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THE EFFECTS OF DIFFERENT LYSINE AND METHIONINE LEVELS ON BROILER CHICKENS PERFORMANCE

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ABSTRACT
The study was conducted to assess the effects of different L-Lysine and DL-Methionine levels on broiler chickens from 1 to 42 d of age. A total of ninety six Hybro strain chicks were selected on the basis of uniform initial live bodyweight (48g/chick). Chicks were randomly divided into four treatments of 6 chicks per pen. Diets were formulated based on sorghum, groundnut meal, sesame meal and bone meal to meet the nutrient requirements of broiler diet. In treatment 1, diet was formulated to contain (3,100 kcal/kg) (22.4% CP, 0.70% Lysine, and 0.00% Methionine). Treatment 2 was (22.4% CP, 0.60% Lysine, and 0.10% Methionine) and treatment 3 was (22.4% CP, 0.50% Lysine, and 0.20% Methionine) which were fed to broilers. Requirements for the 1-to 42-d growth period were determined by body weight gain, feed intake and feed conversion, respectively. The weight gain in treatment 1 was significantly higher than other treatments. No significant differences were observed in feed intake and feed efficiency between treatment groups throughout the experimental period. The results show that birds negatively responded to dietary levels of 0.10% lysine, and 0.60% methionine had a beneficial effect on the performance of broiler chicken. Economically, the study indicated that supplementation of methionine and lysine to broiler diet increased gross marginal profit.

Key words: Lysine, Methionine, performance, marginal profit

INTRODUCTION
Dietary protein is the most expensive component of a broiler diet. Methionine (Met) is an amino acid of critical importance in commercial poultry diets, because it is typically the first-limiting amino acid. Dozier et al. (2009) suggested that one of the most expensive components of broiler chickens diets is protein or more specifically amino acids. (Kidd *et al.*, 2004; Sterling *et al.*, 2006; Dozier *et al.*, 2006) showed that the need for dietary lysine (Lys) is greater for breast meat yield than for growth rate. Baker and Han (1994) indicated that in chickens and pigs, lysine is the reference amino acid in ideal amino acid ratios. Kidd and Fancher (2001) remarked that increasing the percentage of essential amino acids and the balance within dietary crude protein can improve the proportion of productive energy recovered from methionine (Met). This is because broiler chicks fed starter (1 to 18d) dietary lysine at recommendations had optimal growth and carcass attributes at 41 and 42 day. Wang *et al.* (1997) predicted that supplementation of the methionine-deleted diet with L-Cystein significantly improved growth performance. Dozier *et al.*, (2007) found that broilers fed less dense amino acid diets had the ability to increase feed consumption, which in turn increased abdominal fat yield. Rostagno' and Pupa (1995) found that formulating broiler diets based on digestible amino acids gives a better prediction of dietary protein quality and bird performance than total amino acids. Chen et al., (2003) observed an interaction between methionine sources and the dietary arginine: lysine in broilers after only 5 d of exposure to high temperatures**.** Harms (1992) suggested that methionine (a sulfur amino acid) is the first limiting amino

acid in a corn-soybean meal diet for broiler breeder hens. Lysine is the second limiting acid, and tryptophan is the third limiting amino acid. Graber and Baker (1971) documented that the importance of methionine is indicated by its three major functions in poultry: a methyl donor, protein synthesis and as a precursor to cysteine. Aviagen North America (2003) observed that dietary amino acid recommendations are limited on broilers grown to 3.4 kg or greater. Primary breeding guides provide nutrient recommendations to a maximum BW (Body weight) of 3.0 kg. (Dozier et al., 2007b; Rostagno' and Pupa 1995) recommended that decreasing dietary amino acid density to the low regimen tended to reduce total breast meat weight and yield. Dozier and Moran (2001) suggested that feeding high amino acid density diets improves feed conversion and increases breast meat yield of broiler chickens.

The objective of the present experiment was to determine the effects of adding lysine and methionine to dietary levels of the approximate requirement in a common feeding regimen for reared broilers to compare responses to those receiving the level at the same Crude Protein (CP) and Metabolizable Energy (ME).

MATERIALS AND METHODS

Experimental chicks

A total of ninety six 1 day– old commercial unsexed broiler chicks of Hybro strain were purchased from The Arab Company for Livestock Development -Khartoum, and transported to the Student Poultry Premises, Faculty of Agricultural Studies, Sudan University of Sciences and Technology, Shambat. All chicks were weighed with an average initial weight of 48g day old chick. The chicks were then allotted randomly to 4 groups, each of four replicates of six chicks. Ground brooding/rearing system was adopted for the six weeks experimental period. Pens were equipped with one tube feeder and one bell-type drinker, which provided access to feed and water *ad libitum*. Birds were vaccinated at the hatchery for Marek's disease, Newcastle disease, and infectious bronchitis then further immunized for infectious bursal disease at 14 d of age. Soluble multi-vitamin compounds (Pantominovit -Pantex Holland B.V. 5525 ZG Duizel-Holland) and antibiotics (Neomycin, Avico, Jordan) were given during the first 3 days of age and for 4 days before and after vaccination to guard against stress. The experiments were conducted during winter season (December to January) and the temperature averaged between 14. 3 -30.5C$^{\circ}$ for six weeks.

Housing

Open wire mesh-side poultry house was used. The house was constructed on a concrete floor, with a corrugated metal sheets roof and a solid brick Western-Easter wall up to 9.84 feet the eaves and 4-16.40 feet for apex. Twelve pens, 1.5m^2 each, inside the house, were prepared using wire mesh partitioning, light was provided approximately 14 hours/day allowing one hour before sunset and one after dawn. Four bulb (60 watt) lamps were used for this purpose.

Experimental rations

A basal diet was formulated to yield 22.4% CP and 3100kcal ME/kg being adequate in all nutrients except for phosphorous and calcium (Table 1). The available phosphorous (0.6) and calcium (0.90) were balanced by oyster shell flour and bone meal (Suleiman and Mabrouk, Afaf 1999). Lysine was set at 1.20% and the methionine 0.48%. Ration ingredients were sorghum, sesame cake, groundnut cake, and wheat bran methionine and lysine without adding any concentrate (0.0, 0.7), (0.1, 0.6), (0.2, 0.5), (0.0, 0.0) respectively was added to the basal diet resulting in four formulae. Experimental diets were fed for 42 days.

Table 1 Percentage and calculated analysis of experimental diets

Ingredients	Lysine and methionine Levels %			
	(0.0,0.0)	(0.0, 0.7)	(0.1, 0.6)	(0.2,0.5)
Fetarita_(Sorghum)	65.00	65.00	65.00	65.00
Ground nut cake	13.00	22.00	22.00	22.00
Sesame cake	15.00	10.00	10.00	10.00
Sodium Chloride	0.50	0.25	0.25	0.25
Concentrate	05.00	-	-	-
Oyster flour	1.50	0.80	0.80	0.80
Vitamin* & mineral	-	0.25	0.25	0.25
L-Lysine	-	0.70	0.60	0.50
DL-Methionine	-	-	0.10	.20
Total	100	100	100	100
Calculated analysis				
Crude protein%	22.5	22.7	22.3	22.8
Ether extract%	3.30	2.90	3.80	3.00
Crude fiber%	3.80	4.40	4.20	4.10
Ash%	7.60	6.60	6.30	6.6
M- E, kcal/kg	3100	3100	3100	3100
Total Phosphorous%	0.70	0.60	0.60	0.60
Calcium %	1.50	0.90	0.90	0.90

*Guaranteed levels of vitamin and minerals supplements per kg product: vit. A: 300.000 UI; vit. $D_{3:}$ 100.00 UI; vitE. 4.00mg; vit K: 98 mg; vit. B2: 1.320MG; vit. B12: 4.000mg; pantothenate: 2.000mg; niacine: 20.000mg; folic acid: 100 mg; choline: 50.000 mg; copper: 15.000 mg; idoines: 250mg; selenium: 50 mg; manganese: 24.000mg; zinc: 20.000 mg; iron.: 10.000mg; coccidies: 25.000mg; antioxydants; 125mg

Performance data

Average body weight, weight gain and feed consumption (g) for each group were determined weekly throughout the experimental period. Health of the experimental stock and mortalities were closely observed.

Slaughter procedure and data

At the end of the 6th week the birds were fasted overnight with water allowed slaughtered terminally. Birds were weighed individually before slaughter by severing the right and left carotid and jugular vessels, trachea and esophagus. After bleeding they were scaled in hot water, hand-plucked and washed. The head was removed close to skull; feet and shanks were removed at the hock joint. Evisceration was accomplished by a posterior ventral cut to completely remove the visceral organs. Hot carcass and each have the Intestines, liver, and gizzard were separately weighted. Carcass was chilled in refrigerator at 4C^o for 24 hour before further preparation**.**

Carcass data

The cold carcass was prepared for analysis by removal of the skin and neck near the body and each was weighted separately. The carcass was then divided into right and left side by mid-sawing along vertebral column each side was weighed. The left side divided into six commercial cuts, wing, thigh, drumstick, breast, rib back and tail-back (Mohammed, 1997) each cut was weighed separately**.**

Statistical analysis

Statistical examination of the data was performed using the analysis of variance, to Sendecore and Cochran (1980).The means were compare using least significant difference (LSD) procedure as out lined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Table 2 summarizes growth and feed conversion data. Birds performed well during both starter and grower periods. To 27 days of age, birds on the (0.1, 0.6)lysine ; methionine diet were significantly inferior by 124 g body weight and 7 points in feed conversion compared to the control diet. Thus, the lower and higher contents of lysine and methionine resulted in lower bird performance with diets medium (0.1, 0.6) and (0.2, 0.5) to 42 days of age. These results supported the findings of Zarate *et al.* (2003b) who reported that the additive of amino acids to broilers dietary at first four weeks of age should be cost effective because feed intake is relatively low during this period compared with finishing and withdrawal periods. Dozier *et al.* (2007a) observed that the providing broilers high amino acids density through 4 wk of age should be cost effective because feed intake is relatively low during this period compared with finishing and withdrawal periods. Formulation with commercially available purified essential amino acid (EAA) to attain broiler requirements not only improves their overall balance but lends to reduction in crude protein (CP) while improving the proportion of productive energy (PE) derived from metabolizable energy (ME). Stilborn *et al.* (1997) documented that broilers fed less dense amino acid diets had the ability to increase feed consumption, which in turn increased abdominal fat yield. Si *et al.* (2004a) documented that increasing dietary amino acid density from 36 to 59 d improved cumulative feed conversion, but did not alter final growth rate, feed consumption, and the incidence of mortality. Kidd and Fancher (2001) reported that the dietary lysine requirement for growth performance in male chicks (1 to 18d) is about 107% to 111% of recommendations (1.18 to 1.22% total lysine of diet or 1.07 to 1.11% digestible lysine of diet).

Table 2 Analysis of variance and average (mean ± st.dev.) of performance values of broiler chicks fed different lysine and methionine levels for 42 days.

Items	F[✝]	Lysine and methionine Levels %			
1 to 27 d		(0.0,0.0)	(0.0, 0.7)	(0.1, 0.6)	(0.2,0.5)
Initial weight (g)	0.00	48.0±0.00	48.0±0.00	48.0±0.00	48.0±0.00
Final weight (g)	34.98	485.4^{c}±43.5	683.4^{b}±45.1	805.4^{a}±54.3	700.00^{b}±36.0
Weight gain (g)	34.98	410.40^{c}±43.3	608.4^{b}±45.1	730.4^{a}±54.3	625^{b}±36
feed intake (g)	2.50	1020.75^{b}±147	1062.5^{ab}±232	1313.8^{a}±190	1202^{ab}±53.1
Feed conversion ratio	5.00	2.5^{c}±0.03	1.8^{a}±0.04	1.8^{a}±0.03	1.9^{b}±0.01
28 to 42 d					
Final weight (g)	16.3	1279.2^{c}±53.4	1464.6^{b}±70.8	1646.7^{a}±119	1512.5^{b}±25
Weight gain (g)	1.14	793.8^{a}±29.9	781.3^{a}±57,8	841.3^{a}±66.9	812.5^{b}±28.5
feed intake (g)	0.050	1678^{b}±216.9	1672^{a}±169.6	1713.8^{a}±183	1696^{a}±79.2
Feed conversion ratio[1]	0.10	2.1^{a}±0.03	2.1^{a}±0.02	2.1^{a}±0.02	2.1^{a}±0.02

[✝]At (3, 12) d.f.

Means in the same row bearing different superscripts differ significantly ($p<0.05$).

FCR =FC / average weight gain (g)

Si *et al.* (2004a) found that minimum amino acid content of the diet was increased to 110%, performance of birds fed 20% CP diet did not differ significantly from that of the birds fed the 22% CP diet .Dozier *et al.* (2006) remarked that in general, broilers given the high regimen had greater gross feeding margin, as breast meat prices increased, when feeding high amino acid density diets from 36 to 59 d of age. Si *et al.*(2004b) observed that performance of chicks fed diets formulated to meet the minimum recommendations for methionine per se was equal to that of chicks fed similar diets with additional methionine added to meet minimum recommendations significantly ($p<0.05$)

The body weight of the birds sampled for carcass analysis reflected the average weight gain of the respective treatment groups (Table 3). Carcass yield as a percentage of slaughter weight was affected by dietary treatment. Hot and cold dressing meat yield, however, clearly responded to differences in amino acid supply. Carcasses from birds on diet (0.1, 0.6) had only 28.7% slaughter weight, significantly more than the diet with methionine supplied 18.2%, the adding of DL-methionine and L-lysine(0.2,0.5) had 14.5% to diet compensated for about half of this difference, confirming the high sensitivity of the broilers to dietary levels of amino acids. These finding was supported by Si et al. (2004b) who documented that addition of cysteine to corn-soybean meal diets with methionine added to meet only the minimum needs for methionine did not improve performance of chicks. Balnave and Oliva (1990) assessed the methionine requirements of birds grown at various temperatures. They found that birds kept at a constant 30°C achieved optimum growth when fed methionine: lysine of 0.31. Birds under cycling temperatures of 25 to 35°C required ratios of 0.37, whereas maximum growth was obtained with methionine: Lysine of 0.39 for birds at 21°C.

Table 3 Analysis of variance and average (mean ± st.dev) Slaughter and carcass values of broiler chicks fed different lysine and methionine levels for 42 days

Items	F✞	Lysine and methionine Levels %			
		(0.0,0.0)	(0.0, 0.7)	(0.1, 0.6)	(0.2,0.5)
Slaughter weight	16.3	1279.2^{a}±53	1512.5^{b}±25	1646.7^{a}±119	1464.4^{b}±71
Hot dressing%	1.1	69.7 ^{a}±0.80	69.9 ^{a}±0.20	69.3^{a}±0.70	69.9 ^{a}±0.30
Cold dressing%	0.5	68. 8 ^{a}±0.6	68.9 ^{a}±0.20	68.9 ^{a}±0.70	69.2 ^{a}±0.20
Feed conversion %	0.10	2.25 ^{a}±0.2	2.0 ^{ab}±0.1	1.93 ^{b}±0. 2	1.95 ^{b}±0. 2
Mortality%	1.1	4.2	0.0	0.0	0.0

✞ At (3, 12) d.f. Means in the same row bearing different superscripts differ significantly ($p<0.05$).

The results show that birds negatively respond to dietary levels of 0.10% lysine and 0.60% methionine when amino acid is supplemented to diet. Similarly the levels of 0.20% lysine and 0.50% methionine added to diet of ingredient also showed the same trend. The present data set gives further evidence that diet formulation on amino acids will yield more consistent bird performance, moreover, amino acids might be considered as a necessary tool making possible the use of high portions of by-products without variability in performance or formulating with large safety margins.

The economic significance of the diet alterations evaluated in this study is considerable. Based on the performance data obtained Table 4 calculates cost ratios using typical prices for the feedstuffs included (Sudanese market, mid 2004); feed cost per bird and feed cost per kg carcass weight were lowest without supplemented diet. Dozier *et al.* (2007b) documented that feeding high amino acid density diets to broilers increased gross feeding margin.

Table 4. Major inputs and margin over major inputs (per head) of broiler chicks fed different lysine and methionine levels for 42 days

Items	Lysine and methionine Levels %			
	(0.0,0.0)	(0.0, 0.7)	(0.1, 0.6)	(0.2,0.5)
Meat sales (SDG)*	1170.072	1186.128	1263.032	1188.605
Chick purchase (SDG)	185.000	185.000	185.000	185.000
Feed cost(SDG)**	195.6	198.8	220.1	210.7
Major cost of production	519.2	522.5	544.9	535.0
Margin over major inputs	700.0	700.0	700.0	700.0
Profitability (%)	58.42	57.42	60.50	58.86
Profitability ratio	1.00	1.30	1.50	1.40

Dozier *et al.* (2006a) remarked that consideration to breast meat prices and diet cost should be given collectively when establishing commercial feeding programs for broilers grown to heavy market weights. Waibel *et al.* (1998) suggested that economical performance with reduced gain and breast meat yield may be obtained with lower diet protein. Pesti (2009) reported that essential amino acid balance and total amino acid levels should be considered to optimize growth and to maximize profits. The average mortality rate for all the experiment was 2.7%. No effects of dietary lysine or methionine level were observed.

CONCLUSIONS

1. The L-lysine and DL-methionine levels may have been adequate for the 28- to 42-d period for the significant improvements in performance responses.
2. Formulating broiler diets based on digestible amino acids gives a better prediction of dietary protein quality and bird performance.

3. The use of cheap products with adequate supplementation of crystalline amino acids may offer considerable economic benefit to broiler meat production

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