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Effect of Varying Dietary Cation-Anion Balance on Broilers Growth

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Abstract

The project was planed to study the effect of varying dietary cation-anoin balance on the growth performance of broilers. One hundred and twenty day-old (Hubbard) broiler chicks were purchased from a local hatchery and reared in a group for one week of age. At the start of second week, birds were randomly distributed in 12 pens (10 chicks per pen). Four isonitrogenous and isocaloric starter and finisher rations (A, B, C and D) were formulated. Ration A was without supplementations of any cation-anion dietary source but have 170 mEq/kg level of dietary cation-anion balance of the ration while other three rations (B, C and D) in starter and finisher phase have 220, 260 and 300 mEq/kg levels of dietary cation-anion balance of the ration, respectively. Performance of birds in terms of weekly weight gain, feed consumption, and feed conversion ratio (FCR) of each treatment was recorded. The results indicated that maximum weight gain (2192 g), maximum feed intake (4017 g) and better FCR were observed in the birds feeding ration having 260 mEq/kg cation-anion balance.

Keywords: Dietary cation-anion, Boilers, Growth

Introduction

The electrolytes may be divided into cation (the most important being sodium, potassium, calcium and magnesium) and anion (principally chloride, bicarbonate, biphosphate and sulphate ions). Sodium, potassium and chlorine are interrelated in regulating electrolyte balance. These electrolytes need to be taken together since animal cells require a specific balance of cation and anions to function efficiently (McDonald *et al.*, 1995). The primary role of electrolytes is to maintain body water and ionic balance (Johnson and Karunejeewa, 1985). The level of different minerals such as sodium, potassium and chloride are the major factors in the creation of osmotic pressure and take part in the buffer system and pH mechanism of the body and are essential for the transmission of nerve impulses.

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It takes part in all chemical and physical reaction within the body (Hurwitz *et al.*, 1973). Electrolyte balance, also referred to as acid-base balance, is affected by three major factors namely the balance and proportion of these electrolytes in the ration, endogenous acid production and the rate of renal clearance (Lesson and summers, 2001). It is the cation-anion balance of the diet that provides the major mechanism for influencing electrolyte balance in the body when feeding the poultry (Balnave and Gorman, 1993). Failures to maintain the correct electrolyte balance within the cell means that metabolic pathway are diverted to achieve homeostasis at the expense of growth (McDonald *et al.*, 1995). Electrolyte imbalance causes a metabolic disorder, tibial dyschondroplasia in young broiler chicks (Balnave and Gorman, 1993). Electrolyte can also affect the metabolism of number of basic amino acids, particularly Lysine and Arginine (Lesson and Summers, 2001).

Despite the significance of electrolyte balance in broiler ration, no attention has yet been given on this important aspect in our country. Therefore, this project has been designed to investigate the effect of varying dietary cation-anoin balance on the performance of broilers.

Materials and Methods

One hundred and twenty day-old broiler (Hubbard) chicks of mixed sex were purchased from local hatchery. These birds were reared as a group during first week of age as adaptation period. At the start of the second week, the birds were weighed individually. These birds were randomly divided into 12 experimental units of ten chicks each and then tag each bird on wing. The birds were kept in cleaned, white washed and properly disinfected shed. The placement of chicks in the pen was made at random. The chicks were reared on the deep litter system using dry saw dust (soft wood) throughout the experimental period of 6 week. Brooding temperature was maintained at 36°C for first week, and then the temperature was decreased by 3°C each week upto 4 weeks of age. Later on it was maintained at 27°C throughout the experimental period. Routine managemental practices like space, light, ventilation and sanitation were practiced throughout the trail. Four isonitrogenous (22% crude protein) and isocaloric (3000 Kcal/kg metabolizable energy) rations were formulated as starter ration. Finisher rations were formulated with the same energy but

containing 20% crude protein. Ration A served as control ration and was without any dietary supplementation of cation-anion source while 0.41%, 0.75%, 1.09% $NaHCO_3$ in starter ration and 0.46%, 0.81%, 1.15% $NaHCO_3$ in finisher ration (having 220, 260, 300 mili Equivalent/kilo gram (mEq/kg) levels of dietary cation-anion balance of the ration) was supplemented in Ration B, C and D respectively. Composition of broiler starter and finisher rations are given in Table 1. Each experimental ration was allotted to three experimental units at random. Broiler starter rations from 8-28 days while finisher rations from 29-42 days were fed *ad libitum*. Fresh and clean water and 24 hour light were made available throughout the experimental period.

Table 1: Composition of broiler starter and finisher ration

Ingredients	Starter	finisher
Corn	35.74	40
Rice broken	11	8.35
Rice polishing	8	10
Corn gluten meal (30%)	3	3
Corn gluten meal (60%)	6	5
Cotton seed meal	6	3.55
Soybean meal	13	9
Canola meal	5	10
Fish meal	5	4
Limestone	0.9	1
DCP	1.36	1.1
Berga fat	1.5	1.5
Molasses	3	3
Vitamin mineral premix	0.5	0.5
Total	100	100

All the data obtained was tabulated and subjected to statistically analysis using analysis of variance technique in completely randomized design (CRD) and means were compared by Duncan's Multiple Range test (Steel and Torrie, 1981).

Results

Weight Gain

Weight gain in chicks fed on starter and finisher rations are given in Table 2. Maximum weight gain was observed in chicks fed on ration containing 260 mEq/kg dietary cation-anion balance. While lowest weight gain was observed in chicks fed on ration having 170 mEq/kg dietary cation-anion balance (Ration A i.e. control ration).

When the data was subjected to analysis of variance, the results statistical significant revealed differences in weight gain of chicks fed on different rations. For further comparison Duncan's multiple range tests was applied and it was observed that there were significant differences between A&C, A&D and B&D rations while there were non significant differences between other treatment pairs.

Feed Consumption

The feed consumption of starter and finisher rations A, B, C and D having 170, 220, 260 and 300 mEq/kg level of dietary cation-anion balance of the diet are given in Table 3.The large amount of feed (4017 g) was consumed by the chicks fed on ration supplemented with (260 mEq/kg) level of dietary cation-anion balance of the diet while the minimum amount of feed (3954 g) was consumed by the chicks fed 170 mEq/kg level of dietary cation-anion balance of the diet. The data when subjected to analysis of variance revealed non significant difference for feed consumption among rations A, B and D and similarly among B, C and D but there was a significant difference of feed consumption of chicks fed on ration A and C.

Table 2: Average total weight gain of chicks

Parameters	Ration			
	A	B	C	D
Average initial weight at first week (g)	133.7	135.63	134.36	134.03
Average final weight at 28th day of age (g)	1156.7	1190.63	1214.36	1204.03
Average final weight at 42th day of age (g)	2083.7	2188.63	2326.36	2258.03
Average total Weight gain (g)	1950 c	2053 bc	2192 a	2124 ab

Table 3: Average feed consumption of starter and finisher rations

Ration	Average starter ration consumed /chick (g)	Average finisher ration consumed /chick (g)	Total feed consumption during whole trail(g)
A	1686	2268	3954 b
B	1671	2293	3964 ab
C	1680	2337	4017 a
D	1659	2298	3958 ab

Feed Conversion Ratio (FCR)

At the end of experiment, the overall feed conversion values for chicks on ration 170, 220, 260 and 306 mEq/kg level of dietary cation-anion balance of the diet were found to be 2.027, 1.930, 1.833 and 1.863 respectively (Table 4). Better feed utilization was noticed in the chicks fed on ration having 260 mEq/kg of diet, while those kept on controlled ration gave the poorest feed conversion ratio. The data when subjected to analysis of variance showed significant ($P<0.05$) difference among different rations in response of feed conversion ratio of chicks. Duncan's Multiple Range test revealed that there was significant difference in feed conversion ratio between the ration A&C, A&D and B&C while there was non significant difference between other pairs.

Table 4: Feed conversion ratio of chicks fed on different experimental ration.

Ration	Average feed consumption/ chick (g)	Average weight gain (g)	FCR
A	3954	1950	2.027 a
B	3964	2053	1.930 ab
C	4017	2192	1.833 c
D	3958	2124	1.863 bc

Discussion

Weight Gain

It was observed that ration which was supplemented with $NaHCO_3$ at 260 mEq/kg level of dietary cation-anion balance of the diet helped to improve the weight gain of the birds. Oviedo-Rondon *et al.*, (2001) reported that bird performs better in term of weight gain when fed ration having 246-264 mEq/kg level of dietary cation-anion balance of the diet. Bonsembiante *et al.*, (2001) demonstrated that weight gain increased upto 280 mEq/kg level of dietary cation-anion balance of the diet. Mongin (1981) and Johnson and Karunejeewa (1985) found that chicks given purified diets from day old to 28 day of age require an electrolyte balance of 250 mEq/kg level of dietary cation-anion balance of the diet for maximum growth. Mongin (1981) described cellular cation-anion balance of Na, K, Cl (mEq/kg) for poultry, the optimal electrolyte balance was reported as 250 mEq/kg of feed. The above discussion indicates that when dietary cation-anion balance is low in the diet, it adversely effect the efficiency of the cell of the body. The metabolism of the body reduces and less growth rate takes place, so when we provide the dietary cation-anion source in the diet, body cells works efficiently and birds gains better and attains better weight.

Feed Consumption

It has been observed that birds which were kept on rations without supplementation of dietary cation-anion source (NaHCO3) have lowest feed intake, while the ration which having 260mEq/kg level of dietary cation-anion balance of the diet increase the feed intake of the bird. There was non significant difference for feed consumption of rations having different cation-anion balance in feed except between ration A&C. Oviedo-Rondon *et al.*, (2001) reported that ration having 246-264 mEq/kg level of dietary cation-anion balance of the diet increased the feed intake. Balnave *et al.*, (1993) reported that more feed intake could be attained by the dietary cation-anion balance (DCAB) supplementation. The above discussion indicates that when DCAB would be according to the requirement of body, the pH system will be efficient and there will be better feed consumption.

Feed Conversion Ratio (FCR)

It has been observed that ration having 260 mEq/Kg level of dietary cation-anion balance of the diet was most efficient in term of FCR while the controlled having 170 mEq/kg level of dietary cation-anion balance of the diet have the poorest FCR. The results of the present study are in line with the findings of Oviedo-Rondon *et al.*,(2001) who reported that bird perform better in term of FCR when fed ration having 246-264 mEq/kg level of dietary cation-anion balance of the diet of diet. Bonsembiante *et al.*, (2001) and Murakami *et al.*, (2001) demonstrated that FCR remained good upto 280 mEq/kg level of dietary cation-anion balance of the diet. The above discussion indicates that when we provide less dietary cation-anion balance in the diet, ionic balance of the body will be disturbed. The birds try to maintain it by diverting the metabolism of the body at the cost of growth and utilize energy for this purpose. So there is less efficiency of feed conversion, but when proper level of dietary cation-anion balance in the diet will be provided it effects positively in term of FCR and other body functions.

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