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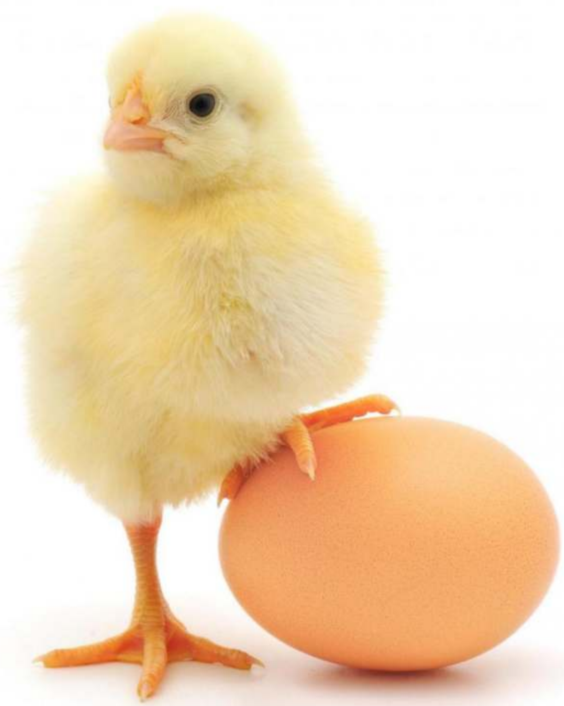

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Methionine Supplementation of Low-Protein Broiler Diets: Influence upon Growth Performance and Efficiency of Protein Utilization

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Abstract: One experiments was conducted to determine the effect of a low-protein diet supplemented with DL- methionine on the growth performance, carcass and litter characteristics of male broilers during the starting (1 to 21d) and growing (22 to 42d) periods. Three levels of DL- methionine (50, 75 and 100% of the level commonly used in commercial broiler diets) were added to the control (22 and 19.4 % CP in the starting and growing periods, respectively) or a low protein diet (19.1 and 16.4% CP in the starting and growing periods, respectively). For those broilers received the control diet, there was no significant effect of methionine level on body weight gain and FCR. For the broilers received the low protein diet, however, those fed the diet with the lowest methionine level had lower feed intake which brought about better FCR ($P < 0.05$). Final body weight was not significantly affected by diet composition. Breast meat yield was improved by increasing methionine level ($P< 0.05$). Nitrogen content of the litter was reduced roughly 10% by each percentage unit reduction in dietary CP content, but was not influenced by methionine supplementation.

Key words: Methionine, protein, broiler, nitrogen, carcass

Introduction

Corn soybean meal diets commonly used in broiler nutrition are often first limiting in sulfur amino acids (Fernandz *et al*., 1994), but contain other essential amino acids in 105 to 176% of the requirements (Khajali, 2001). The potential to reduce excess dietary amino acids becomes a reality and allows the opportunity to meet the amino acid requirements of birds more accurately. An oversupply of amino acids can not be converted to body proteins and may depress performance leading to inefficient and uneconomical meat production (Blair *et al*., 1999). Furthermore, excess nitrogen in the excreta as a result of amino acid oversupply may pollute surface and ground water reserves, which may harm wildlife and humans (Reinhart, 1996).

The challenge for a nutritionist is to formulate economically viable diets, which provide as closely as possible the amino acid requirements of chicken. Feed grade forms of several essential amino acids are currently available to feed manufacturers. Poultry diets that are composed of natural feedstutts can therefore be supplemented with small amounts of synthetic amino acids to meet the bird's requirements for the most limiting amino acids. Synthetic amino acids are highly available and this may be possible to obtain equal response with lesser amounts of supplementation. The purpose of the present studies was to evaluate the performance, carcass traits and nitrogen balance of male broilers fed reduced–CP diet, supplemented with different levels of DL – methionine.

Materials and Methods

A total of 600 male broiler chicks (Ross) were randomized across 30 floor pens (20 chicks per pen; 0.1m^2 floor space per brid). All birds consumed feed and water at will and were reared on continous lighting. Corn and soybean meal were analyzed for CP and amino acids prior to diet formulation to assure accurate treatment amino acid content. Experimental diets were also analyzed for CP and amino acids. Crude protein was determined using kjeldahl procedure (AOAC, 1990). Feed samples were subjected to 6N HCl in duplicate and hydrolyzed for 24h at 110°C
(Andrews and Baldar, 1985). Acid hydrolyzates were subsequently analyzed for amino acid contents using ion exchange chromatography (LKB Biochrom 4151). Per formic acid oxidation was done for the determination of Met+ Cys (Moore and Stain, 1963).

Six dietary treatments were replicated five times (100 birds/ treatment) in a factorial arrangement. Three levels of DL-methionine (50, 75 and 100% of the levels commonly used in commercial broiler diets) were added to the control (22 and 19.4% CP in the starting and growing periods, respectively), or low – protein diet (19.1 and 16.4% CP in the starting and growing periods, respectively). These diets are shown as Diet 1 to Diet 6, respectively. Dietary treatments were formulated according to NRC (1994). Birds received dietary treatments from 1 to 42 days of age.

Pen body weight and feed consumption were recorded weekly throughout the experiment. Feed consumption data was corrected for body weights of mortality. At 42d three birds from each pen (15 birds/treatment) were

Table 1: Amino acid composition of the starter diets (Air-dry basis)

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6
	% in diet					
Yellow corn	49	48.92	48.83	59	58.91	58.83
Soybean meal (44%CP)	40.5	40.5	40.5	32	32	32
Soy oil	5.5	5.5	5.5	4	4	4
Monocalcium phosphate	1.37	1.37	1.37	1.42	1.42	1.42
Oyster shell	1.6	1.6	1.6	1.64	1.64	1.64
Sodium chloride	0.45	0.45	0.45	0.43	0.43	0.43
Vitamin mixture[1]	0.5	0.5	0.5	0.5	0.5	0.5
Mineral mixture[2]	0.5	0.5	0.5	0.5	0.5	0.5
Dl –methionine	0.08	0.165	0.251	0.152	0.238	0.324
L –lysine. HCl	-	-	-	0.04	0.04	0.04
L- threonine	-	-	-	0.04	0.04	0.04
Actual Analysis						
AMEn (Kcal/kg)	3055	3059	3050	3057	3062	3055
Crude protein (%)	21.7	21.9	22.1	18.9	19	19.1
Met + Cys (%)	0.751	0.847	0.937	0.755	0.843	0.93
Met (%)	0.405	0.492	0.581	0.403	0.5	0.605
Lys (%)	1.2	1.21	1.18	1	0.98	0.98
Thr (%)	0.81	0.806	0.8	0.74	0.73	0.74
Arg (%)	1.32	1.3	1.36	1.2	1.18	1.18

[1]Supplied per kg diet: vitaminA, 9000IU; cholecalciferal, 1500 IU; vitamin E, 10 IU; vitamin K, 0.5mg; cobalamin, 0.007 mg; thiamin 0.4 mg; riboflavin, 6 mg; folic acid, 1mg; biotin, 0.15 mg; pantothenic acid 12 mg; niacin, 35mg; pyridoxine, 4mg; cholin chloride, 1000mg. [2]Supplied per kg diet: Mn, 60mg; Cu, 5mg; Zn, 50mg; I, 0.35mg; Se, 0.1mg; iron 40mg.

Table 2: Amino acid composition of the grower diets (Air-dry basis)

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6
	% in diet					
Yellow corn	58.7	58.7	58.63	68.5	68.43	68.36
Soybean meal (44%cp)	32.8	32.8	32.8	24	24	24
Soy oil	4.5	4.5	4.5	3	3	3
Monocalcium phosphate	0.98	0.98	0.98	1.06	1.06	1.06
Oyster shell	1.6	1.6	1.6	1.63	1.63	1.63
Sodium chloride	0.35	0.35	0.35	0.34	0.34	0.34
Vitamin mixture1	0.5	0.5	0.5	0.5	0.5	0.5
Mineral mixture2	0.5	0.5	0.5	0.5	0.5	0.5
Dl –methionine	-	0.067	0.137	0.074	0.144	0.214
L –lysine. HCl	-	-	-	0.145	0.145	0.145
L threonine	-	-	-	0.1	0.1	0.1
L- Arg	-	-	-	0.04	0.04	0.04
Actual analysis						
AMEn (Kcal/kg)	3085	3091	3102	3100	3092	3089
Crude protein (%)	19.4	19.3	19.3	16.2	16.25	16.3
Met + Cys (%)	0.588	0.601	0.692	0.59	0.683	0.697
Met (%)	0.27	0.31	0.39	0.29	0.35	0.41
Lys (%)	0.982	0.985	0.99	0.95	0.94	0.94
Thr (%)	0.7	0.71	0.71	0.7	0.69	0.69
Arg (%)	1.2	1.21	1.18	1.03	1.02	1.03

[1]Supplied per kg diet: vitaminA, 9000IU; cholecalciferal, 1500 IU; vitamin E, 10 IU; vitamin K, 0.5mg; cobalamin, 0.007 mg; thiamin 0.4 mg; riboflavin, 6 mg; folic acid, 1mg; biotin, 0.15 mg; pantothenic acid 12 mg; niacin, 35mg; pyridoxine, 4mg; cholin chloride, 1000mg. [2]Supplied per kg diet: Mn, 60mg; Cu, 5mg; Zn, 50mg; I, 0.35mg; Se, 0.1mg; iron 40mg.

selected for processing. Birds selected for processing had body weigh within roughly ±5% of the average pen body weight. Carcass yield was defined as carcass without giblets and neck relative to the preslaughter live weight (Moran *et al*., 1992). Breast and thighs (with skin) cuts were weighted and expressed as a percentage of evicerated carcass.

Results and Discussion

Amino acid analysis of the diets yielded results in close agreement to the calculated composition. There were significant differences in diet effects for weight gain, feed intake and FCR during the starting period ($P<0.05$) (Table 3).

Reduced weight gain and feed efficiency in broilers subjected to low protein diets (Khajali *et al*., 1998; Kerr and Kidd, 1999) or diets with suboptimal levels of methionine (Khajali *et al*., 2002; Moran, 1994) has been reported. During the subsequent 3wk growing period, there was no significant difference among the dietary treatments in terms of weight gain, feed intake, and FCR (Table 4). These findings agree with other studies

Table 3: Weight gain, feed intake, and feed conversion rate as affected by dietary protein level and DL- methionine supplementation (1 to 21d)

FCR	Feed intake (g)	Weight gain (g)	Methionine	Protein	Treatment
Main effects protein					
1.63	898.2	551			Control
1.62	838	517			Low
0.02	18.9	16.1			SEM
Methionine					
1.61	870.4	530.6			50%
1.63	903	553			75%
1.64	916.7	558.5			100%
0.01	19.56	18.21			SEM
Interaction					
1.64	882	538.4	50%	Control	
1.62	906.7	559.5	75%	Control	
1.61	910.2	565	100%	Control	
1.59	836.5	526	50%	Low	
1.62	841.3	519	75%	Low	
1.63	838.7	514.6	100%	Low	
Significance					
ns	*	*			Protein
*	ns	*			DL- Met
*	ns	*			Protein * DL-met

ns: non- significant. * P<0.05

Table 4: Weight gain, feed intake, and feed conversion rate as affected by dietary protein level and DL-methionine supplementation (21 to 42d)

FCR	Feed intake (g)	Weight gain (g)	Methionine	Protein	Treatment
2.16	2726	1262			Control
2.14	2668	1243			Low
0.03	24.5	18.5			SEM
Methionine					
2.14	2670	1238			50%
2.15	2688	1250			75%
2.12	2671	1263			100%
0.03	26.6	19.7			SEM
Interaction					
2.16	2710	1256	50%	Control	
2.15	2693	1252	75%	Control	
2.15	2693	1265	100%	Control	
2.13	2665	1252	50%	Low	
2.15	2660	1237	75%	Low	
2.12	2675	1262	100%	Low	
Significance					
ns	ns	ns			Protein
*	ns	ns			DL-met
*	ns	ns			Protein*DL-met

ns: non- significant. * P<0.05

(Aletor *et al.*, 2000; Bunchasak *et al.*, 1997). Dietary treatments had no effect on carcass yield. However, breast meat yield was influenced by methionine level (P<0.05) (Table 5). Breast meat yield seemed to be more influenced by methionine level than by protein level. This confirms the results of Huyghebaert *et al.* (1994). Lowering dietary protein tended to increase body fat content (P<0.05). For both protein levels, there was a progressive reduction in body fat deposition with each increment of methionine supplementation (P<0.05). These findings have implications for nutrition in that formulating diets with the optimal balance of essential amino arids, will yield a carcass with more edible meat and less fat. These results proved the hypothesis of Wallis (1999) which implies supplementary sulfur amino acids increase the mass of the breast and reduce abdominal fat deposition.

There were no significant differences in the main effects and interactions between treatments in the moisture content of the litter (Table 6). It can be concluded that the moisture content of the litter in independent of the diet composition. Similar results have been reported (Khajali *et al.*, 2002; Ferguson *et al.*, 1998). Nitrogen content of the litter was significantly (P<0.01) reduced by reducing the CP content of the diet. The reduction of N content of the litter per each unit reduction in dietary CP content

Table 5: Final body weight and carcass characteristics of broilers fed diets with different levels of crude protein and methionine (42 days of age)

Treatments	Protein	DL-met	Body weight (g)	Carcass yield (g)	Breast yield (%)	Body fat content (%)	Body protein content (%)
Protein			1855	70.9	26.5	11.3	18.8
Control			1801	72	27	12.9	18.2
Low							
DL-Met							
50%			1810	70.3	25.7	12.4	18.3
75%			1845	71	26.2	1180%	18.3
100%			1862	71.6	27.3	1120%	18.7
Interactions							
	Control	50%	1835	70.8	25.8	11.60	18.4
	Control	75%	1856	70.4	26.5	11.2	18.2
	Control	100%	1872	7150%	26.8	10.9	18.6
	Low	50%	1820	7100%	26	12.6	17.9
	Low	75%	1798	7130%	26.9	12.3	18.4
	Low	100%	1819	7200%	27.2	11.7	18.9
Significance:							
Protein			ns	ns	ns	*	ns
DL – Met			ns	ns	*	*	ns
Protein x DL–Met			*	ns	*	*	ns

ns: non- significant. * $P<0.05$

Table 6: Effect of dietary crude protein and methionine supplement on litter characteristics (42 days of age)

Treatments	Starter		Grower		Moisture (%)	Nitrogen (%)	pH
	Protein	DL-met	Protein	DL-met			
Main effects							
Protein							
Control					29.7	305%	7.8
Low					28.5	241%	7.6
SEM					0.55	0.07	0.09
DL-Met							
50%					29.5	2.8	7.8
75%					29.1	2.7	7.7
100%					28.6	2.65	7.7
SEM					0.64	0.11	0.2
Interactions							
	Control	50%	Control	90%	29.5	3.01	7.8
	Control	75%	Control	100%	29.1	2.92	7.7
	Control	100%	Control	110%	30.2	2.88	7.8
	Low	50%	Low	90%	29.1	2.45	7.7
	Low	75%	Low	100%	28.4	2.41	7.6
	Low	100%	Low	110%	28.1	2.3	7.7
SEM					0.72	0.15	0.23
Significance:							
Protein					ns	**	*
DL – Met					ns	ns	ns
Protein x DL–Met					ns	ns	ns

was roughly 10%. Methionine supplementation had no significant effect on N content of the litter (Table 6). According to Deschepper and DeGroote (1995), reducing in N excretion per unit reduction in dietary CP for broilers averaged 7.7%. Ferguson *et al.* (1998) indicated that for every percentage unit of reduction in dietary CP, there was a corresponding 7% reduction in the N content of the litter.

Dietary CP content had significant effect on pH of the litter ($P<0.05$). The increased acidity of the litter observed in the low-protein compared to the control diet (7.6 *vs* 7.8) may be associated with a drier litter (Ferguson *et al.*, 1998). In addition, the lower pH reduces the unionized NH_3 available for volatilization. Moisture content and pH of the litter control ammonia volatilization from the liquid phase to the gas phase, and subsequent diffusion to room air (Gates *et al.*, 1997). Thus, the higher values of the pH of the litter is associated with the greater potential for ammonia volatilization.

The results of this study showed that reduction in dietary CP by 2 percentage units can maintain broiler performance while reducing N excretion by 10 percentage units.

References

Aletor, I.I. Hamid and E. Pfeffer, 2000. Low protein, amino acid - supplemented diets in broiler chickens: Effects on performance, carcass characteristics, whole body composition and efficiencies of nutrient utilization. J. Sci. Food Agri., 80: 547- 554.

Andrews, R.P. and N.A. Baldar, 1985. Amino acid analysis of feed constituents. Sci. Tools, 32: 44- 48.

AOAC, 1990. Official Methods of Analysis, 15th ed. Association of Official Analytical Chemists. Washington D.C.

Blair, R., J.P. Jacob, S. Ibrahim and P. Wang, 1999. A quantitative assessment of reduced protein diets and supplements to improved nitrogen utilization. J. Appl. Poult. Res., 8: 25-47.

Bunchasak, C., U. Santoso, K. Tanaka, S. Ohtani and C.M. Collado, 1997. The effect of supplementing methionine plus cystine to a low-protein diet on the growth performance and fat accumulation of growing broiler chicks. Asian-Aust. J. Anim. Sci., 10: 185-191.

Deschepper, K. and G. De Groote, 1995. Effect of dietary protein, essential and non- essential amino acids on the performance and carcass composition of male broiler chickens. Br. Poult. Sci., 36: 229- 245.

Ferguson, N.S., R.S. Gates, J.L. Taraba, A.H. Cantor, A.J. Pescatore, M.L. Straw, M.J. Ford and D.J. Burnham, 1998. The effect of dietary protein and phosphorous on ammonia concentration and litter composition in broilers. Poult. Sci., 77: 1085- 1093.

Fernandz, S.R., S. Aoyagi, Y. Han, C.M. Parsons and D.H. Baker, 1994. Limiting order of amino acids in corn and soybean meal for growth of chick. Poult. Sci., 73: 1887- 1896.

Gates, R.S., J.L. Tarabra, N.S. Ferguson and L.W. Turner, 1997. A technique for determining ammonia equilibrium and volatilization from broiler litter. ASAE paper No. 974074, Minniapolis, MN.

Huyghebaert, G., M. Pack, and G. De Groote, 1994. Influence of protein concentration on response of broilers to supplemental DL- methionine. Arch. Geflugelk, 58: 23-29.

Kerr, B.J. and M.T. Kidd, 1999. Amino acid supplementation of low protein broiler diets. 1. Glutamic acid and indispensable amino acid supplementation. J. Appl. Poult. Res., 8: 298-309.

Khajali, F., 2001. Effect of methionine supplementation of the low-protein diets on growth performance, efficiency of nitrogen utilization and uric acid excretion of broiler chicks. Ph.D. dissertation, Ferdowsi University of Mashad, Iran.

Khajali, F., H. Nasiri Moghaddam and A. Golian, 1998. Amino acid fortification of low-protein broiler diets. Iranian. J. Agri. Sci., 29: 388-396.

Khajali, F., H. Nasiri Moghaddam, M.D. Mesgaran and B. Shareghi, 2002. Iranian J. Agric. Sci. Natur. Resour. Vol. 9: 193-204.

Moore and Stein, 1963. Methods in Enzymology, 6: 819-824.

Moran, E.T. Jr., 1994. Responses of broiler strains differing in body fat to inadequate methionine: Live performance and processing yields. Poult. Sci., 73: 1116-1126.

Moran, E.T. Jr., R.D. Bushong and S.F. Bilgili, 1992. Reducing dietary protein for broilers while satisfying amino acid requirements by least- cost formulation: Live performance, litter composition, and yield of fast- food cut at six weeks. Poult. Sci., 71: 1687-1694.

National Research Council, 1994. Nutrient requirements of poultry. Ninth Rev. Ed. National Academy of Science, Washington, D.C.

Reinhart, K.E., 1996. Environmental challenges as related to animal agriculture- Poultry. In: Nutrient Management of Food Animals to Enhance and Protect the Environment (Ed. E. T. Kornegay). CRC Press.

Wallis, I.R., 1999. Dietary supplements of methionine increase breast meat yield and decrease abdominal fat in growing broiler chickens. Aust. J. Exp. Agri., 39: 131- 141.