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Effect of High Levels of Dietary Salt on Growth Performance, Livability and Carcass Composition of Broilers

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ABSTRACT. This experiment was conducted to investigate the effects of adding high salt levels (2 and 2.4% salt) to starter and finisher diets (0.35% salt) on performance, livability and carcass composition of Hybro and Hypeco broiler chickens.

Results of this experiment revealed that body weights were not significantly affected by dietary salt level. Feed intake was significantly ($p \geq .05$) reduced as the dietary salt level was increased, whereas water intake increased almost linearly with the level of dietary salt. Feed: gain ratio of chickens fed the high salt diets (2 and 2.4% salt) were significantly ($p \geq .05$) better than those fed the 0.35% diet. Water: feed ratio was also higher, whereas livability was lower ($p \geq .05$) in chickens on the high salt diets.

Abdominal fat / body weight and carcass composition were not affected by treatment except for the 6 wk carcass ash which was significantly ($p \geq .05$) higher for the 2.4% salt group. Strain had a highly significant ($p \leq .01$) effect on abdominal fat/body weight and carcass fat.

Young chicks up to 4 wk of age were apparently more susceptible to toxic effects of salt than older birds, as shown by livability record.

Interest in the biological effect of NaCl (Salt) is high because of its value as a source of indispensable nutrients for all animals. The broiler requirement for sodium and chlorine is 0.15% each, equivalent to 0.38% sodium chloride or common salt (NRC 1984). However, the optimal NaCl requirement is still controversial. According to Britton (1990) the sodium and chlorine requirements of the chick for maximum growth is at least 0.45% of the diet. These levels of three times those suggested by

NRC (1984) would agree with the findings of Edwards (1984). Sibbald *et al.* (1962) reported that salt levels of 0.25 to 2% in the feed allowed satisfactory performance when considering body weight, feed efficiency and mortality. According to Damron and Johnson (1985) the mean broiler body weight associated with 1.5% NaCl was significantly higher than 0.50% level. These authors concluded that daily feed intake was significantly increased with the addition of dietary NaCl. Bedford *et al.* (1991) noted that daily feed intake was significantly affected with the addition of dietary salt.

Growth was superior in chicks fed diets supplemented with 1% and 1.5% salt compared with those receiving 0 and 0.5% salt (Barlow *et al.* 1948). Selye (1943) and Peterson (1945) noted that 2% NaCl in solution was highly toxic whereas the same level in feed resulted only in wet litter. Sherwood and Marion (1975) identified strain differences in hen's sensitivity to both deficiency or excess salt in the feed. Kare and Biely (1948) noted individual bird differences in tolerance for high NaCl. For some, 3.18% salt in the diet was fatal; for others, it was harmless. Paver *et al.* (1953) reported that the response of newly-hatched chicks to salt in the feed is widely variable. Clinical signs of toxicity were found to include muscular weakness, diarrhea, nervous disorders, cardiac hypertrophy and congested kidneys (Doll *et al.* 1946, Paver *et al.* 1953).

The National Academy of Science (1980) has suggested a maximum tolerable dietary NaCl level of 2% for poultry and stated the major factor influencing toxicosis is the availability of drinking water. Maurice and Deodato (1982), Marks and Washburn (1983) and Lightsey *et al.* (1983) observed a linear decrease in abdominal fat in broilers as supplemental salt was increased. These results suggest that high water: feed ratios may be associated with reduced abdominal fat.

This study was designed to investigate water intake and water: feed ratio patterns as influenced by high dietary salt and its effect on performance, abdominal fat and carcass composition of two commercial broiler strains.

Materials and Methods

An experiment was conducted using Hybro and Hypeco broiler chickens. On day of hatch 108 non-sexed chicks from each strain were wing banded, individually weighed and randomly allotted to 9 electrically heated battery pens representing 3 experimental groups each of 3 pens and each pen was considered as a replicate.

The basal diets (control) for the experiment consisted of a starter mash diet containing 22% crude protein and providing 3146 Kcal ME/kg for the first 4 wk and a finisher diet containing 20% protein and providing 3190 Kcal ME/kg for the remaining 3 wk (Table 1). The calculated sodium chloride content of the basal diet was equivalent to 0.35% salt. Chickens were reared under continuous lighting regimen and received water and feed ad libitum. The tap water supplied was low in minerals. Sodium and chlorine, in water, were present at 54 and 50 ppm, respectively. Feed grade salt was used as a stimulus for increasing water consumption.

The batteries were in a fan ventilated room. Maximum and minimum room temperature ranged from 22-31 °C. The different experimental groups were randomly assigned to one of the following dietary treatments: Treatment 1) fed the basal starter and finisher diets containing 0.35% salt and was considered as 0.35 NaCl control diets (0.35% diet), treatment 2) was fed starter and finisher diets to which salt was added to contain 2% salt (2% diet), and treatment 3) fed starter and finisher diets containing 2.4% salt (2.4% diet). Water intake (WI) data was measured daily from 0-49 days of age. For estimation of evaporative water losses, two waterers were placed in locations inaccessible to the birds.

Individual body weights (BW) and feed intake (FI) by pen were measured weekly. Weight gain (WG), feed: gain ratio (F : G), and water : feed ratio (W : F) were determined. Water : feed ratio data were calculated by dividing the mean water consumption (grams water intake / pen/ bird) by the mean feed intake / pen / bird.

At 6 wk of age 12 chickens / treatment / strain were randomly selected for carcass composition study. Feed was withdrawn from these chickens over night before processing. Each bird was slaughtered, eviscerated manually and sex was confirmed by organ examination. Abdominal fat (AF) was excised and weighed. AF was the fat surrounding the gizzard and extending within the ischium and surrounding the bursa of fabricus, cloaca and adjacent abdominal fat muscles. Abdominal fat weights were expressed as percentage of live body weight (AF/BW), Carcass weight (CW) was defined as the weight of the fresh-dressed carcass without the neck, giblets and abdominal fat.

From the slaughtered chickens, 8 carcasses (4 males and 4 females) / treatment / strain were used for body composition analysis. Carcasses were individually double ground in a meat grinder to obtain a homogenous mixture. Samples of 250 g from each mince were dried in a forced draught oven at 70 °C. Forty gram samples thoroughly mixed were analyzed for fat by Soxhelt extration for 20 h using diethyl ether. Moisture was determined at 105 °C for 20 h (AOAC 1984). The kjeldahl procedure (AOAC 1984) was applied to duplicate carcass samples to obtain protein and ash content.

At 7 wk of age, another samples of 12 chickens (males and females) / treatment / strain was sacrificed for similar measurements. Data were subjected to statistical analysis using SAS general linear model procedure, King Saud computer center, according to the following model:

$$Y_{ijkl} = \mu + T_i + B_j + S_k + (TB)_{ij} + (TS)_{ik} + (BS)_{jk} + (TBS)_{ijk} + e_{ijkl}$$

Where the Y_{ijkl} is the l^{th} observation of the i^{th} treatment, j^{th} breed and k^{th} sex. μ is the general mean, T_i is the effect of the i^{th} treatment, B_j is the effect of j^{th} breed, S_k is the effect of the k^{th} sex, TB_{ij} is the interaction of the i^{th} treatment with the j^{th} breed, TS_{ik} is the interaction of the i^{th} treatment with the k^{th} sex, BS_{jk} is the interaction of the j^{th} breed with the k^{th} sex, TBS_{ijk} is the interaction of the i^{th} treatment with the j^{th} breed and the k^{th} sex and e_{ijkl} is the random error.

Results and Discussion

Body weight:

Mean body weights were not significantly affected by the level of added salt for all observation periods (Table 2). Similar results have been obtained by Sibbald *et al.* (1962) and Barlow *et al.* (1948). The present results suggest that the 2% and 2.4% salt diets had no adverse effect on body weights during the entire experimental period. Similarly Marks and Washburn (1983) reported that body weights of males receiving high salt diets (1.6 and 2.4%) at 49 days of age were similar to body weights of males receiving 0.4% salt diet. However, males of another line of broilers fed high salt diets (1.6 and 2.4%) had lower 49-day body weights than did birds fed the 0.4% diet. According to Damron and Johnson (1985), addition of sodium chloride at level of 1.25% or above resulted in superior body weights over those receiving lower levels in one experiment. However, in a second experiment weights increased through the 1% level of sodium chloride supplementation, but increases did not occur above that. Treatment x strain interactions were not significant.

Weight gain :

Mean body weight gains were not significantly ($p \leq .05$) different between treatments (Table 2). The Hybro chickens had significantly ($p \leq .05$) higher body

Table 1. Composition of the basal diets[1] fed broiler chickens from 0-7 weeks of age.

Ingredient	Starter diet	Finisher diet
	%	%
Ground corn	20.00	20.00
Soyabean meal (48% CP)	25.00	18.00
Fish meal	4.00	3.50
Bran meal	4.00	0.00
Ground wheat	37.58	48.74
Wheat flour	4.50	0.00
Wheat mill run	0.00	3.00
Fat	2.20	3.60
Limestone	0.90	1.50
Broiler permix[1,2]	0.60	0.50
DL-Methionine	0.20	0.10
Dicalcium phosphate	0.50	0.80
NaCl	0.20	0.20
Coyden (meticlorpindol)[3]	0.50	0.00
Avatec (Lesalocid Sodium)[4]	0.00	0.06
Total	100.00	100.00
Calculated analysis		
Protein %	22.00	20.00
Fat %	5.30	5.30
Fiber %	3.00	3.00
Ca %	0.90	0.90
P %	0.70	0.62
NaCl %	0.35	0.35
ME Kcal/Kg	3146	3190
Determined analysis %		
Moisture %	5.67	5.45
Protein %	23.01	21.99
Fat %	4.50	4.13
Fiber %	3.56	3.09
Ash %	6.20	5.78
Ca %	1.03	1.00
P %	0.69	0.66
Na %	0.14	0.14
Cl %	0.21	0.21

[1] Manufactured by Grain Silos and Flour Mills Organization, Riyadh.

[2] Provided the following per kilogram of the diet: vitamin A, 18,000 IU; vitamin D_3, 7,200 ICU; vitamin E, 30 mg; vitamin C, 120 mg; vitamin K 3, 6 mg; thiamin, 3 mg; riboflavin, 15 mg; pyridoxine, 6 mg; vitamin B_{12}, 0.018 mg; niacin, 42 mg; pantothenic acid, 18 mg; folic acid, 2.4 mg; biotin, 0.24 mg; choline, 600 mg; copper, 18 mg; iron, 60 mg; manganese, 120 mg; zinc, 72 mg; cobalt, 0.6 mg; iodine, 1.2 mg; selenium, 0.24 mg.

[3,4] Coccidiostats.

Table 2. Least squares means for body weight gain, feed intake and feed: gain ratio of non-sexed Hybro and Hypeco broiler chickens fed diets with increasing level salt (NaCl).

	Body weight (g)			Body weight gain (g)			Feed intake (g)			Feed: gain ratio		
	week			week			week			week		
	4	6	7	0-4	0-6	0-7	0-4	0-6	0-7	0-4	0-6	0-7
Treatment (T)	NS	NS	NS	NS	NS	NS	**	**	**	**	**	NS
0.35% salt[1]	822	1506	1838	781	1465	1769	1302^{a}	2930^{a}	3878^{a}	1.69^{a}	2.04^{a}	2.21
2% salt	851	1551	1923	810	1509	1882	1263^{b}	2852^{b}	3869^{a}	1.59^{b}	1.91^{b}	2.09
2.4 salt	822	1536	1837	795	1494	1796	1229^{c}	2765^{c}	3696^{b}	1.58^{b}	1.87^{b}	2.09
Strain (B)	**	*	**	**	*	**	**	**	**	NS	NS	NS
Hybro (HB)	859^{a}	1558^{a}	1925^{a}	818^{a}	1516^{a}	1883^{a}	1314^{a}	2923^{a}	3972^{a}	1.64	1.96	2.16
Hypeco (HP)	814^{b}	1504^{b}	1807^{b}	773^{b}	1463^{b}	1766^{b}	1216^{b}	2774^{b}	3657^{b}	1.60	1.92	2.10
SEM	± 7.90	± 13.67	± 22.19	± 4.05	± 13.65	± 22.14	± 3.17	± 4.26	±10.02	±0.02	±0.02	±0.03
T x B[2]	NS	NS	NS	NS	NS	NS	**	**	**	NS	NS	NS
HB x 0.35%							1377^{a}	3062^{a}	4134^{a}			
HP x 0.35%							1226^{d}	2798^{b}	3623^{b}			
HB x 2%							1299^{b}	2899^{c}	4011^{c}			
HP x 2%							1227^{d}	2805^{b}	3728^{d}			
HB x 2.4%							1265^{c}	2809^{b}	3771^{b}			
HP x 2.4%							1194^{e}	2720^{d}	3621^{b}			

[a-e] Within a given factor, means in a column followed by different letters are significantly different ($p \leq 05$).

[1] 0.35% salt = starter and finisher diets containing 0.35% salt, 2% salt = starter and finisher diets containing 2% salt, 2.4% salt = starter and finisher diets containing, 2.4% salt.

NS = Not significant.

[2] Least squares means are presented only when interactions are significant.

** ($p \leq 0.01$); * ($p \leq 0.05$).

weight gains than those of Hypeco chickens. Treatment x strain interactions were not significant.

Feed intake :

Treatment had a highly significant ($p \leq .01$) effect on feed intake at all periods (Table 2). The controls (0.35%) showed the highest ($p \leq .05$) values followed in a descending order by the 2 and 2.4% salt treatments. The only exception was the group of chickens fed the 2% salt diet which was not significantly ($p \leq .05$) different from the controls (0.35%) during the 0-7 wk period. The data showed a decrease in total feed consumption as the added salt of the diets was increased. Similarly, Heuser (1952), Quigley and Waite (1932) indicated that feed consumption decreased as the salt content of the diet was increased. In contrast, Damron and Johnson (1985) found that feed intake was significantly increased with the addition of dietary sodium chloride. Feed intake of Hybro was significantly ($p \leq 0.5$) higher than that of Hypeco chickens.

Treatment x strain interactions for feed intake were highly significant ($p \leq .01$) at all periods. In all treatments, feed intake was significantly ($p \leq .05$) higher in Hybro than in Hypeco chickens. The dissimilarity in the feed intake patterns between Hybro and Hypeco chickens indicates a possible strain difference in response to elevated dietary salt. Barlow *et al.* (1948) noted that feed intake appears to be unrelated to the quantity of salt in the diet. This is contrary to the findings of Damron and Johnson (1985) who reported that feed intake was significantly increased with the addition of sodium chloride.

Feed : gain ratio :

Treatment had a highly significant ($p \leq 0.01$) effect on feed: gain ratio during the 0-4 and 0-6 wk period (Table 2). Results suggest that feed: gain ratio is inversely related to salt intake. In line with these results, Marks and Washburn (1983) noted that feed efficiency, from 0-4 day of bird receiving 1.6% salt diet was significantly superior to the feed efficiency of birds receiving 0.4 and 0.8% salt diets. Similarly, Dilworth *et al.* (1970) reported that high dietary salt levels from any source significantly improved feed efficieny. Strain had no effect on feed : gain ratio. Treatment x strain interactions for feed: ratio were not significant.

Water intake :

Treatment had a highly significant ($p \leq .01$) effect on water intake at all periods (Table 3). Water intake increased almost linearly with the level of salt added to the diets. This observation might demonstrate a real attempt on the part of the bird to maintain isotonicity of the body fluids. Similarly, Damron and Johnson (1985) reported that between 1 and 1.5% dietary sodium chloride, the water intake increased steadily and significantly. The tendency of chickens to increase their water consumption with the increase in dietary salt confirms the observation of the National Academy of Science (1980) that an adequate water supply would allow animals to tolerate relatively large quantities of salt.

Strain had a highly significant ($p \leq .01$) effect on water intake. Treatment x strain interactions for water intake were highly significant ($p \leq .01$) during the 0-6 wk period and significant ($p \leq .05$) from 0-7 wk period.

Water : feed ratio :

Treatment showed a highly significant ($p \leq .01$) effect on water : feed ratio at all periods (Table 3). These data show that water: feed ratios were significantly ($p \leq .05$) greater in chickens fed the high salt diets (2 and 2.4%) than those fed the 0.35% diet for both strains. Similarly, Marks and Washburn (1983) reported that the addition of 2.4% dietary salt resulted in increased water : feed ratios. However, they pointed out that high water : feed ratios were accomplished without a reduction in feed intake.

Strain had a highly significant ($p \leq .01$) effect on water : feed ratio during the 0-4 and 0-7 wk period. Hybro had significantly ($p \leq .05$) higher water : feed ratios compared with the Hypeco chickens. Water : feed ratios for both strains of chickens increased with the increase in dietary salt.

Livability :

Both groups of chickens fed the high salt diets (2 and 2.4%) had signifiicantly ($p \geq .05$) lower livability than that of the controls 0.35% at the different age periods (Table 3). The present data suggest that high salt diets adversely affected the livability of broiler chickens. Percent livability of Hypeco was significantly ($p \geq .05$) less than that of the Hybro ckickens. The lower livability of chickens fed the high salt diets could outweigh any benefits resulting from high salt diets. Young chicks up to 4-wk of age were apparently more susceptible to toxic effects of salt than older birds.

Body characteristics :

Least squares means for body characteristics of male and female Hybro and Hypeco chickens slaughtered at 6 and 7 wk of age are shown in Table 4. Treatment had no significant effect on body and carcass weights. This is in agreement with Barlow *et al.* (1948) who reported that levels of 2 or 3% added salt resulted in growth which was neither better nor worse than 1% level. According to Marks

Table 3. Least squares means for water intake: feed ratio and livability for non-sexed Hybro and Hypeco broiler chickens fed diets with increasing level salt (NaCl).

	Water intake (g)			Feed intake (g)			Feed: grain ratio		
	week			week			week		
	0-4	0-6	0-7	0-4	0-6	0-7	0-4	0-6	0-7
Treatment (T)	**	**	**	**	**	**	**	**	**
0.35% salt[1]	2552[a]	6172[a]	8213[a]	1.96[a]	2.11[a]	2.12[a]	94[a]	94[a]	94[a]
2% salt	3709[b]	8582[b]	11807[b]	2.93[b]	3.00[b]	3.05[b]	82[b]	79[b]	79[b]
2.4% salt	4007[c]	9245[c]	12497[c]	3.26[c]	3.35[c]	3.39[c]	81[b]	75[b]	75[b]
Strain (B)	**	**	**	**	NS	**	**	**	**
Hybro (HB)	3574[a]	8210[a]	11431[a]	2.74[a]	2.83	2.90[a]	93[a]	90[a]	90[a]
Hypeco (HP)	3271[b]	7789[b]	10246[b]	2.69[b]	2.81	2.80[b]	79[b]	76[b]	76[b]
SEM	±10.48	±20.07	±41.06	±0.006	±0.006	±0.009	±2.23	±2.43	±2.43
T x B[2]	NS	**	*	*	NS	**	NS	NS	NS
HB x 0.35%		6465[a]	8781[a]	1.97[a]		2.12[a]			
HP x 0.35%		5880[b]	7644[b]	1.95[b]		2.11[a]			
HB x 2%		8788[c]	12545[c]	2.98[c]		3.13[b]			
HP x 2%		8374[d]	11068[d]	2.88[d]		2.97[c]			
HB x 2.4%		9377[e]	12968[e]	3.27[e]		3.44[d]			
HP x 2.4%		9113[f]	12026[f]	3.26[e]		3.34[e]			

[a-f] Within a given factor, means in a column followed by different letters are significantly different ($p \leq 05$).

[1] 0.35% salt = starter and finisher diets containing 0.35% salt, 2% salt = starter and finisher diets containing 2% salt, 2.4% salt = starter and finisher diets containing, 2.4% salt.

NS = Not significant.

[2] Least squares means are presented only when interactions are significant.

** ($p \leq 0.01$); * ($p \leq 0.05$).

(1987) body weights of normal females selected under the 0.40% salt environment were greater than selected under 1.6% salt environment.

Strain had a highly significant ($p \leq .01$) effect on body and carcass weights at 7 wk of age. However, the 6-wk values were not affected by strain. The Hybro chickens had significantly ($p \leq .05$) higher values for body and carcass weights than those of Hypeco chickens. Sex showed a significant effect ($p \leq .05$) on the 6 wk body weight and a highly significant ($p \leq .01$) effect on the 7wk body weight and carcass weights at 6 and 7 wk of age. Within each age period, mean body and carcass weights were significantly ($p \leq .05$) higher in males than in females.

Abdominal fat :

Within each age period, abdominal fat percentages of the different treatments were not significantly ($p \leq .05$) different (Table 4). These findings are in contrast with the results obtained by Marks and Washburn (1983) who noted that elevated water : feed ratios induced by high dietary salt were associated with a reduction in abdominal fat. According to Lepkovsky *et al.* (1957) adipose tissue may be a depot for water just as they are for fat.

Hybro chickens had significantly ($p \leq .05$) higher abdominal fat percentage than that of Hypeco chickens. In line with these results, Farr *et al.* (1977) and Nordstrom *et al.* (1978) reported significant differences between strain crosses of broilers for abdominal fat as a percentage of body weight.

Sex had a highly significant ($p \leq .01$) effect on AF/BW at 6 and 7 wk of age. Within each age period, AF/BW for males were significantly ($p \leq .05$) lower than those of females. This is in agreement with Hood and Pym (1982). Treatment x strain interactions for all body characteristics were insignificant.

Carcass composition :

Treatment showed no significant effect on crude protein, fat, moisture and 7wk ash content of chicken carcasses. However, treatment had a highly significant ($p \leq .01$) effect on ash content at 6 wk of age (Table 4). In contrast to these observations, Marks and Washburn (1983) reported that birds fed the 2.4% salt diet had significantly ($p \leq .05$) less carcass lipids than birds fed the 0.40% salt diets.

Strain had no significant effect on crude protein and moisture contents (Table 4). However, strain had a highly significant ($p \leq .01$) effect on fat content of chicken carcasses at 6 and 7 wk of age. Hybro had significantly ($p \leq .05$) higher carcass fat than that of Hypeco chickens. Within each age period, carcass protein and moisture

Table 4. Least squares means for body characteristics carcass composition[1] of male and female Hybro and Hypico broilers chickens slaughtered at 6 and 7 weeks of age and fed diets with increasing levels of salt (NaCl).

	Body weight		Carcass weight		AF/BW[2]		Crude protein		Fat[3]		Moisture		Ash	
Weeks	6	7	6	7	6	7	6	7	6	7	6	7	6	7
	(g)		(g)		(%)		(%)		(%)		(%)		(%)	
Treatment (T)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	NS
0.35% salt[4]	1585	1898	1069	1329	1.34	1.86	49.80	48.17	41.45	42.99	68.98	67.25	8.75[a]	8.84
2% salt	1547	1891	1025	1314	1.37	1.86	50.69	48.96	40.35	42.85	68.78	67.80	8.96[a]	8.19
2.4% salt	1585	1891	1075	1296	1.33	1.63	52.65	50.35	36.30	40.94	69.70	68.12	11.05[b]	8.72
Strain (B)	NS	**	NS	**	NS	**	NS	NS	**	**	NS	NS	**	*
Hybro (HB)	1573	1990[a]	1062	1393[a]	1.41	2.00[a]	52.45	48.15	36.88[a]	44.13[a]	69.75	67.15	10.66[a]	7.72[a]
Hypeco (HP)	1572	1796[b]	1051	1233[b]	1.29	1.57[b]	49.64	50.17	41.85[b]	40.38[b]	68.56	67.94	8.51[b]	9.44[b]
Sex (S)	*	**	**	**	**	**	**	*	NS	NS	**	**	NS	NS
Male (M)	1612[a]	1986[a]	1099[a]	1377[a]	1.13[a]	1.40[a]	53.31[a]	50.30[a]	37.02	40.96	70.13[a]	68.38[a]	9.66	8.74
Female (F)	1533[b]	1800[b]	1013[b]	1249[b]	1.56[b]	2.18[b]	48.78[b]	48.02[b]	41.71	43.56	68.18[b]	67.07[b]	9.51	8.42
SEM	±19.2	±21.5	±14.1	±14.6	±0.04	±0.06	±1.05	±0.47	±1.22	±0.64	±0.34	±0.20	±0.25	±0.31
T x B[4]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	*
HB x 0.35%													8.08[a]	6.94[a]
HP x 0.35%													8.70[a]	10.74[b]
HB x 2%													9.61[a]	7.64[a]
HP x 2%													8.32[a]	8.73[ab]
HB x 2.4%													13.58[b]	8.59[a]
HP x 2.4%													8.52[a]	8.85[ab]
T x S													NS	NS
B x S														
T x B x S														

[a-b] Within a given factor, means in a column followed by different letters are significantly different ($p \leq .05$).

[1] Dry matter basis.

[2] AF/BW = Abdominal fat/Body weight.

[3] Calculated by difference from 100%.

NS = Not significant. [4]least squares means are presented only when interactions are significant.

[5] 0.35% salt = starter and finisher diets containing 0.35% salt, 2% salt = starter and finisher diets containing 2% salt, 2.4% salt = starter and finisher diets containing, 2.4% salt. ** ($p \leq 0.01$); * ($p \leq 0.05$).

were significantly ($p \leq .05$) higher in males than in females. At 7 wk of age, males had significantly ($p \leq .05$) lower carcass fat compared with females. These observations are in agreement with Donaldson *et al.* (1956). Twining *et al.* (1978) and Becker *et al.* (1981) who found an inverse relationship between carcass fat and moisture. Treatment x strain interactions for carcass composition at 6 and 7 wk of age were nonsignificant, except for ash percentages.

The results of this study revealed that body weight, abdominal fat percentage and carcass composition were not influenced by the treatment. Increased salt level in the diet, however led to a significant reduction and increase in feed and water intake, respectively. Feed:gain ratio was significantly improved whereas livability was adversely affected, particularly in young chicks, with increased salt level.

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تأثير المستويات العالية من ملح الطعام في الغذاء على كفاءة النمو ، الحيوية وتركيب الذبيحة لكتاكيت اللحم

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أجريت هذه الدراسة لمعرفة تأثير إضافة مستويات عالية من ملح الطعام (٢ و ٤ , ٢٪) إلى عليقة البادي والناهي والتي تحتوي على مستوى ٣٥ , ٠٪ من ملح الطعام على كفاءة النمو ، الحيوية وتركيب الذبيحة لكتاكيت اللحم ، دلت النتائج على أن وزن الجسم لم يتأثر معنوياً بمستوى ملح الطعام في العليقة كذلك تشير النتائج إلى أن إستهلاك العلف إنخفض معنوياً ($p \leq .05$) كذلك ازداد استهلاك الماء لكن خطياً مع ارتفاع مستوى ملح الطعام في العليقة ، أما فيما يخص معدل تحويل الغذاء فإنه كان أعلى معنوياً ($p \leq .05$) في الطيور التي حصلت على العلائق ذات المستوى العالي من ملح الطعام (٢ و ٤ , ٢٪) منه في طيور المشاهدة والتي حصلت على العليقة العادية (٣٥ , ٠٪) حتى نهاية الأسبوع السادس ، كذلك ازداد معدل استهلاكها من الماء بالنسبة لمعدل استهلاك العلف وانخفضت الحيوية معنوياً ($p \leq .05$) بالمقارنة مع مجموعة المشاهدة ، أما فيما يخص نسبة دهن البطن وكذلك تركيب الذبيحة فإنها لم تتأثر معنوياً بالمعاملة ما عدا رماد الذبيحة حيث كان أعلى معنوياً ($p \leq .05$) عند عمر ستة أسابيع في المجموعة التي حصلت على مستوى ٤ , ٢٪ ملح طعام

في العليقة ، وتشير النتائج إلى أن السلالة لها تأثير معنوي جداً ($p \leq .01$) على نسبة دهن البطن ودهن الذبيحة ، كذلك أظهرت النتائج أن الطيور الصغيرة وحتى عمر أربعة أسابيع كانت أكثر حساسية للتأثيرات السمية لملح الطعام من الطيور الكبيرة كما هو واضح من سجل الحيوية .