EFFECTS OF DIFFERENT LEVELS OF CRUDE PROTEIN AND DIETARY ELECTROLYTE BALANCE ON PERFORMANCE AND BODY COMPOSITION OF BROILER CHICKS

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Abstract
The effect of two levels of crude protein on ideal protein basis (19.00, and 23.00 percent) in starter, and (17.65, and 20.65 percent) in grower period and three levels of electrolyte balance (210, 255, and 300 meq/kg diet) on performance, body composition, and blood serum electrolytes (Na, K, and Cl) were investigated on 1800 male and female broiler chicks. Diets were fed in two phases (0-21, and 22-35 days of age). The effects of diets on body weight gain, feed consumption, gain to feed ratio, mortality, breast meat yield, body composition (dry matter, protein, fat, and ash), tibia ash, litter quality, blood serum electrolyte, and serum PH were measured.
The results indicated that with increasing crude protein level body weight gain, feed consumption, and gain to feed ratio in starter, grower, and total period of experiment improved significantly ($P<0.05$). It also increased breast meat yield ($P<0.05$). Male broiler had better performance and breast meat yield than female ($P<0.05$). Increasing dietary electrolyte balance increased weight gain in starter and feed consumption in grower period ($P<0.05$), but hadn't any significant effects on performance and litter quality in whole period of the experiment. It also decreased serum potassium significantly ($P<0.05$). There weren't significant difference among treatments for tibia ash percentage.

Key words: Ideal protein, dietary electrolyte balance, performance, broiler

Introduction

Broiler diets with crude protein (CP) content lower than the values suggested by the NRC (National Research Council, 1994), and supplemented with the limiting amino acids (lysine, and methionine), can support performance results similar to those diets with higher levels of CP. Such diets can also reduce nitrogen losses, which decreasing environmental pollution.

Electrolytes are electrically charged dissolved substances. Under most circumstances, the dietary mineral balance is adequately expressed as Na+K-Cl (meq/kg). For poultry the optimal electrolyte balance is about 250 meq/kg (Gorman and Balnave, 1995, Hulan et al 1987, Martinez-Amezcua et al, 1998). Electrolyte imbalance results in reduced growth, and induces leg abnormalities such as tibia dyschondroplasia (TD). Amino acid status can influence electrolyte balance particularly in poultry. The lysine-arginine antagonism is influenced by electrolyte status. The effect of excess lysine is magnified by an excess of chloride. Conversely, responses of dietary supplements of Na or K bicarbonate in poultry fed lysine-deficient diets have been reported (Patience, and Wolynetz, 1990). When the dietary electrolyte balance (DEB) decreases below about 175 meq/kg blood PH and bicarbonate drop, indicating metabolic acidosis. The manipulation of the DEB has been proposed one way to improve the performance of chickens fed low-CP diets. The DEB varies according to dietary CP (Adekunmisi, and Robbins, 1987). Because the growth of chickens fed low-CP diets decreases when DEB is altered by Na, and K additions. Reducing of CP in diets results in less potassium due to inclusion of less soybean meal (Mongin, 1981). The reduction of potassium in diets and consequent reduction of DEB can decrease performance, and increase the incidence of TD. The objective of present study was to evaluate the three levels of DEB and two levels of CP on performance, body composition, blood electrolytes levels, TD incidence, and litter quality in two sexes of broiler chicks.

Materials and Methods

In day one, 1800 Ross male and female broiler chicks (900 each) were randomly distributed in a factorial arrangement with three levels of DEB, two levels of crude protein (on ideal protein basis), and two sexes of chicks. Three replicate of 50 birds each assigned to each treatment. Treatment were corn-soybean meal diets were formulated with three levels of DEB (210, 255, and 300 meq/kg), two levels of CP (19.0, 22.3 in starter, and 17.65, 20.65 percent in grower period), and two sexes of chicks. The starter and grower diets were fed from 1to 21 and 22-35 days respectively. Broiler was weighed in the start, 21, and 35 days of the experiment. Feed consumption, body weight gain, gain to feed ratio were elevated in the starter, grower, and whole period of the experiment. Feed and water were provided al libitum. At 35 days of age, two birds from each experimental unit were killed by cervical dislocation to determine breast meat yield, body composition, bone ash. The status of electrolytes (Na, K, and Cl) in blood serum was measured by getting blood sample from wing vein. Samples stored at -3^0 C until analyzing. Amino acid concentration was determined following acid hydrolysis, methionine and cystine following performic acid oxidation using high performance cation exchange column (AOAC, 1995). The factorial arrangement of 12 treatments consisting of three levels of DEB, two levels of CP, and two sexes of chicks were analyzed using the General Linear Model procedure of SAS (SAS Institute, 1998).When differences among means were found, means were separated using Duncan's multiple range test (Steel and Torrie, 1980).

Results and Discussion

Results of this experiment are given in table1. With increasing CP levels in starter, grower, and whole period of the experiment feed consumption, body weight gain, gain to feed ratio, and breast meat yield were improved significantly ($P<0.05$). Increasing of lysine levels in high protein diets and proper balance of essential amino acid may be contributed in this improvement. The present results are in agreement with findings of previous studies (Bilgili et al 1992, Gorman and Balnave, 1995, Han and Baker, 1991**,** Waldroup et al, 1990). Effect of CP levels on body composition (protein, and fat) was significant ($P<0.05$). Body of chicks fed with high protein diets had more protein (50.01 versus 46.49%), and less fat (39.71 versus 48.85 %). Increasing of abdominal fat and body fat in broiler fed low–CP diets due to excess energy available were reported by many researchers (Abebs and Morris**,** 1990, Aleton et al, 2000, Blair et al, 1999).

The effect of DEB levels on body weight gain in starter period was significant ($P<0.05$). Chicks were fed with diets containing 255, and 300 meq/kg DEB had more body weight gain than other. Increasing of DEB levels hadn't significant effect on performance of broiler in whole period of the experiment. These findings are in agreement with pervious studies (Adekunmisi and Robbins, 1987, Karunjeewa et al, 1986, Martinez-Amezcua et al, 1998,). Effect of sex on above traits in starter, grower, and whole period of the experiment was significant ($P<0.05$). Male broiler had better performance than female. Interaction of CP and DEB on body weight gain, feed consumption and gain to feed ratio in starter phase was significant ($P<0.05$). Interaction of CP and sex on body weight gain in starter, grower, and whole period of the experiment was significant ($P<0.05$). The levels of CP, DEB, and sex hadn't significant effects on serum PH, and tibia ash percentage. Increasing DEB levels in diet reduced serum K significantly ($P<0.05$). With increasing CP levels litter quality reduced due to increasing water consumption and increasing of moisture in feces of broiler fed with high protein diets. In the present study the DEB at the levels of (210-300 meq/kg) hadn't significant effect on performance, body composition, and breast meat yield, thus the DEB at the level of 210 meq/kg is a proper amount for broiler chicks. Formulation of diets on ideal protein basis can improve the performance of broiler chicks.

Table 1. *Effect of different levels of CP, DEB, and sex on performance, breast meat yield, tibia ash, body composition, blood serum electrolytes, serum PH, litter quality, and mortality of broiler chicks.*

Traits	CP level		DEB level (meq/kg)			Sex		SEM
	Low	High	210	255	300	M	F	
Body weight gain 0-21 days (kg)	0.697[a]	0.789[b]	0.732[b]	0.751[a]	0.746[a]	0.752[a]	0.733[b]	0.009
Body weight gain 22-35 days (kg)	1.161[b]	1.262[a]	1.197	1.223	1.214	1.297[a]	1.225[b]	0.018
Body weight gain 0-35 days (kg)	1.858[b]	2.050[a]	1.928	1.974	1.960	2.052[a]	1.856[b]	0.025
Feed consumption 0-21 days (kg)	1.022[b]	1.135[a]	1.070	1.096	1.070	1.075	1.082	0.012
Feed consumption 22-35 days (kg)	2.089[b]	2.212[a]	2.108[b]	2.188[b]	2.156a[b]	2.243[a]	2.058[b]	0.022
Feed consumption 0-35 days (kg)	3.119[a]	3.370[b]	3.199	3.300	3.239	3.342[a]	3.150[b]	0.033
Gain: feed 0-21 days	0.688[b]	0.708[a]	0.693	0.695	0.706	0.709[a]	0.686[b]	0.004
Gain: feed 22-35 days	0.557[b]	0.574[a]	0.569	0.562	0.565	0.582[a]	0.549[b]	0.004
Gain: feed 0-35 days	0.600[a]	0.620[b]	0.612	0.606	0.612	0.624[a]	0.596[b]	0.003
Breast meat yield (g)	281.5[b]	338.5[a]	302.0	316.5	311.5	312.9[a]	307.1[b]	-
Tibia ash (%)	53.89	52.46	53.31	53.48	52.81	52.41	53.99	0.59
Body dry matter (%)	97.25	97.27	97.35	97.31	97.12	97.16	97.36	0.059
Body protein (%)	46.49[b]	50.01[a]	47.06	48.08	49.12	49.02	47.84	0.45
Body fat (%)	48.85[a]	39.71[b]	42.12	41.51	40.20	39.73[b]	42.83[a]	0.46
Body ash (%)	6.30	6.80	6.74	6.42	6.49	6.74	6.36	0.14
Serum Na (Mmol/L)	155.62	156.75	156.50	155.57	156.38	156.03	156.39	0.35
Serum K (Mmol/L)	4.12	4.06	4.34[a]	4.11[ab]	3.82[b]	4.01	4.16	0.08
Serum Cl (Mmol/L	107.1	107.89	108.29	107.28	106.83	106.9[b]	108.1[a]	0.27
Serum PH	7.54	7.59	7.53	7.62	7.54	7.65	7.53	0.02
Litter quality score at 35 days	3.89	4.11	4.00	4.00	4.00	4.28[a]	3.72[b]	-
Mortality (%)	3.11[b]	6.32[a]	5.00	4.76	4.50	5.89	3.56	0.70

Means with different superscripts in each rows are significantly different (P<0.05).

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