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Effects of Acid-Base Balance in Low Crude Protein Amino Acids Supplemented Diets on Growth Performance and Blood Parameters of Broiler Chicks

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ABSTRACT

This experiment exploits 288 Ross female broilers to evaluate the effects of dietary electrolyte balance in low protein amino acid supplemented diets on growth performance and blood biochemical parameters. Moreover, the effect of dietary crude protein reduction on serum electrolyte concentration is investigated. It is shown that the feed intake and body weight gain of chicks which are fed with the low crude protein amino acid supplemented diets are significantly higher than chicks with normal diet. The results of this study demonstrates that supplemented diets of low crude protein amino acids have no adverse/marginal effect on broiler performance in 10 to 31 days of its age, whereas abdominal fat content increases significantly. The evaluated optimal dietary electrolyte balance in this study is equal to 250mEq/kg .
KEY WORDS: broiler chicken, essential amino acids, low crude protein, acid-base balance

1. INTRODUCTION

It is well-established that a large portion of costs associated with dietary formulation involves meeting the protein requirements of the birds. Therefore, any attempt that optimizes dietary protein intake and improve the efficiency of protein utilization is of great importance. Currently, a number of synthetic amino acids are produced commercially that can be included in the diets for providing the requirements of limited amino acids. With reduction cost of amino acids production it will be possible to reduce protein density in the diets and maintain the required dietary amino acids of the birds [1] . Recently, several approaches for improving the growth performance of the birds based on low protein diets are suggested (e.g. including changing amino acid balance, increasing dietary potassium carbonate, increasing non-specific nitrogen as ammonium citrate or L–glutamine and increasing the essential amino acids above the NRC (1994) recommendations [2, 3]).

Potassium, as the most abundant main intracellular cation, is the essential element for protein synthesis; which maintains intracellular homeostasis, the electric potential of cell membranes, enzymatic reactions, osmotic pressure and acid-base balance. Sodium and chlorine have also important roles in the extracellular space, osmotic pressure and acid-base balance. Therefore, effects of dietary ionic balance on broiler performance may be dependent on different reasons in dietary acid-base balance [4, 5]. Mongin in [6] discussed the fact that dietary electrolyte balance is often described by simple formula as $DEB(mEq/kg)=Na+K-Cl$ and the balance of electrolyte (250 meq/kg in commercial diets) guarantees a maximum growth rate and optimum bird performance. Instead, acid-base imbalance decreased appetite and increased feed conversion. Such balance is affected by environment, diet and metabolism [4, 5].

In this paper, detailed conditions of our experiments are explained in Section 2, and the effects of low crude protein amino acids supplemented diets on growth performance of female broilers will be investigated in Section 3.

2. Experiment Conditions

2.1. Birds and Housing

This experiment was performed on ten-days-old female Ross-308 broiler chicks housed in a unit testing group, on the litter. The experimental birds were given ad libitum access to water and diet. The ambient temperature was gradually decreased from $32^{\circ C}$ to $24^{\circ C}$ over the period of 1 to 31 days of age. The birds were exposed to a 24h light and chicken vaccination was carried out according to the usual schedule.

2.2. Diet Formulation

Corn, soybean meal and fish meal were sampled before diet formulation to determine crude protein (as Kjeldahl nitrogen × 6.25), moisture, metabolized energy. To calculate the electrolyte balance, a percentage of electrolytes in feed ingredients was extracted from feedstuffs Table [7]. The dietary electrolyte balance was maintained at 250, 200 and 150 mEq/kg in all dietary treatments by using of calcium carbonate, potassium chloride, calcium chloride, calcium sulfate, sodium bicarbonate and

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potassium sulfate. All diets were formulated to be isoenergetic (3150 kcal/kg of AMEn). The concentration of dietary calcium, available phosphorus, sodium and potassium are maintained equal in all treatments. Diets were formulated base on computer software, UFFDA (Tables 1). Dietary amino acids are adjusted in higher levels than recommendations of National Reserch Council in 1994 and according to the rearing guide of Ross 308 strain. Dietary essential amino acids (methionine, lysine, threonine, tryptophan, arginine, valine and isoleucine) were balanced based on standardized ileal digestibility. The experimental design was a 3*3 factorial arrangement in a completely randomized design with 20%, 18% and 16% crude protein levels and 250, 200, and 150 mEq/kg dietary electrolyte balance on 288 broilers allocated in 9 treatments, each with 4 replicated of 8 birds.

2.3. Blood samples

At the age of 31 days, blood sampling is performed in order to measure essential blood parameters. These samples are taken per replicate from the heart and are placed into tubes. Serum samples are immediately transferred into micro tubes and are send to the laboratory to determine some parameters of blood such as; sodium, chlorine, potassium, cholesterol, triglycerides, HDL (high density lipoprotein), LDL (low density lipoprotein), glucose and uric acid. The serum concentration of Na (Sodium) and K(potassium) was determined with ISE method and serum Cl (chlorine) was detected by spectrophotometry. Serum uric acid was measured by enzymatic (uriase) spectrophotometery [8]. Briefly, this enzyme catalyzed the oxidation of uric acid to allantoin with subsequent production of H_2O_2. This method is based on the fact that uric acid has a UV (ultraviolet) absorbance peak at 293 nm, whereas allantoin does not.

2.4. Carcass Characteristics and Whole-Body Analyses

At the end of each week Feed Intake (FI) and Body Weight Gain (BWG) of chickens were measured to determine feed conversion (FCR). At the end of the experimental period (31d), two birds per replicate (with a body weight close to the replicate mean), were slaughtered. After slaughter heart, liver, gizzard, abdominal fat, breast and thigh weight percentage of total carcass weight were determined. Moreover, thigh and breast muscles were isolated from the bone and four uniform samples from each treatment were selected to measure protein, fat and dry matter. At the end of the experimental period (31d) one bird per replicate (with a body weight close to the replicate mean), was slaughtered by cervical dislocation for determination of whole-body composition (protein, fat and dry matter) according to procedures described by Barker and Sell [9]. At 31 days, two birds from each treatment were selected and kept in individual cages and excreta were collected and lyophilized, and were sent to the laboratory for determining nitrogen by Kjeldahl method to determine the nitrogen excretion.

2.5. Statistical Analysis:

All Data are analyzed using the general linear model ANOVA [10] in a completely randomized design. Means are compared using Duncan's multiple range tests. In all cases, significance is set at $P<0.05$.

3. RESULTS

In our experiments, body weight gain and feed intake are significantly increased in chicks fed low CP amino acids supplemented diets (16% and 18%) compared to the chicks fed control diet (20%). In addition, feed conversion reduced significantly in low CP diet and lowest amount was obtained in 16% CP diet (Table 2). In experimental dietary treatments, the essential amino acids were above the NRC (1994) recommendations, standardized ileal digestibility of amino acids were used instead of total amino acids, and diets had optimum dietary sulfur amino acids (dl-methionine and cystine) and suficient potassium [11]. Due to the mentioned reasons, in addition to the reduced dietary protein level supplement, the essential amino acids up to 16%, had positive effect on birds performance. In [12], Araujo used the same amino acids levels (methionine, lysine and threonine), reported that was possible to use diets containing 17% protein without affecting broiler chicken performance. Moreover, in [13] it was found that a 15% crude protein ration with crystalline amino acid supplementation could support similar performance when compared to an NRC (1994), in which there was 23% crude protein diet.

The results of this experiment is in agreement with other studies (e.g. [14]). Different levels of dietary electrolyte balance (250, 200 and 150 meq/kg diet) from highest (250 mEq/kg) to lowest (150 mEq/kg), decreased the body weight gain and feed intake significantly. Instead, increased feed conversion. Borges et al., showed that the electrolyte balance equal to 240 mEq/kg in the diet increases body weight and decreases feed conversion of broiler chickens [16]. In addition, the results of our experiment are in agreement with Mongin [6], Rezaei et al., [15] and Borgatti et al., [16]. Significant differences are observed among interaction means of CP levels and DEB. BWG and FI significantly increased in chicks fed low CP amino acids supplemented diets (16%) with highest levels of dietary electrolyte balance (250 mEq/kg diet). However, FCR is decreased significantly. Mongin [6] showed that when $Na + K - Cl$ is higher or lower than 250 mEq/kg diet, growth is depressed. When the acid-base balance is deviated towards alkalosis or acidosis, apart from the homoeostatic welfare, most of the metabolic pathways cannot work under the required optimal conditions and are more involved in homoeostatic regulation than in growth process. The electrolyte balance and crude protein interaction observed in preceding studies [17-

19] strongly suggested that the electrolyte balance required for maximize growth is proportional to the level of dietary protein.

Table1. Nutritional and Ingredient composition of experimental diets (%)

Treatments[1]

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Diet 8	Diet 9
Yellow corn	57.66	63.38	68.54	57.77	63.38	68.36	57.22	63.37	68.4
Soybean meal	30.54	24.72	18.88	30.32	24.72	19.09	30.43	24.72	19.04
Anchovy meal	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Soybean oil	4.25	4.0	3.7	4.54	4.0	3.7	4.71	4.0	3.7
Di calcium phosphate	1.24	1.28	1.31	1.24	1.28		1.24	1.28	1.31
Potassium chloride	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02	0.0
Sodium carbonate	0.0	0.3	0.66	0.0	0.11	0.3	0.15	0.0	0.18
Calcium chloride	0.15	0.1	0.1	0.51	0.42	0.38	1.0	0.66	0.64
Calcium sulfate	0.0	0.06	0.0	0.0	0.0	0.0	0.3	0.0	0.0
Potassium sulfate	0.0	0.0	0.0	0.0	0.14	0.29	0.0	0.11	0.28
Limestone	0.89	0.91	0.97	0.61	0.7	0.74	0.05	0.51	0.54
Sodium chloride	0.1	0.0	0.01	0.1	0.0	0.0	0.0	0.08	0.08
Mineral premix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin premix[3]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
AMEn(Kcal/kg)	3150	3150	3150	3150	3150	3150	3150	3150	3150
Crude protein(%)	20	18	16	20	18	16	20	18	16
Ca (%)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Available P (%)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Chlorine (%)	0.21	0.16	0.2	0.38	0.31	0.33	0.55	0.48	0.5
Potassium (%)	0.81	0.72	0.62	0.81	0.77	0.74	0.81	0.77	0.73
DEB(mEq/kg)	250	250	250	200	200	200	150	150	150

[1]Teratments: 2) 20% CP,+250 DEB 2) 18% CP + EAA+250DEB 3) 16%CP + EAA+ 250DEB 4) 20% CP +200DEB 5) 18% CP + EAA + 200DEB 6) 16% CP + EAA + 200DEB 7) 20% CP +150DEB 8) 18% CP + EAA+150DEB 9) 16%CP + EAA 150DEB.

[2]mineral premix Added (mg/kg) to the diet: Manganese,110.60; Zinc,110..40; Iron(ferrous sulfate),50; Copper,8.30;Selenium (sodium selenite),0.30; I,1.08; Co,0.1; Mo, 0.05 .

[3]Vitamin premix added (per kg of diet): A (retinyl acetate),11.023 IU; D(cholecalciferol), 118 IU; E (DL-a-tocopheryl acetate), 23.54 IU; K (menadione), 1.47 mg ; B_{12},0.0151 mg ; riboflavin,5.895 mg ; niacin,42.93 mg ; D-Pantothenic acid, 12.11 mg ; Choline, 477.7 mg ; Folic acid, 1.15 mg ; Pyridoxine,4.17 mg ; Thiamin, 1.23 mg and D-Biotin, 0.075 mg .

Table 2. Nutritional composition of experimental diets (%)

Treatments[1]

Item	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Diet 8	Diet 9
AMEn (Kcal/kg)	3150	3150	3150	3150	3150	3150	3150	3150	3150
Crude protein(%)	20	18	16	20	18	16	20	18	16
Ca (%)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Available P (%)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Chlorine (%)	0.21	0.16	0.2	0.38	0.31	0.33	0.55	0.48	0.5
Potassium (%)	0.81	0.72	0.62	0.81	0.77	0.74	0.81	0.77	0.73
DEB(mEq/kg)	250	250	250	200	200	200	150	150	150

[1]Teratments: 2) 20% CP,+250 DEB 2) 18% CP + EAA+250 DEB 3) 16%CP + EAA+ 250 DEB 4) 20% CP +200 DEB 5) 18% CP + EAA + 200 DEB 6) 16% CP + EAA + 200 DEB 7) 20% CP +150 DEB 8) 18% CP + EAA+150 DEB 9) 16%CP + EAA 150DEB.

Table 2) Effect of DEB(mq/kg diet) and dietary CP level supplementation with (EAA) on performance, and Liver, abdominal fat, breast and Thigh relative weight during[1] 10 to 31 d of age .

Levels of Crude Protein	BWG(g)[2] ±SE[3]	FI(g) ± SE	FCR ±SE	Liver ± SE	Abdomi Fat ± SE	Breast ± SE	Thigh ± SE
20% CP	$578^{b} \pm 48$	$996^{c} \pm 101$	$1.72^{a} \pm 0.3$	2.1 ± 0.1	$2.3^{b} \pm 0.2$	15.3 ± 0.4	14.7 ± 0.3
18% CP + EAA[4]	$942^{a} \pm 35$	$1427^{b} \pm 64$	$1.51^{b} \pm 0.1$	2.3 ± 0.1	$2.5^{a} \pm 0.2$	15.5 ± 0.3	14.5 ± 0.4
16% CP + EAA	$992^{a} \pm 31$	$1550^{a} \pm 35$	$1.56^{b} \pm 0.1$	2.2 ± 0.1	$2.7^{a} \pm 0.2$	15.8 ± 0.2	14.2 ± 0.2
Significance level (P< 0.05)			NS		NS	NS	
Levels of DEB(mq/kg diet)							
250	$877^{a} \pm 53$	$1402^{a} \pm 56$	$1.6^{b} \pm 0.1$	$3.4^{a} \pm 0.1$	$2.5^{a} \pm 0.2$	$14.8^{a} \pm 0.3$	$16.2^{a} \pm 0.3$
200	$682^{b} \pm 24$	$1126^{b} \pm 111$	$1.7^{ab} \pm 0.2$	$2^{b} \pm 0.1$	$1.9^{b} \pm 0.2$	$13.5^{b} \pm 0.5$	$13.8^{b} \pm 0.5$
150	$582^{c} \pm 28$	$1045^{b} \pm 45$	$1.8^{a} \pm 0.1$	$1.8^{c} \pm 0.1$	$1.8^{b} \pm 0.2$	$13.1^{b} \pm 0.4$	$13.3^{b} \pm 0.5$
Interaction Between Levels of CP and DEB(mq/kg diet)							
20% CP + 250 DEB	$634^{b} \pm 80$	$1139^{b} \pm 74$	$1.8^{bc} \pm 0.2$	$2.2^{ab} \pm 0.1$	$2.4^{ab} \pm 0.1$	$15.9^{a} \pm 0.4$	$15^{a} \pm 0.3$
18% CP+EAA+250 DEB	$988^{a} \pm 44$	$1464^{a} \pm 60$	$1.5^{c} \pm 0.1$	$2.4^{a} \pm 0.1$	$2.6^{a} \pm 0.2$	$16.4^{a} \pm 0.4$	$14.7^{ab} \pm 0.3$
16% CP+EAA+250 DEB	$1009^{a} \pm 31$	$1602^{a} \pm 39$	$1.6^{bc} \pm 0.1$	$2.5^{a} \pm 0.1$	$2.6^{a} \pm 0.2$	$16^{a} \pm 0.1$	$14.8^{ab} \pm 0.2$
20% CP + 200 DEB	$600^{b} \pm 27$	$876^{bc} \pm 140$	$1.5^{c} \pm 0.4$	$1.9^{bc} \pm 0.2$	$1.6^{cd} \pm 0.3$	$13.9^{b} \pm 0.8$	$13.1^{cd} \pm 0.7$
18% CP+EAA+200 DEB	$459^{c} \pm 25$	$975^{b} \pm 63$	$2.1^{ab} \pm 0.1$	$1.9^{bc} \pm 0.1$	$2^{abc} \pm 0.2$	$13.8^{b} \pm 0.6$	$13.8^{abc} \pm 0.4$
16% CP+EAA+200 DEB	$988^{a} \pm 20$	$1478^{a} \pm 29$	$1.5^{c} \pm 0.1$	$2.1^{abc} \pm 0.1$	$1.9^{bc} \pm 0.1$	$13.6^{b} \pm 0.1$	$13.6^{bcd} \pm 0.2$
20% CP + 150 DEB	$318^{d} \pm 37$	$683^{c} \pm 28$	2.15 ± 0.2	$1.8^{cd} \pm 0.1$	$1.3^{d} \pm 0.1$	$13.2^{b} \pm 0.3$	$13.2^{cd} \pm 0.2$
18% CP+EAA+150 DEB	$478^{c} \pm 32$	$1001^{b} \pm 73$	$2.1^{ab} \pm 0.1$	$1.5^{cd} \pm 0.1$	$1.5^{cd} \pm 0.2$	$12.7^{b} \pm 0.9$	$12.5^{d} \pm 0.7$
16% CP+EAA+150 DEB	$908^{a} \pm 13$	$1450^{a} \pm 35$	$1.6^{c} \pm 0.1$	$2.0^{bc} \pm 0.2$	$2.5^{ab} \pm 0.2$	$13.9^{b} \pm 0.4$	$13.4^{cd} \pm 0.2$

[a-d] Values within columns without a common letter differ significantly . [1]Results are the means of 4replicates (8chicks per replicate) per treatment .[2]BWG =Body Weight gain , FI = Feed intake, FCR = feed conversion ratio, Percent Weight of abdominal fat, breast, and thigh. [3]SE = Standard error.[4]EAA=essential amino acids (L-Thr , L-Arg , L-Trp , L-Ile , and L-Val)

Table 3) Effects of DEB(mq/kg diet) and dietary CP level supplementation with essential amino acids(EAA) on blood serum sample (31d of age)[1].

Levels of Crude Protein	Glu[2] ±SE[3]	U.A±SE	TG±SE	Chol±SE	Na (mEq/L)±SE[3]	K(mEq/L)±SE	Cl (mEq/L)±SE
20% CP	$292^{c} \pm 1$	$5.1^{a} \pm 0.1$	$86.5^{b} \pm 1$	$120.0^{c} \pm 1$	$145.3^{b} \pm 1$	$5.3^{c} \pm 0.1$	$82.7^{b} \pm 1$
18% CP + EAA[4]	$304.5^{b} \pm 1$	$4.8^{b} \pm 0.1$	$87.5^{b} \pm 1$	$123.5^{a} \pm 1$	$146^{b} \pm 1$	$5.4^{a} \pm 0.1$	$86.7^{a} \pm 1$
16% CP + EAA	$307^{a} \pm 1$	$3.7^{c} \pm 0.1$	$89.5^{a} \pm 1$	$122.0^{b} \pm 1$	$148.3^{a} \pm 1$	$5.4^{b} \pm 0.1$	$88^{a} \pm 1$
Levels of DEB(mq/kg diet)							
250	$304.7^{a} \pm 1$	$4.7^{a} \pm 0.1$	$87.3^{c} \pm 1$	$122^{c} \pm 1$	$143.7^{b} \pm 1$	$5.3^{b} \pm 0.1$	88.7 ± 1
200	$281^{b} \pm 1$	$4.9^{a} \pm 0.1$	$101^{a} \pm 1$	$132^{b} \pm 1$	$144.7^{b} \pm 1$	$6.3^{a} \pm 0.1$	82.7 ± 1
150	$272.7^{c} \pm 1$	$4.1^{b} \pm 0.1$	$96^{b} \pm 1$	$138.3^{a} \pm 1$	$151.3^{a} \pm 1$	$5.3^{b} \pm 0.1$	86 ± 1
Significance level (P< 0.05)							NS
Interaction Between Levels of CP and DEB(mq/kg diet)							
20% CP + 250 DEB	$295^{d} \pm 1$	$4.9^{c} \pm 0.1$	$100^{c} \pm 1$	$116^{f} \pm 1$	$138^{e} \pm 1$	$5.3^{c} \pm 0.1$	84 ± 0.1
18% CP+EAA+250 DEB	$309^{a} \pm 1$	$4.8^{cd} \pm 0.1$	$83^{f} \pm 1$	$129^{d} \pm 1$	$146^{c} \pm 1$	$5.2^{c} \pm 0.1$	90 ± 0.1
16% CP+EAA+250 DEB	$310^{a} \pm 1$	$4.5^{d} \pm 0.1$	$79^{g} \pm 1$	$121^{e} \pm 1$	$147^{bc} \pm 1$	$5.4^{c} \pm 0.1$	92 ± 0.1
20% CP + 200 DEB	$303^{b} \pm 1$	$6.2^{a} \pm 0.1$	$93^{de} \pm 1$	$119^{ef} \pm 1$	$146^{c} \pm 1$	$6.1^{b} \pm 0.1$	84 ± 0.1
18% CP+EAA+200 DEB	$272^{e} \pm 1$	$5.3^{b} \pm 0.1$	$106^{a} \pm 1$	$144^{a} \pm 1$	$142^{d} \pm 1$	$6.8^{a} \pm 0.1$	80 ± 0.1
16% CP+EAA+200 DEB	$286^{f} \pm 1$	$3.1^{f} \pm 0.1$	$104^{ab} \pm 1$	$133^{c} \pm 1$	$146^{c} \pm 1$	$5.9^{b} \pm 0.1$	84 ± 0.1
20% CP + 150 DEB	$299^{c} \pm 1$	$4.9^{c} \pm 0.1$	$96^{d} \pm 1$	$144^{a} \pm 1$	$152^{a} \pm 1$	$5.2^{c} \pm 0.1$	80 ± 0.1
18% CP+EAA+150 DEB	$266^{f} \pm 1$	$4.1^{e} \pm 0.1$	$91^{e} \pm 1$	$137^{b} \pm 1$	$150^{ab} \pm 1$	$6.7^{a} \pm 0.1$	90 ± 0.1
16% CP+EAA+150 DEB	$253^{g} \pm 1$	$3.1^{f} \pm 0.1$	$101^{bc} \pm 1$	$134^{bc} \pm 1$	$152^{a} \pm 1$	$5.9^{b} \pm 0.1$	88 ± 0.1
Significance level (P< 0.05)							NS

[a-d] Values within columns without a common letter differ significantly.

[1]Results are the means of 4 replicates (2 chicks per replicate) per treatment .

[2]Glu = glucose (mg/dl), U.A = uric acid (mg/dl) , TG = triglycerides (mg/dl), Chol = chlostrol (mg/dl), Sodium=Na, Chlorine=Cl, and Potassium=K.

[3]SE = Standard error.

[4]EAA=essential amino acids (L-Thr, L-Arg , L-Trp , L-Ile , and L-Val (%)) .

Table 4) Effects of DEB and dietary CP level on chemical composition(%dry matter) Whole-body, breast , thigh[1] and Excreta Netrosion in 31d of age.

Levels of Crude Protein	Fat[2](%) ± SE[3]	CP(%)± SE	EN(%)± SE	Breast CP[4] ±SE	Breast Fat± SE	Dru+Thi[5]CP± SE	Dru+Thi Fat± SE
20% CP	13.7 ± 0.9	20.2 ± 0.8	75.8^{a} ± 0.9	22.5 ± 0.4	3.2 ± 0.2	18.5 ± 0.4	7.1^{c} ± 0.5
18% CP + EAA[6]	14 ± 0.9	19.2 ± 0.5	54.8^{b} ± 0.9	22.4 ± 0.2	2.3 ± 0.2	18.4 ± 0.4	8.3^{b} ± 0.5
16 % CP + EAA	14.1 ± 0.9	18.7 ± 0.8	50.1^{c} ± 1.9	22.2 ± 0.2	3.5 ± 0.2	18.2 ± 0.4	11.3^{a}± 0.5
Significance level (P< 0.05)	NS	NS		NS	NS	NS	
Levels of DEB(mq/kg Diet)							
250	14 ± 0.5	19.2 ± 0.3	60.3^{a} ± 0.1	22.5^{ab}± 0.2	3.3^{a} ± 0.3	18.4 ± 0.2	8.9^{b} ± 0.2
200	15.3 ± 1.1	18.9 ± 0.7	57.1^{ab} ± 0.1	22.8^{a} ± 0.4	3^{ab} ± 0.3	18.4 ± 0.3	10^{a} ± 0.9
150	14.4 ± 1.0	19.2 ± 1.1	58.3^{a} ± 1.8	22.1^{b} ± 0.2	2.7^{b} ± 0.1	18.5 ± 0.3	9.1^{ab} ± 0.4
Significance level (P< 0.05)	NS					NS	
Interaction Between Levels of CP and DEB(mq/kg Diet)							
20% CP + 250 DEB	12.7 ± 0.4	20.7^{a} ± 0.2	76.6^{a} ± 0.4	22.6^{ab}± 0.1	2.9^{bc} ± 0.1	18.4 ± 0.3	7.1^{d} ± 0.1
18% CP+EAA+250 DEB	14.5 ± 0.7	19.2^{ab} ± 0.2	56.8^{c} ± 1.3	22.4^{ab}± 0.1	3.3^{a} ± 0.3	18.2 ± 0.2	8.3^{cd} ± 0.2
16% CP+EAA+250 DEB	14.7 ± 0.4	17.9^{b} ± 0.4	51.7^{cd} ± 2.9	22.5^{ab}± 0.1	3.8^{a} ± 0.5	18.7 ± 0.1	11.4^{a}± 0.2
20% CP + 200 DEB	15.7 ± 0.7	19.7^{ab} ± 0.6	75.4^{a} ± 1.8	22.9^{a}± 0.4	2.8^{bc} ± 0.4	18.6 ± 0.4	8.8^{cd} ± 1
18% CP+EAA+200 DEB	14.8 ± 1.1	19.1 ± 0.6	49.7^{cd} ± 2.5	22.8^{a}± 0.3	2.7^{bc} ± 0.4	18.3 ± 0.1	9.6^{bc} ± 0.9
16% CP+EAA+200 DEB	15.4 ± 1.4	17.8^{b} ± 0.8	46.2^{d} ± 4.5	22.6^{ab}± 0.3	3.5^{ab} ± 0.2	18.2 ± 0.3	11.7^{a}± 0.8
20% CP + 150 DEB	14.1 ± 1.5	20.8 ± 1.4	65^{b} ± 2.3	21.8^{b}± 0.6	2.1^{c} ± 0.1	18.5 ± 0.5	7.2^{d} ± 0.3
18% CP+EAA+150 DEB	13.9 ± 0.7	19.5^{ab} ± 0.7	57.6^{bc} ± 0.8	22.5^{ab}± 0.2	2.7^{c} ± 0.1	18.7 ± 0.2	9.1^{c} ± 0.5
16% CP+EAA+150 DEB	15.3 ± 0.9	17.3^{b} ± 1.1	52.3^{cd} ± 1.9	22.1^{ab}± 0.3	3.3^{ab} ± 0.2	18.3 ± 0.3	11.1^{ab}± 0.2
Significance level (P< 0.05)	NS					NS	

[a-d]Values within columns without a common letter differ significantly .
[1]Results are the means of 4 replicates (1 chicks per replicate) per treatment and
[2]Fat = fat of whole body and
[3]SE = Standard error.
[4]Breast CP = Breast crude protein. Dru+Thi
[5]CP=drumstick + thigh crude protein (% dry matter).

1. DISCUSSION

In this research, the relative weight of abdominal fat increased significantly in low CP diets and highest amount of abdominal fat obtained in diets with 16% CP, but relative weight of liver, breast and thigh are not significantly different among the dietary treatments (Table 2). These results are obtained in [14, 20, 21]. Breast relative weight percentage of chicks fed 16% CP supplemented diet with amino acid are increased compared to the chicks fed control diet. In the research results of Oyedeji et al. [22] and Horniakova and Abas [23] similar results are observed. Thigh weight percentage of total carcass weight decreased linearly that was not significant and are in agreement with Namroud et al., [24] and Darsi et al., [14]. With a reduction in dietary electrolyte balance, the relative weight of liver, breast, thigh and abdominal fat decreased significantly. In contrast, the different levels of dietary electrolyte balance are not significantly affected on these traits in the study of Borges et al., [25]. Rezaei et al., [15] found weight and percentage of breast decreased with reducing dietary electrolyte balance from 250 to 210 mEq/kg . Karunajeewa and Barr [26] observed no significant difference by changing dietary electrolyte balance in the range of 150 to 340 mEq/kg on growth rate, feed efficiency and abdominal fat content. Significant differences are observed among interaction means of levels CP and DEB for relative weight of liver, fat pad formation, breast and thigh. The relative weight of abdominal fat increased significantly in low CP diets and highest amount of abdominal fat obtained in diets with 16% CP and DEB equal 250, 200 and 150 meq/kg diet. Jianlin et al., [27] showed that maintaining the dietary electrolyte balance at 250 meq/kg failed to show any significant benefit on any parameters examined except for abdominal fat. Dietry CP also had significant impact on feather development, viscera development, and fat pad formation. The abdominal fat pad, expressed as a percentage of body weight, is significantly increased with the reduction of dietary CP. Neither the weight nor the percentage of body weight of internal organs such as liver is affected by dietary CP level. The results of this experiment is in agreement with Rezaei et al. [15].

The effects of different levels of dietary protein supplemented with essential amino acids and dietary electrolyte on some blood parameters of broiler chickens are shown in Table 3. In 31 days of age, with a reduction in CP the serum glucose, and triglycerides concentration increased and uric acid decreased significantly but there is no significant difference in serum albumin concentration. Serum uric acid concentration is lower for the chicks fed by low CP amino acid supplemented diets. In low CP diet, if amino acid profiles are set, the amount of fecal nitrogen metabolites such as ammonia, urea and uric acid decreases. Victoria et al., [28] and Namroud et al. [24] also observed similar results. Different levels of dietary electrolyte balance (150, 200 and 250 mEq/kg) significantly decreased serum glucose and uric acid concentration and increased serum cholesterol concentration and had no significant effect on albumin concentration. Namroud et al. [24] investigated the effect of low CP diets supplemented with essential amino acids with electrolyte balance 280 mEq/kg in broilers and found that plasma uric acid concentration decreased with a reduction in CP . In another study Darsi et al. [14] observed similar result in low CP amino acid supplemented diets with electrolyte balance 250 mEq/kg. The results of this study are in agreement with Namroud et al., [24] and Darsi et al., [14]. But disagreement with Safamehr et al.,[29]. Significant increased in serum glucose and decreased in uric acid concentration are observed among interaction means of CP levels and DEB (250, 200 and 150 meq/kg diet). Significant differences are also observed among interaction means of CP levels and DEB for serum albumin, triglyceride, cholesterol, concentration. These results are in contrast with studies of Safamehr et al.,(2009). Reduction of CP affected serum electrolyte concentration in broilers. Serum Na and Cl concentration of chicks fed the low CP amino acids supplemented diet increased significantly while K concentration in serum are not significantly different among the dietary treatments. Since a significant proportion of sodium and potassium ions are excreted through connection to uric acid with negative charge, and are excreted with urine so, when the uric acid production decreases, the excretion of two above electrolytes decreased too and they accumulate in body. Therefore, recommended in broiler chicks fed low CP amino acids supplemented diets, decreased electrolyte balance in parallel with decline in nitrogen intake. These results are in agreement with the studies done by Darsi et al., [14]. The effects of different levels of dietary electrolyte balance increased significantly Serum Na while K concentration in serum are not significantly different between the dietary treatments. In a study conducted by Rezaei et al., [15] the effects of different levels of dietary CP and 3 levels of dietary electrolyte balance on growth performance and body composition were investigated on broiler chickens. By increasing dietary electrolyte balance, the potassium and chloride concentrations decreased in serum. No Significant differences were observed among interaction means of levels CP and DEB (250, 200 and 150 meq/kg diet) for serum Cl. But Significant differences were observed for serum Na, K and Ca.

Although, whole body protein decreased and whole body fat increased, no significant differences are observed. No differences in whole body fat and protein are observed in broilers fed the different levels of dietary electrolyte. No significant differences are observed among interaction means of CP levels and DEB for whole body fat. Significant increases are observed among interaction means of CP levels and DEB (250, 200 and 150 meq/kg diet) in percentage of whole body protein. Significant decreases are observed in excreta nitrogen when dietary CP levels are reduced. These results are all in agreement with Aletor et al., [20]; Bregendahl et al., [2]; Namroud et al.,[24]. Reduction of CP and electrolytes in the diet and interaction of them reduced nitrogen excretion significantly (Table 4). These results are in agreement with Namroud et al., [24] and Jianlin et al., [27] showed that excreta nitrogen content significantly decreased in a linear manner with the reduction of dietary CP (22.48% to 16.61%). For every one percent decrease of dietary CP, there was about 0.3% less nitrogen excreted in the excreta. As a result, a 13% reduction of nitrogen excretion is observed without affecting growth performance, which is in close agreement with Schutte [30]. He concluded that in broiler chick diets based on corn-soybean meal with adequate lysine and methionine, the protein level could be reduced 1.5% to 2% and the nitrogen excretion would be reduced by 15-20%. Fat content of breast and thigh muscle increased for birds fed low CP diets but protein of breast and thigh muscle are not significantly different among the dietary treatments. On the other hand, the fat amount of breast muscles is decreased with reduction of electrolytes level. Interaction of dietary protein levels and dietary electrolyte balance increased fat content of breast and thigh muscle. Aletor *et al*. [20] and Bregendahl *et al*. [2] also observed significant reduction in total carcass protein by reducing dietary CP level. This result are also confirmed by Parr and Summers [31], Namroud *et al*. [24], and Darsi *et al*.[14].

2. Conclusion

The results of this study showed that low protein diets supplemented with amino acids had no adverse effect on broiler performance in 10 to 31 days of age, whereas significant increased abdominal fat content is witnessed. As the main result, the dietary electrolyte balance equal to 250 mEq/kg concludes to the optimal body weight gain.

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