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ROLE OF SODIUM OR ALUMINUM SALTS IN MODULATING PRODUCTIVITY PERFORMANCE AND SOME PHYSIOLOGICAL TRAITS IN LOCAL CHICKENS

1-DURING GROWING PERIOD

By

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Abstract: *An experiment was conducted to study the influence dietary supplemental of either sodium chloride (NaCl) or aluminum sulphate Al2 (SO4)3 on productive performance and some plasma hormones concentration in chickens during the growing period (one day-12 weeks of age). Three hundred unsexed –one day old chicks of El-Salam strain were randomly distributed into four groups (each of 75 chicks) with three replicates. The 1st group (T1) was fed the basal diet, that with 0.3% NaCl and served as the control group. While the 2nd group (T2) was given the basal diet with 0.03% aluminum sulphate Al2 (SO4)3. The 3rd (T3) and the 4th (T4) groups were fed diet with 0.2 and 0.5% NaCl, respectively. Live body weight (LBW), body weight gain (BWG), feed consumption (FC) and feed conversion ratio (FCR), keel length (KL) and shank length (SL), water consumption (WC), litter ammonia (LA), house humidity (HH) and litter pH (LpH) traits were estimated. Blood plasma levels of sodium (PNaC), aluminum (PAlC) and hormones of aldosterone (AldoH) and insulin-like growth factor-1 (IGF-1) were also determined. The results showed that chicks of T2 group were the best for LBW, BWG and FCR following by those of T3 and T4 groups, respectively. While the lowest values were observed for the control ones. Moreover, the highest KL and SL values were shown for chicks of T2 group followed by chicks fed on T4, T1 (control diet) and T3, respectively. Chicks fed on T4 exhibited the highest WC trait compared to the chicks received the T1, T2 and T3 treatments, respectively. Dietary addition Al2 (SO4)3 in (T2) had significantly lowered of the LA, HH and LpH traits compared with other treatments. The increase in NaCl at level of 0.5% on diet T4 was associated with increase in plasma sodium. Therefore, the T2 group had significantly higher plasma concentrations of aluminum and both Aldo and IGF1 hormones compared with other the treatments.*

The results of the present study indicated that sodium or aluminum salts supplementation during the growing period promoted the growth performance and had beneficial effects on some physiological responses of El-Salam chicks.

Key Words: **Sodium, Aluminum Salts, Modulating Productivity, In Local Chickens**

INTRODUCTION

Poultry production of Egypt has become one of the biggest agricultural industries and its improvement is one of the main objectives of the poultry industry. In the case of meat type chicks, maximum physical performance is operational good. Mineral elements have been known for many years as essential dietary nutrients for poultry life (Underwood and Stulle, 2001). On the other hand, it was reported that values of some

blood biochemical and hematological parameters were related to growth performance and could be very important as indicator traits in breeding for high productivity (Obeidah *et al.*, 1978 and Peterson *et al.*, 1982). It is well known that, dietary electrolyte balance (DEB) manipulations have significant influence on LBW, BWG, FC, FCR, WC, litter condition and some blood parameters. The optimum DEB has been reported to be 220 to 270 mEq/kg for broilers of all ages, with up to 0.4% for Na and 0.15 to 0.30% for Cl (Oviedo *et al.*, 2001). Also, Mushtaq *et al.* (2007) suggested that the nutrient requirements of broiler chickens during the finishing phase (29 to 42 day) were 0.20 to 0.25% Na and 0.30% Cl when the ambient temperature ranged from 32 to 40°C. However, Ravindran *et al.* (2008) indicated that feed intake was unaffected by DEB levels. El-Deek *et al.* (2009) found that FCR was significantly improved by 12.5% at 0.5% NaCl during the whole experimental periods (3 to 56 day) of broiler chicks. Maie *et al.* (1992) reported that plasma aldosterone increased significantly ($P<0.01$) in broilers given salt higher than 1g/liter drinking water. Deyhim and Teeter (1994) reported that drinking water supplemented with NaCl increased mass gain and water consumption in broiler chickens. There is no doubt that AVT is the major antidurtetic hormone in birds; the mechanism by which AVT affects kidney function includes decreasing the kidney glomerular filtration rate (Sturkie 1986). Arad and Skadhauge (1986) concluded that plasma osmolality, sodium and chloride concentrations and arginine vasotocin hormone (AVT) concentration were significantly elevated in the domestic fowl fed high dietary NaCl. Donowitz *et al.* (1998) found that chickens fed on a low-Na diet had increased plasma aldosteron, low-NaCl diet decreased ileal and colonic Na depended D-glucose update. On the other hand, Aluminum (Al) as an element is widely distributed in the environment, including the diet. It is usually found at very low levels in most types of animal feeds. High levels of dietary aluminum have been shown to have negative effects on growth and phosphorus metabolism (Hussein *et al.*, 1988 and Zein El-Dein *et al*, 1999). Capdevielle and Scanes (1995) studied the effect of aluminum sulfate on growth and growth-related hormones in a heavy broiler strain between 4 and 18 days old. They found that the average daily gain, skeletal growth and the plasma concentration of both growth hormone and insuline-like growth factor I (IGF1) were increased for the groups receiving the low aluminum sulfate level compared to the corresponding controls. Capdevielle *et al.* (1996) reported that circulating concentrations of aldosterone and corticosterone were increased in the chicks receiving either the high dose of aluminum sulfate or the sulfuric acid relative to chicks fed the unsupplemented control diet. Therefore, the objectives of this experiment were to study the effects of either sodium or aluminum salts supplementation on performance and some plasma hormones concentration in El-Salam chickens during growing period.

MATERIALS AND METHODS

This experiment was carried out at the Poultry Farm of Sakha, Animal Research Station, Animal Production Research Institute, Agricultural Research Center.

Chicks and experimental design

Three hundred unsexed-one-day old chicks of El-Salam strain hatched in January were used in this experiment. All chicks were randomly divided into 4 equal groups (75 chicks, each) with three replicates each, wing banded and individually weighed. The 1st group (T1) was fed the basal diet, with 0.3% NaCl and served as the control group. While the 2nd group (T2) was given the basal diet with 0.03% Al2 (SO4)3. The 3rd (T3) and the 4th (T4) groups were fed diet with 0.2 and 0.5% NaCl, respectively.

Management and feeding:

All chicks were transferred to floor brooding rooms under 33C° throughout the first three days of age. Brooding temperature was then gradually reduced until it reached normal prevailing temperature at four weeks of age. Chicks were exposed to 24 hours light during the first week of age. In the 2nd wks of age, the photoperiod was 19h/d, and was decreased by half an hour per week till the end of experiment. Chicks were separately kept in floor grower rooms from 8 till 12 wks of age, and were fed *ad libitum* and fresh water was available continuously. Chicks were fed a starter diet (19 % CP and 2755 Kcal) up to 8 wks followed by a grower diet (15% CP and 2900 Kcal) up to 12 wks of age.

Measurements:-

Individual live body weight (LBW) in grams was recorded at hatch day and then biweekly up to 12 wks of age. Body weight gain (BWG) was then calculated. Feed consumption (FC), feed conversion ratio (FCR), water consumption (WC), litter ammonia (LA) at bird head height within each room, litter pH (LpH) using comparative pH paper and house humidity (HH) were determined during the same previous intervals. Keel length (KL) and shank length (SL) values for each chick were estimated at 4, 8 and 12 wks.

Blood sampling and analyses:

Six blood samples (5 ml) were collected from each experimental group at the end of the experiment (at 12 wks of age). Blood from each bird was drawn from the wing vein in heparinized tubes in the morning (between 8 and 10 o'clock) before feeding. Blood samples were centrifuged at 3000 rpm for 20 minutes. Plasma was decanted and stored frozen at -20°C until the time of analysis. Blood plasma was analyzed to determine sodium, aluminum and hormones of aldosterone (AldoH) and insulin-like growth factor-1 (IGF-1) using commercial kits.

Data were subjected to computerize one-way analysis of variance and Duncan's multiple range test procedures using SAS (2001). The percentage values were transferred to percentage angle using arcsine equation before subjected to statistical analysis.

RESULTS AND DISCUSSION

Live body weight (LBW) and body weight gain (BWG):

Results obtained from Table (1) indicate that the inclusion of either Al2 (SO4)3 or NaCl in diets significantly improved ($P \leq 0.05$) LBW values of El-Salam chicks at 2, 8, 10 and 12 wks of age compared with those of control diet. The highest LBW values were recorded for chicks of T2 group followed by those of T3 and T4 groups, respectively compared to chicks of T1 (control) throughout the experimental period. Similar previous trend was obtained for BWG values (Table 2). Thus the T1 (control) had the lowest BWG data when compared with the remaining tested ones.

The present results shows that the LBW and BWG traits were markedly improved in Al2 (SO4)3 and NaCl supplemented groups. These results were in accordance with the previous reports of Raup and Bottje (1990), Gorman and Balnave (1994), Oviedo *et al.* (2001) and El-Deek *et al.* (2009). They reported that the optimum Na dietary level was up to 0.50% and 0.15 to 0.30% for Chloride to maintain maximum LBW. These results indicated that NaCl is an important factor to stimulate feed intake especially during the first weeks of age and this depended upon stimulation of appetite for feed (Edwards, 1984 and Britton, 1992). Also, Balnave and Gorman (1993) and Oviedo *et al.* (2001) showed a significant effect of NaCl or similar salts in feed or water on BWG and determined that 0.26 to 0.50% NaCl gave maximum effect on BWG.

In this respect Dela Horra et al (2001) detected that increasing Nacl level in the diet led to increasing the level of plasma AVT hormone which lead to improve significant the active transport of both Na and sugar together in the intestines. However, Sayed *et al.* (2008) indicated that increasing Na level to 0.30% insignificantly improved BWG. Concerning the Al2 (SO4)3 supplemented group it achieved the improvements in LBW and BWG, which were in agreement with the results of Capdevielle and Scanes (1995) and Moore *et al.* (1999). They found that values of BWG, LBW and skeletal growth were increased in broilers received the low concentration of Al2 (SO4)3 compared to the corresponding control birds.

Feed consumption (FC) and feed conversion ratio (FCR):

Data in Table (3) show that there were significant differences among treatments on FC and FCR values during all studied periods. Chicks fed on T2 had significantly lower ($P \leq 0.05$) FC values than those fed on T1, T3 and T4, respectively. The highest FC values were for chicks fed on T3 during periods from 0-2, 2-4 and 10-12 wks of age, also the chicks of T1 group (control) recorded the highest FC values during periods from 6-8 and 8-10 wks of age. The lowest FCR values were recorded with chicks fed on T2 during all periods studied compared with other three treatments. Chicks fed on T1 (control) showed the highest difference among treatments for FCR values during whole periods studied except periods from 2-4 and 10-12 wks of age compared with other three treatments. However, the dietary addition of either Al2 (SO4)3 (T2) or NaCl (T3) or (T4) improved the FCR values compared with the un-supplemented control group. These observed findings were in accordance with Geraert *et al.* (1996), Oviedo *et al.* (2001) and El-Deek *et al.* (2009) who the response of broiler chicks fed practical diets containing nearly the same levels for NaCl that FC and FCR values were significantly improved by 12.5%. On the other hand, Capdevielle and Scanes (1995) reported that for the groups of broiler chicks fed the low level of Al2 (SO4)3 daily gain or FC and FCR values were increased compared to corresponding control. It appears that these supplement have the ability to improve the FC and FCR traits, and these results could be attributed to changes in nutrient digestion or in the metabolic utilization. Therefore, these supplements play an essential role in the processes leading to the absorption of sugars and amino acids in the intestine (Crane, 1965; Lee and Campbell, 1983 and Delahorr *et al.*, 2001).

Keel (KL) and shank lengths (SL):

Shank and keel lengths were significantly different ($P \leq 0.05$) at (4, 8 and 12 wks) of age by using aluminum and sodium salts in diets (Table 4). Their values were generally increased linearly with increasing age. Using Al2 (SO4)3 for chicks fed on T2 significantly increased ($P \leq 0.05$) KL values at all ages studied except at 12 wks of age, where the KL values which were not significantly different from the T1 (control).

Chicks fed on T2 had significantly higher ($P \leq 0.05$) SL values at 8 wks of age compared to other groups. The lowest values of KL and SL values at all ages studied were recorded of chicks using NaCl in T3. It can be noticed that KL and SL values of chicks fed on T2 significantly increased ($P \leq 0.05$) compared to those fed on T3 in this respect at all ages studied. Also chicks fed on T2 significantly increased ($P \leq 0.05$) KL values at 4 and 8 wks of age and SL values at all studied ages compared with T1 (control), while no significant differences in KL at 8 and 12 wks, and SL at 4 and 12 wks of age among chicks fed on T3, T4 and T1 (control). These results are in agreement with the previous findings of Capdevielle and Scanes (1995) who reported that the effect of concentrations of aluminum sulfate on growth and growth-related hormones was examined in a heavy broiler strain between 4 and 18 days old compared to chicks fed a

control diet. Since, for the groups receiving the low aluminum sulfate values for average daily gain, skeletal growth and the plasma concentration of growth hormone, insuline-like growth factor 1 (IGF1) were increased compared to corresponding controls. On the other hand, Mushtaq *et al.* (2007) found that dietary sodium at 0.3% significantly increased toe ash%.

Water consumption (WC):

Concerning water consumption, results in Table (5) showe significant differences (P≤0.05) among treatments due to treatments effect on WC values during all periods studied. The lowest WC values were observed for chicks fed on diet supplemented with Al2 (SO4)3 (T2) during periods (4-6, 6-8 and 10-12 wks of age). Also, for chicks fed on T3 during periods, 2-4, 8-10 and 0-12 wks of age had the lowest WC values, but chicks fed on T4 consumed more water than the other groups during all periods studied except period 2-4 wks of age. The increased water consumption due to NaCl is in close agreement with the findings of many investigators who used the same or different doses via drinking water or diets. Several authors reported that drinking water supplemented with NaCl increased (P≤0.05) broiler mass gain and water consumption (Balnave and Oliva, 1991; Balnave and Gorman, 1993 and Deyhim and Teeter, 1994). This may be due to the high level of NaCl which stimulates the water intake.

Litter ammonia (LA):

In general, significant differences were observed in LA values among treatments (T1, T2, T3 and T4) at all ages except at 8 wks of age (Table 6). The lowest LA values were recorded for chicks fed on T2 at all ages studied followed by T4 and T1 (control) compared with T3 which had the highest values for this trait. The overall means of LA values were significantly decreased for chicks fed on T2 compared with other treatments (T4, T1 and T3 respectively). These results are in agreement with the results of Moore *et al.* (1999) who studied the effects of aluminum sulphate on ammonia volatilization and phosphor run off from poultry litter. They confirmed that Al2 (SO4)3 was one of the most effective (and cost effective) compounds for reducing NH3 volatilization. The ammonia volatilization rates were reduced by 97% for the first 4 wk of the grow out of broiler chicks.

House humidity (HH):

Generally, results in Table (7) declare that provision of either Al2 (SO4)3 (T2) or NaCl (T3 and T4) in diets for El-Salam chicks had significantly decreased (P≤0.05) HH values at all ages except at 12 weeks of age. Also, the chicks of T2 had the lowest HH values at 4, 8 and 12 wks of age, while at 2, 6 and 10 wks of age the lowest values were recorded for chicks fed on T4.. Therefore overall mean of HH values was significantly decreased (P≤0.05) for T2, T4 and T3 compared with T1 (control). The lowest values of both LA and HH traits that had obtained with birds fed diet containing NaCl (T4) although those birds had increased water consumption but the high level of Nacl 0.5% in the diet led to increasing concentration of plasma AVT hormone (anti diuretic effect) which lead to reabsorption of the water and decreasing it in the urine. These results were agreement with the results of Carr *et al.* (1990), Balnave and Oliva (1991) and Balnave and Gorman (1993), Braun and Dantzler (2005) and Arad and Skadheyge (2005) who confirmed these reports.

Litter pH (LpH):

Data of LpH for the various treatments are shown in Table (8). Results obtained showed that the differences in LpH values among treatments were significant (P≤0.05) along the experimental period. Whereas the chicks fed on T1 (control) had the highest LpH values. Also, chicks fed on T3 showed lower values (P≤0.05) of LpH compared with T1(control) at all ages studied except at 2 and 12 wks of age, The overall means of LpH values were significantly

decreased (P≤0.05) for chicks fed on T2 compared with other treatments. These results are agreement with the results of Moore *et al.* (1999) who found that aluminum additions to poultry litter lowered litter pH trait particularly during the first 3 to 4 wk of age, which resulted in less NH3 volatilization and lower atmospheric NH3. Moreover, there is no doubt that AVT is the major antidurtetic hormone in birds; the mechanism by which AVT affects kidney function includes decreasing the kidney glomerular filtration rate (Sturkie 1986).

Blood plasma constituents:

a-Plasma sodium concentration (PNaC):

Results presented in Table (9), show that the highest concentration of PNaC values was observed in chicks fed on T4 followed by those fed on T3, T1(control) and T2, respectively at 12 wks of age. The differences in this respect were significant (P≤0.05) between the chicks of T4 and T2 groups. These results agree with those reported by Arad and Skadhauge (1986) and Roberts (1992) who concluded in the domestic fowl that plasma sodium and chloride concentrations were significantly higher in the high-levels NaCl diets. Also, El-Deek *et al.* (2009) reported that addition of NaCl to the diet induced a slight increase in the percentage of sodium and magnesium content in liver. While, calcium content was significantly increased (P≤0.05) with increasing NaCl supplementation compared with those fed un-supplemented diet.

b- Plasma aluminum concentration (PAlC):

Plasma aluminum concentration showed significant differences (P≤0.05) among treatments at 12 wks old (Table 9). However, PAlC values was significantly increased (P≤0.05) by chicks fed diet containing Al2 (SO4)3 (T2) compared with the other treatments. The differences among chicks fed either a control diet (T1), T3 or T4 were not significant at the same age. The increased PAlC values in the chicks fed diet containing 0.03% Al2 (SO4)3 is in close agreement with the findings of many investigators who used those salts alone or in combination with similar or different doses (Capdevielle and Scanes, 1995; Capdevielle *et al.*, 1996 and Orihela *et al.*, 2005). However, the slight differences among birds fed a control diet or containing NaCl at levels (2 or 5g/kg) may be attributed to the difference in Al regulation and absorption among these treatments.

c- Plasma aldosteron hormone (AldoH):

Significant increases (P≤0.05) have been recorded in AldoH values of chicks received Al2 (SO4)3 (T2) compared with the other treatments at 12 wks of age (Table 9). Chicks fed on 0.5% NaCl (T4) showed significantly higher (P≤0.05) AldoH level than T1 chicks (control), but the chicks significantly differed from T3 ones. Also, insignificant difference was found between T1 and T3 groups. These results are in agreement with the previous reports of Capdevielle *et al.* (1996) who reported that circulating concentrations of AldoH values were increased in the chicks received either the high dose of aluminum or the acid relative to chicks fed control diet and the increase in plasma AldoH values may be appears to be specific to the metabolic acidosis created by Al or acid. The results with respect to the birds fed diet containing sodium chloride at levels (5 or 2g/kg) respectively are in full agreement with those reported by Maie *et al.* (1992). They reported that plasma aldosterone increased significantly (P<0.01) in broilers maintained on salt higher than 1g/liter. On the other hand, Arad and Skadhauge (1986) concluded that plasma osmotic constituents and arginine vasotocin hormone (AVT) concentration were significantly higher in the high NaCl adapted group.

d- Plasma insulin-like growth factor 1 (IGF1):

Data presented in Table (9) showed that using Al2 (SO4)3 (T2) had significantly

increased (P≤0.05) plasma (IGF1) values compared to those fed on T1 (control) or T3 and T4, respectively. It is of interest to note that these findings indicated that the increase in LBW values was associated with the increase of the level of IGF1. These results are in agreement with the previous reports of Capdevielle and Scanes (1995) who found that feeding a heavy broiler strain on low concentrations of aluminum sulfate resulted in increase the plasma concentrations of growth hormone and insulin-like growth factor 1 (IGF1) when compared to their counterparts of unsupplemented control group.

In conclusion the results of the present study indicated that sodium or aluminum salts supplementation to diet during the growth period from one day of age to 12 wks were adequate to optimum growth performance and had a beneficial effect on some physiological parameters that were measured.

Table 1. Effect of sodium or aluminum salts supplementation on live body weight (g) (LBW) of El- Salam chicks at different ages [1].

Treatments	Age (wk)						
	0	2	4	6	8	10	12
T1	34.01	124.18 [b,2]	307.92	556.59	789.22 [b]	1092.19 [b]	1278.13 [b]
T2	33.99	139.16 [a]	310.04	593.98	849.49 [a]	1159.50 [a]	1339.49 [a]
T3	34.30	135.11 [a]	306.81	589.39	839.75 [a]	1152.11 [a]	1337.36 [a]
T4	33.91	137.85 [a]	307.01	574.10	833.59 [a]	1139.34 [a]	1320.28 [a]
SEM	±0.238	±2.877	±6.627	±14.815	±15.984	±17.190	±18.786

[1] Data expressed as LSM ± S.E

[2] a, b.... Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 2. Effect of sodium or aluminum salts supplementation on body weight gain (BWG) (g) of El- Salam chicks during different periods of age [1].

Treatments	Age (wk)						
	0-2	2-4	4-6	6-8	8-10	10-12	0-12
T1	90.17	183.74	248.67 b,2	232.63	302.97	185.94	1244.12 b
T2	105.17	170.88	283.94a	255.51	310.01	179.99	1305.50 a
T3	100.81	171.70	282.58 a	250.36	312.36	185.25	1303.06 a
T4	103.94	169.16	267.09 ab	259.49	305.75	180.94	1286.37 a
SEM	±3.984	±7.531	±11.824	±9.469	±9.942	±8.746	±19.009

[1] Data expressed as LSM ± S.E

[2] a, b.... Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 3. Effect of sodium or aluminum salts supplementation on feed consumption (FC, g/bird/2 weeks) and feed conversion ratio (FCR, g feed/g weight gain) of El-Salam chicks during different periods of age [1].

Traits	Treatments	Age (wk)						
		0-2	2-4	4-6	6-8	8-10	10-12	0-12
FC (g)	T1	314.00[b,2]	593.77[ab]	874.18[b]	961.75[a]	1341.78[a]	1430.76[a]	5516.24[a]
	T2	312.87[b]	587.11[b]	848.64[bc]	880.66[b]	1196.19[c]	1290.08[b]	5115.55[b]
	T3	353.35[a]	663.37[a]	903.37[a]	906.31[b]	1266.47[b]	1452.40[a]	5545.27[a]
	T4	327.76[ab]	640.08[a]	929.77[a]	930.89[ab]	1297.19[ab]	1424.92[a]	5550.61[a]
	SEM	±10.612	±25.434	±57.273	±48.279	±65.178	±75.641	122.983
FCR	T1	3.48[a]	3.23[c]	3.52[a]	4.13[a]	4.43[a]	7.69[a]	4.43[a]
	T2	2.97[c]	3.44[b]	2.99[c]	3.45[c]	3.86[d]	7.17[b]	3.92[b]
	T3	3.51[a]	3.86[a]	3.20[b]	3.62[b]	4.05[c]	7.84[a]	4.26[a]
	T4	3.15[b]	3.78[a]	3.48[a]	3.59[b]	4.24[b]	7.88[a]	4.31[a]
	SEM	±0.192	±0.188	±0.174	±0.157	±0.195	±0.312	±0.151

[1] Data expressed as LSM ± S.E

[2] a, b.... Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 4. Effect of sodium or aluminum salts supplementation on lengths of keel (LK) and Shank (LS) (cm) at 4, 8 and 12 weeks of age of El-Salam chicks [1].

Treatments	Keel length (cm)			Shank length (cm)		
	4 wk	8 wk	12 wk	4 wk	8 wk	12 wk
T1	4.49[bc, 2]	6.38[b]	8.08[ab]	5.05[b]	7.12[bc]	8.23[b]
T2	5.02[a]	7.00[a]	8.54[a]	5.33[a]	7.50[a]	9.00[a]
T3	4.36[c]	6.36[b]	7.96[b]	5.04[b]	6.99[c]	8.14[b]
T4	4.60[b]	6.38[b]	8.24[ab]	5.18[ab]	7.23[b]	8.46[ab]
SEM	±0.064	±0.126	±0.164	±0.075	±0.071	±0.215

[1] Data expressed as LSM ± S.E

[2] a, b.... Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 5. Effect of sodium or aluminum salts supplementation on water consumption (WC) (cm/bird/day) of El- Salam chicks during different periods of age [1].

Treatments	Age (wk)						
	0-2	2-4	4-6	6-8	8-10	10-12	0-12
T1	33.02[c, 2]	68.74[bc]	94.02[a]	106.94	126.00[ab]	151.37[ab]	580.09[b]
T2	34.82[b]	79.73[a]	89.38[b]	102.54	129.00[a]	137.12[b]	572.59[b]
T3	35.33[b]	65.21[c]	92.74[ab]	105.79	119.44[b]	151.15[ab]	569.66[b]
T4	39.17[a]	72.34[b]	96.00[a]	113.84[a]	129.05[a]	160.51[a]	610.91[a]
SEM	±3.896	±5.277	±8.757	±10.186	±11.158	±13.133	20.000

[1] Data expressed as LSM ± S.E

[2] a, b.... Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 6. Effect of sodium or aluminum salts supplementation on litter ammonia (LA) (ppm) of El- Salam chicks at different ages [1].

Treatments	Age (wk)						
	2	4	6	8	10	12	Overall mean
T1	33.13^{a,2}	33.00^{ab}	28.73^{ab}	28.03	33.13^{a}	31.24^{ab}	31.21^{b}
T2	23.89^{b}	28.60^{b}	22.57^{b}	24.77	26.84^{b}	26.71^{b}	25.56^{d}
T3	33.31^{a}	35.20^{a}	31.99^{a}	30.49	35.64^{a}	32.88^{a}	33.25^{a}
T4	29.35^{ab}	30.05^{b}	27.15^{ab}	27.72	31.55^{ab}	28.60^{ab}	29.07^{c}
SEM	±0.57	±0.61	±0.55	±0.69	±0.63	±0.67	0.738

[1] Data expressed as LSM ± S.E

[2 a, b....] Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 7. Effect of sodium or aluminum salts supplementation on house humidity (HH%) of El- Salam chicks at different ages [1].

Treatments	Age (wk)						
	2	4	6	8	10	12	Overall mean
T1	59.05^{a,2}	67.37^{a}	57.87^{a}	56.96^{a}	53.43^{a}	38.04	55.45^{a}
T2	44.61^{b}	32.53^{d}	43.66^{b}	42.60^{b}	40.89^{b}	34.50	39.80^{c}
T3	47.73^{b}	53.09^{b}	47.12^{b}	55.86^{a}	47.58^{b}	38.57	48.33^{b}
T4	35.50^{c}	45.03^{c}	34.47^{c}	47.69^{ab}	38.16^{b}	39.25	40.02^{c}
SEM	±3.01	±2.32	±2.24	±3.56	±3.15	±3.09	0.768

[1] Data expressed as LSM ± S.E

[2 a, b....] Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 8. Effect of sodium or aluminum salts supplementation on litter pH (L pH)(degree) of El- Salam chicks at different ages [1].

Treatments	Age (wk)						
	2	4	6	8	10	12	Overall mean
T1	6.67^{b,2}	7.50^{b}	7.27^{a}	6.93^{a}	8.10^{a}	7.10^{a}	7.26^{a}
T2	5.43^{c}	5.50^{d}	5.17^{d}	4.37^{d}	5.17^{d}	5.47^{c}	5.19^{b}
T3	7.53^{a}	6.83^{c}	6.13^{c}	6.63^{c}	7.53^{b}	7.07^{a}	6.95^{a}
T4	7.57^{a}	8.00^{a}	6.53^{b}	6.30^{b}	6.10^{c}	6.50^{b}	6.83^{a}
SEM	±0.49	±0.33	±0.49	±0.41	±0.39	±0.39	0.794

[1] Data expressed as LSM ± S.E

[2 a, b....] Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

Table 9. Effect of sodium or aluminum salts supplementation on blood plasma Sodium (PNaC), aluminum(PAlC), and hormones of aldosterone (AldoH) and Insulin-like growth factor-1 (IGF-1) at 12 weeks of age of El- Salam chicks [1].

Treatments	Na (mmol/l)	Al (mg/dl)	AldoH (ng/ml)	IGF-1 (ng/ml)
T1	148.48 [ab, 2]	0.104 [b]	3.95 [c]	46.75 [b]
T2	133.68 [b]	0.159 [a]	6.28 [a]	57.50 [a]
T3	153.04 [ab]	0.128 [b]	4.75 [bc]	41.88 [b]
T4	176.24 [a]	0.118 [b]	5.14 [b]	46.75 [b]
SEM	±9.448	±0.018	±0.282	±1.492

[1] Data expressed as LSM ± S.E

[2 a, b,...] Means with different superscripts within column are significantly different (P≤0.05).

T1:Control 0.3% NaCl T2:Control + 0.03% Al2 (SO4)3 T3:0.2% NaCl T4: 0.5% NaCl

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الملخص العربى

دور كل من أملاح الصوديوم أو الألومنيوم فى تحسين الأداء الانتاجى وبعض الصفات الفسيولوجية فى الدجاج المحلى

١- خلال فترة النمو

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معهد بحوث الانتاج الحيوانى – مركز البحوث الزراعية – الدقى - الجيزة

أجريت هذه الدراسة فى محطة بحوث الانتاج الحيوانى بسخا – كفر الشيخ – معهد بحوث الانتاج الحيوانى وذلك بهدف دراسة تأثير كل من أملاح الصوديوم أو الألومنيوم على كل من الأداء الانتاجى وبعض الصفات الفسيولوجية فى الدجاج خلال فترة النمو (من عمر يوم حتى عمر ١٢ أسبوع). واستخدم فى هذه الدراسة عدد ٣٠٠ كتكوت غير مجنس من سلالة السلام وقسمت عشوائيا الى أربع مجموعات متساوية العدد (٧٥ كتكوت / مجموعة) وكل مجموعة تم تقسيمها الى ثلاث مكررات متساوية العدد (٢٥ كتكوت/مكررة) وتم تغذية المجموعات الأربع كالتالى:

١- المجموعة الأولى:- تم تغذيتها على العليقة الأساسية (كنترول) وتحتوى على ٣و % كلوريد صوديوم.

٢- المجموعة الثانية :- تم تغذيتها على العليقة الأساسية مضاف اليها ٠٣و % كبريتات الألومنيوم.

٣- المجموعة الثالثة:- تم تغذيتها على عليقة تحتوى على ٢و % كلوريد صوديوم.

٤- المجموعة الرابعة:- تم تغذيتها على عليقة تحتوى على ٥و % كلوريد صوديوم.

وتتلخص أهم النتائج المتحصل عليها فيما يلى:

- سجلت المجموعة الثانية والتى تغذت على العليقة الأساسية مضاف اليها ٠٣و % كبريتات الألومنيوم سجلت زيادة فى وزن الجسم والوزن المكتسب وتحسن فى معامل التحويل الغذائى وزيادة فى طول كل من عظمتى القص والساق وانخفاض فى استهلاك العلف وأيضا انخفاض فى نسب كل من الأمونيا ، الرطوبة وتركيز أيون الأيدروجين فى الفرشة مقارنة بالمجاميع التجريبية الأخرى.
- وجد أن المجموعة الرابعة والمغذاه على عليقة تحتوى على ٥و % كلوريد صوديوم أستهلكت ماء أعلى عن المجاميع الأخرى.
- وجد أن زيادة مستوى الصوديوم فى العليقة الى ٥و % (المجموعة الرابعة) أدى الى زيادة تركيز الصوديوم فى الدم ، بينما تغذية الطيور على العليقة الأساسية مضاف اليها كبريتات الألومنيوم (المجموعة الثانية) أدى الى زيادة تركيز كل من الألومنيوم وهرمونى الألدوستيرون وهرمون النمو المشابه للأنسولين فى الدم مقارنة بالمجموعات الأخرى.

من هذه النتائج يتضح لنا أن كل من أملاح الصوديوم أو الألومنيوم فى عليقة الدجاج خلال فترة النمو (من عمر يوم حتى عمر ١٢ أسبوع) أدى الى تحسين الأداء الانتاجى وأظهر تأثيرا ايجابيا على بعض الاستجابات الفسيولوجية فى كتاكيت سلالة السلام.