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Betaine (Betafin®) Replacement for Methionine in Diet on Growth Performance and Carcass Characteristics of Broiler Chickens

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Abstract: An *in vivo* experiment was conducted to determine the effect of dietary betaine supplementation as a replacement for methionine on broiler performance and carcass characteristics. Three hundred day old Ross 308 broilers were used in a randomized completely design with 4 treatment and 5 replicates in each treatment and 15 birds/replicates and reared on the floor pens for 42 days. A basal diet was formulated as control according to NRC, recommendations for starter (1-21 days) and grower (22-42 days) periods. In experimental diets, methionine levels were as formulated (control (T_1)) and at 90 (T_2), 80 (T_3) and 70% (T_4) of the control. The incompleted levels of the methionine in T_2, T_3 and T_4 supplemented by adding Betafin to the diets. The result of present study indicated that feed intake was no affected by treatments ($p>0.05$). The birds under T_2 and T_4 had lower body weight gain during 1-42 days as compared with control group. Also, the using of T_4 in both of 22-42 and 1-42 days and T_2 in 1-42 days significantly resulted to undesirable feed conversion ratio ($p<0.05$). Supplementation levels of betafin in diets no significantly ($p<0.05$) affected the amount of carcass and its cuts ($p>0.05$), except the percent of thigh was significantly higher than control group ($p<0.05$).

Key words: Betfin, methionine, diet, performance, carcass, broiler

INTRODUCTION

Methionine is an essential amino acid for poultry and is crucial to several metabolic reactions, such as the synthesis of carnitine and creatine. It is well understood that choline may act as a methyl group donor but, in order to function as a methyl group donor, it needs to be converted to betaine in the mitochondria (Baker and Tuma, 1983). Pesti *et al*. (1980, 1981) noted a methionine sparing effect in choline. The efficacy of increasing the conversion of homocysteine to methionine by betaine is shown by Baker and Czarnecki (1985). Study regarding the methionine sparing effect of betaine is scarce. In addition to a possible sparing effect of methionine by betaine, it may also interfere with lipid metabolism (Stryer, 1988). Betaine is indirectly involved in the synthesis of carnitine, which is required for transporting long chain fatty acids across the inner mitochondrial membrane for oxidation (De Ridder and Van Dam, 1975) and therefore, may result in a leaner carcass. Many consumers place a high value on lean products. The abdominal fat pad of broilers usually represents a waste product and betaine may decrease the carcass fat of broilers (Saunderson and Mckinlay, 1990). Although, betaine is involved in lipid metabolism, a reduction in carcass fat in poultry as result of betaine supplementation is not clearly documented and more research is needed to help clarify this issue. Recently, the sensitivity of breast meat yield in broilers to dietary methionine was shown (De Ridder and Van Dam, 1975). It is not clear, whether betaine might also be capable of sparing methionine in this respect. Therefore, the objective of this study was to examine the methionine sparing effect of betaine (Betafin®), by conducting a growth study with broiler chickens.

MATERIALS AND METHODS

Bird and diet: In this study, 300 broiler chickens of the commercial Ross 308 strain were used in a randomized completely design with 4 treatment and 5 replicates in each treatment and 15 birds/replicates and reared on the floor pens for 42 days. A basal deit was formulated as control according to NRC (1994) recommendations for starter (1-21 days) and grower (22-42 days) periods (Table 1). In experimental diets, methionine levels were as formulated (control (T_1)) and at 90 (T_2), 80 (T_3) and 70% (T_4) of the control. The incompleted levels of the

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Table 1: Ingredient compositoin (as percent of dry matter) and calculated analysis of the basal diets

Ingredients	Starter (1-21 days)	Grower (22-42 days)
Corn	58.7	61
Soybian meal	30	29
Wheat bran	5	5
Fish meal	2	0
Soybian oil	1	2
Oister shell meal	1.2	1
DCP	1.07	1
Vitamin and mineral perimix	0.5	0.5
DL-Methionine	0.13	0.1
L-lysine	0.15	0.25
Salt	0.25	0.1
Coccidiostat	0	0.05
Total	100	100
Nutrient content		
ME (Kcal kg^{-1})	2850	2950
Crude protein (%)	20.48	18.44
Crude fiber (%)	3.89	3.81

Vitamin and mineral provided per kilogram of diet: Vitamin A, 360,000 IU; vitamin D3, 800,000 IU; vitamin E, 7200 IU; vitamin K3, 800 mg; vitamin B1, 720 mg; vitamin B9, 400 mg; vitamin H2, 40 mg; vitamin B2, 2640 mg, vitamin B3, 4000 mg; vitamin B5, 12000 mg; vitamin B6, 1200 mg; vitamin B12, 6 mg; Choline chloraid, 200000 mg, Manganeze, 40,000 mg, Iron, 20,000 mg; Zinc, 40,000 mg, coper, 4000 mg; Iodine, 400 mg; Selenium, 80 mg

methionine in T_2, T_3 and T_4 supplemented by adding Betafin to the diets. During the experiment, water and feed were given to the birds *ad-libitum*.

Sample collection: Weighing of the feed and chickens were made on a weekly basis. At the end of the experiment, two birds from each replicate of treatments were slaughtered for separation of carcasses (Perreault and Leeson, 1992).

Statistical analysis: All data were analyzed using the One-Way Anova procedure of SAS® (1998) for analysis of variance. Significant differences among treatments were identified at 5% level by Duncan (1955) multiple range tests.

RESULTS AND DISCUSSION

Growth performance: The effect of experimental treatments on the performance of broiler chickens is given in Table 2. Feed intake within the different periods given was not affected by treatment. Body weight gain at 1-21 and 22-42 days was not affected by betafin supplementation. However, Body weight gain of T_1 and T_3 groups at 1-42 days was significantly lower than that of control ($p<0.05$). Increasing the level of betafin from 22-42 and 1-42 days in diet, resulted in significant increase of feed conversion ratio ($p<0.05$).

This result agrees with those of Saunderson and McKinlay (1990), which show no difference in body weight between broilers fed with DL-methionine supplemented and DL-methionine + betaine supplemented diets. Zhan *et al.* (2006) and Kermanshahi (2001), reported that feed intake and feed conversion ratio within the periods given were not affected by treatment. In the El-Husseiny *et al.* (2007) study, betaine supplementation to a diet containing 0.45% methionine, did not affect performance. Xu *et al.* (1999), reported that the efficiency of additional betaine is reduced at dietary levels above 0.08%. Betaine is an N-containing substance which requires energy to be excreted (Eklund *et al.*, 2005). Consequently, excessive betaine in the ration may cause energy loss due to their excretion and increasing the dietary betaine level may reduce its efficacy. This may be main cause of decrease body weight gain. In the other hand, Virtanen and Rosi (1995) and Virtanen and Rumsey (1996) concluded that supplementation of betaine to a broiler diet marginally deficient in methionine is more effective in promoting growth and feed efficiency than methionine. According to Garcia *et al.* (1999), the relative bioavailability of betaine compared with methionine is 50-67% in broiler chickens, based on weight gain and feed conversion. Accordingly, Attia *et al.* (2005) showed that in slow growth type chickens, supplementation of either 0.07% betaine or 0.05% methionine improved weight gain and feed conversion compared with the basal diet marginally deficient in methionine. However, the findings on growth performance were in contrast to those of McDevitt *et al.* (2000), Esteve-Garcia and Mack (2000), Schutte *et al.* (1997) and Matthews *et al.* (1997).

Carcass composition: The effect of experimental treatments on the composition of the bird carcasses (g) and the carcass efficiency (%) are given in Table 3. Supplementation levels of betfin in diets no significantly ($p<0.05$) affected the amount of carcass characteristics ($p>0.05$), but the percent of thigh in birds received betafin significantly was higher than control group ($p<0.05$).

Esteve-Garcia and Mack (2000), reported that the effects of betaine on breast yield and abdominal fat were small and non-significant. On the consistent, the present findings together with those of Schutte *et al.* (1997) suggest that betaine has no significant influence on abdominal fat deposition in broiler chickens. This observation is in contrast to the data of Virtanen and Rosi (1995), who reported betaine to be more efficient than DL-methionine in supporting breast meat yield. Also, Sun *et al.* (2008), reported that supplementation of betaine

Table 2: The main effects of treatments on performance of broiler chickens (Mean±SE)

	Feed intake (g)			Body weight gain (g)			Feed conversion retio (g g^{-1})		
Treatments	1-21 days	22-42 days	1-42 days	1-21 days	22-42 days	1-42 days	1-21 days	22-42 days	1-42 days
T_1	1127±4.04	3102±19.68	4229±23.59	695±12.28	1773.69±40.68	2468±43.59^a	1.62±0.02	1.75±0.1^b	1.71±0.08^b
T_2	1139±7.75	3340.7±13.17	4480±31.11	677±10.98	1625.65±56.1	2305.55±45.11^b	1.68±0.02	2.05±0.03^{ab}	1.94±0.02^a
T_3	1152±17.67	3343.33±7.35	4495.7±55.29	685±13.64	1678.33±81.22	2363.75±69.29^{ab}	1.68±0.04	2±0.14^{ab}	1.9±0.09^{ab}
T_4	1162±14.57	3399.7±7.71	4561.7±60.16	675±14.42	1615±18.02	2290±22.64^b	1.72±0.02	2.1±0.02^a	1.99±0.02^a
p-values	0.48	0.22	0.21	0.69	0.22	0.13	0.25	0.09	0.07

^{a,b}Means in each column with different superscripts are significantly different (p<0.05)

Table 3: The effect of feed additives on carcass composition of broiler chickens

	Treatments				
Variables	T_1	T_2	T_3	T_4	p-value
As (g)					
Carcass	1590±78.15	1413.45±73.56	1571.75±54.56	1463.25±44.19	0.23
Breast	530±25.64	463.25±38.76	511.75±20.88	460±18.92	0.24
Thigh	375±15.27	378.45±20.27	420±16.07	388.25±18.55	0.32
Abdominal fat	28.51±1.27	26±1.56	28.81±1.21	27.48±1.33	0.46
As (%)					
Carcass	72.02±0.59	71.24±0.42	71.78±0.78	70.71±0.31	0.45
Breast	33.38±0.22	32.65±0.31	32.94±0.21	31.6±0.58	0.37
Thigh	23.66±0.15^b	26.79±0.76^a	26.76±0.15^a	26.56±0.42^a	0.21
Abdominal fat	1.29±0.02	1.31±0.01	1.31±0.06	1.32±0.08	0.33

^{a,b,c}Means in each row with different superscripts are significantly different (p<0.05)

at the level of replacing 25% of total methionine increased (p<0.05) breast meat yield and protein content of breast meat, but decreased (p<0.05) abdominal fat yield. As pointed out before, these differences between reported results could be related to management and environmental conditions.

CONCLUSION

The present study does not support the hypothesis that betaine can be an effective replacer of methionine in broiler diets under the conditions of this experiment. Further research is needed to asses whether or not betaine is able to share its methyl groups with choline and methionine in broilers.

REFERENCES

Attia, Y.A., R.A. Hassan, M.H. Shehatta and S.B. Abd-El-Hady, 2005. Growth, carcass quality and serum constituents of slow growing chicks as affected by betaine addition to diets containing 2. Different levels of methionine. Int. J. Poult. Sci., 4: 856-865. http://www.pjbs.org/ijps/fin463.pdf.

Baker, A.J. and D.J. Tuma, 1983. Betaine, metabolic by-product or vital methylating agent? Life Sci., 32: 771-774.

Baker, D.H. and G.L. Czarnecki, 1985. Transmethylation of homocysteine to methionine: Efficiency in the rat and chick. J. Nutr., 115: 1291-1299. http://jn.nutrition.org/cgi/reprint/115/10/1291.

De Ridder, J.J.M. and K. Van Dam, 1975. Control of choline oxidation by rat liver mitochondria. BBA, 408: 112-122.

Duncan, D.B., 1955. Multiple range and F-tests Biometrics, 11: 1-42.

Eklund, M., E. Bauer, J. Wamatu and R. Mosenthin, 2005. Potential nutritional and physiological functions of betaine in livestock. Nutr. Res. Rev., 18: 31-48. http://journals.cambridge.org/download.php?file=%2FNRR%2FNRR18_01%2FS095442240500003Xa.pdf&code=88f798472b2d5982559d97c60a9e146d.

El-Husseiny, O.M., M.A. Abo-El-Ella, M.O. Abd-Elsamee and M.M. Ab-Elfattah, 2007. Response of broilers performance to dietary betaine and folic acid at different methionine levels. Int. J. Poult. Sci., 6: 515-523. http://www.pjbs.org/ijps/fin873.pdf.

Esteve-Garcia, E. and S. Mack, 2000. The effect of DL-methionine and betaine on growth performance and carcass characteristics in broilers. Anim. Feed Sci. Technol., 87: 85-93. http://cat.inist.fr/?aModele=afficheN&cpsidt=794864.

Garcia, M.N., T.P. Chendrimada, G.M. Pesti and R.I. Bakalli, 1999. Relative bioavailability of two labile methyl sources methionine and betaine. Poult. Sci., 78 (Suppl. 1): 87(Abstr.).

Kermanshahi, H., 2001. Betaine replacement for DL-Methionine in the performance and carcass characteristics of broiler chicks. J. Agric. Sci. Technol., 3: 273-279. http://jast.modares.ac.ir/browse.php?mag_id=12&slc_lang=en&sid=1.

Matthews, J.O., T.L. Ward and L.L. Southern, 1997. Interactive effects of betaine and Monensin in *Eimeria acervulina*-infected chicks. Poult. Sci., 76: 1014-1019. http://ps.fass.org/cgi/reprint/76/7/1014?maxtoshow=&HITS=10&hits=10&RESULTORMAT=&fulltext=Interactive+effects+of+betaine+%28BetafinBCR%29+and+Monensin+in+Eimeria+acervulina&searchid=1&FIRSTINDEX=0&sortspec=relevance&resourceype=HWCIT.

McDevitt, R.M., S. Mack and I.R. Wallis, 2000. Can betaine partially replace or enhance the effect of methionine by improving broiler growth and carcase characteristics? Br. Poult. Sci., 41: 473-480. http://www.ingentaconnect.com/content/tandf/cbps/2000/00000041/00000004/art00013.

NRC (National Research Council), 1994. Nutrient Requirements of Poultry. 9th Edn. National Academy Press, Washington, DC. http://books.nap.edu/open-book.php?isbn=0309048923.

Perreault, N. and S. Leeson, 1992. Age-related carcass composition changes in male broiler chickens. Can. J. Anim. Sci., 72: 919-929.

Pesti, G.M., A.E. Harper and M.L. Sunde, 1980. Choline/methionine nutrition of starting broiler chicks. Three models for estimating the choline requirement with economic considerations. Poult. Sci., 59: 1073-1081. http://www.ncbi.nlm.nih.gov/pubmed/7393840.

Pesti, G.M., N.J. Benevenga, A.E. Harper and M.L. Sunde, 1981. Factors influencing the assessment of the availability of choline in feedstuffs. Poult. Sci., 60: 188-196.

SAS Institute Inc., 1998. SAS/STAT User's Guide: Edn: SAS Institute Inc., Cary, North Carolina.

Saunderson, C.L. and J. Mckinlay, 1990. Changes in body weight, composition and hepatic enzyme activities in response to dietary methionine, betaine and choline levels in growing chicks. Br. J. Nutr., 63: 339-349. http://journals.cambridge.org/download.php?file=%2FBJN%2FBJN63_02%2FS0007114590000393a.pdf&code=a0e8a5b197220d8d14e1b68b258da7cd.

Schutte, J.B., J. De Jong, W. Smink and M. Pack, 1997. Replacement value of Betaine for DL-Methionine in male broiler chicks. Poult. Sci., 76: 321-325. http://ps.fass.org/cgi/content/abstract/76/2/321.

Stryer, L., 1988. Biosynthesis of Amino Acids and Heme. 3rd Edn. In: Freeman, W.H. and Company (Ed.). Biochemistry. New York, pp: 575-626.

Sun, H., W.R. Yang, Z.B. Yang, Y. Wang, S.Z. Jiang and G.G. Zhang, 2008. Effects of betaine supplementation to methionine deficient diet on growth performance and carcass characteristics of broilers. Am. J. Anim. Vet. Sci., 3 (3): 78-84. http://www.scipub.org/fulltext/AJAV/AJAV3378-84.pdf.

Virtanen, E. and G. Rumsey, 1996. Betaine supplementation can optimize use of methionine, choline in diets. Feedstuffs, 68: 12-13. http://www.fao.org/agris/search/display.do?f=./1997/v2324/US9740514.xml;US9740514.

Virtanen, E. and L. Rosi, 1995. Effects of Betaine on Methionine Requirement of Broilers under Various Environmental Conditions. In: Balnave, D. (Ed.). Proceedings of the Australian Poultry Science Symposium. University of Sydney, Sydney, Australia, 7: 88-92.

Xu, Z.R., D.Y. Yu and Y.Z. Wang, 1999. The effects of betaine on weanling piglets and its mechanism. J. Zhejiang Agric. Univ., 25: 543-546.

Zhan, X.A., J.X. Li, Z.R. Xu and R.Q. Zhao, 2006. Effects of methionie and betaine supplementation on growth performance, carcase composition and metabolism of lipids in male broilers. Br. Poult. Sci., 47 (5): 576-580. DOI: 10.1080/00071660600963438.