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ROLE OF DIETARY IODINE ON MODULATING PRODUCTIVE, REPRODUCTIVE, PHYSIOLOGICAL AND IMMUNOLOGICAL PERFORMANCE IN LOCAL CHICKENS
1-DURING GROWTH PERIOD

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ABSTRACT: An experiment was conducted for a period of 9 wks to investigate the possible usefulness of supplying different dietary levels of iodine as potassium iodide (KI) on modulating growth performance, some physiological and hematological parameters, mortality rate, carcass characteristics and immune status of Silver Montazah (SM) cockerels (Egyptian developed strain). One hundred and eighty SM cockerels 5 wks old were taken from a large flock and divided into five treatment groups, each with 3 replicates (12 cockerels each). The 1st group (T1) represented the overall mean weight of the cockerels flock and fed the basal diet (0.3 mg iodine/kg diet) and served as control 1, the other four groups were taken from the same flock having an average weight lesser than the overall mean by 25%. Cockerels were divided on treatments as follows, the 2nd group (T2) was fed the basal diet and served as control 2, while the 3rd (T3), the 4th (T4) and the 5th (T5) groups were fed the basal diet plus 1.2, 2.4 and 4.8 mg iodine/kg diet, respectively. Results indicated that iodine supplementation especially at 4.8 followed by 2.4 mg iodine/kg diet significantly ($P \leq 0.01$) improved live body weight, body weight gain, and feed conversion ratio of SM cockerels compared to the control 2 group. Moreover, significant increases were obtained for blood hemoglobin, hematocrite, red and white blood cells count mainly lymphocytes. As well, plasma total protein, globulin, T3 and T4 hormones, calcium and phosphorus salts were elevated at 4.8 mg iodine/kg diet. Conversely, supplemental iodine reduced significantly plasma concentration of total lipid, cholesterol, LDL, AST and ALT activities. Relative weights of carcass and lymphoid organs (spleen and thymus gland) of SM cockerels were increased linearly with iodine provision

In conclusion, dietary supplementation of iodine as KI is a practical application at 4.8 mg I/kg diet to the cockerels and had beneficial effects on growth performance, carcass characteristics, physiological and hematological parameters and immune status.

Key words: Iodine, Modulating Growth, Carcass, Immune Status, Local Cockerels.

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INTRODUCTION

The poultry industry in Egypt is under continuous pressure to provide more economical and high quality product to the consumer. Iodine is considered as a trace mineral, which is essentially required for birds in small amount for normal production and metabolic functions. It plays a great physiological role as a component of the thyroid hormones, thyroxin (T4) and triiodothyronine (T3), thus the gland cannot synthesize its hormones without adequate quantities of iodide in the blood (Sturki, 1986 and Patrick, 2008). Potassium iodide (KI) has been used to block uptake of iodine in the thyroid gland which play a basic role in biology, acting on gene transcription to regulate the basal metabolic rate (Patrick, 2008). KI is a white to yellow crystalline powder with a minimum content of 67% total iodine and 21% potassium (Eurl, 2012). The thyroid gland needs about 70 to 100 micrograms iodine/day to synthesis the requisited daily amount of T4 and T3 hormones (Brown, 1991). Mcnabb and King (1993) cited that, excess iodine has symptoms similar to those of iodine deficiency and commonly encountered symptoms are abnormal growth of the thyroid gland and disorders in functioning and growth of the organism as a whole. Harpal and Nordskog (1982) reported that body weight, is an important indicator of general health and the maintenance of optimum body weight is dependent more on proper nutrition, management and disease control than on genetically-determined body size. Moreover, Lesson and Summers (2001) indicated that in intact chickens, it is generally thought that the use of thyro active substances has little advantage in the production of meat birds because thyroid hormones usually function as a catabolic agent in intact chickens whereas they demonstrated that the productive performance of broiler chickens was improved by an appropriate amount of thyroactive substances.

El-Wardany et al. (2011) showed that administration of 1mg calcium iodide (CaI)/kg diet in broiler chickens could improve the productive performance compared with the control diet in association with considerable changes in thyroidal hormones (T3 and T4) and their ratio T3/T4. Moreover their results reflect the beneficial use of CaI as a safe additive without hazards effects on organs histology. Likewise, Abdel-Malak et al., (2012) reported that growth and egg production as well as feed conversion ratio of Golden Montazah laying hens were the best for hens, fed diet containing 1.2 followed by 2.4mg I/kg diet as KI without any adverse effect on growth or egg production, also blood thyroid hormones and phosphorus were significantly increased by increasing iodine levels. Nima et al. (2012) reported that daily body weight gain increased and feed conversion ratio improved as dietary I increased from 0.46 to 0.86mg/kg diet during the growth period. Moreover El-Ansary et al. (1996) in chickens demonstrated that, addition of potassium iodide (KI) in the drinking water at level of 400ppm KI/Litter drinking water significantly improved body weight, body weight gain, feed conversion ratio, carcass weight and decreased the mortality rate. Hamdy and Abd El-latif (1999) supplemented KI at 300 and 600 ppm/L drinking water for Japanese quail and mentioned that KI increased serum total protein and total lipids but decreased serum glucose. While El-Kaiaty et al., (2004) injected Muscovy ducklings with (0, 0.5, 1.0 or 1.5cm) of potassium iodide solution, plasma T3 was higher in the groups injected with KI compared with the control. Abaza et al., (2003) found that when they study the effects of different thyroid status on male (Alexandria cockerels) reproductive characteristics and immune response that thymus and spleen relative weights and white blood cells count, mainly lymphocytes, were higher than the controls in hyper thyroid males and this was a companied with better immune response to SRBC and higher immunoglobulines (IgG and IgM). Therefore, the objectives of this experiment were to study the influence of varying dietary levels of iodine on marketing body weight, some physiological and hematological parameters, carcass characteristics and immune status of local SM cockerels.

MATERIALS AND METHODS

This study was carried out at Inshas Poultry research Station (El-Sharkia Governorate), Animal Production Research Institute, Agricultural Research Center, Egypt.

Chicks and experimental design

A total number of one hundred and eighty Silver Montazah cockerels (Egyptian local strain) 5 wks old were taken from a large flock, wing banded and individually weighed then divided into five treatment groups, each of 36 cockerels with three replicates (12 cockerels each). The 1st group (T1) represented the overall mean weight of the cockerels flock and fed the basal diet (0.3 mg iodine/kg diet) and served as control 1, the other four groups (144 cockerels) were taken from the same flock with an average weight lesser than the overall mean by 25%. Cockerels were divided on treatments as follows, the 2nd group (T2) was fed the basal diet and served as control 2, whereas the 3rd (T3), the 4th (T4) and the 5th (T5) groups were fed the basal diet supplemented with potassium iodide (KI) that produced by Elgomhoria Company for medicine. Egypt to get iodine concentration of 1.2, 2.4 and 4.8 mg iodine/kg diet, respectively. All cockerels were kept under the same managerial hygienic and environmental conditions in a windowed house with light cycle regimen of 16h light:8h darkness throughout the experimental period. Feed and water were provided ad libitum. The basal experimental diet was formulated to meet the nutrient requirements of SM cockerels during growth period according to feed composition Tables for animal and poultry feed stuffs used in Egypt (2001). The composition and calculated analysis of the experimental basal diet is present in Table 1. Treatments were lasted for 9 wks until the cockerels were 14 week old.

Measurements:-

Productive performance:-

Individual live body weight (LBW) for each replicate within each treatment group was recorded at 5, 9, and 14 wks of age to the nearest gram. Body weight gain (BWG) was calculated by subtracting the previous weeks body weight from the week being recorded. Feed consumption (FC) was recorded weekly for each replicate and treatment group so that feed conversion ratio (FCR) was calculated as gram feed consumed per gram body weight gain (g feed/g gain) for the same periods. Mortality rate was daily recorded and calculated as a percentage of total mortality due to the treatment effect.

Carcass traits:-

At the end of the experimental period (14 wks of age) six cockerels from each group were randomly taken, weighed, slaughtered and after complete bleeding, feathers were removed. The birds were weighed after removing heads, legs and viscera to determine the percentage of carcass weight included wings and necks. The heart, liver, empty gizzard, and lymphoid organs (thymus and spleen) as well as different parts of carcass were separated, weighed and their relative percentages to live body weight were calculated.

Blood biochemical analysis and hematological picture:-

Blood samples were collected from

each slaughtered bird during exsanguinations in two heparinized test tubes. Blood of the first tube was used to evaluate the total count of red and white blood cells, hematocrit value (PCV%), hemoglobin concentration (Hb), and blood smears were done and stained with Leishman's stain for the differential counts of leucocytes. The other blood tube was centrifuged at 3000 rpm for 20 minutes, so plasma samples were harvested and stored at -20°C until the biochemical analyses of total protein (TP), albumin (A), globulin (G), calcium, inorganic phosphorus, total lipids (TL), total cholesterol (Tch), high density lipoproteins (HDL), low density lipoproteins (LDL), and hepatic enzymes aspartate amino transaminase (AST) and alanine amino transaminase (ALT) were done at animal production research institute laboratories. Globulin (G) was calculated by subtraction of plasma albumin from total protein, and albumin /globulin (A/G) ratio was calculated. Plasma triiodothyronine (T3) and thyroxin (T4) hormones were determined by using radioimmunoassay KIT produced by (Beckman Coulter Company PI-1447) according to the manufacture recommendations of commercial kits.

Statistical analysis:

Data were subjected to one-way analysis of variance using SAS (2001). Differences among means were detected by using Duncan's multiple range test (Duncan, 1955). The percentage values were transferred to percentage angle using arcsine equation before subjected to statistical analysis, and then actual means are presented. The following model was used:

Yij = G + Ti + eij.

Where, Yij = observation for each dependent variable; G = General mean;

Ti = Treatment effects (i = 1,2... and 5); eij = Random error.

RESULTS AND DISCUSSIONS

Productive performance traits:

Live body weight (LBW), body weight gain (BWG) and mortality rate (MR):

Results of LBW and BWG at different ages and periods showed significant ($P \leq 0.01$) differences among treatments (Table 2). The inclusion of iodine as (KI) in the diets significantly improved LBW values of SM cockerels at 9 and 14 wks of age compared with those of T2. The heaviest LBW values were recorded for cockerels of T5 group followed by those of T4 and T3 groups, respectively throughout the experimental period irrespective of cockerels of T1 (control 1 group). Similar previous trend was obtained for BWG values (Table 2). Thus the T2 had the lowest LBW and BWG data when compared with the remaining tested ones. These results are in agreement with those reported by Nima et al., (2012) who found that daily BWG increased as dietary I increased from 0.46 to 0.86mg/kg diet during the growth period. Likewise these results are in full agreement with those reported in chicken by El-Ansary et al. (1996) who demonstrated that addition of KI in the drinking water significantly improved body weight and body weight gain. Also, El-Wardany et al. (2011) in broilers and Abdel-Malak et al. (2012) in local chickens found an improvement in the productive performance using dietary 1 mg CaI and graded levels of iodine (0.6, 1.2 and 2.4) mg/kg diet, respectively. The increase in body weight and body weight gain of SM cockerels treated with 4.8mg I/kg diet may be due to the increase in feed intake and/or to increases of thyroid hormones (T3 and T4) which are needed for normal growth and development as reported here in Table 6. Thyroidal hormones are necessary with growth hormone for early growth and development which involved in IGF-1 production, stimulating cellular protein synthesis in almost every tissue of the body throughout the life of chickens (Tsukada et al., 1995). From Table 2, it is clear that KI treatments had a positive effect on survivability of SM cockerels, as they recorded zero mortality during the growth period of experiment comparable to the birds of T2 that showed 2.7% mortality due to mainly more unhealthy cockerels whose it contained than the other heavier groups (Singh and Nordskog, 1982). The current findings support the suggestion that the maximization of profit from meat type chicks could be achieved from not only improving growth rate, but also increasing livability of marketable chicks. This beneficial effect of iodine supplementation may be due to the role of I in activation of the immune system and increased autoimmunity in birds (El-Kaiaty, et al., 2004).

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

Data concerning FC, showed a non-significant differences among iodine treatment groups (Table 3). The T1 group recorded the highest FC during the whole experimental period from 5-14 wks of age. While, FCR showed significant differences among treatment groups, in which cockerels of T5 fed 4.8mg I/kg diet recorded the best FCR followed by those given 2.4mg I/kg diet (T4). These findings are consistent with the findings of El-Ansary et al (1996) in chicken and Hamdy and Abdel-Latif (1999) in Japanese quail, who reported an improvement in FCR due to dietary or drinking water supplementation of KI. Also, El-Wardany et al. (2011) and Abdel-Malak et al. (2012) reported that, addition of 1mg CaI or 1.2 and 2.4mg I/kg in broiler or local chickens diets, respectively improved the feed conversion ratio. The influence of iodine on feed utilization may be due to an alteration of the microflora of the gut, consequently, more nutrients are available for better growth performance of chicks (Stanley and Bailey, 1989). It's worthy to note that the better FCR may be due to the increase in body weight gain that achieved during the whole experiment periods (5-14) wks of age.

Hemato-biochemical parameters:

Hematological characteristics:

The results showed that iodine treated cockerels had significantly high RBC's number especially T5 that fed 4.8mg I/kg diet (Table 4). The increase in RBC's number was accompanied with a significant increase in hemoglobin (Hb) and heamatocrite (PCV). These results comes in agreement with the previous findings of Elnagar et al. (2001) on broiler chicken, El-Sebai et al. (2002) on Japanese quail and Abaza et al. (2003) on Alexandria cockerels. They reported that RBC's number was significantly increased with hyperthyroidism, which was accompanied by a significant increase in Hb concentration and heamatocrite values. Data concerning white blood cell (WBC's) count, are presented in Table 4. As shown there were significant differences among treatment groups, in which WBC's count was significantly increased ($P \leq 0.05$) in cockerels fed diet containing 2.4mg I/kg diet and 4.8mg I/kg diet compared with the control 2 group. This mainly due to an increase ($P \leq 0.05$) in the lymphocyte percentage. In spite of, the absence of significance among treatments respecting the H/L ratio, it is observable that the KI groups had numerically lower values compared with the non supplemented one (T2), indicating better immune responses. This comes in good agreement with the findings of Abaza et al. (2003) who reported that DL-thyroxin in the rate of 0.5ppm in the diet increased the number of WBC's particularly of lymphoid cells. Also, Beckman and Mashaly (1987) stated a positive correlation between thyroxin levels and number of circulating lymphocytes.

Biochemical characteristics:

Data of some plasma blood constituent of Silver Montazah cockerels as affected by feeding diet containing varying levels of iodine (KI) are presented in Table

5. It is clear that the effect of iodine supplementation was more pronounced in cockerels received the high level of iodine (4.8mg I/kg diet), thus plasma total lipids concentration was decreased significantly. Moreover, plasma cholesterol, triglycerides and LDL followed the same trend of plasma total lipids. On the contrary, plasma levels of HDL was significantly the highest for the iodine supplemented groups comparable to the control 2 group. These results are in agreement with the finding of Mohamed (1995) and El-Gendi (1997) who reported that cholesterol significantly decreased by injection of 1mg eltroxin/kg body to Fayoumi, Dandrawi and RIR pullets when compared with the control group. Also, Elnagar et al. (2001) and El-Sebai et al. (2002) found that serum total lipids, triglycerides and cholesterol were significantly decreased under hyperthyroidism status when DL-thyroxin at level of 0.5ppm added to the diet of chickens or Japanese quail. These results may be due to the role of iodine on lipid metabolism (Mcnabb and King, 1993).

Plasma total protein (PTP), albumin (A), globulin (G) and A/G ratio are presented in Table 5. It is evidently shown that dietary supplementation of iodine has been linearly ($P \leq 0.05$) increased both plasma total protein and globulin but not albumin levels. These results are in agreement with those reported by Hamdy and Abd El-Latif (1999), who showed that supplementation of KI at 300 and 500ppm/L drinking water in Japanese quail increased significantly serum total protein. The A/G ratio that has been well known as an indicator for the immune resistance, was significantly the highest in the untreated cockerels (T2) control 2 group, indicating the worst immune status. Where the low A/G ratio indicate more disease resistance and immune response (Lee et al., 2003). These findings are in harmony with the results of body weight. Hassaan et al. (2008) in chickens and Bayomi et al. (2008) in Japanese quail, reported that chicks of heavy body weight group showed significant elevation in serum total protein than the chicks of low body weight group. Plasma total protein level could be referred to the suggested effect of KI which used to block uptake of iodine in the thyroid gland which play a basic role in biology, acting on gene transcription to regulate the basal metabolic rate and synthesis of protein (Patrick, 2008).

Respecting the influence of supplemental dietary iodine on plasma concentration of calcium and phosphorus. Results shown in Table 5 revealed that, non supplemented control groups had significantly the lowest plasma concentration of both minerals (Ca and P) when compared to the other supplemented ones. Besides, calcium and phosphorus levels were markedly increased in plasma of cockerels whose diet contained the high level of iodine (T5 group) followed by those in T4 and T3 groups, respectively. These results are in harmony with El-Sebai et al. (2002) who reported that both serum Ca and P concentrations significantly increased under hyperthyroidism, where serum Ca and P concentrations were raised by 16 and 28%, respectively. Interestingly, the current findings pointed out that treatment groups showed significantly ($P \leq 0.05$) difference on Ca and P levels in which the heavy body weight group exhibited high levels of both Ca and P compared with the other groups at the end of the experimental period. These results are in full agreement with those reported by Hassaan et al. (2008) who showed that chicks of heavy body weight group showed significant elevation in serum Ca and P than the chicks of low body weight group. This may be attributed to the differences in Ca and P regulation and absorption among the experimental groups. As well, thyroid hormones increased the total Ca and P absorption efficiency (Abdel-Hamid et al., 2000).

Thyroid activity and liver functions:

Data presented in Table 6, illustrate the effect of dietary iodine supplementation on thyroid gland activity and liver functions of SM cockerels. Plasma concentrations of thyroid hormones (T3 and T4), as an indication of thyroid activity, were significantly increased ($P \leq 0.01$) by increasing dietary iodine levels compared with the control groups (T1 and T2), which recorded the lowest levels of both hormones. These results agreed with El-Wardany et al. (2011) in broilers and Abdel-Malak et al. (2012) in laying hens by adding CaI 1mg/kg diet or different levels of iodine (0.6, 1.2 and 2.4) mg/kg diet, respectively. They showed that thyroid hormones were significantly increased by increasing iodine levels. The current results showed that serum concentration of T3 hormone was significantly elevated in the heavy cockerels group compared to the light ones. These results are in agreement with those of Hammouda et al. (2001) in broiler chicks and Hassaan et al., (2008) in local chicks. They reported that chicks of the heavy line whose LBW was the highest exhibited the highest values of T3 hormone compared with those had the lowest LBW. These data confirmed the important role of T3 hormone in the regulation of protein metabolism and protein turnover, especially in skeletal muscles (Hayashi et al., 1992). In this respect, El-Husseiny et al. (2000) concluded that T3 hormone was 2-3 times as biologically active as T4 hormone in the chicks and oxygen consumption was significantly increased by T3 or T4 thereby, increased growth rate. Furthermore, the results of Nyoman et al. (1989) supported the hypothesis that the response of chickens to thyroid hormones varied by sex and dose.

It is clearly observed that, dietary addition of iodine levels, (Table 6) could significantly affect the hepatic enzymes activities. Where, cockerels of control groups recorded the highest values of both aspartate amino transaminase (AST) and alanine amino transaminase (ALT) enzymes comparable to cockerels of the other supplemented groups. These results indicated that supplemental iodine had no deleterious effect on liver functions and may protect the hepatocytes of SM cockerels from being destroyed and that is meant a better liver function associated with iodine supplementation. The current results are in harmony with Elnagar et al. (2001) in broiler chicks and El-Sebai et al. (2002) in Japanese quail, they found that serum AST concentration was significantly decreased with hyperthyroidism. Therefore, the results indicated that the heavy body weight treated cockerels had a better liver functions than the light ones. These results are in harmony with those of Hassaan et al. (2009) who reported that light weight chicks on the average produce the lowest meat and egg mass, because this class would include mainly more unhealthy chicks than the heavy birds, which confirm the results of the present study.

Carcass traits:-

Results presented in Table 7 indicated that, overall means of carcass percentage was significantly ($P \leq 0.05$) increased in SM cockerels at the end of the experimental period (14 wks of age) that fed diet containing varying levels of iodine, especially the high level of iodine (4.8mg I/kg diet) compared with the control groups. These results are in agreement with the findings of El-Ansary et al. (1996) and El-Husseiny et al. (2000) in chickens, they demonstrated that addition of (KI) in the drinking water, or iodocasein at level of 400ppm KI/liter drinking water, significantly improved the carcass weight. Meanwhile, the carcass and dressing weight percentages followed the same trend of LBW and BWG, where high positive genetic and phenotypic correlations were found among body weight and carcass traits (Hanan, 1999 and Pramod et al., 2002)

Overall means of relative weights of primary (thymus) and secondary (spleen) lymphoid organs are presented in Table 7. Relative lymphoid organ weights are easily measured and reflect the body's ability to afford lymphoid cells during an immune response (Heckert et al., 2002). Primary lymphoid organs are those organs whose function is to regulate the production and differentiation of lymphocytes and other leukocytes. While the secondary lymphoid organ functions are to trap antigens and serve as the site for interaction between foreign antigens and different types of leukocytes (Kuby, 1997). Supplementation of dietary iodine significantly improved the immune status as reflected by the relative weights of lymphoid organs compared with the control 2 group. These results are in harmony with those reported by Abaza et al. (2003) on Alexandria cockerels and Abdel-Fattah and Abdel-Azeem (2007) on ISA Brown chicken layers. They reported that thymus and spleen relative weights and white blood cells count, mainly lymphocytes, were higher than the controls in hyperthyroid chicks, resulting in better total secondary immune response and IgG anti-SRBc's as compared to the control group. The latter result may interpret the advantage of productive adaptability. Fathi et al. (1998) confirmed that, chickens possessed higher lymphocytes had a better productive performance.

In conclusion, the present study indicated that supplemental iodine especially 4.8mg I/kg diet to SM cockerels, of -25% from the overall mean weight, is required to achieve optimum growth performance and carcass characteristics. Moreover, this I level had beneficial effects on some physiological, hematological and immunological parameters for attaining the goal of improvement of meat production in local and developed Egyptian cockerels.

Table (1): Composition and calculated analysis of the experimental basal diet.

Ingredients	Percentage (%)
Yellow corn	59.84
Soya bean meal 44%	24.20
Wheat bran	8.20
Corn gluten 60%	4.00
Di Calcium phosphate	1.53
Lime stone	1.52
Sodium Chloride	0.37
*Premix	0.30
DL-Methionine	0.04
Total	100.00
Calculated values (%) **	
Crude protein %	19.0
Metabolizable energy (Kcal/kg)	2800
Crude fiber (C.F.) %	4.124
Ether extract %	3.052
Calcium %	0.995
Available Phosphorous %	0.447
Lysine %	0.949
Methionine %	0.403
Methionine & cysteine %	0.734

*premix added to the 1 kg of diet including Vit.A 10000 I.U; vit. D3 2000 I.U; vit. E 15 mg; vit. K3 1 µg; vit B1 1mg; vit. B2 5mg; vit. B12 10 µg; vit B6 1.5mg; Niacin 30mg; Pantothenic acid 10mg; folic acid 1mg; Biotin 50 mg; choline 300 mg; zinc 50mg; copper 4mg; iodine 0.3 mg; iron 30mg; selenium 0.1mg; manganese 60mg; cobalt 0.1mg and carrier CaCo3 up to 1kg.

** According to feed composition Tables for animal and poultry feedstuffs used in Egypt, (2001).

Table (2): Effect of supplemental dietary iodide on live body weight (g), live body weight gain (g) and cumulative mortality rate of Silver Montazah cockerels at different ages (Means ± S.E).

Trait	Age (wks)	Treatments					
		T1	T2	T3	T4	T5	Sig.
Live body weight (g)	5 wk	440.00 ^{a}±16.62	330.00 ^{b}±14.82	330.00 ^{b}±15.98	330.00 ^{b}±15.81	330.00 ^{b}±14.48	**
	9 wk	654.52 ^{a}±16.20	522.56 ^{c}±17.90	569.45 ^{b}±22.43	585.08 ^{b}±14.95	604.16 ^{b}±15.20	**
	14 wk	1194.45 ^{a}±13.13	986.11 ^{d}±18.04	1016.67 ^{d}±19.48	1066.69 ^{c}±15.22	1120.83 ^{b}±17.66	**
Live body weight gain (g)	5-9 wk	214.52 ^{c}±9.94	192.56 ^{d}±8.70	239.45 ^{b}±10.30	255.08 ^{b}±9.75	274.16 ^{a}±7.24	**
	9-14 wk	539.93 ^{a}±21.12	463.55 ^{d}±19.18	447.22 ^{e}±16.43	481.61 ^{c}±18.80	516.67 ^{b}±13.34	**
	5-14 wk	754.45 ^{b}±29.18	656.11 ^{d}±26.39	686.67 ^{c}±23.66	736.69 ^{b}±21.32	790.83 ^{a}±29.18	**
Mortality rate %	5-14	0.00	2.70	0.00	0.00	0.00	

a, b,c …Means within a row with different superscripts are significantly differ. *= $P \leq 0.05$; **= $P \leq 0.01$; NS=Not significant. T1=Control 1 group, T2=Control 2 group, T3=Fed the basal diet + 1.2 mg iodine/kg diet, T4=Fed the basal diet + 2.4 mg iodine/kg diet, T5=Fed the basal diet + 4.8 mg iodine/kg diet.

Table (3): Effect of supplemental dietary iodide on feed consumption (g/cock) and feed conversion ratio (g feed/g weight gain) of Silver Montazah cockerels at different ages (Means ± S.E).

Trait	Age (wks)	Treatments					
		T1	T2	T3	T4	T5	Sig.
Feed consumption (g)	5-9 wk	1250.00±13.22	1221.00±14.28	1235.00±12.16	1264.00±14.84	1251.00±15.18	NS
	9-14 wk	1797.00 ^{a}±23.90	1656.00 ^{b}±22.82	1617.00 ^{b}±24.12	1631.00 ^{b}±25.06	1653.00 ^{b}±23.12	**
	5-14 wk	3047.00 ^{a}±34.80	2877.00 ^{b}±32.69	2852.00 ^{b}±33.24	2895.00 ^{b}±32.86	2904.00 ^{b}±34.12	**
Feed conversion ratio	5-9 wk	5.83 ^{b}±0.07	6.34 ^{a}±0.09	5.16 ^{c}±0.08	4.96 ^{c}±0.06	4.56 ^{d}±0.09	**
	9-14 wk	3.33 ^{b}±0.04	3.57 ^{a}±0.06	3.62 ^{a}±0.05	3.39 ^{b}±0.08	3.20 ^{c}±0.03	**
	5-14 wk	4.04 ^{c}±0.03	4.38 ^{a}±0.02	4.15 ^{b}±0.04	3.93 ^{d}±0.01	3.67 ^{e}±0.05	**

a, b,c …Means within a row with different superscripts are significantly differ. *= $P \leq 0.05$; **= $P \leq 0.01$; NS=Not significant. T1=Control 1 group, T2=Control 2 group, T3=Fed the basal diet + 1.2 mg iodine/kg diet, T4=Fed the basal diet + 2.4 mg iodine/kg diet, T5=Fed the basal diet + 4.8 mg iodine/kg diet.

Table (4): Effect of supplemental dietary iodide on hematological parameters of Silver Montazah cockerels at 14 wks of age (Means ± S.E).

Trait	Treatments					
	T1	T2	T3	T4	T5	Sig.
RBCs x ($10^{6}/mm^{3}$)	$2.03^{b}\pm0.12$	$1.76^{c}\pm0.26$	$2.03^{b}\pm0.23$	$2.20^{a}\pm0.15$	$2.28^{a}\pm0.08$	*
PCV%	$31.33^{a}\pm1.76$	$27.33^{c}\pm1.20$	$29.67^{b}\pm1.45$	$31.65^{a}\pm0.88$	$32.23^{a}\pm2.31$	*
Hb (g/dl)	$16.33^{b}\pm1.20$	$14.00^{c}\pm0.58$	$17.12^{b}\pm1.53$	$19.22^{a}\pm1.15$	$19.87^{a}\pm0.88$	*
WBCs x ($10^{3}/mm^{3}$)	$4.30^{a}\pm0.66$	$4.03^{b}\pm0.22$	$4.28^{ab}\pm0.35$	$4.32^{a}\pm0.25$	$4.57^{a}\pm0.19$	*
Differential leucocyte count (%)						
Heterophils (H) %	$22.67^{a}\pm1.45$	$22.88^{ab}\pm1.15$	$22.33^{a}\pm1.20$	$22.57^{a}\pm1.45$	$21.84^{b}\pm3.51$	*
Lymphocytes (L) %	$68.33^{b}\pm1.76$	$66.12^{c}\pm5.51$	$68.97^{b}\pm2.73$	$71.69^{a}\pm1.78$	$73.16^{a}\pm1.53$	*
Monocytes%	$7.00^{a}\pm0.58$	$7.33^{a}\pm0.77$	$5.70^{b}\pm0.61$	$4.13^{b}\pm0.76$	$3.33^{c}\pm0.66$	*
Eosinophils%	$2.00^{b}\pm0.42$	$3.67^{a}\pm0.46$	$3.00^{a}\pm0.57$	$1.61^{c}\pm0.33$	$1.67^{c}\pm0.33$	*
Basophils%	0.00	0.00	0.00	0.00	0.00	NS
H/L ratio	0.33±0.016	0.35±0.022	0.32±0.017	0.31±0.020	0.30±0.018	NS

a, b,c …Means within a row with different superscripts are significantly differ. *= $P \leq 0.05$; **= $P \leq 0.01$; NS=Not significant. T1=Control 1 group, T2=Control 2 group, T3=Fed the basal diet + 1.2 mg iodine/kg diet, T4=Fed the basal diet + 2.4 mg iodine/kg diet, T5=Fed the basal diet + 4.8 mg iodine/kg diet.

Table (5): Effect of supplemental dietary iodide on some plasma biochemical parameters of Silver Montazah cockerels at 14 wks of age (Means ± S.E).

Trait	Treatments					
	T1	T2	T3	T4	T5	Sig.
Total lipids (mg/dl)	241.75^{a}±7.78	246.78^{a}±8.98	233.91^{b}±8.36	224.79^{c} ±7.73	221.22^{c}±7.45	*
Cholesterol (mg/dl)	128.16^{a}±4.19	136.29^{a}±4.34	117.72^{b}±4.66	107.83^{bc}±3.92	105.55^{c}±5.95	*
Triglycerides (mg/dl)	109.59^{a}±1.31	111.18^{a}±1.42	105.15^{b}±0.72	103.77^{b} ±0.39	101.17^{b}±0.72	*
HDL (mg/dl)	47.42^{a} ±1.55	32.73^{c} ±1.30	35.34^{bc}±1.28	39.44^{b} ±1.46	42.60^{b} ±1.38	*
LDL (mg/dl)	84.56^{a} ±2.19	86.88^{a} ±3.12	83.14^{ab}±2.79	77.25^{b} ±2.98	75.67^{b} ±2.90	*
Total protein (g/dl)	3.86^{b} ±0.13	3.75^{b} ±0.17	4.45^{ab} ±0.33	4.65^{a} ±0.28	4.81^{a}±0.46	*
Albumin (A) (g/dl)	1.39±0.15	1.50±0.13	1.60±0.18	1.68±0.14	1.71±0.22	NS
Globulin (G) (g/dl)	2.47^{b} ±0.20	2.25^{b} ±0.16	2.85^{a} ±0.14	2.97^{a} ±0.17	3.10^{a}±0.24	*
A/G (Ratio)	0.56^{b} ±0.09	0.67^{a} ±0.18	0.56^{b} ±0.13	0.56^{b} ±0.15	0.55^{b} ±0.19	*
Calcium (mg/dl)	11.91^{b} ±0.29	11.14^{c} ±0.18	11.95^{b} ±0.64	13.95^{a} ±0.21	14.35^{a} ±0.38	*
Phosphorus (mg/dl)	4.97^{b} ±0.33	4.55^{c} ±0.21	5.12^{b} ±0.46	5.59^{a} ±0.58	5.85^{a} ±0.63	*

a, b,c …Means within a row with different superscripts are significantly differ. *= $P \leq 0.05$; **= $P \leq 0.01$; NS=Not significant.
T1=Control 1 group, T2=Control 2 group, T3=Fed the basal diet + 1.2 mg iodine/kg diet, T4=Fed the basal diet + 2.4 mg iodine/kg diet, T5=Fed the basal diet + 4.8 mg iodine/kg diet.

Table (6): Effect of supplemental dietary iodide on thyroid activity and liver functions of Silver Montazah cockerels at 14 wks of age (Means ± S.E).

Trait	Treatments					
	T1	**T2**	**T3**	**T4**	**T5**	**Sig.**
Thyroid activity						
T3 (ng/ml)	4.96 ^{b}±0.55	4.28 ^{c}±0.31	5.11 ^{b}±0.35	5.98 ^{a}±0.42	6.21 ^{a}±0.82	**
T4 (ng/ml)	14.85^{b}±1.38	13.76^{c}±1.63	14.92^{b}±1.86	15.52^{a}±1.82	15.70^{a}±1.56	**
Liver functions						
AST (U/L)	54.44^{a}±6.50	59.45^{a}±6.18	52.36^{a}±6.82	43.80^{b}±6.32	42.60^{b}±6.80	**
ALT (U/L)	26.89^{ab}±1.85	29.96^{a}±1.82	25.19^{b}±1.65	22.35^{bc}±1.33	22.02^{c}±1.68	**

a, b,c …Means within a row with different superscripts are significantly differ. *= P ≤ 0.05; **= P ≤ 0.01; NS=Not significant.

T1=Control 1 group, T2=Control 2 group, T3=Fed the basal diet + 1.2 mg iodine/kg diet, T4=Fed the basal diet + 2.4 mg iodine/kg diet, T5=Fed the basal diet + 4.8 mg iodine/kg diet.

Table(7): Effect of supplemental dietary iodide on relative weight of carcass, some lymphoid and internal organs of Silver Montazah cockerels at 14 wks of age (Means ± S.E).

Trait	Treatments					
	T1	**T2**	**T3**	**T4**	**T5**	**Sig.**
Carcass weight	64.77^{ab}±0.81	63.25^{b}±0.76	65.53^{a}±0.65	65.83^{a}±0.61	66.88^{a}±0.69	*
Spleen weight	0.26^{ab}±0.03	0.19^{c}±0.01	0.24^{b}±0.02	0.25^{b} ±0.01	0.29^{a}±0.04	*
Thymus weight	0.55^{bc}±0.08	0.52^{c}±0.06	0.57^{b}±0.04	0.58^{b}±0.06	0.62^{a}±0.09	*
Liver weight	2.30 ±0.13	1.97±0.16	2.10±0.22	2.22±0.24	2.25±0.18	NS
Heart weight	0.52±0.04	0.49±0.03	0.51±0.05	0.52±0.04	0.55±0.07	NS
Gizzard weight	2.52±0.11	2.37±0.13	2.40±0.15	2.39±0.25	2.53±0.23	NS

a, b,c …Means within a row with different superscripts are significantly differ. *= P ≤ 0.05; **= P ≤ 0.01; NS=Not significant.

T1=Control 1 group, T2=Control 2 group, T3=Fed the basal diet + 1.2 mg iodine/kg diet, T4=Fed the basal diet + 2.4 mg iodine/kg diet, T5=Fed the basal diet + 4.8 mg iodine/kg diet.

REFERENCES

Abaza,M.,Elnagar, S. And El-Sebai, A. (2003) Thyroid effects on semen quality and immune responses of mature Alexandria cockerels. Egypt. Poult. Sci,-23: 721 – 736.

Abdel-Fattah, S.A. and Abdel-Azeem, F. (2007). Effect of vitamin E, thyroxin hormone and their combination on humoral immunity, performance and some serum metabolites of laying hens during summer season. Egypt. Poult. Sci., 27:335-361.

Abdel-Hamid, E.F. ;Hussein, H.M and El.Wardany, I.E.(2000). Calcium and Phosphorus absorption as related to thyroxine and estrogen administration in two local strains of laying hens.Egypt J.Appl.Sci.,15 (11):33—55.

Abdel-Malak, N.Y., Osman, Sahar, M.H., Bahakaim, A.S.A., Omar, A.S. and Ramadan, Nehad, A. (2012). Effect of using different levels of iodine in layer's diets on egg iodine enrichment. Egypt. Poult. Sci., 32:851-864.

Bayomi, F.A., Abdel-Fattah, S.A., El-Hommsany, Y.M., Nermin Abdel-Gawad and Maie, F.M. (2008). Immunocompetence, hepatic heat shock protein 70 and physiological responses to feed restriction and heat stress in two body weight lines of Japanese quail. Int. J. Poult. Sci., 7:174-183.

Beckman, S.E. and Mashaly, M.M. (1987). Relationship between circulating thyroid hormones and cell mediated immunity in immature male chickens. Developmental and Comparative Immunology. 11 (7):203-213.

Brown, G.K. (1991). Extra thyroidal iodide concentrating mechanisms. Physiol. Rev. 41 (1): 189.

Duncan, D.B. (1955). Multiple range and multiple F-tests. Biometrics,11:1-42.

El-Ansary, E., El-Sharawy, G.E. and Zaki El-Din, M. (1996). Effect of iodine on the growth rate of chicks and egg production of hens. Egypt. Poult. Sci., 16:513-533.

El-Gendi, G.M. (1997). Effects of experimental hypo-and hyper thyroid function on some metabolic and productive parameters in Rhode Island Red, Fayoumi and Dandarawi hens. Second Hungarian Egypt. Poult. Conference. 16-19 September. Godollo, Hungary.

El-Husseiny, D., Arafa, S.A., Hashish, S.M. and Madian, A.H.H. (2000). Response of broiler performance to triiodothyronine (T3), thyroxin (T4), iodocasein and thiouracil supplemented diets. Egypt. Poult. Sci., 20:347-371.

El-Kaiaty, A.M., Ibrahim, A.A. and Ali, Nematallah, G.M. (2004). Responses in growth, blood constituents, physiological functions and immune response due to iodide injection of growing Muscovy ducklings. Egypt. Poult. Sci., 24:787-805.

El-Nagar. Samar.; El-Sebai, Azza and Abaza,M.(2001). Manipulation of thyroidal activity in broiler chicks:I.Birds Performance, Physiological and biochemical observations. Egypt.Poult.Sci. 21:1101—1119.

El-Sebai, Azza; Abaza, M.A. and El-Nagar, Samar.A. (2002). Relationship between thyroid gland and some reproductive and physiological traits of Japanese quail reared under short day photoperiod. Egypt. Poult. Sci., 22:519-530.

El-Wardany, I., El-Daly, Eman, F., Abd El-Gawad, A.H., Hemid, A.E.A. and Abd El-Azeem, Nafisa, A. (2011). Effect of thyroid activity modulation on some histological and biochemical aspects in broiler chickens. American-Eurasian J. Agric. And Environ. Sci., 11(6):902.

Eurl, (2012). Report on potassium iodide and calcium iodate anhydrous. Europen commission, Feed additives. No. 454413.

Fathi, M.M., El-Wardany, I.E., El-Hommosany, Y.M., Ali, U.M., Gad, A.G. and Zein-El-Dein, A. (1998). The effect of dietary crude protein concentration on semen yield and quality in male broiler breeder fowls. Egypt. Poult. Sci., 30:935-945.

Feed Composition Tables for Animal and Poultry Feedstuffs Used in Egypt (2001). Technical Bulletion No.1, Central lab for Feed and Food; Ministry of Agriculture, Egypt.

Hamdy, A.M.M. and Abd El-Latif, S.A. (1999). Effect of iodinated water on some productive and metabolic parameters of Japanese quail hens. Proceedings of the 6th scientific conferences on Anim. Nutr., 19-21 October, El-Arish, Egypt Part II. Egypt. J. of Nutr. and Feeds: Special issue, 703.

Hammouda, Y.A.F, El-Daly, E.F. and El-Wardany, I. (2001). Response of two broiler strains to dietary protein level in hot climate; nutritional and physiological study. Egypt. Poult. Sci; 21 : 677 – 699.

Hanan, A.H. (1999). Estimation of some phenotypic parameters for growth and productive traits in two lines of Fayoumi chicken. M.Sc. Thesis, Cairo Univ., Fayoum, Egypt.

Harpal, S. and Nordskog, A.W. (1982). Significance of body weight as a performance parameter. Poult. Sci., 61:1933-1938.

Hassaan, S.F., Abdel-Fattah, S.A., Elsalmony, A.E. and Hassan, M.S.H. (2009). Relationship between some serum enzyme activities, liver function and body weight in growing local chickens. Inter. J. Poult. Sci., 8 (1).

Hassaan, S.F., Elsalmoney, A.E. and Fathi, M.M. (2008). Relationship between triiodothyronine (T3) and Insulin-like growth factor (IGF1) hormones in Egyptian local chickens during growth period. Egypt. Poult. Sci., 28:251-263.

Hayashi, K., Keneda, S., Orsuka, A. and Tomita, Y. (1992). Effect of ambient temperature and thyroxin on protein turnover and oxygen consumption in chicken skeletal muscle. Proceeding IX World’s Poultry Congress.

Vol. 2, Amsterdam, The Netherlands, 20-24.

Heckert, R.A., Estevez, I., Russek-Cohen, E. and Pettit-Riley, R. (2002). Effects of density and perch availability on the immune status of broilers. Poult. Sci., 81:451-457.

Kuby, J. (1997). Immunology. W.H. Freeman and Co., New York, NY, PP. 40-70 & 99-225.

Lee, D.N., Cheng, F.Y., Line, R.S. and Wu, P.C. (2003). Effect of dietary chromium picolinate supplementation on growth performance and immune responses of broilers. Asian Austr. J. Anim. Sci., 16:227-233.

Lesson, S. and Summers, J.D. (2001). Minerals-Iodine. In Scotl's Nutrition of the chicken. 4th ed., pp. 408-412. Guelph, Ont. University Books.

McNabb,F.M.A and King , D.B.(1993). Thyroid hormone effects on growth, development and metabolism.In : The Endocrinology of Growth, Development, and metabolism in Vertebrates,Academic press, New York , PP.393—417.

Mohamed, S.E. Enas (1995). Performance of productive efficiency and egg quality of some Egyptian chickens. M.Sc. Thesis, Fac. Agric. Zagazig Univ., Benha Branch, Egypt.

Nima, E; Hamed, A.; Mahmud, S.; AbolFazl, Z and Niloofar, A.(2012). Effct of different calcium iodate levels on performance, carcass traits and concentration of thyroid hormone in broiler chickens. Annals of Biological Research, 3(5): 2223 – 2227.

Nyoman, S., Hayashi, K., Toyomiza, M. and Tomita, Y. (1989). Effect of dietary thyroxin on growth and muscle protein metabolism in broiler chickens. Poult. Sci., 68:1396-1401.

Patrick, L. (2008). Iodine deficiency and therapeutic considerations. Altern Med. 13 (2): 116.

Pramod, K., Verma, S.B., Mandal, K.G., Akhtar, S.M. and Kumar, P. (2002). Influence of sex on body weight and conformation traits in a random bred population of Japanese quail. Indian J. of Anim. Health, 41:1, 61-63.

SAS institute, (2001). SAS Users Guide Statistics Version 10th, 16-Edition, SAS Inst., Cary, NC.

Singh, H. And Nordskog, A.W (1982). Significance of body weight as a performance parameter. Poult. Sci., 61:1933—1938.

Stanley, V.G. and Bailey, J.E. (1989). Effect of iodine treated water on the performance of broiler chickens reared under various stocking densities. Poult. Sci., 68:435.

Sturkie, P.D. (1986). In "Avian physiology" (4th ed) Springer-Verlag. New York.

Tsukada, A., Okhubo, T., Sakaguchi, K., Tanaka, M. and Hoshino, S. (1995). Thyroid hormones are involved in insulin like growth factor (IGF1) production by regulating growth hormone receptor in the chicken. Poult. and Avian biology Reviews, 6-No. 4:303.

الملخص العربى

دور أيودين الغذاء فى تحسين الآداء الإنتاجى والتناسلى والفسيولوجى والمناعى فى الدجاج المحلى

١-أثناء فترة النمو

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أجريت هذه الدراسة لدورة مدتها ٩ اسابيع لبحث إمكانية الإستفادة من إمداد مستويات غذائية مختلفة من الأيودين فى صورة يوديد البوتاسيوم على تحسين أداء النمو وبعض المقاييس الفسيولوجية والهيماتولوجية ومعدل النفوق وصفات الذبيحة والحالة المناعية لديوك سلالة المنتزه الفضى (سلالة مستنبطة مصرية). ولهذا الغرض أخذ عدد ١٨٠ ديك عمر ٥ أسابيع من قطيع أكبر وتم تقسيمهم إلى ٥ مجاميع تجريبية وكل مجموعة تجريبية قسمت إلى ٣ مكررات بكل مكررة عدد ١٢ ديك. المجموعة الأولى (T1) تمثل المتوسط العام لوزن قطيع الديوك ككل وغذيت على العليقة الأساسية التى تحتوى ٠,٣ ملجم أيودين/كجم علف وحفظت على أساس (كنترول ١) . الاربع مجاميع الاخرى من الديوك (١٤٤ ديك) أخذت من نفس القطيع بمتوسط وزن اقل من المتوسط العام للوزن بي ٢٥% ووزعت الديوك على المعاملات كالتالي :-

- المجموعة الثانية (T2) غذيت أيضا على العليقه الأساسية الكنترول وحفظت على أساس (كنترول ٢) .بينما المجموعة الثالثة (T3) والرابعه (T4) والخامسه (T5) غذيت على العليقة الأساسية مضافا إليها ١,٢ و ٢,٤ و ٤,٨ ملجم أيودين/كجم عليقه على التوالي. وأوضحت النتائج المتحصل عليها مايلى:

-أدت إضافة الأيودين لزيادة معنوية جدا فى وزن الجسم الحى ووزن الجسم المكتسب وتحسن معدل تحويل الغذاء لديوك المنتزه الفضى أثناء مرحلة النمو من ٥-١٤ أسبوع من العمر مقارنة بالمجموعة التجريبية الثانية (كنترول٢) عند مستوى ٤,٨ ملجم أيودين/كجم يليه مستوى ٢,٤ ملجم أيودين/كجم عليقه. كذلك أدت لزياده معنويه في مستوى هيموجلوبين الدم و الهيماتوكريت وعدد كلاً من كرات الدم الحمراء والبيضاء خاصة الخلايا الليمفاوية وبالمثل وجد أن مستوى البروتين الكلى والجلوبيولين وهرمونات T3, T4 ونسبة الكالسيوم والفسفور فى بلازما الدم زادت معنويا للمجاميع المغذاة على الأيودين وخاصة بمستوى ٤,٨ ملجم أيودين/كجم عليقه (المجموعة التجريبية الخامسة). وعلى العكس المجاميع المعامله بالايودين سجلت تركيزات منخفضه معنوياً من مستويات الليبيدات الكلية والكوليسترول، LDL ، وكذلك إنزيمات AST, ALT فى بلازما الدم.ووجد أن الاوزان النسبيه للذبيحة والأعضاء الليمفاوية (الطحال والغدة الثيموسية) لديوك المنتزه الفضي زادت خطياً بزيادة مستويات الأيودين المعطاة.

نستخلص من هذه الدراسة أن الإمداد الغذائي من الأيودين فى صورة يوديد البوتاسيوم هو تطبيق عملي خاصة بمستوى ٤,٨ ملجم أيودين/كجم عليقه للديوك التي تقل في الوزن بنحو ٢٥% عن مثيلتها في نفس العمر حيث كان لها تأثيرات مفيده على آداء النمووصفات الذبيحة وبعض المقاييس الفسيولوجيه والهيماتولوجيه والحاله المناعيه.