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Short Communication

Evaluation of cysteamine associated with different energy patterns in diets for broiler chickens

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ABSTRACT - This experiment was conducted with the objective of evaluating cysteamine (CS) supplementation in broiler chick diets with different energy density patterns. A total of 980 chicks of the Cobb 500 strain at one day of age were allocated into 28 plots. A completely randomized design in a 2 × 2 factorial arrangement, with 7 replications, was adopted. The factors under study were the supplementation (or absence) of cysteamine (60 mg/kg and 80 mg/kg of feed in the starter and growth/finishing phases, respectively) and two patterns of apparent metabolizable energy corrected by nitrogen balance (AMEn) in the diets. The energy levels (Mcal/kg of feed) practiced in pattern 1 were 3.00; 3.10; and 3.20, and for pattern 2, they were 3.05; 3.20; and 3.30 in the starter, growth and finishing phases, respectively. The diets were on the basis of corn and soybean meal with a feeding program with three diets. Feed intake, weight gain, feed conversion, feasibility and carcass yield were evaluated. There was no interaction between the CS supplementation and AME patterns in the diet upon the performance and/or carcass characteristic evaluated. Broilers fed the diet supplemented with CS presented improved feed conversion along the rearing cycle, but feed intake and weight gain were not affected by the supplementation of CS. The highest pattern of energy density (2) provided increased weigh gain in the starter phase of rearing and better feed conversion of the birds over the whole rearing period. The carcass yield was not influenced by the cysteamine supplementation and/or energy levels studied.

Key Words: additive, nutrition, poultry meat production

Introduction

Industrial poultry farming seeks for effective alternatives to reduce the costs and optimize production, for such purpose, the study of an increasing range of products capable of positively influencing the poultry production, contributing towards the improvement of the performance indices is necessary. Cysteamine is an example of additive studied in countries such as China and Thailand with the purpose of establishing beneficial effects on the performance of pigs and broilers. In Brazil, there are no reports of research about this metabolite which is produced and thought of as a performance-improving additive, mainly in eastern regions.

Cysteamine (mercaptoethylamine, HS-CH2-CH2-NH2) is a compound biologically derived from the cysteine metabolism with an inhibitory action of somatostatin, a hormone which inhibits the GH secretion of the growth hormone (Francis et al., 1990; Layer & Ohe, 1991). Cysteamine occurs naturally both in plant and animal tissues; it is endogenously synthesized, metabolized and excreted rapidly by the animal organism (EMEA, 1998).

In animal production, studies with cysteamine have demonstrated growth-promoting action in fish, pigs and poultry (Hall et al., 1986; Yang et al., 2005; Tse et al., 2006). Ai & Han (2002) reported that when added to the goose diets, cysteamine increased the pancreatic secretion, a fact that could be explained by the inhibition of somatostatin, which would lead to increased gastrointestinal transit and thus enhance the enzyme secretion by the pancreas and finally improve the digestive activity in geese.

Potentially positive results with cysteamine supplementation for broiler chickens were found by Zavy & Lindsey (1988) and Yang et al. (2006), but there is no technical consensus about which supplementation level should be utilized according to the rearing phases of those birds. There is, in general, a limitation of recent studies with this additive for species of economic interest such as birds, pigs and fish, making clear the importance of new studies which come to collaborate with information about the

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physiological effects and thus variables of general interest such as weight gain, feed conversion and carcass yield.

There are a lot of factors which influence the obtainment of responses as to the use of performance-improving additives in poultry farming, among which the energy and nutrient density (amino acids and minerals) of the diet stand out, which also are of extreme technical and economic importance in broiler chicken production. According to Lesson & Summers (2001), when there is increase in the energy level of the diet without the adequate adjustment of nutrients such as protein, amino acids, vitamins and minerals, there is nutrient unbalance, which causes excess deposition of fat in the carcass and decreased growth rate.

Therefore, the objective of the present study was to evaluate the effects of the use of cysteamine associated with two energy density patterns of the diets (maintaining the nutrient:calorie ratio) upon the performance and carcass yield of broiler chickens.

Material and Methods

The experiment was conducted in the Poultry Farming Sector of the Department of Animal Science at Universidade Federal de Lavras. A total of 980 chickens of the Cobb 500 strain aged one day were allocated into 28 plots of 1.50 × 2.00 m. Each experimental plot constituted of 35 birds, containing a bell drinker, tubular feeder and drums with incandescent bulb of 200 W for heating the birds in the starter phase of rearing. Both feed and water were supplied *ad libitum*.

A completely randomized design in factorial scheme (2 × 2) with 7 replications was adopted, constituted of the supplementation (or absence) of cysteamine (60 mg/kg of feed in the starter phase and 80 mg/kg of feed for the growth and finishing phases) and two patterns of energy density of the diets in the different rearing phases; pattern 1 was characterized by the following energy levels (AMEn Mcal/kg of feed) 3.00; 3.10; and 3.20, while in pattern 2, the energy levels were 3.05; 3.20; and 3.30 in the starter, growth and finishing phases, respectively. The nutrient/calorie ratio in the different patterns of energy density was kept based upon the concept of the control of feed/diet primarily by the energy of the diets (Bertechini, 2006).

To obtain the dosages of the active ingredient evaluated (experimental treatments), a source of cysteamine was utilized (cysteamine chloride) with concentration of 20% in replacement of kaolin (inert material).

The experimental diets (Table 1) were based on corn and soybean meal, formulated to meet the nutrient requirements of broilers according to the recommendations of Bertechini (2006). The feeding program was composed of three diets (starter diet, from 1-21 days; growth diet, from 22-35 days; and finishing diet, from 36-42 days).

For the calculation of the performance of the birds, weighting sessions were conducted on the 21st and 42nd days of the age of birds. The control of feed intake was done though the weighting of orts in each period. Mortality was monitored daily for correction of feed intake, in addition to the calculation of feasibility of the rearing, expressed in percentage.

The evaluation of carcass yield was undertaken by means of the individual weighting of the birds before slaughter (live weight) after fasting period of about 4 hours, followed by bleeding, scalding, plucking, evisceration and chilling. Carcass yield was obtained by the ratio between carcass weight (without viscera, feet and neck) and live weight, whilst the yield of breast, thigh + drumstick, by the ratio between its respective weight and eviscerated carcass weight (without viscera, feet and neck).

The data were submitted to the statistical analysis by using the software for balanced data Sisvar (Sistema de Análise de Variância, version 4.0), reported by Ferreira (2000), adopting the 0.05 probability as least significance in F test. For interpretation of the results, based upon the significance of the F test, the interaction was unfolded when significant.

Results and Discussion

There was no interaction ($P>0.05$) between the use of cysteamine and the energy density of the diets for feed intake, weight gain or feed conversion, showing that there is no relation for this phase between the energy levels studied and cysteamine supplementation (Table 2). In the same way, there was no effect ($P>0.05$) of the supplementation of cysteamine upon bird performance in this phase.

The energy levels had a significant influence ($P<0.05$) upon weight gain and feed conversion, whereby birds fed the diet of greatest energy density presented increased weigh gain and improved feed conversion at the end of the 21 days. The feed intake in this phase was not influenced ($P>0.05$) by the different energy levels.

The results found for energy levels in the starter phase are in accordance with those reported by Hidalgo et al. (2004), who also found improvement in weight gain and in feed conversion with increasing energy level of the diet. These authors investigated different metabolizable energy programs (maintaining a fixed calorie/nutrient ratio) in the

Table 1 - Formulation (g/kg) and nutrient composition of the experimental diets

Ingredient	Energy density					
	Starter phase		Growth phase		Finishing phase	
	Pattern 1	Pattern 2	Pattern 1	Pattern 2	Pattern 1	Pattern 2
Corn	575.67	549.06	611.00	565.16	622.05	576.04
Soybean meal	357.78	371.39	317.21	338.77	296.57	318.26
Soybean oil	26.01	38.45	34.36	57.95	47.15	70.70
Dicalcium phosphate	18.79	19.20	17.08	17.83	16.26	16.95
Limestone	7.94	8.01	7.20	7.31	6.77	6.84
Comum salt	4.24	4.35	3.89	4.08	3.75	3.91
Vitamin premix[1*]	1.00	1.02	1.00	1.02	1.00	1.02
Mineral premix[2*]	1.00	1.02	1.00	1.02	1.00	1.02
Sodium bicarbonate	1.00	1.00	1.00	1.00	1.00	1.00
DL-methionine (99%)	2.41	2.49	1.93	2.08	1.69	1.81
L-lysine (78%)	1.31	1.18	1.27	1.11	1.25	1.05
L-threonine (99%)	0.41	0.39	0.46	0.36	0.16	0.05
Cl-choline (70%)	0.57	0.57	0.43	0.43	0.36	0.36
Salinomycin (12%)	0.50	0.50	0.50	0.50	-	-
Zinc bacitracin (15%)	-	-	0.25	0.25	-	-
Colistin (8%)	0.13	0.13	-	-	-	-
Treatment[3]	1.00	1.00	1.00	1.00	1.00	1.00
Calculated nutrient composition						
AMEn (Mcal/kg)	3.00	3.05	3.10	3.20	3.20	3.30
Crude protein (g/kg)	215.0	219.0	199.0	205.0	190.0	196.0
Digestible lysine (g/kg)	11.35	11.54	10.36	10.69	9.84	10.14
Digestible Met+cys (g/kg)	8.24	8.38	7.43	7.67	7.00	7.21
Calcium (g/kg)	8.67	8.82	7.88	8.14	7.47	7.77
Available phosphorus (g/kg)	4.58	4.66	4.22	4.36	4.04	4.17
Sodium (g/kg)	2.14	2.18	2.00	2.07	1.94	2.00

AMEn - apparent metabolizable energy.
[1] Enrichment (pattern 1) per kg of feed: vit. A - 12,000 IU; vit. D - 2,200 IU; vit. E - 30 mg; vit. K - 2.5 mg; niacin - 53 mg; folic acid - 1.0 mg; pantothenic acid - 13 mg; biotin - 110 µg; vit B1 - 2.2 mg; vit. B2 - 6 mg; vit. B6 - 3.3 mg; vit. B12 -16 µg; selenium - 0.25 mg.
[2] Enrichment (pattern 1) of trace minerals per kg of feed: iron - 50 mg; cupper - 8.5 mg; zinc - 70 mg; manganese - 75 mg; iodine - 1.5 mg; cobalt - 0.2 mg.
[3] Obtained by the addition of the source of cysteamine in replacement of kaolin (inert material).
[*] Enrichment of vitamins and microminerals in energy pattern 2 with increased supplementation of the premixes for maintenance of the nutrient:calorie ratio.

different rearing phases of broiler chickens and concluded that the program containing 3.02; 3.09; and 3.18 Mcal/kg in the starter, growth and finishing phases, respectively, provided better performance of broiler chickens as compared with the program with 2.98; 3.02; and 3.09 Mcal/kg of diet, supporting the importance that the energy levels impinge upon weight gain and feed conversion.

The results of the present study corroborate those found by Mendes et al. (2004), who found improvement in feed conversion (decreasing linear effect) of birds fed increasing levels of metabolizable energy (2900 to 3200 AMEn kcal/kg of diet with interval of 60 kcal between the treatments evaluated), with increased impact in the finishing phase of rearing (21-42 days).

Considering the supplementation of cysteamine, the results found in the starter phase of rearing were different from those obtained by Yang et al. (2006), who found greater weight gain for the group of birds given diet with the supplementation of cysteamine at 60 mg/kg of feed. Zavy & Lindsey (1988) observed decreased feed intake in

Table 2 - Performance of broiler chickens in the phase of 1 to 21 days of age

Energy (AMEn, Mcal/kg)	Cysteamine		Means	CV (%)
	Without	With		
Feed intake				
Pattern 1 (3; 3.1; 3.2)	1190.4	1187.4	1188.8	
Pattern 2 (3.05; 3.2; 3.3)	1192.5	1167.3	1179.9	1.90
Mean	1191.5	1177.4	1184.2	
Weight gain[1]				
Pattern (3; 3.1; 3.2)	865.3	870.9	868.1b	
Pattern (3.05; 3.2; 3.3)	893.2	890.0	891.6a	2.40
Mean	879.3	880.5	879.9	
Feed conversion[1]				
Pattern 1 (3; 3.1; 3.2)	1.376	1.363	1.370b	
Pattern 2 (3.05; 3.2; 3.3)	1.335	1.311	1.323a	1.73
Mean	1.355	1.337	1.346	

Variable	Probability		
	Energy (E)	Cysteamine (CS)	E*CS
Feed intake	0.319	0.117	0.198
Weight gain	0.009	0.986	0.587
Feed conversion	0.000	0.077	0.303

[1] Means followed by different lowercase letters in the column differ statistically by the F test (P<0.05).
CV - coefficient of variation.

birds which were given cysteamine at 1200 and 1800 mg/kg of the diet, differing from the results of the present study. It is important to stress that the limited number of scientific studies related to cysteamine supplementation for broiler chickens published over the world does not always enable the comparison with studies within the same supplementation pattern (level) according to the rearing phases, which characterizes the importance of new studies about this additive.

The evaluation of 1 to 42 days of age (Table 3) demonstrated that there was no interaction (P>0.05) between the cysteamine and energy levels of the diets for the performance characteristics evaluated; there was also no single effect (P>0.05) of the cysteamine supplementation and of the energy levels upon the feed intake and weight gain of the birds. The rearing feasibility was not influenced either (P>0.05) by the use of cysteamine and/or by the energy density adopted in the diets.

Cysteamine supplementation proved to be positive, improving (P<0.05) feed conversion in the evaluation of the whole rearing period. These results were contradictory when compared with those found by Yang et al. (2006), who found no improvement in the feed conversion of the birds which were given diets with cysteamine.

Table 3 - Performance of broiler chickens in the phase of 1 to 42 days of age

Energy (AMEn, Mcal/kg)	Cysteamine		Mean	CV (%)
	Without	With		
Feed intake				
Pattern 1 (3; 3.1; 3.2)	4603.8	4608.2	4606.0	
Pattern 2 (3.05; 3.2; 3.3)	4605.3	4503.6	4554.5	2.91
Mean	4604.6	4555.9	4580.3	
Weight gain				
Pattern 1 (3; 3.1; 3.2)	2725.2	2747.7	2736.5	
Pattern 2 (3.05; 3.2; 3.3)	2749.2	2752.5	2750.8	2.64
Mean	2737.2	2750.1	2743.7	
Feed conversion[1] (g/g)				
Pattern 1 (3; 3.1; 3.2)	1.689	1.677	1.683b	
Pattern 2 (3.05; 3.2; 3.3)	1.675	1.636	1.655a	1.55
Mean	1.682B	1.657A	1.669	
Feasibility (%)				
Pattern 1 (3; 3.1; 3.2)	89.04	93.09	91.07	
Pattern 2 (3.05; 3.2; 3.3)	90.61	90.68	90.64	4.58
Mean	89.82	91.89	90.85	

Variable	Probability		
	Energy (E)	Cysteamine (CS)	E*CS
Feed intake	0.323	0.352	0.296
Weight gain	0.633	0.672	0.717
Feed conversion	0.013	0.019	0.143
Feasibility	0.790	0.203	0.217

[1] Means followed by lowercase letters in the column and capital in the row differ statistically by the F Test.
CV - coefficient of variation.

Birds fed a diet of increased energy density presented best (P<0.05) feed conversion at 42 days of age. The results found confirm the ones obtained by Braga & Baião (2001) and Mendes et al. (2004), who found improved feed conversion in broiler chickens fed a diet with higher energy density, differing, however, from the results obtained by Lima et al. (2008), who found no improvement in feed conversion utilizing different energy levels.

There was no interaction (P>0.05) between cysteamine supplementation and energy density of the diets on the carcass traits (carcass yield, breast yield, thigh + drumstick yield) and abdominal fat percentage (Table 4).

No single effects (P>0.05) of the use of cysteamine and energy levels on the evaluated measures of carcass yield were found.

The results of carcass yield for energy levels presented in this study corroborate those found by Leandro et al. (2000), Oliveira Neto et al. (2000) and Duarte et al. (2007), who also found no effect of the dietary energy on carcass yield.

Concerning the abdominal fat percentage, similar results were found by Duarte et al. (2007) and Lima et al. (2008), who observed no effect of the energy levels on abdominal fat. However, these findings differ from the results presented by Mendes et al. (2004), who found increase in the abdominal fat by evaluating increasing levels of energy. According to Saleh et al. (2004), when

Table 4 - Carcass traits of broiler chickens at 42 days of age

Energy (AMEn, Mcal/kg)	Cysteamine		Mean	CV (%)
	Without	With		
Carcass yield (%)				
Pattern 1 (3; 3.1; 3.2)	73.30	71.93	72.61	
Pattern 2 (3.05; 3.2; 3.3)	72.52	73.25	72.88	2.04
Mean	72.91	72.59	72.75	
Breast yield (%)				
Pattern 1 (3; 3.1; 3.2)	34.53	34.47	34.50	
Pattern 2 (3.05; 3.2; 3.3)	35.88	34.92	35.40	5.33
Mean	35.20	34.70	34.95	
Thigh + drumstick yield (%)				
Pattern 1 (3; 3.1; 3.2)	30.55	30.95	30.75	
Pattern 2 (3.05; 3.2; 3.3)	30.91	30.74	30.83	3.32
Mean	30.73	30.84	30.79	
Abdominal fat (%)				
Pattern 1 (3; 3.1; 3.2)	2.28	2.70	2.49	
Pattern 2 (3.05; 3.2; 3.3)	2.28	2.23	2.26	23.47
Mean	2.28	2.47	2.37	

Variable	Probability		
	Energy (E)	Cysteamine (CS)	E*CS
Carcass yield	0.637	0.574	0.073
Breast yield	0.214	0.476	0.531
Thigh + drumstick yield	0.838	0.768	0.460
Abdominal fat	0.288	0.387	0.272

CV - coefficient of variation.

there is increasing supply of energy and the ratio of protein and amino acids is not kept constant, there is increased deposition of abdominal fat in broiler chickens.

The improved feed conversion of the birds by cysteamine supplementation in the diets in the present experiment, among other hypothesis, can be related to the increased activity of digestive enzymes in the pancreas and intestinal content according to the results obtained by Yang et al. (2006), who found greater activity of protease, amylase and lipase in broiler chickens which were given diets with this additive. In addition, a study conducted by Yang et al. (2007) demonstrates better response of the immune intestinal system in broiler chickens with the use of cysteamine.

Conclusions

The use of cysteamine promotes better feed conversion of broiler chicken across the rearing cycle. The highest energy density promotes increased weight gain in the starter phase of rearing and better feed conversion of the birds in the whole rearing period. Carcass yield is not affected by the cysteamine supplementation or energy levels adopted.

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