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Effects of Amno Acids Supplemented to a Low-Protein Broiler Diet

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低蛋白質 브로일러 飼料에 아미노산 添加効果

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摘 要

低蛋白質의 브로일러(0～3주령) 사료에 합성 아미노산 첨가 효과를 규명하기 위하여 3회의 사양시험을 실시하였다. 모든 필수 아미노산을 요구량 이상으로 함유한 단백질 22% 사료를 基準飼料로 하고 단백질 18% 사료에 몇가지 결핍된 아미노산을 첨가하여 비교하였다. 단백질 18% 사료에 適量의 methionine과 lysine을 첨가하였을때 병아리의 성장과 사료효율을 개선하였다. 그러나 이들 아미노산을 過量으로 첨가하였을때에는 오히려 성적이 떨어졌는데 이는 이들 아미노산의 過量첨가로 제3의 아미노산의 결핍이 惡化되었기 때문으로 추정되었다. 이때 제3의 아미노산으로 arginine을 첨가하였을때 methionine과 lysine의 과량 첨가로 인한 성장 억제 효과가 완화되었다.

I. INTRODUCTION

Rosebrough *et al.* (1982) reported that supplementation of a 23% protein diet with methionine (Met) and lysine (Lys) improved performance of turkey poults comparable to those fed a 30% protein diet. Similar results were obtained with finishing broilers (Daghir, 1983). A more recent study (Edmonds *et al.*, 1985) revealed that when a low-protein corn-soybean meal diet was fed to broiler chicks the critical limiting amino acids were Met, arginine (Arg), Lys, threonine and valine.

The purpose of the current study was to determine the possibility of sparing protein in the broiler starter diet by adding limiting amino acids in the crystalline forms.

II. MATERIALS AND METHODS

Three experiments were conducted. Basal diets of two different levels of protein (22 and 18%) were formulated (Table 1). The 22% protein diet was calcu-

Table 1. Formula and nutrient compositions of basal diets

Ingredients or composition	22% protein	18% protein
Ingredients	1.9	1.9
Yellow corn	52.7	64.1
Soybean meal (44% protein)	35.5	24.1
Fish meal (60% protein)	3.0	3.0
Tallow	5.0	5.0
Limestone	1.1	1.1
Tricalcium phosphate	1.5	1.5
Salt	0.3	0.3
Vit.-min. mixture[1]	0.8	0.8
Coccidiostat[2]	0.1	0.1
Calculated composition		
Crude protein	22.06	18.05
ME (kcal/kg)	3303	3131
Calcium	1.00	0.99
Phosphorus	0.73	0.69
Met	0.39	0.34
Cys	0.34	0.28
Lys	1.31	1.00
Arg	1.54	1.22

1. Vitamin-mineral mixture supplied the following per kg of diet; vit. A, 12,000 IU; vit. D_3 2,400 IU; vit. E, 11.2 IU; vit. K_3, 2.4 mg; thiamin, 0.64 mg; riboflavin, 6 mg; vit. B_6, 2.4 mg; vit. B_{12}, 16 ug; niacin, 36 mg; Capantothenate, 8 mg; cholin chloride, 320 mg; folic acid, 1.12 mg; Mn, 104 mg; Zn, 56 mg; Cu, 4 mg; Fe, 28 mg; I, 0.32 mg; BHT, 4 mg.
2. Supplied 60 ppm of Na-salinomycin.

lated to be adequate in all essential amino acids, except for sulfur amino acid (SAA), which could be met by adding 0.2% DL-Met, according to National Research Council (NRC, 1984). The 18% protein diet was considerably deficient in SAA and Lys.

In each of the three experiments dietary treatments were as shown in Table 2. In all three experiments day-old broiler chicks of Maniker strain were allocated to each treatment with 6 replications (3 pens of males and 3 pens of females), either 20 chicks (in Experiment I) or 10 chicks (in Experiments II and III) per pen. Chicks were housed in steel wire batteries and each experiment lasted three weeks. Experimental feeds and water were provided *ad libitum*.

Table 2. Growth and feed conversion of chicks fed 22% and 18% protein diets supplemented with amino acids

Treatments (Diets)	Experiment I		Experiment II		Experiment III	
	Weight gain	Feed/gain	Weight gain	Feed/gain	Weight gain	Feed/gain
	(g)		(g)		(g)	
1) 22% Pprotein	536.8^{ABCb}	1.47^{ABa}				
2) As 1) + 0.2% DL-Met	571.5^{Aa}	14.5^{Aa}	571.3^{ABa}	1.54^{Aa}	604.8^{a}	1.44^{Aa}
3) 18% protein	493.9^{Cc}	1.61^{Dc}	524.3^{Bb}	1.66^{Bc}	575.3^{a}	1.56^{Bb}
4) As 3) + 0.3 DL-Met	532.8^{ABCb}	1.53^{Cb}				
5) As 3) + 0.25% L-Lys.HCl	516.2^{BCbc}	1.55^{Cb}				
6) As 3) + 0.3% DL-Met + 0.25% L-Lys.HCl	545.2^{ABab}	1.52^{BCb}	586.5^{Aa}	1.55^{Aab}	588.5^{a}	1.48^{Aa}
7) As 3) + 0.5% DL-Met + 0.4% L-Lys.HCl			531.8^{Bb}	1.61^{ABbc}		
8) As 6) + 0.2% L-Arg					592.7^{a}	1.44^{Aa}
9) As 7) + 0.2% L-Arg			559.0^{ABab}	1.53^{Aa}		

^{ABC}Values with the same superscript are not significantly different ($P<0.01$).

^{abc}Values with the same superscript are not significantly different ($P<0.05$).

Ⅲ. RESULTS AND DISCUSSION

Since there was no treatment x sex interaction in any performance parameter in any experiment all data were pooled over sexes. In Experiment I, Met fortification (Diet 2) of the Met deficient 22% protein diet (Diet 1) significantly ($P<0.05$) improved weight gain of broilers (Table 2). Chicks fed the 18% protein (Diet 3) gained significantly less weight ($P<0.01$) with poorer feed conversion rate ($P<0.01$) than those fed Diet 2. Supplementation of Diet 3 with 0.3% DL-Met (Diet 4) improved weight gain ($P<0/05$) and feed conversion ($P<0.01$). Adding 0.25% L-Lys · HCl (Diet 5) to Diet 3 also improved feed conversion ($P<0.01$). Further improvement in weight gain was achieved by adding both DL-Met and L-Lys. HCl (Diet 6) to Diet 3 ($P<0.01$). However, chicks fed Diet 6 gained numerically less weight and required significantly ($P<0.01$) more feed/gain than those fed Diet 2. This may indicate either that the levels of Met and Lys supplemented to Diet 6 were not sufficient or that a third amino acid is still limiting in Diet 6.

In Experiment II, higher levels of Met and Lys were added with (Diet 9) or without (Diet 7) supplemental Arg. In this experiment, however, Diet 6 achieved a comparable performance to that of Diet 2. Adding excessive levels of Met and Lys (Diet 7) was rather detrimental ($P<0.01$), indicating that the excess of these amino acids aggravated deficiency of the third amino acid. Supplememnting diet 7 with 0.2% L-Arg (Diet 9) tended to alleviate this aggravating effect, indicating that the third limiting amino acid in the low protein diet was Arg.

In Experiment III, chicks fed the unsupplemented low protein diet (Diet 3) achieved considerably good weight

gain. Thus there was no significant difference in performance among treaments, except that birds fed Diet 3 required significantly ($P<0.01$) more feed/gain than those fed other diets. Met and Lys fortification of this diet, with (Diet 8) or without (Diet 6) Arg added, improved feed conversion comparable to that of Diet 2.

Ⅳ. SUMMARY

Three experiments were conducted to show effects of adding amino acids to a broiler starter diet (0 – 3 weeks of age) low in protein. A diet of 22% protein with adequate levels of all essential amino acids was used as a reference diet. Supplementing an 18% protein diet with adequate amounts of methionine and lysine significantly improved performance of chicks. However, adding excessive amounts of these amino acids was detrimental, indicating that the excess aggravated deficiency of the third amino acid. Supplememtal arginine tended to alleviate this aggravating effect.

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