EFFECT OF ALTERING DIETARY CATION ANION DIFFERENCE ON PERFORMANCE AND BONE MINERALIZATIONG IN BROILERS

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ABSTRACT

The present study was conducted to evaluate mainly the effect of different levels of dietary electrolyte balance (DEB) higher or lower than the literature suggested levels, on leg deformities and moralities of broilers in different growth stages. Moreover, to study the relation between dietary electrolyte balance and growth performance, bone mineralization and blood concentration of these minerals. So, live body gain, feed intake and feed conversion were calculated. Also, serum and bone of legs were analyzed for Ca, P, Na and K to show the effect of different DEB elements content on the concentration of these minerals in serum and bone construction.

The study has been carried out using 200 one-day-old commercial Hubbard broiler chicks. The chicks were allotted into 5 equal experimental groups and reared under the recommended health program in separate pens. The the first group (control) was fed on basal diet calculated to provide DEB 229 and 196 meq / kg diet for starter and grower diets respectively. The other 4 groups were fed 2 lower (181, 130 and 150, 96) and 2 higher (321, 280 and 300, 247), levels of DEB than control in each respective growth stage.

The results showed that feeding lower DEB values than the control, induced significant decline in cumulative body weight gain, feed intake and inefficient feed utilization .

The leg deformities was increased with age in the groups fed low DEB in which began to occur by the end of the starting period and aggravated by the end of the experimental period.. Significant reductions in the measurements of the affected tibia (length and thickness), ash % and Ca % of ash in the starting period, ash %, Ca %, and P % in the grower period were demonstrated. Also, the serum content of minerals showed a significant decrease in both Ca and P levels in the starting period and in serum Ca level in grower period.

INTRODUCTION

Nutrition plays a significant role in preventing and correcting the incidence of leg abnormalities and the provision of adequate dietary levels of various nutrients that influence leg weakness acquired greater significance in the recent times. The monovalent minerals (Na, K and Cl) are essential for synthesis of tissue protein, bone mineralization, maintenance of intracellular and extra cellular homeostasis and electrical potential of cell membranes, enzymatic reactions, osmotic pressure, and acid-base balance.

Adjusting dietary electrolyte balance (DEB) is important to obtain optimum performance, because when the balance is altered due to acidosis or alkalosis, metabolic pathways cannot function properly. Both Na^+ and K^+ have indirect alkalogenic effects on body fluids, and bicarbonate has a buffering effect. Moreover, Na and Cl^- have many important physiological functions. *Mongin (1980)* reported that optimum dietary balance of these minerals allows better chicken performance and may reduce leg problems.

Adesina and Robbins (1987) and Hooge (1998), reported that increased dietary Cl levels have an indirect acidogenic effect on bird metabolism and Cl^- should be maintained at or near requirement levels, because Cl^- excess can cause leg and articulation problems in broiler chickens. Based on pH, HCO_3 and TCO_2 parameters, it was estimated that broiler chickens fed diets containing 0.20 to 0.30% Cl^- were in acid-base balance, which supported the best performance.Cation and anion imbalance affects chicken growth and could influence the incidence of leg problem (*Karunajeewa and Bar, 1988, and Teeter and Belay, 1995*). Tibial dyschondroplasia (TD) incidence is increased with Cl^- excess when it is not balanced with Na^+ or K^+ (*Ruiz–Lopez et al., 1993*).

Litzow et al. (1967) reported that Ca losses due to chronic renal disease were returned to zero when the case was treated for acidosis. Also, *Petito and Evans (1984)* concluded that dietary acid-base balance affects the mineralization of bones.

Chronic metabolic acidosis alters the renal metabolism of vitamin D_3 by preventing the conversion of the vitamin to its metabolically active from [1, $25(OH)_2$ D_3] . With greater metabolic acidosis, it would be possible to observe increased area of hypertrophic cartilage region and consequently greater TD incidence. (Rama Rao *et al.*, 2003).

The best DEB for the starter phase was between 246 and 315 meq / kg, under conditions of these tests. It was demonstrated that using approximately these dietary levels acid-base balance is normal, and TD incidence is minimized. However, lower levels of Na^+ appear to increase TD incidence. Litter moisture increases linearly as dietary Na^+ increases, even though dietary Cl^- has no effect on this variable *(Murakami et al., 2001). Borges et al. (2003)* found that the 240 DEB treatments gave significantly higher weight gain, feed intake, water intake, and water: feed ratio and lower feed conversion ratio than the 145 and 130 DEB.

The objective of the present study is to demonstrate the effect of various dietary electrolyte balance (DEB) on the incidence of leg problems and growth performance of broiler chicks.

Materials & Methods

1.Materials:

1.1. Experimental chicks:

The present study has been carried out using 200 one-day-old commercial Hubbard broiler chicks. The chicks were reared on deep litter system and maintained under good ventilation, suitable temperature, and continuous lightening program, fed ad-libitum with free access of water. The chicks were allotted into 5 experimental groups each of 40 birds and reared in separate pens. All experimental birds were subjected to the recommended vaccination program against Newcastle (ND) and Gumboro diseases.

3.1.2. Experimental diets:

The chicks were fed on basal diet formulated mainly from, (as fed analyses) ground yellow corn (8 % CP), soybean meal (43.84 % CP), fish meal (Herring 71.92 % CP), corn gluten (64.95 % CP) and corn oil.

The ingredient composition and proximate chemical analysis of the basal diets are presented in Table (1).Moisture, crude protein, ether extract, calcium and phosphorus were chemically analyzed in the diets according to AOAC (1984).

Table (1): Composition of the basal diet in percentage (as fed basis).

	Starter	Grower
I. Ingredient composition (on fresh basis)		
Yellow corn	55	61.23
Soybean meal (44% protein)	28	24
Fish meal (herring 72% protein)	5	3
corn oil	4	4
Corn gluten	4	4
Dicalcium phosphate	0.75	0.35
Limestone	1.75	2.22
Common salt	0.06	0.06
Mineral and vitamin premix(1)	0.30	0.30
Sod. bicarbonate	0.3	-
Sand (fine)(2)	0.800	0.800
II. Proximate chemical analysis (as fed)		
Energy (Kcal ME/kg) (3)	3100	3150
Crude protein	23	20.3
Fat	7.3	7.3
Ca	0.99	0.93
Total P	0.72	0.67
Available P(3)	0.45	0.37
K(3)	0.79	0.71
Na(3)	0.15	0.12
Cl(3)	0.15	0.13
Ca/P	2.2/1	2.5/1
DEB(4)	229	196

(1)Provides (in IU/kg diet) vitamin A1500, vitamin D3 200, vitamin E 10 and (in mg/kg diet) vitamin K 0.5, vitamin B12 0.01, biotion 0.15, choline 1000, folacin 0.55, Niacin 30, Pantothenic acid 10, Pyridoxine 3.5, Riboflavin 3.6 and Thiamin 1.8.

(2)To be replaced by the electrolyte supplement if needed according to the experimental design.

(3) Calculated according to the feed composition table s given by NRC for poultry .

(4) DEB = milliequivalent of (Na + K-Cl) / kg diet.

Table (2):The dietary electrolytes content to adjust DEB of different treatments.

Item	DEB (meq/kg)(**)							
	Starter period				Grower period			
	181	130	321	280	150	96	300	247
Electrolyte supplement								
NH_4 Cl(*)	0.25	0.53	-	-	0.25	0.53	-	-
$NaHCO_3$ %(*)	-	-	0.8	0.45	-	-	0.80	0.45
Cation-anion content								
Na %	0.15	0.15	0.37	0.27	0.12	0.12	0.36	0.24
K %	0.79	0.79	0.79	0.79	0.71	0.71	0.71	0.71
Cl %	0.31	0.5	0.15	0.15	0.30	0.48	0.13	0.13

(*) : Hemajet company.
(**)Calculated according to the chemical composition of feedstuffs (**NRC, 1994**).

The basal diets were starter diet which was fed from 1 to 21 day old and grower diet which was fed from 22 to 42 days old.
The calculated values of the basal diet for dietary electrolyte balance (DEB) demonstrated 229 and 196 meq / kg diet for starter and grower diets respectively *(NRC, 1994)* (Table 1).

The diets were supplemented with 0.25 or 0.53% of NH_4Cl for the diets fed to the groups 2 and 3 respectively and with 0.80 and 0.45% of $NaHCO_3$ for the diets fed to the groups 4 and 5 respectively during both the starter and grower periods. This replacement was on the expense of sand to adjust the DEB in 2 levels lower and 2 levels higher than the control level in both starter and grower diets (Table 2).

2. Methods:

2.1. Objectives and studied parameters:

The present study was conducted to evaluate mainly the effect of different levels of DEB (higher or lower than the literature suggested levels) on the leg deformities of broilers in the different growth stages. Moreover, the literature reported that there is relation between electrolyte balance and growth performance, kidney functions and blood concentration of these electrolytes, so, live body gain, feed intake and feed conversion were calculated. Also, serum and bone of legs were analyzed for Ca *(Glinger and King, 1972)*, P *(Kilchling and Freiburg, 1951)* and Na & K *(Collins and Palkinthome, 1952)* to show the effect of different DEB elements

The different growth performance parameters were examined weekly and calculated in cumulative manner all over the experiment, however, metabolic profile of the tested minerals and leg bone I (tibia) measurements and mineralization were examined at the end of each growth stage period of the experiment. Eventually, the leg deformities and moralities of chickens in the different groups were recorded throughout the experimental period.

2.2. Experimental design:

The chicks were reared for 6 weeks and the different dietary (DEB) values were adjusted to the experimental diet from the 1st day to the last day of the experiment. Table (3) demonstrate the 5 nutritional treatments for the control, two higher and two lower levels of DEB in diets fed to the 5 groups in the starter and grower periods.

Table (3) The 5 nutritional treatments DEB in the experiment diets

Diets / Experimental groups	Starter (1-21 days)	Grower (22-42 days)
(1) Control	229	196
Lower levels		
(2)	181	150
(3)	130	96
Higher levels		
(4)	321	300
(5)	280	247

RESULTS & DISCUSSION

The challenge of the effect of DEB on leg abnormality in poultry using the salts $NaHCO_3$, and NH_4Cl were investigated by several researchers who have attempted to relate leg anomalies and production responses to a linear combination of the sodium, potassium and chlorine. For exploring responses to various mixtures of $NaHCO_3$ and NH_4Cl and consequently various DEB levels on the main objective of this study which was carried out to examine how this dietary cation-anion expression is related to growth performances and leg abnormalities in broiler chickens. Effects of alteration of DEB on body weight gain, feed intake, and feed conversion ratio are presented in tables (4 to 6). These results showed that when DEB values were lower than the control (181 and 150) or (130 and 96) as compared with control (229 and 196) in starting and finishing periods respectively, the body weight gain was insignificantly decreased in the starting period but by the end of the experiment it showed significant decline in cumulative body weight gain

The obtained results are explained by going through the data of feed intake (Table5) which demonstrated a decrease in feed intake which migh be attributed to imbalance in electrolyte supplementation at these levels of DEB that can cause inappetance with weight gain reduction when compensatory mechanism are not enough to maintain the acid-base homeostasis *(Mongin, 1981)* or there was no chance to DEB correction. These results are coincided with the finding of *Borges et al. (2003)* who stated that the best performance of chicken could be obtained by DEB 240 meq/kg diet. Also, *Sauveur and Mogin (1978) and Hooge (1995, 1998)* reported that the best chicken performance obtained when DEB ranged from 246 to 264 meq/kg diet. Moreover, these results are in agreement with the finding of *Borges et al. (2003)* which indicated that the chickens showed higher body weight and feed intake when fed a diet of DEB 240 meq/kg diet than chickens fed a diet from 0 to 130 meq/kg diet. Also, it has been reported that optimal performance can be achieved with diet containing 250 meq/kg Diet *(Murakami et al., 2001).*

The present results indicted that increasing the DEB concentration in the starter to 321 meq/kg (by adding 0.8% $NaHCO_3$) or to 280 meq/kg (by adding 0.4% $NaHCO_3$) and in the grower period to 300 meq/kg by adding (0.8% $NaHCO_3$) or to 247 meq/kg by adding 0.45% $NaHCO_3$), have supported the growth performance as the body weight gain was increased as well as feed intake as compared to the groups fed low DEB.

The beneficial effects of manipulating the dietary cation-anion difference (DCAD) or DEB concentration to 280 meq/kg and 321 meq/kg in the starter period and to 247 meq/kg and 300 meq/kg in the grower period on performance in this experiment would likely be due to increased feed intake. Adding Na to the diet in the from of sod. bicarbonate results in maintaining the body weight gain without significant increase from control group and these results adapted to *Murakami et al. (1997b)* who reported that excess dietary Na increased the body weight gain but disagree with results observed by *Mongin (1981)* who reported that the excess in dietary Na lead to reduction in body weight gain and poorer feed efficiency.

The results concerning feed conversion ratio (Table 6) revealed that the groups fed low DEB (group 2 and 3) demonstrated inefficient feed utilization as compared with other experimental groups (2.4, 2.2 FC versus 2.0, 2.02, 2.02) in groups 2 and 3 versus groups 1, 4, 5, respectively. This may be attributed to the dietary electrolyte imbalance affecting the feed digestion and assimilation, the same cause of inappetance and decreased feed intake *(Johonson and Karunajeewa, 1985).*

Considering the major objective of the present study, the effect of DEB manipulation on leg disorder in broilers are presented in Table (7), which demonstrate that when DEB deviate downward from 229 meq/kg diet in starter period and 196 meq/kg in grower period (control group) to 181 or 130 meq/kg diet in starter period and 150 or 96 meq/kg diet in grower period respectively, led to increased number of the chicken suffering from lameness in ratios 42.5 % and 55% respectively of the total number of the chicken fed these diet by the end of the experimental period. The lameness increased by age till the end of the experiment nearly to be the double number in the starter period.

The bad effect of manipulating the DEB concentration on leg abnormality in this experiment would likely be due to the indirect acidogenic effect on body fluids *(Mongin, 1980)* and, on bird metabolism *(Hooge, 1998).* With greater metabolic acidosis hypertrophic cartilage region increased and consequently greater TD incidence *(Adesina and Robbins, 1987, Ruiz-Lopez and Austic, 1993 and Hooge, 1998).*

From another point of view, alteration of DEB to 181 meq/kg, 130 meq/kg and to 150 meq/kg, 96 meq/kg in the starter and the grower period respectively produced chronic metabolic acidosis and the renal metabolism of vitamin D_3 may be altered by preventing conversion of vitamin D to its metabolically active form (1,25 -dihydroxy cholecalciferol) which result in imperfect bone mineralization *(Rama Rao et al., 2003).*

Moreover, the leg deformities increased by age, began to occur by the end of the starting period and aggravated by the end of the experimental period may be due to poor bone calcification and mineralization as it appeared from the obtained results (Table 8) which demonstrate significant reduction in the measurements of affected tibia (length and thickness), ash % and Ca % of ash in the starting period, ash %, Ca %, and P % in the grower period. Also, the serum profile of minerals in consideration of bone formation (Table 9) assured these findings in long bone investigation. There was a significant decrease in both Ca and P levels in the starting period and in Ca level in grower period in the serum of the groups fed low DEB, which of course affect calcification and mineralization of bone. *Halley et al. (1987)* reported that there is a high correlation between TD and acid-base imbalance, this relationship affected bone mineralization. Lameness occur when the ends of the long bones become enlarged and exceedingly flexible due to a lake of calcification. This often facilitates the development of a bowed appearance most noticeable at the ends of the tibia (*Wise, 1975).*

Increasing the dietary Cl^- in the present work increased the incidence of leg problem and these results coincided with the findings of *Leach and Nesheim (1972), Ruiz-Lopez et al., (1993), Hooge (1998) and Rama Rao (2003)* who reported increased incidence of TD due to increasing the level of Cl^- in the chicken diet. The present results do not agree with the finding of *Murakami (2001*) who reported that there is no effect for dietary Cl^- level on TD incidence in chickens, and also *Edward (1984)* stated that there is no effect of cation-anion balance on TD score in chicken, also *Simons et al. (1987)* indicated that dietary Cl^- alone was without effect on TD incidence. So, narrowing the dietary cation-anion ratio could increase the incidence of leg problems

Serum concentration of minerals under investigation, (Table 9) also, demonstrated significant decrease in phosphorus in the groups fed high DEB(groups 4 and 5) in both starting and growing periods. This may be attributed to the compensatory mechanisms undergoing to maintain the acid base homeostasis. Also, it could be explained as the high DEB in these groups provide adequate level of Ca which enhance bone formation and increased bone ash content and consequently a greater incorporation of inorganic phosphate into bone, thus lowering plasma levels of P *(Edwards et al., 1984).*

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Table (4):Cumulative body weight gain (g / bird).

Group / Exp.periods	(1)	(2)	(3)	(4)	(5)
1	X 69^{a} ± 7	73^{a} ± 8.7	67.5^{a} ± 9.7	68^{a} ± 8.7	69^{a} ± 11
2	X 254^{a} ±		216^{b} ± 14.5		254^{a} ± 18
3	X 558^{a} ± 32.4	225^{a} ± 21.5	481.5^{b} ± 32.5	256^{a} ± 17.1	544^{a} ± 94
4	X 937^{a} ± 21	506^{a} ± 34.5	787.5^{b} ± 44	551^{a} ± 61.2	894^{a} ± 104
5	X 1422^{a} ± 25	816^{a} ± 57	1158.5^{b} ± 80	900.5^{a} ± 100	1334^{ab} ± 81
6	2013^{a} ±	1202^{b} ± 91	1608^{b} ± 128	1349.5^{ab} ± 82	1915^{ab} ± 183
		1668^{b} ± 148		1935.5^{b} ± 123	

Means (X) with different superscripts within same raw differ significantly at ($P < 0.05$)
(1) DEB229 and 196 meq./kg diet (control) in starter & grower period respectively.
(2) DEB181 and 150 meq./kg in starter & grower period respectively.
(3) DEB130 and 96 meq./kg~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(4) DEB321 and 300 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ .
(5) DEB280 and 247 meq./kg~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.

Table (5): Cumulative feed intake (g / bird) allover the experimental period.

Group / Exp period	(1)	(2)	(3)	(4)	(5)
1	135	147	136	135	134
2	507	472	458	508	508
3	1116	1074	967	1108	1098
4	1874.5	1774	1657	1828	1816
5	2845	2646	2509	2728	2701
6	4028	3699	3566	3911	3876

Means (X) with different superscripts within same row differ significantly at ($P < 0.05$)
(1) DEB229 and 196 meq./kg diet (control) in starter & grower period respectively.
(2) DEB181 and 150 meq./kg in starter & grower period respectively.
(3) DEB130 and 96 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(4) DEB321 and 300 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(5) DEB280 and 247 meq./kg in starter & grower period respectively

Table (6) Cumulative feed conversion ratio allover the experimental period.

Group / Exp. period	(1)	(2)	(3)	(4)	(5)
1	1.96	2.01	2.01	1.99	1.94
2	2.00	2.10	2.12	1.98	2.00
3	2.00	2.12	2.01	2.01	2.02
4	2.00	2.17	2.10	2.03	2.03
5	2.00	2.20	2.17	2.02	2.02
6	2.00	2.41	2.20	2.02	2.02

Means (X) with different superscripts within same row differ significantly at (P < 0.05)
(1) DEB229 and 196 meq./kg diet (control) in starter & grower period respectively.
(2) DEB181 and 150 meq./kg in starter & grower period respectively.
(3) DEB130 and 96 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(4) DEB321 and 300 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(5) DEB280 and 247 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.

Table (7) Cumulative leg abnormalities % allover the experimental period.

Group	1	2	3	4	5
Weekly leg abnormalities	%	%	%	%	%
1	0	0	0	0	0
2	0	2.5	5	2.5	0
3	0	10	15	2.5	2.5
4	0	17.5	22.5	2.5	5
5	0	27.5	37.5	5	5
6	2.5	42.5	55	7.5	7.5

Means (X) with different superscripts within same row differ significantly at (P < 0.05)
(1) DEB229 and 196 meq./kg diet(control) in starter & grower period respectively
(2) DEB181 and 150 meq./kg in starter & grower period respectively.
(3) DEB130 and 96 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(4) DEB321 and 300 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(5) DEB280 and 247 meq./kg in ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.

Table (8): Tibia measurements and its minerals content (on the dry basis) (a) at the end of the starting period and (b) at the end of the growing period (42 days).

Group / Parameter	(1)	(2)	(3)	(4)	(5)
Length (cm)	X (a) 7.5 ± 0.1 (b) 9.56 ± 0.56	7.4 ± 0.92 6.38 ± 1.7	7.38 ± 1.0 6.13 ± 1.3	7.4 ± 0.13 9.5 ± 0.59	7.4 ± 0.13 9.37 ± 0.44
Thickness (cm)	X (a) 0.65 ± 0.05 (b) 0.93 ± 0.07	0.73 ± 0.11 0.55 ± 0.18	0.63 ± 0.11 0.5 ± 0.13	0.65 ± 0.07 0.9 ± 0.09	0.65 ± 0.05 0.9 ± 0.07
Ash %	X (a) 56.5 ±0.12$^{(a)}$ (b) 54.5 ± 0.47$^{(a)}$	43.7 ± 2.2b 34.9 ± 3.4$^{(b)}$	40.6 ± 6.3b 37.8 ± 1.36$^{(b)}$	53 ± 3.1$^{(a)}$ 55.7 ± 0.95$^{(a)}$	46 ± 3.4$^{(ab)}$ 54.7 ± 1.14$^{(a)}$
Ca% of ash	X (a) 37.5 ± 1.36$^{(a)}$ (b) 37.7 ± 2.6$^{(a)}$	36.3 ± 0.77$^{(a)}$ 37.3 ± 0.8$^{(a)}$	37.35 ± 4$^{(a)}$ 35.35 ± 1.36$^{(a)}$	34.9 ± 0.9$^{(a)}$ 38.5 ± 5.5$^{(a)}$	36.8 ± 2.1$^{(a)}$ 38.8 ± 4.5$^{(a)}$
P % of ash	X (a) 20.74 ± 2.7$^{(a)}$ (b) 22.3 ± 1.7$^{(a)}$	22.3 ± 2.9$^{(a)}$ 20.22 ± 2.3$^{(a)}$	18.9 ± 1.89$^{(a)}$ 17.86 ± 1.11$^{(a)}$	20.3 ± 1.7$^{(a)}$ 22.0 ± 3.3$^{(a)}$	19.66 ± 1.7$^{(a)}$ 20.7 ± 1.5$^{(a)}$
Ca/P	X (a) 1.81 ± 0.16$^{(a)}$ (b) 1.7 ± 0.14$^{(a)}$	1.61 ± 0.22$^{(a)}$ 1.86 ± 0.18$^{(a)}$	1.98 ± 0.4$^{(a)}$ 1.97 ± 0.08$^{(a)}$	1.72 ± 0.15$^{(a)}$ 1.75 ± 0.09$^{(a)}$	1.87 ± 0.12$^{(a)}$ 1.69 ± 0.2$^{(a)}$
Na% of ash	X (a) 7.11 ± 1.72$^{(a)}$ (b) 6.64 ± 0.46	6.24 ± 0.28$^{(a)}$ 5.84 ± 0.12	6.11 ± 0.14$^{(a)}$ 5.90 ± 0.1	6.07 ± 0.20$^{(a)}$ 6.10 ± 0.13	5.67 ± 0.47$^{(a)}$ 5.70 ± 0.14
K% of ash	X (a) 3.91 ± 1.1$^{(a)}$ (b) 3.39 ± 0.45	3.62 ± 1.24$^{(a)}$ 5.21 ± 0.45	4.39 ± 0.42$^{(a)}$ 5.87 ± 0.1	4.95 ± 4.5$^{(a)}$ 8.69 ± 0.1	4.95 ± 1.96$^{(a)}$ 5.21 ± 0.45

Means (X) with differente superscripts within same raw differ significantly at ($P < 0.05$)
(1) DEB229 and 196 meq./kg diet(control) in starter & grower period respectively.
(2) DEB181 and 150 meq./kg in starter & grower period respectively.
(3) DEB130 and 96 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(4) DEB321 and 300 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(5) DEB280 and 247 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.

Table (9) Ca, P, Na and K concentrations in serum (a) at the end of the starting period (3 wk) and (b).at the end of the grower period (42d)

DEB / Parameter	(1)	(2)	(3)	(4)	(5)
Ca (mg%)	X (a) 10.5 ± 0.32$^{(a)}$ (b) 9.92±0.55$^{(a)}$	9.7 ± 0.41 $^{(ab)}$ 8.3 ± 0.321$^{(b)}$	9.0 ± 0.25$^{(b)}$ 8.6 ± 0.42b	10.3 ± 0.31 $^{(a)}$ 10.3 ± 0.2$^{(a)}$	9.92 ± 0.41$^{(a)}$ 9.6 ± 0.51$^{(a)}$
P (mg%)	X (a) 4.7 ± 0.41$^{(a)}$ (b) 4.2 ± 0.61$^{(a)}$	3.91 ± 0.32$^{(ab)}$ 3.8 ± 0.51$^{(a)}$	4.0 ± 0.42$^{(a)}$ 3.6 ± 0.41$^{(a)}$	3.9 ± 0.31$^{(ab)}$ 2.69 ± 0.3$^{(b)}$	.3 ± 0.28$^{(b)}$ 2.75 ± 0.4$^{(b)}$
Na (m.mol/L)	X (a) 166 ± 12$^{(a)}$ (b) 145 ± 13$^{(a)}$	166 ± 16 $^{(a)}$ 169 ± 12$^{(a)}$	167 ± 13$^{(a)}$ 158 ± 15$^{(a)}$	169 ± 15$^{(a)}$ 163 ± 12$^{(a)}$	161 ± 17$^{(a)}$ 172 ± 17$^{(a)}$
K (m mol/L)	X (a) 15 ± 2.5$^{(a)}$ (b) 14 ± 2.8$^{(a)}$	13 ± 2.8$^{(a)}$ 12 ± 3.1$^{(a)}$	13 ± 5.1$^{(a)}$ 13 ± 3.7$^{(a)}$	12 ± 2.9$^{(a)}$ 9 ± 2.5$^{(a)}$	9.0 ± 1.5$^{(a)}$ 6.5 ± 3.5$^{(a)}$

Means (X) with different superscripts within same row differ significantly at ($P < 0.05$)
(1) DEB229 and 196 meq./kg diet (control) in starter & grower period respectively.
(2) DEB181 and 150 meq./kg in starter & grower period respectively.
(3) DEB130 and 96 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(4) DEB321 and 300 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.
(5) DEB280 and 247 meq./kg ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~.

الملخص العربى

اثر التغير في الكاتيونات والانيونات المضافة الىالعليقة على أداء ونسب المعادن في العظم في بدارى التسمين

ماجدة شعبان طه
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أجريت هذه الدراسة لمعرفة مدى تأثير التغذية بعلائق اقل تركيز أو اكبر تركيز من العلائق المتزنة اليكتروليتيا وتأثير ذلك على تشوه الأرجل في بداري التسمين وأيضا العلاقة بين الاتزان الالكتروليتى للعليقة ومظاهر النمو ووجود هذه الالكتيروليتات في الدم والعظم .
وقد أجريت هذه التجربة على عدد 200 كتكوت عمر يوم حيث قسمت إلى 5 مجموعات كل مجموعة تحتوى على 40 كتكوت . وقد أعطيت المجموعة الأولى (الضابطة العليقة المتزنة الكتروليتيا . بينما أعطيت المجموعة الثانية والثالثة نسب من الالكتروليتات اقل من العليية المتزنة. أما المجموعة الرابعة والخامسة نسب أعلي من العليقة المتزنة .
وقد أظهرت النتائج :
– انخفاض معنوي في زيادة الوزن ومعدل استهلاك الغذاء في المجموعات التي أعطيت نسب اقل أو أعلى من العليقة المتزنة .
– زيادة في تشوه الأرجل للمجموعات التي أعطيت نسب اقل من المجموعة الضابطة .
– حدوث انخفاض معنوي في طول وعرض الساق وأيضا في نسب الرماد والكالسيوم والفسفور في العظم كما حدث انخفاض معنوي في الكالسيوم والفسفور في السيرم