group while choline, first, has to be activated and then converted to betaine before methyl groups are liberated to fulfill its methylation function (McKeever et al., 1991). Dietary choline is preferentially used for biosynthesis of acetylcholine (that is neurotransmission) and phosphatidylcholine (that is cell membrane integrity) (Garrow, 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 (Vitamin B12 dependent and independent) in the conversion of homocysteine to MET is inhibited, betaine can be used to convert homocysteine to MET in the transmethylation pathway in the liver (Barak et al., 1996). Betaine needs no activation once in the cystol and regardless of its origin, it is used to methylate homocysteine to MET, through the action of the enzyme betaine homocysteine methyl transferase (BHMT) (McKeever et al., 1991; Dilger, 2007).

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The metabolic product of betaine (dimethyl glycine and sarcosine) contributes methyl groups used for the formation of activated folic acid (Devlin, 1982) and the conversion of homocysteine to methionine (Barak et al., 1996). The objective of the study was to find out the effect of low MET diet and replacement of MET 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. Thus, if betaine were able to spare choline and MET, this effect would manifest as a reduction in the total dietary MET and choline requirement.

MATERIALS AND METHODS

Two hundred and fifty 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 each. Randomized Complete Block Design was used for the statistical analysis of data. A basal diet deficient in MET was formulated. The five treatment groups were: (A) basal diet + supplemented with MET at 0.14% (Positive control), (B) basal diet (MET deficient) (Negative control), (C) basal diet + choline chloride at 0.17%, (D) basal diet + betaine supplemented at 0.14% and (E) basal diet + betaine supplemented at 0.07% in starter diets, respectively. Treatment Groups A, B and C were supplemented with choline as choline chloride 50% at 700 mg/ kg of basal diet. Data of weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) were collected from 0 to 28 days on weekly intervals. The data obtained were then analyzed using a computer software "MSTAT-C" (Russell, 1986).

RESULTS AND DISCUSSION

Results of average weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) of the respective treatments obtained after 28 days are given in Table 2. The feed was formulated as MET deficient (0.36%) and the estimated cumulative quantity of sulfur amino acid (MET + cysteine) was 0.66% in basal starter diet. Supplementation of MET to the basal diet in the positive Control Group (A) for the experimental period (28 days) revealed a statically significant effect (P<0.05) as compared to Group (B) given MET deficient basal diet. The weight gain was 16.87% more than the MET deficient Treatment Group B. The addition of MET had a better feed intake and FCR (P<0.05). For 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) suggested that low MET diet depressed growth; limiting MET had a negative effect on growth, feed intake and efficiency to utilize nutrients. However Ohta and Ishibashi (1995) suggested that for optimal growth, 0.30% of MET is required irrespective of total sulfur amino acids and exceeding dietary MET level to 0.70 % reduced growth performance and Takahashi et al., (1994) suggested that limiting sulfur amino acid had no effect on carcass yield. In the present study, data revealed that limiting MET had a negative impact on growth performance. Gorman and Balnav (1996) suggested that increasing the concentration of all indispensable amino acids improves weight gain. Choline, in typical feedstuffs is not completely available for absorption; however choline chloride, the common form of supplemental choline considered to be 100% bioavailable (Emmert and Baker, 1997) and 722 mg/kg diet is suggested by Dilger et al. (2007). In the present study choline as choline chloride (50%) was added at 700 mg/kg basal diet and Treatment Group (C) further supplemented at 0.17%. the inclusion of choline to MET deficient basal diet did not improve WG or FCR as compared to Groups (A, D and E) rather, there was a negative effect on FI; consumed 6.52% less feed and 16.88% less WG than Group A. Choline is preferentially used for biosynthesis of acetylcholine and can only supply methyl groups after it has been oxidized to betaine (Garrow, 2007) to convert homocysteine to MET. The supplementation rate of choline as choline chloride might have disturbed the ion balance and resulted in lower FI and WG. Choline and MET supplementation improved growth, but overall choline supplementation to MET deficient basal diet did not equal growth achieved with MET (Vogt, 1994). However, Baranova (1993) suggested that the 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 at 0.14 and 0.07% respectively and the inclusion rate had an insignificant effect (P>0.05), while a significantly higher gain is recorded over Treatment Groups B and C and the effect of adding betaine to the feed at the expense of MET and choline showed 6.66% improvement in growth as compared to MET deficient basal diet and choline supplemented Treatment Groups (B and C) respectively (P<0.05). Virtanen and Rosi (1995) concluded that both betaine and MET supplementation had equal improvement in growth and feed conversion as well as better carcass yield. Sun et al. (2008) also reported that supplementation of betaine to replace up to 25% of total dietary MET did not affect the growth performance of broilers. BET could be used to spare 25% of the total MET in broiler diet. However, the negative effect of betaine has also been documented (Rhone–Poulenc, 1996; Rostagno and Pack, 1996). Dilger et al., 2007 suggested that betaine can spare choline but still 150 mg/diet has to be supplied as supplement; but Waldroup et al. (2006) suggested that either choline or betaine supplementation had no apparent MET sparing effect; improvement in growth did not catch the level of MET supplemented treatment and; the WG was 9.58% less than the positive Control A (P<0.05).

Conclusion

In conclusion, it is suggested that betaine can partially spare MET and choline in chicks. This conclusion is based on the repeatable observation that betaine was able to affect chick growth performance in the MET and choline deficient diet.

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