



Effect of dietary levels of methionine + cystine on performance of broiler breeders

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ABSTRACT - The objective of this experiment was to evaluate levels of methionine + cystine levels for broiler breeders from 40 to 60 weeks of age. It was used 288 Cobb broiler breeders, distributed in a randomized experimental design with six levels of methionine+ cystine in the diets (0.39; 0.47; 0.55; 0.63; 0.71 and 0.79%), eight repetitions and six breeders per experimental unit. The diets were isocaloric and isoprotein (2,850 kcal ME/kg and 12.58% CP) and offered at a fixed amount (155 g) per bird. For the entire studied period, by using polynomial analysis, it was observed a quadratic effect of methionine + cystine levels on the percentage of egg production, on number of eggs per hen housed, on number of eggs per hen and egg weight. There was also a linear effect on shell weight when it was calculated in relation to egg weight. The total methionine + cystine requirement for broiler breeders was calculated at 0.521% for percentage of egg production and number of eggs per hen, which corresponds to a daily intake of 808 mg of methionine + cystine/day. The digestible methionine + cystine requirement for broiler breeders was estimated at 727 mg for laying percentage and number of eggs per hen.

Key Words: eggs, requirement, sulfur amino acid

Efeito dos níveis dietéticos de metionina + cistina no desempenho de matrizes pesadas

RESUMO - Com o objetivo de avaliar níveis de metionina + cistina para matrizes pesadas de 40 a 60 semanas de idade, conduziu-se um experimento com 288 matrizes da linhagem Cobb-500, distribuídas em delineamento inteiramente casualizado, com seis níveis de metionina + cistina nas dietas (0,39; 0,47; 0,55; 0,63; 0,71 e 0,79%), oito repetições e seis matrizes por unidade experimental. As rações foram isocalóricas e isoproteicas (2.850 kcal EM/kg e 12,58% PB) e fornecidas em quantidade fixa (155 g) por ave. No período total estudado, por meio de análise polinomial, foi observado efeito quadrático dos níveis de metionina + cistina sobre o percentual de produção de ovos, o número de ovos por ave alojada, o número de ovos por ave e o peso dos ovos. Houve também efeito linear sobre o peso da casca quando calculado em relação ao peso dos ovos. A exigência de metionina + cistina total para matrizes pesadas foi estimada em 0,521% para percentual de produção de ovos e número de ovos por ave, o que corresponde a uma ingestão diária de 808 mg de metionina + cistina total. A exigência de metionina + cistina digestível para matrizes pesadas é de 727 mg para percentual de postura e número de ovos por ave.

Palavras-chave: aminoácidos sulfurosos, exigência, ovos

Introduction

Broiler breeder rearing is characterized by utilization of specialized birds with high genetic potential. However, the lack of consistent data on the nutritional requirements of these birds makes it difficult to formulate correctly diets for the different periods of production in order to permit their genetic potential be expressed. Furthermore, knowledge of the nutritional requirements of the broiler breeders is important to

optimize the use of food by birds and to formulate diets with minimal costs.

Methionine is considered the first limiting amino acid in diets for poultry. However, the recommendations of methionine + cystine found in the literature for broiler breeders in the production phase, besides to being scarce, show considerable variation. In the literature, it is observed recommendations of 785 mg of methionine + cystine/bird/day (McDaniel et al., 1981), 870 mg (Pearson & Herron, 1981) and 754 mg (Wilson & Harms, 1984), which differ from the

700 mg for broiler breeders, as recommended by NRC (1994) for birds in peak production.

The objective of this experiment was to determine the nutritional requirements of methionine + cystine to broiler breeders at 40 to 60 weeks of age.

Material and Methods

The experiment was conducted at the Setor de Avicultura of the Departamento de Zootecnia at Universidade Federal de Viçosa (UFV). Cobb-500 line broilers were kept under traditional management conditions, described by Arenázio (1994) in the starting and growing phases (0-23 weeks) and in the first phase of production.

When completing 40 weeks of age, birds were weighed and distributed in the experimental units according to body weight, totaling 288 females. One male and six females were housed per experimental unit, a total of 48 experimental units. Each stall had 1.30 m × 1.90 m, totaling 2.27 m² of area, four nests of 30 × 30 × 30 cm and feeder suitable for male and female. The difference between the feeders of males and females was based on the greater height of feeders for males and in the presence of exclusion grid installed in the feeders for females, preventing access of males to diet of females.

The experiment was conducted in completely randomized design with six treatments, eight replicates and six females per experimental unit. The treatments consisted of isocaloric and isonitrogenous diets (2,850 kcal/kg and 12.58% CP) containing different methionine + cystine levels. The methionine + cystine levels were obtained from the basal diet supplemented (Table 1) with six levels of DL-methionine (98%) in replacing corn starch. It was assumed that crystalline methionine is 100% available (Han & Baker, 1994). The levels of DL-methionine used were 0.00, 0.082, 0.163, 0.245, 0.326 and 0.408%, resulting in a total of 0.390, 0.470, 0.550, 0.630, 0.710 and 0.790% of methionine + cystine. The other nutrient levels used met at least the requirements specified for the period (NRC, 1994). It was provided daily, a fixed value of 155 g of feed per broiler breeder, totaling 930 g of feed per experimental unit.

The temperature in the shed was monitored daily at 12:00 p.m. by means of maximum and minimum thermometer, which was maintained in the center of the shed at the height of the birds. The average values recorded during the experimental period were 23.6 and 13.8°C.

The experiment lasted 20 weeks and it was subdivided into five periods of 28 days. The birds were weighed at the beginning and end of the experiment for calculation of weight gain and average weight of birds. Egg production was recorded daily and eggs collected twice daily at

8:00 a.m. and 1:00 p.m. The average egg production per bird and average cumulative number of eggs per bird for period of 28 days were calculated according to the number of birds in the experimental units. To calculate the number of eggs per bird housed, it was used the number of birds housed at the beginning of the experimental period.

The eggs collected during the last six days of each period were used to determine average egg weight, yolk weight, shell weight, albumen weight, yolk weight/egg weight, shell weight/egg weight and albumen weight/egg weight.

To separate the components of eggs, it was used the cooking process, following the procedure adopted by Carnino (1992). The eggs were dipped in cold water, heated and removed 10 minutes after boiling. After cooling, the shell was broken and the parts were separated for weighing of the shell and yolk. The albumen weight was obtained as the difference of the total weight of the egg before cooking. The shells were air dried before weighing.

The statistical analysis was performed by using the program SAEG (System for Genetic Analysis and Statistics - UFV, 1996). The estimates of nutritional requirements were established by regression analysis and quadratic models, and/or discontinuous Linear Response Plateau (LRP), described by Braga (1983) according to the best fit obtained for each variable.

Table 1 - Percentage composition of basal diet

Composition	%
Corn (7.67% CP) ¹	11.671
Sorghum - LT (9.65% CP) ¹	63.718
Soybean meal (43.75% CP) ¹	11.492
Soybean oil	1.461
Starch	0.500
Limestone	7.833
Dicalcium phosphate	1.988
Mineral supplement ²	0.050
vitamin supplement + choline ³	0.220
Salt	0.450
L-lysine HCl	0.482
L-threonine	0.094
L-tryptophan	0.031
Antioxidant (butylated hydroxytoluene)	0.010
Nutritional composition	
Crude protein (%)	12.58
Metabolizable energy (kcal/kg)	2,850
Methionine + cystine total (%)	0.390
Lysine total (%)	0.850
Tryptophan total (%)	0.170
Calcium (%)	3.500
Available phosphorus (%)	0.450

¹ Values determined in the Laboratório de Nutrição Animal at UFV, according to Silva (1990).

² Product composition: selenium - 0.25 mg; manganese - 106 mg; iron - 100 mg; copper - 20 mg; cobalt - 2 mg; iodine - 2 mg and excipient qsp - 1,000 g.

³ Product composition: vit. A - 10,000 IU; vit. D3 - 2,000 IU; vit. E - 30 IU; vit. B1 - 2 mg; vit. B6 - 3 mg; pantothenic acid - 12 mg; Biotin - 0.1 g; vit. K3 - 3 mg; folic acid - 1 mg; nicotinic acid - 50 mg; vit. B12 - 0.015 mg; excipient q.s.p. - 1,000 g, choline chloride (60%) - 72 g of choline.

Results and Discussion

All parameters for the assessment of egg production were affected by the concentration of methionine + cystine in the experimental diets (Table 2). Quadratic effect was observed for percentage of posture, number of eggs per bird housed and number of eggs per bird, considering the average values of all experimental period. Similarly, Sá et al. (2007) evaluated the effect of increasing levels of methionine + cystine in the diet on performance of laying hens from 34 to 50 weeks of age and also observed quadratic effect on egg production.

Body weight of birds increased linearly when the levels of methionine + cystine were added to the diets. Value similar to the average weight of 4.08 kg obtained at the end of this experiment was reported by Lopez & Leeson (1995), who studied the effects of diets with different levels of protein supplemented with synthetic amino acids, so as to maintain constant levels of methionine + cystine and lysine in broiler breeders during the breeding season and observed with a diet of 14% CP, average body weight of 4.11 kg in birds at 60 weeks of age.

The levels of total methionine + cystine used in the diets had a quadratic effect on egg weight and the estimated value of the requirement was 0.590%. Similarly, Jordão Filho et al. (2006) evaluated the inclusion of increasing levels of methionine + cystine in the diet of laying hens from 20 to 44 weeks of age and observed a quadratic effect on egg weight of birds.

The great average weight of eggs obtained in the experiment (68.62 g) was expected because the birds were assessed at 40 to 60 weeks of age and it is known that egg size of broiler breeders increases as age advances. The average weight of eggs from broiler breeders at 44 weeks of age was 64.5 g according to Brake (1985). Harms (1991) observed that the average egg weight of broiler breeders was 71.7 g and 73.25 g, respectively, from 52 to 57 and 58 to 61 weeks of age.

There was no effect of levels of methionine + cystine on the percentage of yolk and albumen. However, it was obtained a linear increase ($P < 0.05$) for the average percentage of shell ($\hat{Y} = 9.6640 + 0.8063X$; $R^2 = 0.55$). Similarly, Jordan Son et al. (2006) observed no significant effect of levels of methionine + cystine in the diet on the percentage of yolk and albumen of eggs from laying hens from 20 to 44 weeks of age.

The mean percentages found in this study were 10.14% of the shell, 31.62% of yolk and 58.24% of albumen to egg weight of 68.62 g. Thus, the observed percentage of yolk and albumen was higher than the values cited by Spratt & Leeson (1987), who observed a mean percentage composition of eggs of broiler breeders at 40 weeks of age from 29.50% for yolk, 59.70% for albumen and 10.80% for shell to eggs with 63 g. The egg yolk weight, according to these authors, increased with age of the breeders. The yolk content, expressed as percentage of total egg weight also increased whereas the albumen content decreased.

However, it should be considered that in this study that eggs were cooked to determine weight and percentage of its components. Hussein et al. (1992) observed that when the eggs are cooked, there is an increase in weight of yolk and a decrease on weight of albumen. The authors verified that these variations resulted in increased yolk:albumen ratio from 0.43 to 0.49, respectively, for values of fresh and cooked eggs. Cherian et al. (1990) attributed the decrease of albumen moisture to migration of water from the albumen to the yolk when eggs are cooked.

The average values for all the experimental phase were used to determine the nutritional requirements by the broiler breeders. It could be seen by the quadratic model that levels of methionine + cystine that would result in maximum yield would be 0.680%, considering the parameters percentage of egg production and number of eggs per hen in the period, and 0.667% for number of eggs per hen housed. However, the lowest value obtained for the sum of squared of deviations when the data were submitted to the LRP model

Table 2 - Performance, egg weight and relative weight of egg component of broiler breeders fed diets with different levels of methionine + cystine

Parameter	Level of methionine + cystine (%)						Mean	Effect	CV (%)
	0.39	0.47	0.55	0.63	0.71	0.79			
Posture (%)	47.60	53.20	56.76	56.43	57.10	56.82	54.65	Q**	7.26
Number of eggs per hen housed	13.33	14.90	15.89	15.80	15.70	15.75	15.23	Q**	6.94
Number of eggs per hen	13.33	14.90	15.89	15.80	15.99	15.91	15.30	Q**	7.26
Body weight at 60 weeks of age	3.94	3.97	4.16	4.19	4.12	4.12	4.08	L*	4.80
Egg (g)	67.84	68.94	68.88	68.86	70.03	67.17	68.62	Q*	3.25
Shell (%)	10.03	9.88	10.23	10.18	10.33	10.23	10.14	L*	2.60
Yolk (%)	31.43	31.15	32.05	31.10	31.89	32.13	31.62	NS	4.51
Albumen (%)	58.55	58.97	57.76	58.77	57.77	57.64	58.24	NS	2.56

L = linear effect.; Q = quadratic effect; CV = Coefficient of variation.
 **($P < 0.01$); *($P < 0.05$), by F test.

indicates that this methodology better explained the behavior of the data and the requirements were estimated at 0.521% for the percentage of egg production and number of eggs per hen in the period and at 0.515% for number of eggs per hen housed (Table 3). The plateau was observed in mean values of 56.78% of posture, 15.90 eggs per hen and 15.78 eggs per hen housed.

As consumption was fixed at 155 g of feed/hen/day, these values correspond to an intake of 808 mg for percentage of egg production and number of eggs per hen in the period and 799 mg of methionine + cystine, considering the average number of eggs produced per hen housed. Considering the approximate digestibility of 90% for methionine + cystine (Rostagno et al., 2005), the requirements of digestible methionine + cystine for broiler breeders was estimated at 727 mg for percentage of egg production and number of eggs per hen in the period, and 719 mg for the average number of eggs produced per hen

housed. The average percentage of egg production observed in the experiment was 54.65%. Thus, the requirements suggested have to be adjusted in herds with different average percentage of egg production. The values obtained were higher than those recommended as the daily requirement of broiler breeders by Rostagno et al. (2005), of 765 mg of methionine + cystine and 688 mg of digestible methionine + cystine for broiler breeders with a body weight of 3.3 kg. These values are also higher than that recommended by NRC (1994), 700 mg of methionine and cystine/hen/day. On the other hand, they are much lower than the recommendation by the manual of handling of broiler breeder (Cobb 500) in this laying period, which is 0.62% or 961 mg/hen/day, considering a daily consumption of 155 g of feed. Although the recommendations contained in the manuals indicate considerable safety margin, the large discrepancy of the recommendations suggests that the levels suggested by NRC (1994) may be underestimated.

Table 3 - Regression equations of the quadratic model and Linear Response Plateau (LRP), nutritional requirements estimated and R² of the different parameters

Parameter	Quadratic equation	Requirement	R ²
% posture	$\hat{Y} = 4.9431 + 155.205X - 114.140X^2$	0.680	0.96
Egg weight	$\hat{Y} = 54.9807 + 48.8793X - 41.4421X^2$	0.590	0.53
Parameter	Line equation - LRP	Requirement	R ²
% posture	$\hat{Y} = 20.3275 + 69.9402X$	0.521	1.00
Egg/hen/housed	$\hat{Y} = 5.6915 + 19.5836X$	0.515	1.00
Egg/hen	$\hat{Y} = 5.6915 + 19.5836X$	0.521	1.00

Conclusions

The requirement for total methionine + cystine for broiler breeders is 0.521%, which corresponds to an intake of 808 mg/hen/day of total methionine + cystine, and the requirement of digestible methionine + cystine for broiler breeders is 727 mg/bird /day.

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