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Effect of Dietary Iodine Supplementation on Productive Performance of Pekin and Domyati Ducks during Growth Period

Ali, W. A. H.[1]; Kh. A. A. Ali [1]; Amal M. Hekal[1]; Fadila M. Easa[1]; M. A. A. EL- AIK[1] and Reham A. M. Ali [2]

[1] Department of Rabbit Breeding Research, Animal Prod. Res. Inst., Agric. Res. Center, Ministry of Agric., Dokki, Giza, Egypt.

[2]Animal and Poultry production Dept., Fac. of Agric., and Natural Resources, Aswan Univ., Egypt.

ABSTRACT

A total number of Two hundred and forty , day old unsexed Pekin and Domyati ducklings (120/each breeds) at one-day old were used in the present study. The experimental period extended for 12 weeks of age. Experimental ducks were randomly divided into four equal treatments (30 Pekin or Domyati ducks each) in three equal replicates (10 ducks each). Ducks were fed diets containing Potassium iodide at levels of 0, 1, 1.5 and 2 mg iodine/kg ration for T1, T2, T3 and T4, respectively. The results showed that growing ducklings fed ration supplemented with Potassium iodide (2, 1.5 and1%) were significantly increased live body weight, body weight gain, feed intake, feed conversion ratio, shank and keel length and body circumference. Relative weight of carcass, and lymphoid organs were significantly increased with iodine. Moreover, blood hemoglobin, red and white blood cells counts and lymphocytes cells% were significantly increased by iodine supplementation to diets . On the other hand, heterophils (%) and H/L ratio were significantly lower by different levels of Potassium iodide supplementation. As well as, plasma total protein, albumin, globulin, A/G ratio, calcium, phosphorus and T_3 were significantly higher in treated than the control groups. Conversely, duckling fed ration supplemented with Potassium iodide recorded a significant decrease in plasma total lipids, cholesterol, triglyceride, AST and ALT concentrations .Conclusively, potassium iodide at 2mg/kg diet level resulted in better performance without any adverse effect on physiological responses and carcass quality traits .

Keywords: Pekin ducks, Domyati ducks, Potassium iodide, physiological responses , productive performance.

INTRODUCTION

Demands for animal proteins have been increased as a result of increasing human population . This needs an increase in animal production especially poultry meat production (Adeola, 2006). Duck carcasses contain about 30% fat while broiler carcasses had 15% fat at market age, therefore; the increase in consumers preference for leaner meat had stimulated interest in reducing abdominal fat deposition in ducks, (Plavnik *et al*., 1982). Ducks industry in Egypt is under continuous pressure to provide high quality and more economical product to the consumer.

Trace minerals such as iodine, manganese, copper, selenium and zinc were essentially required for ducks in a small amount for normal production as well as physiological functions. Iodine importance was considered as limited element for thyroidal hormones, Triiodothyronine (T_3) and Thyroxin (T_4). Since, Magilvery (1979) found that thyroid hormones regulated growth development and metabolic activity. Thyroid gland consume from 70 to 100 µg of iodine daily for hormone synthesis. Deficiency of iodine in dietary intake could be covered by re-utilizing iodine released upon degradation of hormones (Sturkie, 1986).) Thyroid hormones action may be divided into metabolic effect such as water regulation, transport of ions, metabolism regulation, and promote growth development action (McNabb and King, 1993).

Potassium iodide (KI) has been used to block uptake of iodine in thyroid gland which played an important role in biological, acting on genes transcription to regulate basal metabolic rate (Patrick, 2008). Moreover, Eurl (2012) reported that potassium iodide from white to yellow crystalline powders contains 67 percentage of iodine and 21 percentage of potassium.

Christensen and Ort (1991) reported that iodine toxicity might occur in large white turkey hens when diets contain iodine at a level of 350 ppm. Abaza *et al.* (2003) showed that reproductive performance and immune response were higher than the controls in hyper thyroid males of Alexandria cockerels; it was companied with better immune-response to sheep red blood cell and immuno-globulines (IgM and IgG). El-Wardany *et al.* (2011) observed that administration of 1mg calcium iodide (CaI) per kg diet compared with the control diet could improve productive characteristics of broiler chicks, where average body weight, feed intake, feed conversion ratio, and also thyroidal hormones (T_3 and T_4) and their ratio T_3/T_4 were significantly improved in hyperthyroidism groups . Their experiment supported using CaI as a safe additive without hazards effects on organs histology. Abdel-Malak *et al.* (2012) showed that addition of iodine as KI at different concentrations (0.6, 1.2 and 2.4) mg/kg diet of Golden Montazah laying hens over the requirements had no adverse effect on growth and egg production whereas the best feed conversion ratio was recorded for those fed diet containing 1.2 followed by 2.4mg KI/kg diet. They added that concentration of T_3 and T_4 were significantly increased by increasing iodine levels. Moreover, laying hens fed diet supplemented with 0.6, 1.2, 2.4 and 4.8 mg iodine/kg diet recorded the best economical efficiency compared to the control. Nima *et al.* (2012) found that daily body weight gain and feed conversion ratio was increased as dietary supplementation of iodine increased from 0.46 to 0.86 mg/kg diet during the growth period. El-Kaiaty *et al.* (2004) reported that the Muscovy ducklings fed with (38, 77, and 115 mg iodine/kg diet) of Potassium iodide solution higher plasma T_3 compared with the control once. While, plasma total protein and albumin were affected with doses but the differences were not significant.

The goal of the present study was to evaluate the effect of different dietary supplementation levels of iodine on growth performance and some physiological parameters in both Pekin and Domyati ducks.

MATERIALS AND METHODS

This study was carried out at El-Serw Research Station, which belonging to Water Fowl Research Department, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt. The experiment was carried out during summer season.

Birds, diet and treatments:

A total number of Two hundred and forty of both unsexed Pekin and Domyati ducklings (120/ breed) at one-day old were used in the present study. The experimental period extended for 12 weeks of age. Experimental ducks were randomly divided into four equal treatments (30 either Pekin or Domyati ducks / each) and each treatment was randomly divided into three equal replicates (10 ducks / each), Ducks were fed diets containing 0, 1, 1.5 and 2 mg iodine/kg ration for T1, T2, T3 and T4, respectively. Ducks were maintained in deep litter floor pens. Birds were examined against diseases, healthy and vaccines. Fresh water and feed were available *ad libitum*. All ducklings were fed on a starter ration contain 21.30% crude protein and 2919 kcal/kg metabolized energy during the first four weeks of age followed by a grower diet contain 17.25% crude protein and 2936 kcal/kg, contained adequate levels of nutrients recommended by NRC, (1994). Compositions of starter and grower ration are shown in Table 1.

Table 1. Composition of the rations.

Ingredients	Starter diets	Grower diet
Yellow corn (Kg)	60.00	67.00
Wheat bran	7.00	12.50
Soybean meal 44%(Kg)	22.45	10.00
Broiler concentrate (Kg)	10.00	10.00
Limestone (Kg)	0.30	0.25
Premix (Kg)	0.25	0.25
Total (Kg)	100.00	100.00
Chemical composition		
Metabolizable energy	2919	2936
Crude protein	21.30	17.25
Crude fiber	3.75	3.64
Ether extract	4.25	4.10
Calcium	1.06	1.01
Av. Phosphorus	0.54	0.53
Methionine & cystine	0.70	0.58
Lysine	1.10	0.85

*** Each 2.5 kg of vitamins and minerals mixture contain; 12000.000 IU vitamin A acetate; 2000.000 IU vitamin D3; 10.000 mg vitamin E acetate; 2000 mg vitamin K3; 100 mg vitamin B; 4000 mg vitamin B2; 1500 mg vitamin B6; 10 mg vitamin B12 ; 10.000 mg Pantothenic acid; 20.000 mg Nicotininc acid; 1000 mg Folic acid; 50 mg Bioten; 500.000 mg Chorine; 10.000 mg Copper; 1000 mg Iodine; 30.00 mg Iron; 55.000 mg Manganese; 55.000 mg Zinc; and 100 mg Selnium.**

Measurements:

Growth performance:

Live body weight , weight gain, feed consumption, feed conversion ratio (g feed / g weight gain) and mortality rate of the ducks were calculated every four weeks during the experimental period. Also, shank length, keel length and breast circumference were measured. At 12 weeks of age, three birds from each experimental treatment were weighed and slaughtered by slitting the jugular vein, then scalded and de-feathered. Carcasses were manually eviscerated and weighed. Liver, heart, gizzard, digestive tract and abdominal fat were removed and their relative percentages of live body weight were estimated.

Biochemical parameters:

Blood samples were collected at afternoon from the nine birds into heparinized test tubes from each experimental treatment at 12 weeks of age. Fresh blood used to count both white and red blood cells and hemoglobin concentration (Hb). Red blood cells were counted in fresh blood samples using hemocytometer and light microscope. Two hundred white blood cells were counted and differentiated into Lymphocytes (L) and Heterophils (H), then H/L ratio was calculated.

Each blood sample was centrifuged immediately at the speed of 3000 r.p.m. for 15 minutes; then plasma samples were kept in plastic tubes and stored at -20 °C until biochemical analysis. Plasma calcium, inorganic phosphorus, total protein, albumin, globulin, albumin/ globulin ratio, total lipids , total cholesterol, Triglycerides and transaminase enzymes activities (ALT and AST) were determined by using available commercial kits purchased from Diamond Diagnostics Company. While, plasma concentrations of triiodothyronine (T3) hormone were determined by radioimmunoassay (RIA) as described by Darras *et al.* (1992).

Histological studies:

Tissue samples from liver and thyroid gland were taken and fixation was accomplished by immersion in freshly prepared solution of Boun's fixative, then processed by standard technique and sections ware stained with haematoxylin and Eosin (Bancroft and Cook, 1994).

Statistical analysis:

Data were analyzed by the least squares analysis of variance using the General Linear Models procedure of the statistical analysis model (SAS, 2001). The statistical model was as follows: **Yijk= μ + Ti + Bj + TBij + Eijk**

Where: **Yijk = An observation; μ = Overall mean; Ti = Effect of dietary iodine supplementation (i = 1, 2, 3, 4); Bj = Effect of breed of ducks (j = 1, 2): TBij = Interaction effect between dietary iodine supplementation and breed of ducks and Eijk= Random error component assumed to be normally distributed. The significant differences among treatment means were determined by Duncan's multiple range test (Duncan, 1955).**

RESULTS AND DISCUSSION

Productive performance of Pekin and Domyati ducks:

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

Data of Table 2 showed that live body weight (LBW) was significantly changed with duckling breed at all ages. It was significantly affected due to KI supplementation during these ages except at 0 and 4 weeks of age. Live body weight of Pekin ducklings was significantly higher by 20.27, 35.27, 6.79 and 16.97% than Domyati ducklings at 0, 4, 8 and 12 weeks of age, respectively. Awad *et al*. (2013) reported that live body weight was significantly affected due to duckling breed of Pekin and Domyati at 0, 4, 8 and 12 at age of weeks, respectively. The heaviest body weight values were recorded for ducks of T4 group followed by those of T3 and T2 groups compared with control, respectively during experimental period. Potassium iodide supplementation (2, 1.5 and1%) was significantly higher by 5.65, 4.79 and 3.34% than control once at 12 weeks of age, respectively.

Additionally, Interaction between duckling breed and Potassium iodide supplementation was significantly effect on live body weight at different ages, live body weight of Pekin ducklings was significantly higher than Domyati ducklings with any KI supplementation.

Similar trend was obtained for body weight gain values (Table 2). Body weight gain of Pekin ducklings was significantly higher by 36.81, 44.89 and 16.90% than Domyati ducklings during 0-4, 8-12 and 0-12 weeks of age, respectively. All duckling fed ration supplemented with KI was significantly higher in body weight gain than control ones during 0-4, 8-12 and 0-12 weeks of age. Improvement of body weight gain values was 5.80, 4.89 and 3.43% for duckling fed ration supplemented with KI (2, 1.5 and1%) compared to those fed the control ration during 0-12 weeks of age. These results are in agreement with Nima *et al.* (2012) who reported that body weight gain was increased as dietary iodide increased from 0.46 to 0.86 mg/kg diet through growth period.

Interaction between duckling breed and KI supplementation had significant effect on body weight gain during different experimental period, Pekin ducklings was significantly higher of BWG than Domyati ducklings without KI supplementation.

Table 2. Effect of different levels of potassium iodide on live body weight and body weight gain at different ages of duckling breed.

Items	DB	Potassium iodide				Av.	Probability		
		0	1	1.5	2		B	T	BT
				Live body weigh (g)					
	P	41.72 ^{a} ±0.31	41.31 ^{a} ±0.31	41.52 ^{a} ±0.31	41.13 ^{a} ±0.31	41.42^{a}	*	NS	*
0	D	34.55 ^{b} ±0.31	34.33 ^{b} ±0.31	34.74 ^{b} ±0.31	34.12 ^{b} ±0.31	34.44^{b}			
	Av.	38.14	37.82	38.13	37.63				
	P	610.85^{b} ±40.67	625.76^{b} ±41.74	640.53^{a} ±41.52	662.74^{a} ±41.78	634.97 ^{a}	*	NS	*
4	D	436.41^{d} ±40.42	460.74^{c} ±40.63	475.61^{c} ±41.71	500.45^{c} ±41.36	468.30 ^{b}			
	Av.	523.63	543.25	558.07	581.60				
	P	1355.36^{b} ±43.86	1378.36^{b} ±51.36	1395.14^{a} ±49.57	1401.35^{a} ±50.36	1382.55^{a}	**	**	**
8	D	1241.34^{d} ±51.34	1275.37^{d} ±49.67	1315.34^{c} ±50.39	1346.74^{b} ±52.62	1294.70^{b}			
	Av.	1298.35^{b}	1326.87^{b}	1355.24^{a}	1374.01^{a}				
	P	2005.11^{b} ±70.36	2064.63^{b} ±72.96	2087.69^{a} ±69.31	2110.12^{a} ±74.31	2066.89^{a}	**	**	**
12	D	1701.16^{d} ±75.97	1765.36^{c} ±68.14	1795.98^{c} ±75.14	1805.56^{c} ±77.91	1767.02^{b}			
	Av.	1853.14^{c}	1915.00^{b}	1941.84^{a}	1957.84^{a}				
				Body weight gain (g)					
	P	569.13^{b} ±41.32	584.45^{b} ±40.35	599.01^{a} ±42.37	621.61^{a} ±44.31	593.55^{a}	**	**	**
0-4	D	401.86^{d} ±42.36	426.41^{d} ±43.64	440.87^{c} ±39.74	466.33^{c} ±38.93	433.86^{b}			
	Av.	485.49^{b}	505.43^{b}	519.94^{a}	544.06^{a}				
	P	744.51^{c} ±52.31	752.6^{b} ±51.74	754.61^{b} ±50.41	738.61^{c} ±53.87	747.58^{a}	**	NS	**
4-8	D	804.93^{a} ±48.23	814^{a}.63±50.14	839.73^{a} ±49.75	846.29^{a} ±51.37	826.4^{b}			
	Av.	774.72	783.62	797.17	792.32				
	P	649.75±56.32	686.27±55.37	692.55±55.96	708.77±56.31	684.34^{a}	**	**	**
8-12	D	459.82±53.11	489.99±52.47	480.64±53.25	458.82±54.14	472.32^{b}			
	Av.	554.79^{b}	588.13^{a}	586.6^{a}	583.83^{a}				
	P	1963.39^{b} ±76.48	2023.32^{a} ±77.67	2046.17^{a} ±69.34	2068.99^{a} ±78.36	2025.47^{a}	**	**	**
0-12	D	1666.61^{d} ±69.74	1731.03^{c} ±68.16	1761.24^{c} ±70.65	1771.44^{c} ±68.31	1732.58^{b}			
	Av.	1815.00^{c}	1877.18^{b}	1903.71^{a}	1920.21^{a}				

a,b,c,d: Means with different superscripts in the same row within item differ significantly; NS = Not significant;
$*= (P\leq0.05)$; $**= P\leq0.01)$; DB= Duckling breed; D= Domyati ducks; P= Pekin ducks.

Feed intake (FI) and Feed conversion ratio (FCR):

The effect of different treatments on FI and FCR is presented in Table 3. Feed intake was significantly affected by duckling breed at all ages, it could be observed that Pekin ducklings had consumed significantly higher amount of ration than Domyati ducklings during different experimental period by about 8.53% during 0-12 weeks of age. Duckling fed ration supplemented with KI (2, 1.5 and1%) was significantly higher by 3.62, 2.56 and 0.89% than control during 0-12 weeks of age, respectively. These results are in line obtained by Awad *et al.* (2007) who observed that Pekin ducklings had consumed 9 kg during 0-12 weeks of age. Additionally, Awad *et al.* (2011) reported that Domyati ducklings consumed 8kg at the same period.

Table 3. Effect of different levels of potassium iodide on feed intake and feed conversion ratio at different ages of duckling breed.

Items	DB	Potassium iodide (KI)				Av.	Probability		
		0	1	1.5	2		B	T	BT
				Feed intake (g / duckling)					
	P	1891^{b}±13.11	1911^{a} ±14.51	1935^{a} ±12.65	1942^{a} ±14.26	1919.75^{a}	**	**	**
0-4	D	1655^{d} ±12.56	1685^{d} ±13.57	1755^{c} ±12.45	1780^{c} ±13.41	1718.75^{b}			
	Av.	1773^{c}	1798^{b}	1845^{a}	1861^{a}				
	P	3281 ^{b} ±15.36	3314 ^{a} ±16.45	3356 ^{a} ±13.64	3387 ^{a} ±14.75	3334.5 ^{a}	**	**	**
4-8	D	3135 ^{c} ±14.36	3157 ^{c}±12.96	3186 ^{c} ±15.47	3217 ^{b} ±16.78	3173.75^{b}			
	Av.	3208 ^{c}	3235.5 ^{b}	3271 ^{b}	3302 ^{a}				
	P	3641 ^{b}±18.36	3665 ^{b} ±14.36	3752 ^{a} ±17.74	3789 ^{a} ±14.63	3711.75 ^{a}	**	**	**
8-12	D	3325 ^{d} ±16.36	3347 ^{d} ±13.64	3378 ^{d} ±15.67	3425 ^{c} ±18.57	3368.75 ^{b}			
	Av.	3483^{c}	3506 ^{b}	3565 ^{b}	3607 ^{a}				
	P	8813 ^{b} ±17.36	8890 ^{b} ±15.78	9043 ^{a} ±17.96	9118 ^{a} ±17.69	8966 ^{a}	**	**	**
0-12	D	8115 ^{e} ±18.52	8189 ^{e} ±14.69	8319 ^{d} ±18.74	8422 ^{c}±13.87	8261.25 ^{b}			
	Av.	8464 ^{d}	8539.5 ^{c}	8681^{b}	8770 ^{a}				
				Feed conversion ratio (g feed / g BWG)					
	P	3.32 ^{c} ±0.07	3.27 ^{c} ±0.04	3.23 ^{c} ±0.07	3.12 ^{c} ±0.04	3.23 ^{b}	**	NS	**
0-4	D	4.12 ^{a} ±0.05	3.95 ^{b} ±0.03	3.98 ^{b} ±0.06	3.82 ^{b} ±0.03	3.96 ^{a}			
	Av.	3.65	3.56	3.55	3.42				
	P	4.41 ^{a} ±0.11	4.40 ^{a} ±0.12	4.45 ^{a} ±0.08	4.59 ^{a} ±0.13	4.46 ^{a}	**	NS	**
4-8	D	3.89 ^{b} ±0.08	3.88 ^{b} ±0.07	3.79 ^{b} ±0.06	3.80 ^{b} ±0.11	3.84 ^{b}			
	Av.	4.14	4.13	4.10	4.17				
	P	5.60 ^{c} ±0.14	5.34 ^{c} ±0.25	5.42 ^{c} ±0.23	5.35 ^{c} ±0.22	5.42 ^{b}	**	**	**
8-12	D	7.23 ^{a} ±0.21	6.83^{b} ±0.16	7.03 ^{a} ±0.17	7.46 ^{a} ±0.19	7.13 ^{a}			
	Av.	6.28 ^{a}	5.96^{c}	6.08 ^{b}	6.18 ^{a}				
	P	4.49±0.11	4.39±0.12	4.42±0.09	4.41±0.08	4.43 ^{b}	*	*	NS
0-12	D	4.87±0.07	4.73±0.09	4.72±0.12	4.75±0.07	4.77 ^{a}			
	Av.	4.66 ^{a}	4.55 ^{b}	4.56 ^{b}	4.57 ^{b}				
				Mortality%					
	P	5.47	5.02	4.59	4.06	4.79			
0-12	D	3.58	2.32	3.11	2.25	3.07			
	Av.	4.53	4.17	3.85	3.16				

a,b,c,d,e: Means with different superscripts in the same row within item differ significantly; NS = Not significant;
$*= (P\leq0.05)$; $**= P\leq0.01)$; D= Domyati ducks; P= Pekin ducks.

Interaction between duckling breed and KI supplementation was significantly effect on FI during different experimental period, Pekin ducklings was significantly higher of FI than Domyati ducklings with any KI supplementation.

Feed conversion ratio was significantly affected by duckling breed at all ages (Table 3), it noted that Domyati ducklings was significantly attenuated than Pekin ducklings during 0-4, 8-12 and 0-12 weeks of age. Feed conversion ratio was decreased by 7.67% for Pekin than Domyati ducklings during 0-12 weeks of age. Duckling breed fed ration supplemented with KI had the best feed conversion ratio as compared with the control during 8-12 and 0-12 weeks of age (Table 3). The improvement of feed conversion values was 1.97, 2.19 and 2.42% for duckling fed ration supplemented with KI (2, 1.5 and 1%) as compared with control during 0-12 weeks of age, respectively. These results are in agreement with El-Ansary *et al.* (1996) who noted that feed conversion ratio was improved with drink water and dietary supplemented of Potassium iodide. Hassaan *et al.* (2015) reported that better feed conversion ratio may be due to increase the BWG during all experimental period (5-14) weeks of age.

Interaction between duckling breed and Potassium iodide (KI) supplementation was significantly effect on FCR during different all experimental period except with 0-12 weeks of age.

Mortality rate:

It can be observed from Table 3 that mortality rate during 12 week of age was significantly high in Pekin (4.79%) than Domyati (3.07%). It may be due to that Pekin was more sensitive and Domyati was more adapted to the Egyptian conditions. These results are in agreement with Fattouh (1994) who reported low and insignificant differences in mortality rate from 4-20 weeks of age between Pekin, Domyati and Muscovy ducks. Ali (2005) indicated that the mortality percentage was 4% for Domyati during the periods 0-12 weeks of age.

Duckling fed ration supplemented with different KI levels was insignificantly decreased in mortality than those fed the control ration from 4.53 to 3.16%. This improvement in mortality could be due to KI had play an important role in enhance resistance to stress as well as the immunity system.

Body measurements:

Data in Table 4 declared that significant breed differences at 12 weeks of age in body measurements were observed. Shank and keel length and body circumference were significantly longer by about 14.69, 10.07 and 5.21% in Pekin ducklings than Domyati, respectively. These values were close to those reported by Ali (2005) where it was 5.01, 2.03 and 2.36% in Khaki-Campbell ducklings than Domyati at 12 weeks of age.

All body measurements were significantly affected due to treatments supplemented with KI. Shank length was significantly increased by 18.87, 14.22 and 7.98%, respectively. Moreover, keel length was 15.09, 11.85 and 8.81%, respectively. While, body circumference was 9.83, 5.69 and 3.92% respectively, for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control once.

Interaction between duckling breed and KI supplementation was significantly effect on body measurements at 12 weeks of age.

Table 4. Effect of different levels of potassium iodide on body measurements at 12 weeks of ages for duckling breed.

Items	DB	Potassium iodide (KI)				Av.	Probability		
		0	1	1.5	2		B	T	BT
Shank length	P	$7.55^{b}\pm0.15$	$8.01^{a}\pm0.16$	$8.16^{a}\pm0.15$	$8.74^{a}\pm0.14$	8.12^{a}	*	*	*
	D	$6.23^{c}\pm0.21$	$6.87^{c}\pm0.11$	$7.58^{b}\pm0.14$	$7.64^{b}\pm0.15$	7.08^{b}			
	Av.	6.89^{c}	7.44^{b}	7.87^{b}	8.19^{a}				
Keel length	P	$11.24^{b}\pm0.25$	$12.56^{a}\pm0.35$	$12.63^{a}\pm0.24$	$12.98^{a}\pm0.25$	12.35^{a}	*	*	*
	D	$10.35^{c}\pm0.24$	$11.15^{b}\pm0.21$	$11.52^{b}\pm0.31$	$11.87^{b}\pm0.21$	11.22^{b}			
	Av.	10.80^{c}	11.86^{b}	12.08^{a}	12.43^{a}				
Body circumference	P	$32.14^{c}\pm0.67$	$33.45^{b}\pm0.63$	$33.65^{b}\pm0.68$	$34.84^{a}\pm0.71$	33.52^{a}	*	*	*
	D	$30.11^{e}\pm0.71$	$31.25^{d}\pm0.55$	$32.14^{c}\pm0.74$	$33.54^{b}\pm0.63$	31.86^{b}			
	Av.	31.13^{c}	32.35^{b}	32.90^{b}	34.19^{a}				

a,b,c,d,e: Means with different superscripts in the same row within item differ significantly; NS = Not significant;
***= (P≤0.05); **= P≤0.01); D= Domyati ducks; P= Pekin ducks.**

Carcass characteristics:

The overall means of carcass weight (%) and the proportional weights of some body organs are presented in Table 5. Carcass, liver and total edible parts percentages were significantly increased due to duckling breed. Carcass and total edible parts percentage were significantly increased by 3.35 and 4.00% for Pekin duckling than Domyati, respectively. All carcass characteristics were significantly affected due to treatments supplemented with KI. Carcass percentage were significantly increased by 5.92, 4.34 and 2.33%, respectively for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control. Total edible parts percentage were significantly increased by 6.06, 4.47 and 2.32%, respectively for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control. These results are in agreement with *Hassaan et al.* (2015) who reported that addition of KI at level 1.2, 2.4 and 4.8 mg iodine/kg diet significantly improved the carcass weight in Silver Montazah (SM) cockerels. Carcass percentage the same trended of live body weight and body weight gain, which high positive phenotypic and genetic correlation among body weight and carcass characteristics *(Pramod et al., 2002)*.

Lymphoid Organs:

Table 5 shows the effect of iodine treatments on some relative weight of lymphoid organs and glands. Potassium iodide levels significantly improve the relative weights of lymphoid organs compared with control group as reflected by immune status. These results explained the important role of iodine in stimulating autoantibodies secretion in response to triiodothyroxine and thyroglobulin which in turn increased autoimmunity in birds. Results are in agreement with *El-Kaiaty (2004)* reported that the

Muscovy ducklings fed with (38, 77, and 115 mg iodine/kg diet) of Potassium iodide were higher the relative weight of thyroid gland.

Interaction between duckling breed and KI supplementation was significantly effect on carcass and total edible parts at 12 weeks of age.

Hematological parameters:

The results observed herein Table 6 showed that, the effect of iodine treatments on hematological parameters was significantly high in hemoglobin, red blood cells, white blood cells, heterophils cells H%, lymphocytes cells L% and H/L ratio.

Table 5. Effect of different levels of potassium iodide on carcass traits, some lymphoid organs and glands at 12 weeks of ages for duckling breed.

Items	DB	Potassium iodide (KI)				Av.	Probability		
		0	1	1.5	2		B	T	BT
Carcass traits%									
Carcass	P	72.41^{ab} ±0.87	74.58^{a} ±0.77	75.28^{a} ±0.81	76.57^{a} ±0.79	74.71^{a}	**	**	**
	D	70.11^{b} ±0.56	71.25^{b} ±0.64	73.41^{ab} ±0.67	74.39^{a} ±0.88	72.29^{b}			
	Av.	71.26^{b}	72.92^{b}	74.35^{a}	75.48^{a}				
Gizzard	P	3.02±0.08	3.04±0.09	3.09±0.09	3.15±0.06	3.08	NS	*	NS
	D	2.84±0.06	2.85±0.07	3.01±0.08	3.03±0.05	2.93			
	Av.	2.93^{b}	2.95^{ab}	3.05^{a}	3.09^{a}				
Liver	P	2.25±0.08	2.41±0.07	2.55±0.07	2.61±0.08	2.46^{a}	**	NS	NS
	D	1.94±0.05	1.97±0.06	1.99±0.09	2.00±0.06	1.98^{b}			
	Av.	2.10	2.19	2.27	2.31				
Heart	P	0.79±0.04	0.81±0.05	0.85±0.03	0.88±0.04	0.83	NS	NS	NS
	D	0.71±0.03	0.75±0.04	0.77±0.05	0.79±0.03	0.76			
	Av.	0.75	0.78	0.81	0.84				
Total Giblets	P	6.06±0.22	6.26±0.34	6.49±0.24	6.64±0.16	6.36	NS	*	NS
	D	5.49±0.15	5.57±0.24	5.77±0.13	5.82±0.21	5.66			
	Av.	5.78^{c}	5.92^{b}	6.13^{a}	6.23^{a}				
Edible parts	P	78.47^{c} ±1.02	80.84^{b} ±0.89	81.77^{b} ±1.03	83.21^{a} ±1.05	81.07^{a}	*	**	**
	D	75.60^{e} ±1.08	76.82^{d} ±0.97	79.18^{c} ±0.98	80.21^{b} ±0.92	77.95^{b}			
	Av.	77.04^{c}	78.83^{b}	80.48^{ab}	81.71^{a}				
Abdominal fat	P	1.35 ±0.03	1.37 ±0.04	1.37±0.03	1.38±0.02	1.37	NS	NS	NS
	D	1.19 ±0.03	1.21 ±0.02	1.23 ±0.04	1.24±0.05	1.22			
	Av.	1.27	1.29	1.30	1.31				
Lymphoid Organs and glands %									
Spleen	P	0.05^{c}±0.02	0.06^{c} ±0.01	0.07^{b} ±0.03	0.07^{b} ±0.01	0.06^{b}	*	*	*
	D	0.07^{b} ±0.03	0.08^{a} ±0.02	0.08^{a} ±0.02	0.09^{a} ±0.03	0.08^{a}			
	Av.	0.06	0.07	0.08	0.08				
Thymus	P	0.003^{d} ±0.01	0.005^{c} ±0.01	0.006^{b} ±0.02	0.006^{b} ±0.03	0.005^{b}	*	*	*
	D	0.006^{b} ±0.02	0.008^{a} ±0.03	0.008^{a} ±0.01	0.009^{a} ±0.01	0.008^{a}			
	Av.	0.005^{c}	0.007^{b}	0.007^{b}	0.008^{a}				
Thyroid	P	0.002^{d} ±0.01	0.004^{b} ±0.1	0.004^{b} ±0.02	0.005^{a} ±0.02	0.004^{a}	*	*	*
	D	0.002^{d} ±0.2	0.003^{c} ±0.03	0.004^{b} ±0.03	0.004^{b} ±0.01	0.003^{b}			
	Av.	0.002^{c}	0.004^{b}	0.004^{b}	0.005^{a}				

a,b,c,d,e: Means with different superscripts in the same row within item differ significantly; NS = Not significant; *= (P≤0.05); **= P≤0.01); D= Domyati ducks; P= Pekin ducks.

Table 6. Effect of different levels of potassium iodide on hematological parameters at 12 weeks of ages for duckling breed.

Items	DB	Potassium iodide (KI)				Av.	Probability		
		0	1	1.5	2		B	T	BT
Hemoglobin (g/ dI)	P	12.36^{c} ±0.21	13.65^{b} ±0.23	14.36^{ab} ±0.20	15.22^{a} ±0.24	13.90	NS	**	**
	D	12.11^{c} ±0.22	13.53^{b} ±0.21	14.11^{ab} ±0.23	15.14^{a} ±0.25	13.72			
	Av.	12.24^{c}	13.59^{b}	14.24^{ab}	15.18^{a}				
RBC ($\times 10^3/mm^3$)	P	2.04^{d} ±0.11	2.12±0.12	2.22^{b} ±0.11	2.35^{a} ±0.13	2.18	NS	*	*
	D	2.01^{d} ±0.12	2.11^{c} ±0.13	2.15^{c} ±0.12	2.31^{a} ±0.15	2.15			
	Av.	2.03	2.12	2.19	2.33				
WBC ($\times 10^3/mm^3$)	P	17.25^{b} ±0.45	18.14^{a} ±0.46	18.36^{a} ±0.41	18.69^{a} ±0.41	18.11	NS	*	*
	D	17.23^{b} ±0.42	18.11^{a} ±0.41	18.23^{a} ±0.44	18.65^{a} ±0.45	18.06			
	Av.	17.24^{b}	18.13^{a}	18.30^{a}	18.67^{a}				
Heterophils (H)%	P	33.75^{a} ±1.35	29.36^{b} ±1.41	28.63^{c} ±1.19	26.31^{d} ±1.45	29.51	NS	**	**
	D	33.65^{a} ±1.29	29.31^{b} ±1.39	28.15^{c} ±1.28	26.22^{d} ±1.36	29.33			
	Av.	33.70^{a}	29.34^{b}	28.39^{c}	26.27^{d}				
Lymphocyte (L)%	P	66.63^{d} ±1.55	70.31^{b} ±1.64	71.36^{b} ±1.45	73.14^{a} ±1.65	70.36	NS	**	**
	D	65.25^{e}±1.75	69.11^{c} ±1.36	71.94^{b} ±1.71	72.11^{a} ±1.73	69.60			
	Av.	65.94^{d}	69.71^{c}	71.65^{b}	73.63^{a}				
H/L ratio	P	0.51^{a} ±0.01	0.42^{b} ±0.03	0.40^{b} ±0.02	0.36^{d} ±0.01	0.42	NS	*	*
	D	0.52^{a} ±0.03	0.42^{b} ±0.02	0.39^{c} ±0.03	0.36^{d} ±0.03	0.42			
	Av.	0.51^{a}	0.42^{b}	0.40^{b}	0.36^{c}				

a,b,c,d,e: Means with different superscripts in the same row within item differ significantly; NS = Not significant; *= (P≤0.05); **= P≤0.01); DB= Duckling breed; D= Domyati ducks; P= Pekin ducks.

Blood hemoglobin was significantly increased by 24.02, 16.34 and 11.03%, respectively for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control once. Red blood cells counts were significantly increased by 14.78, 7.88 and 4.25%, respectively. Also, White blood cells counts were significantly increased by 8.29, 6.15 and 5.16%, respectively for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control once. Moreover, lymphocytes cells percentage was significantly improved, on the other hand, heterophils cells percentage and H/L ratio were significantly lower with KI supplementation. Also, *Beckman and Mashaly (1987)* reported that there is a positive correlation between thyroxin levels and number of circulating lymphocytes. These results are in agreement with *Hassaan et al.* (2015) who reported that addition of KI at level 1.2, 2.4 and 4.8 mg iodine/kg diet significantly improved the Hb, RBC and WBC counts in Silver Montazah (SM) cockerels.

Blood constituents:

From data presented in Table 7, it could be noticed that some blood constituents of Pekin and Domyati ducklings were affected by different levels with KI supplementation. Results showed no significant effect of duckling breed on total protein, albumin, globulin, A/G ratio, calcium, phosphorus, AST, ALT, T3 while, other parameters studied were significantly affected. Pekin ducklings recorded significantly increase in total lipids, cholesterol and triglyceride by 27.12, 6.43 and 9.23%, respectively as compared with Domyati duckling at 12 weeks of age. Moreover, total lipids, cholesterol and triglyceride were significantly decreased for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control. These results are in agreement with *El-Gendi (1997)* who found that cholesterol was significantly low by injection of 1 gm eltroxin/kg body for Rhode Island Red, Fayoumi and Dandarawi hens compared with control once. Also, these resulted may be due to the major role of iodine on lipid metabolic *(McNabb and King, 1993)*.

Table 7. Effect of different levels of potassium iodide on blood constituents at 12 weeks of ages for duckling breed.

Items	DB	Potassium iodide (KI)				Av.	Probability		
		0	1	1.5	2		B	T	BT
Total protein (g/ dI)	P	5.65^{b} ±0.14	6.11^{a} ±0.19	6.41^{a} ±0.13	6.72^{a} ±0.15	6.22	NS	*	*
	D	5.31^{b} ±0.16	6.01^{a} ±0.18	6.24^{a} ±0.12	6.46^{a} ±0.13	6.01			
	Av.	5.48^{b}	6.06^{a}	6.31^{a}	6.59^{a}				
Albumin (g/ dI)	P	2.37±0.15	2.44±0.13	2.65±0.13	2.95±0.17	2.60	NS	NS	NS
	D	2.29±0.16	2.37±0.14	2.54±0.16	2.78±0.19	2.50			
	Av.	2.33	2.41	2.60	2.87				
Globulin (g/ dI)	P	3.28±0.17	3.67±0.21	3.76±0.15	3.77±0.18	3.62	NS	NS	NS
	D	3.02±0.14	3.64±0.19	3.70±0.16	3.68±0.20	3.51			
	Av.	3.15	3.66	3.73	3.73				
A/G ratio	P	0.72^{c} ±0.11	0.66^{e} ±0.08	0.70^{cd} ±0.09	0.78^{a} ±0.10	0.72	NS	*	*
	D	0.76^{b} ±0.09	0.65^{e} ±0.07	0.69^{d} ±0.07	0.76^{b} ±0.11	0.71			
	Av.	0.74^{d}	0.66^{c}	0.70^{b}	0.77^{a}				
Total lipids (mg/dI)	P	570.28^{a} ±12.61	536.25^{a} ±12.63	511.69^{a} ±15.71	491.91^{b} ±14.78	527.53^{a}	**	**	**
	D	441.11^{c} ±15.84	421.37^{c} ±16.74	400.11^{d} ±13.45	397.36^{e} ±13.54	414.99^{b}			
	Av.	505.70^{a}	478.81^{b}	455.90^{c}	444.64^{d}				
Cholesterol (mg/dI)	P	161.55^{a} ±4.55	150.36^{b} ±4.36	141.08^{c} ±4.25	135.33^{d} ±5.41	147.08^{a}	*	*	*
	D	145.22^{c} ±5.61	140.47^{c} ±6.74	136.64^{d} ±5.36	130.47^{d} ±6.47	138.20^{b}			
	Av.	153.39^{a}	145.42^{b}	138.86^{c}	132.90^{c}				
Triglyceride (mg/dI)	P	119.36^{a} ±3.11	112.91^{a} ±2.87	91.85^{b} ±2.87	87.12^{c} ±3.11	102.81^{a}	*	*	*
	D	100.47^{a} ±3.15	97.35^{b} ±3.25	97.31^{b} ±2.43	81.36^{c} ±2.95	94.12^{b}			
	Av.	109.92^{a}	105.13^{a}	94.58^{b}	84.24^{c}				
Calcium (mg/dI)	P	11.93^{b} ±0.28	12.94^{b} ±0.31	14.36^{a} ±0.26	14.98^{a} ±0.33	13.55	NS	*	*
	D	11.37^{b} ±0.25	12.87^{b} ±0.29	14.25^{a} ±0.25	14.39^{a} ±0.29	13.22			
	Av.	11.65^{b}	12.91^{b}	14.31^{a}	14.69^{a}				
Phosphorus (mg/dI)	P	4.96^{b} ±0.21	5.25^{a} ±0.23	5.31^{a} ±0.22	5.91^{a} ±0.21	5.36	NS	*	*
	D	4.92^{b} ±0.24	5.21^{a} ±0.19	5.28^{a} ±0.27	5.88^{a} ±0.23	5.32			
	Av.	4.94^{b}	5.23^{a}	5.30^{a}	5.90^{a}				
AST (U/L)	P	32.93^{a} ±4.62	30.54^{a} ±3.69	28.36^{b} ±3.54	25.63^{b} ±4.25	29.37	NS	*	*
	D	31.14^{a} ±4.25	30.54^{a} ±4.11	27.63^{b} ±4.12	23.54^{b} ±3.67	28.21			
	Av.	32.03^{a}	30.54^{a}	27.10^{b}	24.59^{b}				
ALT (U/L)	P	25.62^{a} ±3.54	23.54^{a} ±3.84	20.65^{a} ±4.18	20.22^{a} ±4.25	22.51	NS	*	*
	D	24.31^{a} ±3.74	23.35^{a} ±4.14	21.25^{a} ±3.67	19.35^{b} ±4.69	22.07			
	Av.	24.97^{a}	23.45^{a}	20.95^{a}	19.79^{b}				
T_3 (ng/mI)	P	4.62^{c} ±0.66	5.12^{b} ±0.54	6.32^{a} ±0.54	6.54^{a} ±0.67	5.65	NS	**	**
	D	4.58^{c} ±0.45	5.02^{b} ±0.67	6.21^{a} ±0.65	6.44^{a} ±0.53	5.56			
	Av.	4.60^{c}	5.07^{b}	6.27^{a}	6.49^{a}				

a,b,c,d,e: Means with different superscripts in the same row within item differ significantly; NS = Not significant;
***= (P≤0.05); **= P≤0.01); D= Domyati ducks; P= Pekin ducks.**

Plasma total protein, albumin (A), globulin (G) and A/G ratio are shown in Table 7, it could be noticed that the effect of iodine treatments were significantly high in both total protein and A/G ratio but not in albumin (A) and globulin (G). These results are in agreement with Hamdy and El-Latif (1999) who noted that Potassium iodide supplementation at 300 and 500 ppm /L drinking water in Japanese quail was significantly high in total protein.

Influence of KI supplementation in ration on calcium and phosphorus in Table 7. Calcium was significantly increased by 26.09, 18.59 and 10.82%, respectively. While, P was significantly increased by 19.43, 7.29 and 5.87%, respectively for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control once. These results are in agreement with Hassaan *et al.* (2008) who reported that chickens weight showed with heavey significantly increased in calcium and phosphorus than the chickens of low body weight. This may be dye to thyroid hormone increased calcium and phosphorus absorption (Abdel-Hamid *et al.,* 2000).

Liver function and thyroid activity are presented in Table 7. It could be noticed that the effect of iodine treatments were significantly high. Plasma AST and ALT were significantly lower with duckling breed fed ration supplemented with Potassium iodide than control. It well known that the increasing level of AST is an indicator of hepatocytes damage however low AST values reflect the relationship between protein metabolism and the level of transaminase (Abd El-Hakim *et al*., 2002). Plasma ALT activity was useful in diagnosis of obstructive and degenerative hepatic diseases (Coles, 1986). While,Thyroid hormones was significantly increased by 41.09, 36.30 and 10.22%, respectively for duckling breed fed ration supplemented with Potassium iodide (2, 1.5 and 1%) as compared with control. These results are in agreement with Abdel-Malak *et al.* (2012) who noted that Potassium iodide supplementation at (0.6, 1.2 and 2.4) mg/kg diet in chicken had significantly increased thyroid hormones by increased iodine levels.

Interaction between duckling breeds and KI supplementation were significantly effect on blood constituents during different all studied except with albumin and globulin at 12 weeks of age.

Histological examination of liver and thyroid gland sections as influenced by treatments are illustrated in Fig. 1 to 8 . It is clear that dietary supplementation with KI had no negative impacts on the histological structure of both breeds .

Histological examination:

Treat. 1

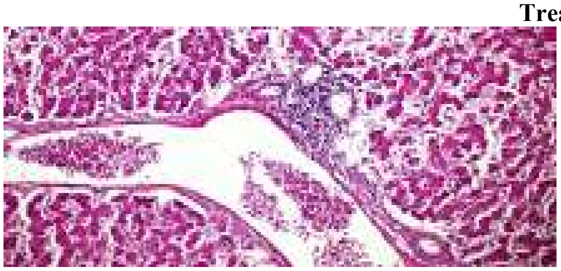

Fig. 1. Liver section showing some lymphocytic infiltrations in portal area as well as dilatation of portal blood vessel accompanied by sinusoidal dilatations.

Fig. 2. Thyroid gland section showing thyroid follicles with colloidal secretions as well as patent inter follicular cells.

Treat. 2

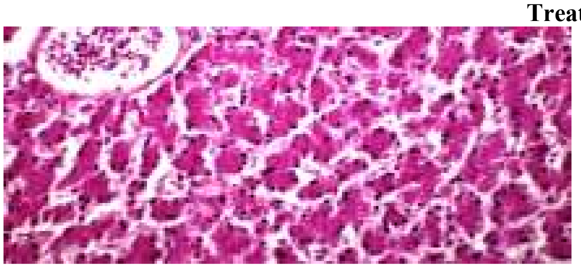

Fig. 3. Liver section showing patent hepatic rosette with patent central vein and hepatic sinusoids.

Fig. 4. Thyroid glands section showing patent active thyroid follicles with colloidal secretions as well as patent inter follicular cells.

Treat. 3

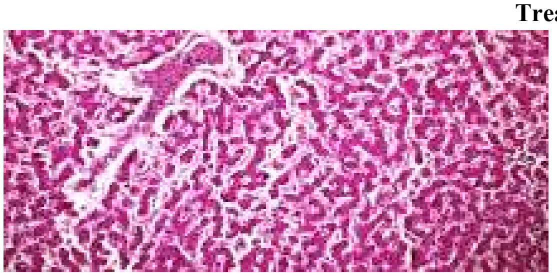

Fig. 5. Liver section showing dilated congested central vein with dilated hepatic sinusoids.

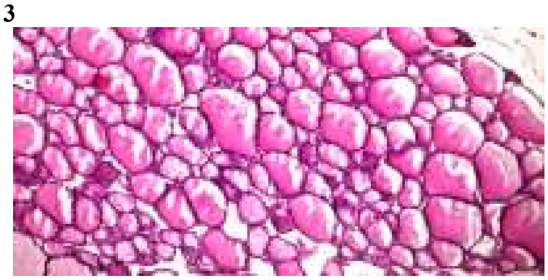

Fig. 6. Thyroid glands section showing patent thyroid follicles with colloidal secretions as well as patent inter follicular cells.

Treat. 4

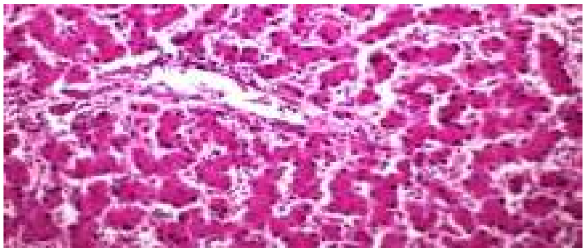

Fig 7. Liver section showing patent central vein and hepatic sinusoids as well as patent hepatic rosette.

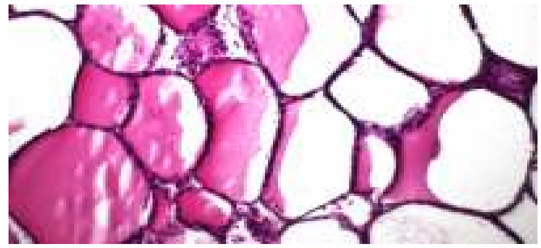

Fig. 8. Thyroid glands section showing patent thyroid follicles with colloidal secretions as well as patent inter follicular cells.

General Discussion

Dietary potassium iodide (KI) alleviated heat load on performance and some biochemical blood parameters of ducks breed under summer season in Egypt. High ambient temperature is considered as a potent climatic stressor causing impaired antioxidant status in ducks. Iodine is an important nutrient for metabolism and has significant effects on the thyroid gland.

Iodine is an essential element and vital to natural growth and development. About 65% of iodine is stored in the human body in the thyroid gland. It has many health benefits that play an important role in the functioning of the thyroid, which secrete hormones and control the rate of basic metabolism of the body. In fact the thyroid without iodine does not secrete hormones.

Iodine plays an important role in maintaining optimal energy levels because it ensures the proper use of calories and does not allow the accumulation of excess fat. Important functions of iodine, including the main backer of the immune system. Iodine also removes free hydroxyl radicals. It also stimulates the performance of antioxidants throughout the body to give the body strength against various diseases.

CONCLUSION

It could be concluded that ducklings of both breeds that fed ration supplemented with 2 mg iodine/kg ration had better performance without any adverse effect on physiological responses and carcass quality. Since , this iodine level is recommended for both Pekin and Domyati ducklings .

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تأثير إضافة الأيودين فى العليقة لتحسين الأداء الانتاجى للبط البكينى والدمياطى أثناء فترة النمو

وائل على حسن على[1] ،خالد عبد المعبود احمد على[1] ، أمل مغاورى هيكل[1] ، فضيلة محمد عيسى[1] ، مسعد عبد الفتاح أحمد العايق[1] و رهام على محمد على[2]

[1] قسم بحوث تربية الارانب والرومى والطيور المائية – معهد يحوث الانتاج الحبوانى – مركز البحوث الزراعية – وزارة الزراعة – الدقى – الجيزة - مصر.

[2] قسم الانتاج الحيوانى والدواجن- كلية الزراعة والموارد الطبيعية - جامعة اسوان- مصر.

أجريت التجربة بهدف دراسة تأثير استخدام مستويات مختلفة من اليود على الاداء الانتاجى والصفات الفسيولوجية لكل من سلالتى البط البكينى والدمياطى .استخدم فى هذه الدراسة عدد 240 كتكوت بط عمر يوم لكل من السلالتين 120) بطة/ سلاله) تم وزن وتقسيم كتاكيت البط من كل سلالة عشوائيا الى اربع مجاميع تجريبية متساوية العدد (30 بطة / المجموعة) وكل معاملة قسمت إلى 3 مكررات (10 بطة / مكررة(، تم اضافة اليود) فى صورة يوديد البوتاسيوم (للعليقة الاساسية للمجموعات بتركيزات) صفر، 1 ، 1.5 ، 2) ملجم / كيلوجرام عليقة خلال فترة النمو(عمر يوم 12- أسبوع) وأظهرت النتائج الآتى :ادى اضافة الايودين لتحسن معنوى فى وزن الجسم النهائى ومعدل الزيادة اليومية ومعدل استهلاك العلف اليومى والكفاءة التحويلية للغذاء وطول الساق وطول عظمة القص ومحيط الجسم مقارنة بالمجموعة المقارنة (الكنترول) خلال فترة التجربة (عمر يوم -12 أسبوع). لوحظ تحسن معنوى فى الاوزان النسبية للذبيحة والاعضاء الليمفاوية والغدة الدرقية بزيادة مستويات الايودين المعطاه. لوحظ تحسن معنوى فى البروتينات الكلية والألبيومين والجلوبيولين وهيموجلوبين الدم وعدد كل من كرات الدم الحمراء والبيضاء خاصة الخلايا الليمفاوية وعلى العكس المجاميع المعاملة بالايودين سجلت انخفاضا معنويا فى مستويات الليبدات الكلية والكوليسترول والجلسريدات الثلاثية وانزيمات الكبد بالمقارنة بالكنترول. التوصية: وجد من هذه الدراسة أن اضافة مستويات محتلفه من الايودين فى علائق البط خاصة عند مستوى 2 ملجم / كيلوجرام عليقة ادى الى تحسن الاداء لأنتاجى للبط دون آى تأثير سيئ على الأستجابة الفسيولوجية وجودة الذبيحة.