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EFFECT OF DECREASING DIETARY PROTEIN LEVELS WITH OPTIMAL AMINO ACIDS PROFILE ON THE PERFORMANCE OF BROILERS

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ABSTRACT

A six-week trial was conducted to study the effect of decreasing dietary crude protein (CP) level on the performance of broilers in hot climatic conditions. Four experimental rations having CP 23 (control group), 22, 21 and 20%, with optimal amino acid balance were prepared. All the four rations were isocaloric having ME 3200 kcal/kg with Energy: Protein (E:P) 139.0, 146.5, 152.4 and 160 in diets A, B, C and D respectively. One hundred and twenty day-old chicks were randomly distributed into 12 experimental units, each having 10 chicks. Rations were randomly allotted to experimental units such that each unit received three replicates. The experimental diets were fed to birds from day 1st to 42nd. Performance of birds was monitored in terms of weight gain, feed consumption and feed conversion ratio (FCR). At the end of experiment, two birds per each replicate were randomly selected and slaughtered to record the data on carcass yield, breast meat yield, abdominal fat and composition of breast meat. Results of the trial suggested that weight gain was significantly ($P<0.01$) increased in birds on diets with CP 20 and 21%. Feed consumption and FCR remained un-changed for all the treatment groups. Eviscerated carcass yield was significantly ($P<0.05$) higher for the group fed on diet with 20% CP. Breast meat yield, abdominal fat and composition of breast meat also remained un-changed. Economic evaluation of the trial revealed that decreasing CP levels from 23 to 20% resulted in reduced feed cost per kg of live weight gain, which clearly indicated that this approach was useful especially in severe summer conditions. The overall picture of the study suggests that dietary protein level of broilers could be reduced from 23 to 20%, with beneficial effects on growth performance and carcass characteristics and increased economic returns in hot environmental conditions, provided that levels of essential amino acids are closely looked after.

Key words: Dietary protein, amino acids, broilers.

INTRODUCTION

A major concern of modern poultry enterprise is to reduce feed cost for optimal economic returns because feed constitutes approximately 70% of the total production cost. One way to reducing the feed cost is through improvement in the feed efficiency of birds. While formulating a broiler's diet, the main emphasis is placed on the crude protein (CP), because it is one of the major cost components of the poultry diets. Broilers have high dietary CP needs. Dietary protein level, therefore, has major effect on growth performance and overall cost of finished product. Dietary CP level could possibly be reduced if there were adequate of the minimum levels of amino acids needed to support growth and muscle of broilers (Firman and Boling, 1998). Broiler chicks fed diets marginal in protein but fortified with methionine and lysine have been reported to perform well as those fed a diet higher in protein (Jensen and Colnago, 1991).

Birds utilize excess dietary amino acids inefficiently because the amino acids surplus to the birds' requirements are deaminated and nitrogen is excreted as uric acid. On the other hand, birds fed on diets marginal in amino acids will over consume to meet their requirements for gain, thus resulting in increased carcass fat contents with reduced feed efficiency (Thomas *et al*., 1978). If the amino acid pattern provided in the diet exactly matches the birds' amino acids requirements, excesses can be avoided. Consequently, protein accretion can occur with maximum efficiency (Chung and Baker, 1992). Reduction in CP also reduces the nitrogen (N) level in excreta and litter, thereby decreasing disposal problems (Moran *et al*., 1992). Feeding low CP diet has also been reported to improve the performance of birds in hot temperatures (Thim *et al*., 1997).

The present trial was envisaged to determine the effect of decreasing dietary CP content (from 23 to 20%) while maintaining optimal essential amino acids profile on the performance of broilers in hot climatic conditions.

MATERIALS AND METHODS

One hundred and twenty day-old broiler chicks (Hubbard) of mixed sex were wing banded and randomly divided into twelve experimental units (replicates) of 10 chicks each. Four experimental broiler rations (A, B, C, D) were formulated (Table 1). Ration A served as control with 23% CP. In rations B, C and D, the CP was reduced to 22, 21 and 20%, respectively. All four rations were isocaloric (ME = 3200 Kcal/kg) with Energy: Protein (E:P) 139.0, 146.5, 152.4 and 160 in diets A, B, C and D respectively. Lysine, which was maintained at 1.1% in each ration, was chosen as reference amino acid to which all other essential amino acids were ratioed in ideal acid pattern (Baker, 1997).

Each of four rations was allotted randomly to 3 replicates. The experimental diets were fed to birds from days 1 to 42. Performance of birds was monitored in terms of weight gain, feed consumption and feed conversion ratio. At the end of experiment, two birds per replicate were randomly selected and slaughtered to record the data on carcass yield, breast meat yield, abdominal fat and composition of breast meat. The economics of all the rations was also calculated.

The data thus obtained on various parameters were subjected to statistical analysis according to completely randomized design using analysis of variance technique. Duncan's Multiple Range test was applied to compare the significance of differences between the means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Dilution of the CP content of the diet, while maintaining essential amino acids as per NRC (1994) in hot climatic condition, resulted in a significant ($P<0.01$) increase in weight gain in chicks of groups C and D fed on experimental diets with 21 and 20% CP as compared to control (group A) with 23% CP and group B with 22% CP (Table 2). Similar results were reported by Thim *et al*. (1997) when dietary protein level was reduced to 20% at a temperature higher than 26.7ºC.

An increase in feed intake was also noted in response to protein dilution and energy:protein widening which was non-significant. As the calorific value of all the experimental rations was the same and even the diet with the lowest protein level (i.e. 20%) supplied sufficient amount of essential amino acids required for the growth of birds, it was natural that the feed consumption of the birds remained the same on different experimental diets. The results of the present trial on feed intake are in accordance with the feedings of Han *et al*. (1992), Bartov and Plavnik (1998) and Hai and Blaha (1998), who found no difference in feed intake of broiers when dietary CP contents were decreased from 23 to 20%. The results are however, not supported by the findings of Kidd *et al*. (2001), Bregendahl *et al*. (2002) and Ferguson *et al*. (1998), who found significant increase in feed intake by broiler chicks fed on diet with CP 20% and supplemented with amino acids as against those fed a 23% CP diet.

Feed conversion ratio (FCR) was slightly improved by decreasing dietary CP level. The difference was, however, non-significant. The results are in accordance with the findings of Han *et al*. (1992), Bartov and Plavnik (1998) and Hai and Blaha (1998), who found no difference in FCR of broilers when the CP content of the diet was decreased from 23 to 20%. The results of the present trial are not supported by the findings of Kidd *et al*. (2001), Bregendahl *et al*. (2002) and Ferguson *et al*. (1998), who noted significant increase in FCR of broiler chicks fed diets with 20% CP supplemented with essential amino acids (EAA) compared to those fed a diet with 23% CP.

Dilution of the CP content of the diet resulted in significant ($P<0.05$) increase in eviscerated carcass weight/yield (Table 2). The improvement in weight gain and carcass yield with the use of low CP diet (supplemented with EAA) could be due to reduced heat increment, which was associated with the metabolism of excess protein. Reduced heat increment led to reduced heat stress and, therefore, improved feed intake and weight gain. Kidd *et al*. (2001) and Bartov and Plavnik (1998) also reported increased carcass yield when a low protein diet (19%) was fed as compared to high protein (22.5%) diet. In contrast, Bregendahl *et al*. (2002) reported that chicks fed low CP diet (20%) supplemented with essential amino acids gained less weight as against the control diet (23% CP). Breast meat yield, abdominal fat and CP and edible energy content of breast meat remained unaffected in response to dietary protein dilution.

Overall, the results of the present trial indicated that decreasing dietary CP level associated with optimal essential amino acids did not significantly affect the carcass characteristics. It was also obvious from these results that decrease in CP was not associated with over consumption of feed, hence there was not any appreciable increase in abdominal fat contents. The results corresponded with those of Han *et al*. (1992).

Economic evaluation of the trial revealed that decreasing CP levels from 23 to 20% resulted in reduced feed cost per kg of live weight gain which clearly indicated that this approach was useful

Table 1: Percent ingredient composition of experimental rations

Ingredients	Experimental diets			
	A	B	C	D
Corn	31.03	30.37	31.79	31
Wheat	8.0	8.0	8.0	9.0
Rice	8.47	12.49	11.7	12
Rice polishings	8.0	8.0	8.0	9.25
Soybean meal	7.0	7.0	7.0	7.0
Canola meal	3.0	3.0	3.0	3.5
Cotton seed meal	8.59	5.42	5.97	5.6
Corn gluten (60%)	8.0	8.0	8.0	6.0
Fish meal	8.0	8.0	6.0	6.15
Vegetable oil	4.78	4.5	4.7	4.92
Dicalcium phosphate	1.0	1.08	1.26	0.85
Limestone	0.55	0.51	0.79	0.90
Molasses	3.0	3.0	3.0	3.0
Vit/min premix	0.5	0.5	0.5	0.5
L-Lysine	0.06	0.1	0.18	0.18
DL-Methionine	0.03	0.04	0.06	0.09
L-Threonine	0	0	0.04	0.06
Total	100	100	100	100
Calculated nutrient and amino acid composition				
CP (%)	23	22	21	20
ME (kcal/kg)	3200	3200	3200	3200
Energy:Protein (E:P)	139.0	146.5	152.4	160.0
CF (%)	4	4	4	4
Ca (%)	1.0	1.0	1.0	1.0
Available P(%)	0.45	0.45	0.45	0.45
Lysine (%)	1.10	1.10	1.10	1.10
Methionine (%)	0.50	0.50	0.50	0.50
Arginine (%)	1.25	1.25	1.25	1.25
Histidine (%)	0.55	0.50	0.50	0.49
Phenylalanine (%)	1.10	1.04	1.01	0.95
Threonine (%)	0.80	0.80	0.80	0.80
Leucine (%)	2.17	2.12	2.06	1.88
Isoleucine (%)	0.80	0.80	0.80	0.80
Valine (%)	1.08	1.04	1.0	0.96
Tryptophan (%)	0.20	0.20	0.20	0.20

Table 2: The effect of decreasing protein level with optimal amino acids profile on the growth performance and carcass characteristics of broilers during 0-6 weeks

parameters	Dietary CP levels (%)			
	23	23	21	20
Average weight gain (g/chick)	1408^b	1439^b	1525^a	1551^a
Average feed intake (g/chick)	2970^a	2974^a	3103^a	3100^a
Feed conversion ratio	2.11^a	2.06^a	2.07^a	2.03^a
Carcass yield (%)	55.13^c	59.26^b	58.83^b	62.40^a
Breast meat yield (%)	23.20^a	23.73^a	23.53^a	24.16^a
Abdominal fat	3.03^a	3.17^a	2.80^a	3.70^a
CP content of breast meat	70.79^a	70.63^a	68.67^a	68.39^a
EE content of breast meat	7.12^a	7.47^a	7.72^a	8.05^a
Cost/kg live weight gain (Rs)	24.69	23.62	22.60	21.78

Mean values within rows showing different superscripts differ significantly (P<0.05) especially in severe summer conditions. The overall picture of the study suggests that dietary protein level of broilers could be reduced from 23 to 20%, with beneficial effects on growth performance and carcass characteristics and increased economic returns in hot environmental conditions, provided levels of essential amino acids are maintained according to NRC (1994).

REFERENCES

Baker, D.H., 1997. Ideal amino acid profiles for swine and poultry and their applications in feed formulation. Biokyowa Technol. Rev., 9: 1-24.

Bartov, I. and I. Plavnik, 1998. Moderate excess of dietary protein increases breast meat yield of broiler chicks. Poult. Sci., 77(5): 680-688.

Bregendahl, K., J.L. Sell and D.R. Zimmerman, 2002. Effect of low protein diets on growth performance and body composition of broiler chicks. Poult. Sci., 81: 1156-1167.

Chung, T.K. and D.H. Baker, 1992. Ideal amino acid pattern for 10-kilogram pigs. J. Anim. Sci., 70: 3102-3111.

Ferguson, N.S., R.S. Gates, J.L. Taraba, A.H. Cantor, A.J. Pescatore, M.J. Ford and D.J. Burnham, 1998. The effect of dietary crude protein on growth, ammonia concentration, and litter composition in broilers. Poult. Sci., 77(10): 1481-1487.

Firman, J.D. and S.D. Boling, 1998. Ideal protein in turkeys. Poult. Sci., 77: 105-110.

Han, Y., H. Suzuki, C.M. Parsons and D.H. Baker, 1992. Amino acid fortification of a low protein corn and soybean meal diet for chicks. Poult. Sci., 71: 1168-1178.

Hai, D.T. and J. Blaha, 1998. Effect of low protein diets with supplementation of essential amino acids on broiler chicken performance. Agric. Tropica Subtropica, 31: 109-116.

Hai, D.T. and J. Blaha, 2000. Effect of low-protein diets adequate in levels of essential amino acids on broiler chicken performance. Czech. J. Anim. Sci., 45(9): 429-436.

Jensen, L.S. and G.L. Colnago, 1991. Amino acids and proteins for broilers and laying hens. Proc. Maryland Nutr. Conf. Feed Manufacturers. Baltimore. MD, USA, pp: 29-36.

Kidd, M.T., P.D. Gerard, J. Heger, B.J. Kerr, D. Rowe, K. Sistani and D.J. Burnham, 2001. Threonine and crude protein responses in broiler chicks. Anim. Feed Sci. Technol., 94: 57-64.

Moran, E.T., Jr., R.D. Busnong and S.F. Bilgili, 1992. Reducing dietary crude protein for broilers while satisfying amino acids requirements by least cost formulations. Live performance, litter composition, and yield of fast food carcass cuts at six weeks. Poult. Sci., 71: 1687-1694.

NRC, 1994. Nutrient Requirements of Poultry 9th ed. National Academic Press, Washington, D.C., USA.

Steel, R.G.D. and J. H. Torrie, 1980. Principles and Procedures of Statistics. A Biometrical Approach. 2nd ed. McGraw-Hill Book Co., New York. USA.

Thomas, O.P., P.V. Twining, Jr. and E.H. Bossard, 1978. The lysine and sulfur amino acids for broilers Proc. Georgia Nutr. Conf., Atlanta, GA, USA. pp: 27-35.

Thim, K.C., M.L. Hamre and C.N. Coon, 1997. Responses of broilers to dietary protein levels and amino acid supplementation to low protein diets at various environmental temperatures. J. Appl. Poult. Res., 6: 18-33.