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Effects of dietary lysine requirement levels on carcass yields of male and female Arian broiler

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Abstract

An experiment was conducted to evaluate the carcass yields of male and female Arian broilers fed with three different lysine levels *viz.* high lysine (110% NRC), standard (NRC) and low lysine (90% NRC). This experiment was conducted using 600 male and female broiler chickens in 6 treatments with 5 replicates (20 broilers) in the completely block randomized design. Increasing lysine level (110% NRC) in diet significantly increased growth characteristics in male and female broilers. Results obtained in our study suggested that diets based on DAA and 110% NRC lysine requirement level significantly increased carcass yields in both sex. Broiler can respond to higher levels of dietary lysine than has been reported in the NRC.

Keywords: Digestible, Lysine, Carcass, Breast, Female, Male

Introduction

In the past, poultry feeds were formulated to meet crude protein (CP) requirements. However, the growth of the synthetic amino acids (AA) reduced the use of CP levels in diets and nutritionists were then able to formulate diets considering the specific requirements of essential AA. Studies showed that the importance of formulation based on digestible amino acids of feedstuffs, as well as AA balance, for optimal performance and reduction of environmental contamination due to better use of the protein of the diet and lower amount of nitrogen in the excreta (Rostagno et al., 1995; Dari and Penz, 1996). Lysine (Lys) is one of the key AA for protein synthesis and muscle deposition has been demonstrated to be involved in the synthesis of cytokines, proliferation of lymphocytes and thus in the optimum functioning of immune system in response to infection (Geraert and Mercier, 2010). An inadequate supply of Lys would reduce antibody response and cell-mediated immunity in chickens (Geraert and Mercier, 2010). Lys need for optimizing breast meat yield may be higher than the amount needed for optimal body weight gain and feed efficiency (Moran and Bilgili, 1990; Acar et al., 1991).

The objective of the nutritionists has long been to optimize growth and tissue accretion by increasing nutrient density such as AA. The question remains about the potential benefits of AA beyond the protein synthesis for muscle developments. Essential AA recommendations for broilers by the NRC (1994) are largely based on experimentation conducted several decades ago. Therefore, the objective of this study was to evaluate the three different Lys levels diets and two ways of expressing AA (Total, TAA or Digestible, DAA) effects on the carcass yield of Arian male and female broilers.

Materials and Methods

An experiment with Arian male broilers was conducted from 1 to 6 weeks of age. At day one, six hundred male and female chicks were placed in 30 floor pens (20 chicks per pen and 0.1m^2 floor space/chick). The total amino acid (TAA) values of the ingredients were assayed by high-pressure liquid chromatography analysis (Moore, 2004). In order to determine digestible amino acid (DAA), the levels of TAA determined in the analysis were multiplied by their respective digestibility coefficients, as determined by Ajinomoto Heartland (2004).

A completely randomized experimental design was used, in a factorial scheme (2 × 3). Therefore, the following treatments were applied.

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- Diet with High Lysine (H Lys) requirement level (110% NRC), formulation based on TAA,
- Diet with Standard Lysine (S Lys) requirement level (NRC), formulation based on TAA,
- Diet with Low Lysine (L Lys) requirement level (90% NRC), formulation based on TAA,
- Diet with High Lysine (H Lys) requirement level (110% NRC), formulation based on DAA,
- Diet with Standard Lysine (S Lys) requirement level (NRC), formulation based on DAA,
- Diet with Low Lysine (L Lys) requirement level (90% NRC), formulation based on DAA.

Diets were formulated isoenergetic and isonitrogenic as shown in Tables 1 and 2.

A completely randomized experimental design was used, in a 2 × 3 factorial scheme of two formulation methods and three levels of dietary Lys. The Data were analyzed by 2 way ANOVA of GLM procedure according to SAS (2001) and where significance occurred, means were compared with the Duncan multiple range tests.

Results and Discussion

The results of carcass characteristics of male and female Arian broilers are given in Table 3 and 4. These results are consistent with Rostagno et al. (1995) and Dari and Penz (1996), who found a significant difference in carcass yield. Diet formulated on DAA basis did significantly influence breast percentage and abdominal fat deposition in male broilers. In male broilers, carcass weight and percentage as well as breast percentage were significantly low in TAA × 110% NRC group (Table 3). However, breast, thigh, abdominal weight were significantly high in DAA × 110% NRC fed group. Similarly, on the basis of Lys requirement, 110% NRC group had significantly higher growth performance.

In female broilers, carcass percentage was significantly low in DAA × 90% NRC group. While carcass, breast, thigh and abdominal weight were significantly high in 110% NRC (Table 4). On the basis of Lys requirement, 110% NRC had comparatively significant effect on most of the growth characteristics. Dietary Lys levels significantly influenced carcass and breast percentage, and carcass, breast and thigh weight in male and female broilers as reported elsewhere (Bilgili et al., 1992; Kidd et al., 1998). Diets containing low Lys can limit breast meat formation early in development by reducing protein accretion from protein synthesis and RNA content (Tesseraud et al., 1992 & 1996). Breast muscle development is also affected by sex, age, breed and genetics strain (Acar et al., 1991; Bilgili et al., 1992). Their studies have also shown that an additional Lys increase breast meat accretion.

The results confirmed that Lys requirement for growing chicks is higher than that of NRC (1994)

Table 1: Composition of experimental diets in starter (0-21 d) period

Amino Acids of Feed		Total			Digestible	
lysine requirement levels	110%	Standard	90%	110%	Standard	90%
Item Treatment	1	2	3	4	5	6
Corn	55.47	56.27	57.32	54.01	55.01	55.39
Soybean meal 48%	35.56	35.01	33.94	37	36.21	36.01
Soybean oil	3	3	3	2.8	2.8	2.8
Fish meal	2	2	2	2	2	2
Oyster shells	1.88	1.88	1.88	1.88	1.88	1.88
Dical. Phos.	1	1	1	1	1	1
Common salt	0.2	0.2	0.2	0.2	0.2	0.2
Vitamin premix *	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix *	0.25	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.11	0.09	0.1	0.11	0.1	0.1
L-lysine HCl	0.28	0.05	0.05	0.5	0.3	0.12
Nutrients contents						
Men (Mcal/Kg)	3.10	3.10	3.10	3.10	3.10	3.10
Protein (%)	23.00	23.00	23.00	23.00	23.00	23.00
Ether extract (%)	5	5	5	5	5	5
Linoleic acid (%)	2.5	2.5	2.5	2.5	2.5	2.5
Calcium (%)	1.00	1.00	1.00	1.00	1.00	1.00
Avail. phosphorus (%)	0.5	0.5	0.5	0.5	0.5	0.5
Sodium (%)	0.16	0.16	0.16	0.16	0.16	0.16
LYS (%)	1.25	1.14	1.03	1.25	1.14	1.03
MET (%)	0.51	0.51	0.51	0.51	0.51	0.51

*Provides per kg of diet. vitamin A (7,000 IU), vitamin D3 (1,400 IU), vitamin E (16.65 mg), vitamin K (1.5 mg), vitamin B1 (0.6 mg), vitamin B2 (2.36 mg), vitamin B6 (0.6 mg), vitamin B12 (0.013 mg), biotin (0.15 mg), choline (1.54 g), pantothenic acid (9.32 mg), niacin (30.12 mg), folic acid (1.42 mg), selenium (0.65 mg), iodine (0.35 mg), iron (57.72 mg), copper (12.30 mg), zinc (141.48 mg), manganese (173 mg).

Table 2: Composition of experimental diets in grower (22-42 d) period

Amino Acids of Feedstuffs	Total			Digestible		
lysine requirement levels	110%	Standard	90%	110%	Standard	90%
Treatment Item	1	2	3	4	5	6
Corn	65.6	65.85	66.78	64.97	65.87	67.6
Soybean meal -48%	28.72	28.2	27.14	28.93	28.1	27.01
Soybean oil	3	3.24	3.22	3.27	3.4	3
Oyster shells	1.6	1.7	1.8	1.5	1.5	1.4
Dical. Phos.	0.2	0.2	0.2	0.23	0.23	0.23
Common salt	0.2	0.2	0.2	0.2	0.2	0.2
Vitamin premix *	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix *	0.25	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.1	0.06	0.11	0.2	0.1	0.06
L-lysine HCl	0.08	0.05	0.05	0.2	0.1	0
Nutients contents						
Men (Mcal/Kg)	3.2	3.2	3.2	3.2	3.2	3.2
Protein (%)	19	19	19	19	19	19
Ether extract (%)	5	5	5	5	5	5
Linoleic acid (%)	2.5	3	2.5	2.5	3	2.5
Calcium (%)	0.09	0.09	0.09	0.09	0.09	0.09
Avail. phosphorus (%)	0.42	0.42	0.42	0.42	0.42	0.42
Sodium (%)	0.16	0.16	0.16	0.16	0.16	0.16
LYS (%)	1.1	1	0.9	1.1	1	0.9
MET (%)	0.46	0.46	0.46	0.46	0.46	0.46

*Provides per kg of diet. vitamin A (7,000 IU), vitamin D3 (1,400 IU), vitamin E (16.65 mg), vitamin K (1.5 mg), vitamin B1 (0.6 mg), vitamin B2 (2.36 mg), vitamin B6 (0.6 mg), vitamin B12 (0.013 mg), biotin (0.15 mg), choline (1.54 g), pantothenic acid (9.32 mg), niacin (30.12 mg), folic acid (1.42 mg), selenium (0.65 mg), iodine (0.35 mg), iron (57.72 mg), copper (12.30 mg), zinc (141.48 mg), manganese (173 mg).

Table 3: Effects of type of amino acids of feedstuffs and lysine requirement levels on carcass composition of Arian male broilers at 42 days of age

T	(Amino Acids × Lys levels)	Carcass (%)	Carcass (g)	Breast (%)	Breast (g)	Thigh (%)	Thigh (g)	Abdominal Fat (g)
1	(TAA × 110% NRC)	66.63 ^{a}	1237 ^{b}	21.59 ^{a}	394 ^{b}	22.62	420 ^{b}	17.05 ^{b}
2	(TAA × Standard NRC)	66.18 ^{a}	1215 ^{b}	21.19 ^{a}	396 ^{b}	22.79	417 ^{b}	15.10 ^{b}
3	(TAA × 90% NRC)	60.94 ^{b}	1113 ^{c}	18.88 ^{b}	345 ^{b}	21.88	400 ^{b}	19.10 ^{b}
4	(DAA × 110% NRC)	65.18 ^{a}	1463 ^{a}	21.92 ^{a}	472 ^{a}	23.30	524 ^{a}	40.33 ^{a}
5	(DAA × Standard NRC)	66.35 ^{a}	1227 ^{b}	21.27 ^{a}	400 ^{b}	23.71	438 ^{ab}	12.43 ^{b}
6	(DAA × 90% NRC)	63.03^{ab}	1223 ^{b}	20.78 ^{ab}	402 ^{b}	21.63	421 ^{b}	33.10 ^{a}
	P-value	0.017	0.036	0.087	0.031	0.332	0.039	0.002
	(SEM)	1.175	52.93	0.381	22.71	0.719	29.35	4.577
	Amino Acids of Feedstuffs							
	Total	64.58	1188 ^{b}	20.56 ^{b}	378 ^{b}	22.43	412	17.08 ^{b}
	Digestible	64.85	1304 ^{a}	21.79 ^{a}	426 ^{a}	22.88	461	28.62 ^{a}
	P-value	0.780	0.037	0.042	0.023	0.452	0.056	0.006
	(SEM)	0.678	78.32	0.293	13.11	0.415	16.94	2.643
	Lysine requirement levels							
	110% NRC	65.91 ^{a}	1350 ^{a}	21.76 ^{a}	433 ^{a}	22.96	472	28.69 ^{a}
	Standard	66.26 ^{a}	1221 ^{ab}	21.24 ^{ab}	398 ^{ab}	23.25	427	13.76 ^{b}
	90% NRC	61.98 ^{b}	1168 ^{b}	19.83 ^{b}	374 ^{b}	21.75	410	26.10 ^{a}
	P-value	0.003	0.046	0.041	0.045	0.116	0.126	0.010
	(SEM)	0.831	63.45	0.181	16.06	0.508	20.75	3.237

$^{a–c}$ Means followed by different superscript letters are significantly different (P< 0.05)

recommendation for maximal growth (Kidd and ancher, 2001; Nasr and Kheiri, 2011). It is also confirmed that increasing dietary Lys level increased growth in male and female Arian broilers. This study showed a higher efficiency of these diets as they allowed a better transformation of AA intake into tissue synthesis and accretion. This is possibly related to a higher AA availability for muscle synthesis.

Table 4: Effects of type of amino acids of feedstuffs and lysine requirement levels on carcass composition of Arian female broilers at 42 days of age.

T	(Amino Acids × Lys levels)	Carcass (%)	Carcass (g)	Breast (%)	Breast (g)	Thigh (%)	Thigh (g)	Abdominal Fat (g)
1	(TAA × 110% NRC)	66.51 [a]	1177 [a]	21.75	386 [a]	22.35	396 [ab]	29.58 [a]
2	(TAA × Standard NRC)	65.12 [a]	956 [b]	20.14	297 [b]	23.08	338 [b]	14.15 [b]
3	(TAA × 90% NRC)	63.87 [ab]	1117 [ab]	21.85	377[ab]	23.19	394 [ab]	25.00 [a]
4	(DAA × 110% NRC)	67.26 [a]	1176 [a]	21.43	399 [a]	22.51	418 [a]	29.32 [a]
5	(DAA × Standard NRC)	63.11 [ab]	1118 [ab]	20.03	356 [ab]	20.81	370 [ab]	21.85 [ab]
6	(DAA × 90% NRC)	60.87 [b]	1092 [ab]	20.17	362 [ab]	20.77	371 [ab]	18.62 [b]
	P-value	0.047	0.039	0.444	0.039	0.332	0.045	0.022
	(SEM)	1.114	56.97	0.861	23.73	0.719	17.24	2.941
	Amino Acids of Feedstuffs							
	Total	65.16 [a]	1083	21.25	353	22.87 [a]	376	22.91
	Digestible	63.74 [b]	1129	20.54	373	21.36 [b]	386	23.25
	P-value	0.044	0.057	0.332	0.223	0.032	0.516	0.451
	(SEM)	0.712	32.89	0.48	13.61	0.435	9.94	2.86
	Lysine requirement levels							
	110% NRC	66.88 [a]	1177 [a]	21.59 [a]	392 [a]	21.56	407	24.09 [a]
	Standard	64.11 [ab]	1037 [b]	20.08 [b]	326 [b]	21.95	354	18.01 [b]
	90% NRC	62.36 [b]	1104 [ab]	21.01 [ab]	369 [ab]	22.85	383	27.16 [a]
	P-value	0.023	0.046	0.041	0.045	0.216	0.126	0.015
	(SEM)	0.931	40.45	0.181	16.06	0.517	20.75	2.217

[a–c] Means followed by different superscript letters are significantly different (P< 0.05)

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