Effect of dietary lysine to crude protein ratio in diets containing corn, cottonseed meal and soybean meal on broiler performance during starter period

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Abstract: This experiment was conducted to determine the effects of dietary lysine to crude protein ratio on performance of broiler chickens in starter period. All diets were isocaloric and isonitrogenous with different ratios of lysine to crude protein, and basis of diets contained corn, soybean meal, and cottonseed meal. A complete randomized design with dietary lysine to crude protein was used to experiments The six starter diets ,based on lysine to crude protein ratios were A_1(0/050), A_2(0/055) ,A_3(0/060) ,A_4(0/065), A_5(0/070) A_6(0/075). Growth performance and carcass composition were evaluated during the experiment. The results showed that dietary lysine to crude portion ratio significantly affected the body weight gain (BWG), feed convection ratio (FCR), feed intake (FI), breast meat yield (BMY) and thigh yield (TY) (p<0/05); However, treatments' effect on carcass percentage was not significant. A modeling approach was applied to determine the optimum level of supplemental lysine, and inflection point in spline models was considered as an optimum point. Using linear broken-line model, inflection points for BWG, FC, BMY, were 0.0.062, 0.00.063 and 0.067 of ratio, respectively. These values in quadratic broken-line model were 0.069, 0.058 and 0.075 of ratio, respectively. Ratio of current study revealed that in diets comprising cottonseed meal were required the higher dietary lysine to curde protein ratio as compared with conventional diets. Moreover, due to low digestibility of lysine in cottonseed meal higher requirements are needed rather than the recommended level of NRC (1994) that recommended 0.052 during starter phase.

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Key words: lysine, crud protein, broiler, ratio, broken line.

Introduction

Growth rate and carcass composition of poultry are receiving considerable attention there is an emphasis on increasing the meat yield especially improvement of FCR and breast meat yield and decreasing the fat content of the broiler chicken carcass (Bedford and summers, 1985:Hickling et al 1990; Kerr et al, 1999; Rezaei et al, 2004). The NRC (1984) indicated optimum dietay lysine to protein ratio of 0.052, 0.050 and 0.047 during starter, grower and finisher phases, respectively. Ngambi et al. (2009) showed dietary lysine to crude protein ratios of 0.066 and 0.077 supported optimum growth rate and feed conversion and they showed the ratio for optimum breast meat yield was lower than for optimum growth rate and feed conversion ratio. Bedford and Sammers (1985) showed the increasing lysine to protein ratio in the diet will increase carcass protein and decrease carcass fat increasing dietary lysine content an increase in broiler chicken growth ,carcass protein retention and a decrease in fat storage (Sibbald and Wolynetz1986); however higher and lower optimum dietary lysine to crude protein ratios have been reported by some workers such as Han and Baker, 1991; Mack et al. 1999; Kerr et al. 1999; Rezaei et al. 2004). These results have been found with conventional diets based on corn – soybean meal but current experiment was conducted with diets based on corn–cottonseed meal- soybean meal. Chickens fed diet with less than the required lysine to crude protein ratio raise slowly, and have a poor feed conversion ratio and lower carcass yield (Heckling et al. 1999; Rezei et al, 2004). Thus, the objective of the present study was to determine the dietary lysine to crude protein ratio for optimum performance of broiler in starter period (first two weeks of age) with the basal diet of corn- cottonseed meal – soybean meal.

Materials and Methods:

Birds and diets

This experiment was conducted at Institute of especial domestic animals of Zabol University. The trial was used to determine the effect of dietary lysine to crude protein ratio on performance of male Ross 308 broiler chicks between one and 14 days old, at day old 360 male Ross 308 chicks were randomly assigned to six treatment with four replicates each having 15 bird, thus 24 floor pens (1.5m^2/pen) were used in total the experimental diets were isocaloric and isonitrogenous Corn –soybean - cottonseed meal basal diet was formulated to meet or exceed the NRC (1994) requirement for all nutrients, and dietary lysine to crude protein were obtained with addition of lysine-HCl at expense of cornstarch (Tables 1 and 2). The birds were offered with feed and water as ad libitum. Feed intake was measured weekly and chicks were weight at 0-7and 14 days of age. The initial live weight of the birds was taken at the start of experiment average live weight of the birds was taken at the start of experiment. Average live weight per bird was measured at weekly by weighting the chickens in each pen and total live weight was divided by the total number of bird in the pen to get the average live weight of the chickens, these live weight were used to calculate growth rate, feed consumed divided by the weight of live birds Plus the weight of birds that died or were called minus weight of all birds in the pen. Two birds of each pen were used for breast meat and tight dissection. The breast muscle was carefully dissected and immediately weight.

Statistical analysis

The calculated to determine the effect of dietary lysine to crude protein ratio on performance of broiler chickens in starter period were used for statistical analysis with treatment ratio A_1 (0/052), A_2(0/057) ,A_3(0/062) ,A_4(0/067), A_5(0/072) A_6(0/077). Five analyses were conducted: 1) PROC REG (SAS Institute, 2002) using linear response to evaluating lysine to crude protein ratio; 2) PROC REG (SAS Institute, 2002) using quadratic response to evaluating lysine to crude protein ratio (SAS Institute, 2002); 3) PROC NLIN (SAS Institute, 2002) conducting linear broken-line model based on Robbins (2006); 4) PROC NLIN (SAS Institute, 2002) conducting quadratic broken-line model based on Robbins et al. (2006); 5) PROC GLM (SAS Institute, 2002) to separate differences among means using LSD option of SAS. Lysine to crude protein ratio were estimated using both linear broken-line and quadratic broken-line models when a significant response occurred ($p<0.05$). R-square and sum of square residual of each model were used to compare nonlinear models (Table 5). Regression models for estimation dietary lysine to crude protein ratio were as follow:

Linear Broken-Line Model: $y= L+U\times(R-x)$, if $R<x$, else $(R-x)=0$

Quadratic Broken-Line Model: $y= L+U\times(R-x)(R-x)$, if $R<x$, else $(R-x)=0$

Results and Discussion:

Results of the effect of dietary lysine to crude protein ratio on body weight gain, feed intake, breast meat yield and tight yield of male Ross 308 broiler chickens from 1 to 14 days of age were significance ($p<0/05$). Dietary lysine to protein ratio had no effect on carcass yield of the chickens during starter phase that are presented in Table 3.

The results of the present study indicated that optimum dietary lysine to crude protein ratio during the starter phase was 0.062 and 0.69 based on linear broken line and quadratic broken line , receptivity. These values are higher than 0/049 estimated by the NRC (1984,1994) for starter phase, this ratio is higher than the Han and Bake (1994) and Rezaie et al. (2004) for broiler chickens between three and six weeks old. The present results indicate that dietary lysine to crude protein ratio for optimizing body weight gain increased, the interpretation for higher dietary lysine to crude protein ratio for body weight gain in the present studies maybe related to the changing genotype of the birds (Acare et al 1999; Han and Baker, 1991) or less bioavailability of lysine in cottonseed meal (Nagalakshimi, 2007)

Dietary lysine to crude protein ratio of 0.055 and 0.061 optimized breast meat yield at the starter with liner broken line and quadratic broken line receptivity. These are higher than the dates of Rezaie et al, (2004). Labadan et al (2001) and the NRC (1984, 1999) indicated that dietary lysine to crude protein ratio for optimum breast meat yield is higher than body weight gain. Acar et al (1993) demonstrated that pectoral major is more sensitive to lysine intake rather than muscle. This response also has been shown in the current study.

This high ratio maybe related to the protein quality of the basal diet (Kidd and Fancher, 2001); however gossypol in cottonseed meal increased dietary lysine to protein in diet (nagalakshimi. 2007)

Optimum dietary lysine to crude protein ratio of 0.057 and 0.062 optimized feed conversation to the during starter with linear broken line and quadratic broken line receptivity. This ratios are similar the 0.06 of Han and Baker (1991), 0.058 of Morris et al (1987) and higher than the 0.052 of the NRC (1984) and 0.049 of the NRC (1994)

This study showed that dietary lysine to protein for body weight gain; feed converting, breast meat yield higher than estimated of the researchers (NRC. 1994. 1998; Rezaei, 2004; Han and Baker, 1991)

This high ratio maybe related to the protein quality in basal diet (Kidd and Fancher, 2001) Adverse effects of anti-nutritional factors and lower digestible lysine in cottonseed meal (Nagalakshhmi, 2004) increases the ratio lysine to crude protein for normal growth and performance. Searchers used cottonseed meal in the basal diet and higher estimate of ratio me be attributed to this occurrence. All in all, this study showed that the diets containing cottonseed meal require higher dietary lysine to protein ratio.

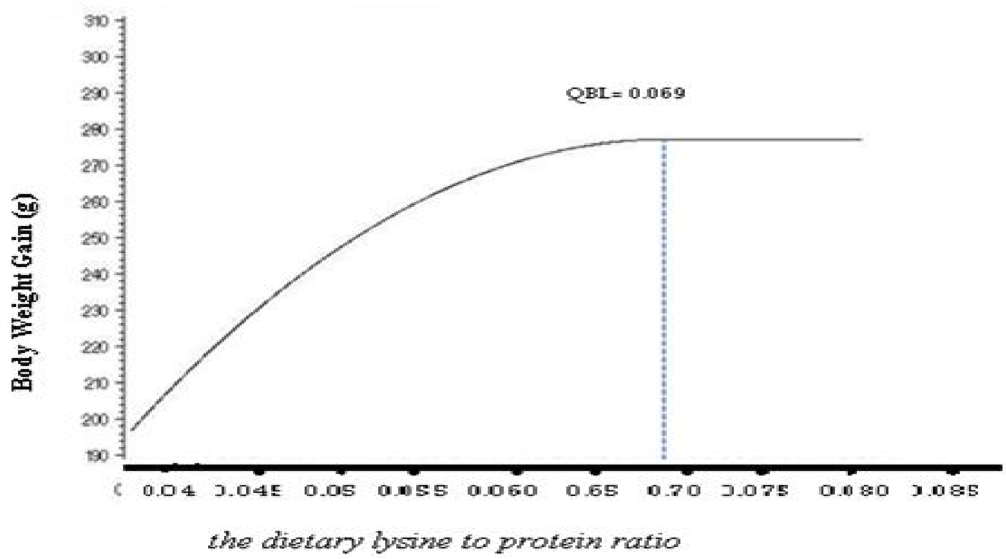

Figure 1. the dietary lysine to protein ratio for breast meat yield using quadratic broken-line model.

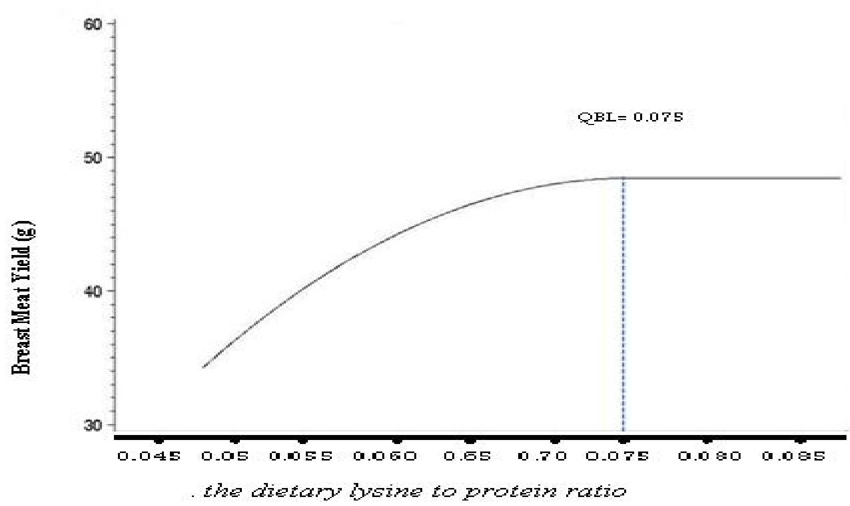

Figure 2.. the dietary lysine to protein ratio for breast meat yield using quadratic broken-line model.

Table 1 Nutrition composition of the diets

	Diet					
	A1	A2	A3	A4	A5	A6
Dry matter (g/kg)	889	889	889	889	889	889
ME (kcal/kg)	3200	3200	3200	3200	3200	3200
Total lysine:CP ratio	0.05	0.055	0.060	0.065	0.070	0.075
Crude protein (g/kg)	210	210	210	210	210	210

Increment: 0.005

***Table 2**. Composition of basal diet.*

Ingredients	Basal Diet (%)
Corn	56.37
Cottonseed meal	15.0
Soybean meal	15.0
Fish meal	5.66
Oil	4.54
Limestone	1.40
Corn starch	1.00
DL-Met	0.34
L-Thr	0.08
NaCl	0.10
Vit premix[1]	0.25
Min premix[2]	0.25
Nutrient composition	
ME (kcal/kg)	3200
CP (%)	21.0
Ca (%)	0.90
Available P (%)	0.43
Lysine (%)	1.06
dig Lysine (%)	0.88
Met (%)	0.69
dig Met (%)	0.64
Thr (%)	0.86
dig Thr (%)	0.70
Trp (%)	0.24
dig Trp (%)	0.20
Arg (%)	1.61
dig Arg (%)	1.45

[1]Vitamin premix provides per kilogram of diet: vitamin A, 4,500 IU; vitamin D_3, 2,250 ICU; vitamin E, 50 IU; thiamin HCl, 15 mg; riboflavin, 15 mg; nicotinic acid, 50 mg; folic acid, 6 mg; pyridoxine, 6 mg; biotin, 0.6 mg; vitamin B_{12}, 0.02 mg; choline Cl, 2,500 mg; d-calcium pantothenate, 20 mg; menadione sodium bisulfite, 1.5 mg; butylated hydroxytoluene, 100 mg; glucose to make 12 g.
[2]Mineral premix provides per kilogram of diet: $CaCO_3$, 25.6 g; $CaHPO_4\_2H_2O$, 5.6 g; KH_2PO_4, 14 g; NaCl, 5.1 g; $MnSO_4\_H_2O$, 0.33 g; $FeSO_4\_7H_2O$, 0.33 g; KI, 0.003 g; $CuSO_4\_5H_2O$, 0.05 g; ZnO, 0.1 g; $CoCl_2\_6H_2O$, 0.0017 g; $NaMoO_4\_2H_2O$, 0.0083 g; Na_2SeO_3, 0.0004 g.

Table 3. Growth performance of broiler chicks fed varying dietary lysine to crude protein ratio *from days 0 to 14 of age.*

lysine to crude proten ratio	BWG (g)	FCR (g/g)	FI (g)	BM yield (g)	THG yield (g)	Carcass yield (%)
0.050	236.4^{b}	1.46^{a}	345.1^{b}	35.0^{c}	19.9^{c}	69.1
0.055	253.8^{b}	1.38^{ab}	350.9^{b}	39.6^{bc}	22.0^{bc}	70.6
0.060	279.4^{a}	1.39^{ab}	388.7^{a}	46.1^{ab}	23.9^{ab}	71.0
0.065	283.5^{a}	1.38^{ab}	391.8^{a}	45.7^{ab}	24.4^{a}	72.6
0.070	277.4^{a}	1.39^{ab}	385.6^{a}	48.4^{a}	24.6^{a}	71.6
0.075	288.6^{a}	1.29^{b}	372.4^{a}	50.0^{ab}	24.3a^{b}	70.6
SEM	13.1	0.07	14	5.0	1.6	3.3
p>F						
Ratio	0.0001	0.0922	0.0005	0.0046	0.0025	0.7530
Linear	<0.0001	0.1818	<0.0003	0.0009	0.0002	0.1665
Quadratic	0.0105	0.2417	0.0518	0.2699	0.0935	0.5911

[a-b-c] Values within rows without a common superscript are significantly different ($P \leq 0.05$).

Table 4. *The dietary lysine to protein ratio for starting broiler chicks using different models and response criteria.*

	BWG		BM yield		FC yield	
	LBL[1]	QBL[1]	LBL	QBL	LBL	QBL
Ratio	0.062	0.069	0.067	0.075	0.063	0.058
R-square	69.8	68.5	55.2	57.0	63	33
SE[2]	0.028	0.073	0.062	0.160	0./14	0.09
SSR[3]	3257.272	3402.807	474.050	455.030	12	0.12
95% CI[4]	1.00-1.11	1.00-1.29	1.04-1.28	0.98-1.60	0.99-1.23	0.98-1.3
p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

1. Linear broken-line (LBL) and quadratic broken-line (QBL) are y=L+U(R-x), and y=L+U(R-x)(R-x) respectively, if R<x. L= ordinate value; U= random component of the slope; R= abscissa of the break point.
2. SE= standard error
3. SSR= sum of squared residual
4. CI= confidence interval

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