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EFFECT OF LIGHTING REGIMENS AND DIETARY IODINE SOURCES ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCE FOR MANDARAH CHICKEN STRAIN

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ABSTRACT:The objective of the present experiment was to examine the effect of lighting regimens, iodine sources and levels and their interactions on productive performance, hatching traits, some biochemical blood parameters and thyroid hormones of Mandarah chickens. A total of 400 Mandarah chicks at 8 weeks of age were housed in closed system house and divided randomly into two equal groups (200 chicks / group). Chicks of the first group were exposed to Step-Up Photoperiod (SUP): The photoperiod was increased gradually from 10 h/d at 8 wks of age by half an hour each wk to reach 16 h/d at 20 wk of age (Lr1), Chicks of the second group were exposed to Constant–Step Up Photoperiod (C- SUP): The photoperiod was kept constant at 12 h/d at 8 weeks of age until 16 wk of age and increased gradually by an hour each wk to reach 16 h/d at 20 wk of age (Lr2). The chicks within each lighting regimen were divided equally into four dietary supplementations groups (5 replicates of 10 birds each) as follows: basal diet supplemented with 0 .5 mg Potassium iodide (control, T1), 2 mg Potassium iodide (T2), 0 .5 mg Iodide-enriched yeast (T3) and 2 mg Iodide-enriched yeast (T4) / Kg diet. The results during the laying period up to 36 wk have shown that exposing Mandarah chickens to Lr1 regimen significantly improved egg weight, egg production (%) , egg mass , feed conversion ratio, fertility (%), hatchability (%),body weight at hatch, yolk sac and fabricious gland (%) compared to Lr2 regimen. Moreover, plasma IgM, IgG, TAC, HDL, HDL/LDL ratio and T4 significantly increased for Lr1 compared with Lr2. Feeding Mandarah chickens on 2mg organic iodine/kg diet significantly improved the laying performance , feed conversion ratio, plasma IgM, HDL, HDL/LDL, T3/T4, L%, H%, H/L ratio compared with inorganic iodine either o.5 or 2 mg /kg diet. Also, the interaction of Lr1× organic iodine × 2 represented highest ($p<0.05$) values of egg production%,egg mass,plasma IgM, HDL,HDL/LDL,T3/T4 ratio and L (%), Besides improvement of feed conversion compared with other interactions.

In conclusion, it is possible to use the SUP regimen combined with feeding on 2 mg organic iodine /kg diet in laying management from 8-36 weeks of age to improve productive and reproductive performance, hatching traits, hatched chicks body weight and immunity system of Mandarah chickens.

Key words:lighting regimens,iodine,productive,hatching traits, blood parameters,laying hens.

INTRODUCTION

It is a well-known that the daily light length and the pattern of daily change produce biological responses associated with egg production and number of physiological mechanisms including growth, thyroid function and reproductive development (Olanrewaju et al., 2006). The responses are the result of increased activity of the anterior lobe of the pituitary gland (Karakaya et al., 2009).

Immature pullets do not have an organized channel of communication between the hypothalamus, the anterior pituitary and the ovary. At puberty, this communication becomes established and hens start to recruit follicles from a pool of small follicles on the undeveloped ovary, which leads to the onset of egg production (Fedail et al., 2014).

From various metabolic factors it is critical for pullets to respond to light stimulation at 18 to 23 weeks of age. It is of practical importance to know how many hours of light must be given to the bird before and after sexual maturity in order to maximize egg production for hens, whereas the activity of birds is positively and greatly affected by the photoperiod length, since the physical activity was found to be almost zero in the dark (Geng et al., 2014).

Poultry metabolism and growth rely on well-balanced diet constitute different micro and macronutrients. The micronutrients make a little part of the complete diet but they perform a vital role in several metabolic phenomena taking place inside the body (Song et al., 2006). Excess or deficiency of these micronutrients can adversely affect the standard biochemical processes of the bird's body (Hunchak et al., 2016). Iodine is a crucial micronutrient which performs an important function in the metabolism of thyroid hormones (Ali et al., 2018).

Iodine is fed to birds with food or water, most often in inorganic forms. However, inorganic sources are unstable for they are prone to oxidation and/or reduction. Moreover, iodine evaporates (iodates are more stable than iodides) when processing and storing mixed fodders and premixes; light and moisture accelerate the decomposition of salts and sublimation of free iodine (Kavtarashvili et al., 2017).

Iodine is a part of thyroid hormones - thyroxin and its derivatives. They regulate metabolism (particularly the cellular oxidation processes) and significantly affect the growth and productivity of poultry. Iodine deficiency can interrupt metabolism, reduce egg production, hatchability and cause hypertrophy of the thyroid gland in laying hens (Lewis,2004). Thyroid hormones participate in the function of the pituitary gland, responsible for birds' photosensitivity and puberty (Proudman and Siopes, 2002), as well as iodide, accumulate in the ovary.

Organic sources of iodine (for example, iodinated yeast, where iodine is bound covalently and can be cleaved almost exclusively enzymatically) are more stable. Despite the greater preservation of iodates in feeds and premixes if compared to iodides (Slupczynska,2014). Yeast has biologically valuable proteins,vitamin B-complex,important trace minerals and several unique "plus" factors (Paryad and Mahmoudi, 2008). Many other beneficial factors identified such as utilization by animals and improvement of feed conversion (Yalcin et al., 2010).

In this regard, the purpose of our research was conducted to investigate the effect of lighting regimens, iodine sources and levels during rearing and laying stages on productive performance, some hatching traits, some biochemical blood parameters and thyroid hormones of Mandarah chicken strain.

MATERIALS AND METHODS

The present experiment was carried out at El-Sabahia Poultry Research Station, Alexandria, Animal Production Research Institute, Agriculture Research Center, Egypt.

Experimental design

A total number of 400 chicks at 8 weeks of age from Mandarah (local strain) were housed in an environmentally controlled light proof house (close system) in floor pens (2.0 m × 1.2 m × 2.0 m) and divided randomly into two equal groups (200 chicks / each). Chicks of the first group were exposed to Step-Up Photoperiod (SUP):The photoperiod was increased gradually from 10 h/d at 8 weeks by half an hour each wk to reach 16h/d at 20 wk of age. Whereas, chicks of the second group were exposed toConstant - Step Up Photoperiod (C-SUP): The photoperiod was kept constant at 12h/d at 8 weeks of age until 16 wk of age and increased gradually by an hour each wk to reach 16h/d at 20 wk of age . The scheme of design is illustrated in figure (1).

Light source used was incandescent bulbs Forty-watt located at the center of each pen at about 2.5 m height and the light intensity during the rearing period was ~10 lux at bird's level while it was increased to ~20 lux during the laying period.

Lighting regimen for each group was in separate partition and had the same hygienic measurement.

The chicks within each lighting regimen were divided equally into four dietary supplementations groups. Each treatment subdivided into 5 replicates of 10 birds in each floor pen (5 replicates × 10 chicks (9 female +1 male)× 2 lighting regimens).

The basal diet covered the nutrient requirements according to Feed Composition Tables for Animals and Poultry Feedstuffs used in Egypt (2001), as shown in Table (1). The component of Vit.-mineral mixture which used in the basal diet was free from Iodine. Feed and water were provided *adlibituim* during the experimental period (8-36 wk).

The four dietary experimental groups for each lighting regimen as follows:

T1-Fed basal diet supplemented with 0.5 mg inorganic iodine (Potassium iodide) / Kg diet (control).

T2-Fed basal diet supplemented with 2 mg inorganic iodine (Potassium iodide) / Kg diet.

T3-Fed basal diet supplemented with 0 .5 mg organic iodine (I-enriched yeast) / Kg diet.

T4- Fed basal diet supplemented with 2 mg organic iodine (I-enriched yeast) / Kg diet.

Iodine enriched yeast as an organic iodine and Potassium iodide as an inorganic iodine were purchased from Sigma-Aldrich (st. Louis, MO, USA).

Data collection and calculations

Productive traits:

Egg production traits egg weight (gm) , egg production (%) and egg mass (gm/ hen/day) were recorded from 24 to 36 wk of age . Feed consumption by gram was detected for each bird per day. Feed conversion ratio was calculated as amount of consumed feed (gm) required for producing a unit (gm) of egg mass.

At 36 weeks of age, eggs produced from the four treatments of Mandarah hens were collected daily. One thousand and four hundred hatching eggs were stored for six days in room temperature being supplied with fan .

All eggs replicated in three trays for each previously mentioned groups. Eggs were set and randomly distributed at different places in the same trolley of the incubator to reduce possible position effects. The eggs were incubated in Egyptian-made incubator. On the 18th days of incubation the eggs were transferred into hatcher for the remainder of the incubation period at 37.2°C (98.6°F) and 70% RH for 3 days till the hatch. Macroscopic fertility was estimated as a percentage of fertile eggs out of the number of eggs set. Hatchability of fertile eggs was estimated as a percentage of sound chicks out of the fertile eggs. All percentages data of hatchability were subjected to arcsine square root percentage transformation prior to analyses. Embryonic malposition was recorded. Hatched chicks were weighed to nearest gram on the day of hatch . At hatch , 48 chick (6 chick/treatment) were killed by cervical dislocation and embryonic yolk sac and fabricious gland were removed and weighed to the nearest 0.1 gm.

White blood cells count's, Immunoglobulin and biochemical constituents

At 36 wk of age, twenty four blood samples were randomly taken from the branchial wing vein in heparinized tubes from 3 hens for each dietary group within each photoperiod regimen at 9:00 AM before access to feed and water. Half of the blood samples were taken to measure the white blood cells (WBC's) count's, lymphocyte (L) % and heterophil (H) % according to Wintrobe (1967). Plasma samples were obtained by centrifuged the remaining of blood at 3000 rpm for 20 minutes, the plasma was stored at ~ 20°C until analysis. Immunoglobulin M (IgM) (mg/dl) , Immunoglobulin G (IgG) (mg/dl), total lipids (g/dl), low density lipoprotein (LDL) (mg/dl), high density lipoprotein (HDL) (mg / dl) , total antioxidant capacity (TAC) mg/dl , lipid peroxide (malondialdehyde) MDH (mg/dl),triiodothronine T3 (ng/ml) and thyroxin T4(ng/ml) were measured by using available commercial kits.

Statistical analyses

Data were analyzed using the Proc GLM according to SAS (2001). The model was as follows:

$Y_{ijkl} = \mu + A_i + L_j + S_k + (AL)_{ij} + (AS)_{ik} + (LS)_{jk} + (ALS)_{ijk} + e_{ijkl}$

where:

Y_{ijkl} = an observation taken on the lth sample

μ = overall mean

A_j = a fixed effect of the ith iodine level (i=1 to 2)

L_j = a fixed effect of the jth light (j=1 to 2)

S_k = a fixed effect of the kth iodine source (k=1 to 2)

AL_{jj} = an interaction between iodine level and light

AS_{ik} = an interaction between iodine level and iodine source

LS_{jk} = an interaction between light and iodine source

ALS_{jjk} = an interaction between iodine level, light and iodine source

e_{ijkl} = Random error assumed to be independent by and normally distributed with mean = 0 and variance = σ2

Duncan multiple range test was conducted to determine differences among means, using 5% significant level (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Productive traits

Data of productive performance of Mandarah laying hens during the laying period until 36 wk of age are presented in Table 2. It is clearly shows that lighting regimen 1 (Lr1) represented the highest record ($P \leq 0.05$) of egg weight (gm) by (4.80%), egg production (%) by (16.36%) and egg mass (gm/hen/day) by (21.14%) compared to lighting regimen 2 (Lr2).

While, the highest amount of feed consumption (gm/hen/day) recorded by chickens exposed to (Lr2) compared to (Lr1). Moreover, feed conversion ratio (gm feed / gm egg mass) was significantly improved for hens exposed to (Lr1) compared to (Lr2). Regarding the effect of iodine sources on the previous mentioned traits, egg weight , egg production and egg mass were increased ($P \leq 0.05$) for organic iodine group compared to inorganic iodine group. Moreover, feed consumption was decreased ($P \leq 0.05$) and feed conversion was significantly improved for organic group. Irrespective of lighting regimens and sources of iodine , There was no significant differences in egg weight between the two levels of iodine, While, level 2 of iodine (2mg Iodine/kg diet) represented higher ($P \leq 0.05$) recording of egg production and egg mass compared to iodine level 1 (0.5 mg Iodine/kg diet). Birds of IL2 group consumed feed less than those for IL1 group. While, feed conversion ratio was significantly ($P \leq 0.05$) improved for group of (IL2) compared with (IL1) group. With respect to the interactions between (Lr× S × IL), results reveals that the highest ($P \leq 0.05$) egg weight was recorded for interaction of Lr1× S2 × 2 compared to other interaction groups except of Lr1 × S2 × 0.5 group. Also, The highest values ($P \leq 0.05$) for egg production and egg mass, Besides, improvement ($P \leq 0.05$) of feed conversion ratio were observed for Lr1 × S2 × 2 compared to all interactions groups . While, feed consumption was lowest for interactions of Lr1 × S2 × 2 compared to other interactions groups.

From the present results it might be concluded that exposing Mandarah chickens from 8 to 20 wks of age to Lr1 improved the productive performance. These improvements might be due to the effect of light on the thyroid gland. The thyroid system is known to be heavily involved in seasonal reproduction, regulating the release of follicle-stimulating hormone and luteinizing hormone from the pituitary gland, and it is activated during the breeding season resulting in a dramatic change in gonadal size (Ikegami and Yoshimura, 2012). Thyroid hormones participate in the function of the pituitary gland, responsible for birds' photosensitivity and puberty (Proudman and Siopes , 2002). Lighting is an important environmental factor used to control the physiological functions of poultry, because it affects their behavior, well-being, and productive performance (Parvin et al., 2014). The results of the present study are in line with the findings of Gous and Cherry (2004) who indicated that hens reared on short photoperiod i.e. 8-h (L) and then transferred to 16-h at 19 wk of age, produced 7.3 more eggs than those reared on constant 17-h from 4 day-old to 60 wk. Also, Rajmund et al. (2019) reported that egg production was lower in groups exposed to (intermittent (4 L:2D); L-light, D-dark regimen) than in groups exposed to lighting regimen (16 L:8D). On the contrary, Lewis et al. (2010) observed that photoperiod had no effect on productive performance of chickens. Results of the decrease in feed consumption and improvement of feed conversion ratio for chickens exposing to step-up photoperiod regimen are parallel to that reported by El-Prollosy (2006) who indicated that Gimmizah pullets group exposed to step-up photoperiod regimen consumed less feed than those on constant- step up photoperiod program during 6-22 wk of age. Moreover, Farghly and Makled (2015) mentioned that short photoperiods increased sleep, lowerd physiological stress and improved feed conversion ratio. Regarding iodine sources, results of significant increase of the same previous mentioned traits for organic iodine group are keeping with those previously mentioned by different research workers. Zhang et al. (2016) showed the beneficial effect of organic trace minerals on production parameters in terms of bioavailability have been made in broiler chickens compared with inorganic trace minerals due to improve the transport and absorption of minerals (Xiao et al.,2015) and more effective on productive performance. Moreover, Flachowsky et al. (2017) reported that organic iodine supplementation decreased feed intake and improved feed to egg mass ratio compared with inorganic iodine. Regardless of lighting regimens and iodine sources, Results of the significant improvement of egg weight, egg production, egg mass and feed conversion ratio due to level of dietary iodine supplementation (2mg Iodine/kg diet) compared to (0.5 mg Iodine/kg diet) are parallel to that reported by Saki et al. (2012) who observed that increasing I supplementation led to higher egg weights. Also, Ibrahim et al. (2015) reported that iodine supplementation (1.2 and 2.4 mg/kg diet) resulted in a significant linear feed consumption decreased, significantly improved feed conversion and the laying performance compared to the control diet. Whereas, Kaufmann and Rambeck (1998) reported that increasing iodine concentration in the feed (maximum 5.0 mg/kg) did not affect egg production. It can be observed from interaction data of this table that application the step-up photoperiod regimen with supplementation the diet with 2 mg organic iodine/kg diet could be recommended for improving egg weight, egg production and feed conversion ratio for Mandarah laying hens.

Hatching traits

Data of macroscopic fertility (%), hatchability of fertile eggs (%), embryonic malposition, hatched chicks weight, relative weight of yolk sac and fabricious gland (%) are detected in Table 3. Lighting regimen 1 (Lr1) recorded the highest significant percentages of macroscopic fertility and hatchability of fertile eggs compared to Lr2. While, the lowest significant percentage of embryonic malposition was observed for Lr1 compared to Lr2. Chicks of Lr1 group represented the highest significant ($P \leq 0.05$) values for body weight , relative weight of yolk sac and fabricious gland (%) at hatch compared with those for Lr2 group. With respect to iodine sources, highest significant ($P \leq 0.05$) records of macroscopic fertility(%) and hatchability of fertile eggs were observed for organic iodine group (S2) (90.68,75.60%) compared to inorganic iodine group (S1) (86.61,67.11%), respectively. On the contrary, S2 group represented the lowest significant percentage of embryonic malposition compared to S1 group. Hatched chicks weight(gm), yolk sac (%) and fabricious gland (%) of S2 group were significantly ($P \leq 0.05$) larger than those for S1 group. Irrespective of lighting regimens and iodine sources, Supplementation the diet with high level of iodine (IL2) numerical increased macroscopic fertility % , hatchability of fertile eggs % and hatched chicks weight (gm) compared with IL1 (0.5 mg I/Kg diet). While, IL2 was significantly decreased ($P \leq 0.05$) embryonic malposition (%) compared with IL1. Relative weight of yolk sac and fabricious gland were significantly ($P \leq 0.05$) increased for group supplemented with

2mg iodine/Kg diet compared with those of 0.5 mg iodine/Kg diet. In addition to, the highest value of interaction for macroscopic fertility was observed for group of Lr1 × S2 × 2 compared to Lr2 × S1 × 0.5, Lr2 × S1 × 2 and Lr2 × S2 × 0.5 groups. Moreover, the interaction of hatchability of fertile eggs % represented the highest significant value in Lr1 × S2 × 2 compared with the other interactions except Lr1× S2 × 0.5 and Lr1 × S1 × 2 groups. While, the lowest value ($P \leq 0.05$) of interaction for embryonic malposition was recorded with Lr1 ×S2 × 2 group compared with other interaction groups, and the highest value ($P \leq 0.05$) was recorded for Lr2 × S1 × 0.5 group. Moreover, the highest significant values of chicks body weight (gm) and yolk sac(%) at hatch were observed for chicks of Lr1 × S2 × 2 group compared to other interaction groups except to Lr1 × S2 × 0.5 and Lr1 × S1 × 2. Also, values of fabricious gland (%) was significantly increased for Lr1 × S2 × 0.5 and Lr1 × S2 × 2 groups compared with those for other interaction groups.

From the current results, the increase of macroscopic fertility for eggs of Lr1 group was reflected on the improvement of hatchability for these group. This improvement might due to the role of step-up light regimen for activating the thyroid gland to secrete thyroid hormone (T4), which is the most important hormone linked with hatchability. Our results are in agreement with results of Shanawany(1993) who noted that fertility and hatchability improved by Step-Up Photoperiod regimen (SUP) in domestic fowl. Moreover, El-Prollosy (2006) reported that exposing of Gimmizah pullets to SUP regimen during 6-22 wk of age improved fertility and hatchability compared with other photoperiod regimens. Furthermore, the observed increase of chicks body weight at hatch for Lr1 group compared with Lr2 group could be due to the increase of egg weight Table 2, and also the increase of yolk sac for chicks of this group. Supporting to results and interpretation herein, Abiola,(1999) opined that hatching egg weight, yolk sac and chick weight were interrelated. The main effect of egg size, which lies in the mass of the residual yolk sac that the chick retained. Small eggs produced smaller offspring with smaller body weight at hatch compared to those from larger eggs (Mcloughlin and Gous,1999). Also, the increase of relative weight of fabricious gland for chicks of Lr1 group could be due to that step-up lighting regimen may improve immune response for Mandarah chickens as representing the increase of IgM and IgG Table 5. Some researchers came to the same conclusion, as (Blahova et al.,2007; Ahmed and El-Ghamdi,2008) who demonstrated that lighting regimens maintain the vitality of anatomical stress indicators such as bursa of fabricious, which consider the main organ that could refer to the immunological status as well. Moreover, Abbas et al.(2008) reported that step-up photoperiod regimen activated both peripheral T and B lymphocytes proliferation and increased antibody production compared to the continuous lighting regimen. In contrast, El Sabry et al. (2015) found that there were no effect of lighting regimen (18L: 6D (control) or 14 L : 4 D : 2 L : 4 D (split darkness)) on relative weight of bursa of fabricious.

Increased fertility and hatchability for eggs of chickens which fed on organic iodine could due to that organic forms of iodine are less toxicity for poultry, safe for transfer to eggs and deposit into the body iodine pool, primarily in muscle tissues and increased secreting of thyroid hormones which play a major role in the hatching process (Opaliński et al., 2012). Similar results were reported by Christensen and Davis (2004) who mentioned that embryo thyroid function during hatching is affected by the maternal dietary organic iodine in turkey. While, reduced hatchability was observed for eggs of chickens fed inorganic iodine reported by Anas et al. (2020). Furthermore, the increase of hatched chicks weight for group of organic iodine in spite of the increase of their egg and yolk sac weight. Also, the increase of chicks weight at hatch could due to that organic iodine easily transferred to egg and improve the transport and absorption of minerals (Xiao et al.,2015) and regulate the metabolism of embryo (Davis et al., 2000). Similar results were reported by Patra et al. (2016) who mentioned that the size of egg had a significant effect on chicks̕ weight at hatch. The observed increase of relative weight of fabricious gland for chicks of organic iodine group compared with those of inorganic iodine might due to that organic iodine transferred easily to egg, then to embryo and take advantage of alternative absorption routes, provides protection towards mineral antagonisms, against indigestible complexes formation and can elevated immunological function compared to inorganic iodine (Saripinar-Aksu et al., 2012).

Supplementation 2mg iodine /kg diet improved hatchability percentage , the current result was parallel with Ibrahim et al. (2015) who mentioned that hatchability percentage was significantly improved as dietary supplemented with 1.2 and 2.4 mg iodine/ kg diet. Also, Ali et al. (2018) reported that iodine level treatments (1.0 and 2.0 mg I/Kg diet) significantly improved the hatchability of fertile eggs compared to other treatment groups. Furthermore,the increased relative weight of yolk sac for chicks produced from birds fed 2 mg iodine /Kg diet could due to increase in egg weight for the same group. This conclusion is keeping with those mentioned by Nangsuay et al. (2011) who found that embryos and chicks of the large eggs had greater yolk-free body weight from d 14 to hatching than the small eggs. Also, Iqbal et al. (2016) observed that the relative weight of yolk sac was amplified ($p<0.05$) with increasing the egg size. Moreover, with increased of iodine dosage (2mg/kg diet), the relative weight of fabricious increased linearly. Bursa of fabricious could refer to the immunological status, and increased fabricious gland (%) an indicator to improve immunology chicks of this group. These results are coincided with the results reported by Onbasilar et al. (2007) who concluded that bursa of fabricious consider main organ that could refer to the immunological status. Also, Bilal, et al. (2017) mentioned that the higher level of iodine reinforces immune response via strengthened antibody production and phagocytosis.

Lack of information in the literature was found regarding influence of lighting regimens, sources and levels of iodine on embryonic malposition. Generally, the results of interactions revealed that exposing the chicken to step-up photoperiod regimen accompanied with supplementing the diet of Mandarah chickens with 2 mg organic iodine/Kg diet could be considered as new recommendation for improving fertility (%), hatchability(%),health and immunity system of Mandarah embryo and chicks, Besides decreasing embryonic malposition.

Biochemical blood parameters

Data of Table 4 represented some biochemical blood constituent, total antioxidant and thyroid hormones of Mandarah laying hens at 36 weeks of age as affected by lighting regimens, sources and levels of iodine. From in sepection of the data of this table, total lipids, LDL andmalondialdhyde (MDH) were significantly ($p<0.05$) decreased in Lr1 laying compared to those for Lr2 group, while, there was no significant differences between Lr1 and Lr2 groups with respect to plasma T3 and T3/T4 ratio. On the other hand, plasma HDL , HDL/LDL ratio,total antioxidant capacity (TAC) and T4 were significantly increased for chickens of Lr1 compared to those for Lr2 group. Regarding to sources of iodine, concentrations of plasma total lipids , LDL and T4 were increased ($P\leq0.05$) for inorganic iodine group (S1) compared to organic iodine group (S2). While, values of plasma HDL , HDL/LDL ratio , TAC, T3 and T3/T4 ratio were significantly increased for chickens fed organic iodine compared to those of inorganic iodine. There was numerical reduction in MDH for chickens of organic iodine (S2) compared to S1 group. In addition, dietary supplementation with 2mg iodine/Kg diet (IL2) caused decrease in plasma total lipids and MDH for chickens compared to 0.5 mg iodine/kg diet (IL1). On the other hand, the same level of iodine (IL2) was significantly increased concentration of plasma HDL , HDL/LDL ratio,T3 and T3/T4 ratio compared to IL1. Also, plasma TAC was numerical increased for chickens of IL2 group compared to those for IL1 group. Levels of iodine did not represent statistical difference in plasma LDL and T4. With respect to the interaction between Lr × S × IL, concentration of plasma total lipids was decreased ($P\leq0.05$) for Lr1 × S2 × 2 group compared with all interaction group except to those for Lr1 × S2 × 0.5 group. The interaction between Lr1× S2 × 2 increased ($P\leq0.05$) concentrations of plasma HDL , HDL/LDL ratio and T3/T4 ratio compared with all interaction group. On the other hand, the lowest ($P\leq0.05$) concentration of plasma LDL was observed for Lr1 × S2 × 2 group compared to all the interactions. Moreover, Lr1 × S2 × 2 and Lr1 × S2 × 0.5 groups represented the highest increase ($P\leq0.05$) of plasma TAC compared with the other interactions. Moreover, plasma MDH was significantly increased for chickens of Lr2× S1 × 0.5 group compared with those for other interaction groups. Plasma T3 hormone increased ($P\leq0.05$) for Lr1 × S1 × 2 group compared with the other interactions except to Lr1 × S2 × 2 and Lr2× S2 × 0.5 groups. Furthermore, value of plasma T4 concentration for hens was significantly ($P\leq0.05$) increased for Lr1 × S1 × 2 group compared to those for all interaction groups.

The decrease of plasma total lipids, LDL , MDH concentrations and increasing of HDL , HDL/LDL ratio, total antioxidant capacity (TAC) and T4 for chickens exposing to step-up photoperiod regimen may due to the effect of this regimen on thyroid gland activity. It is well known that there are a strong relationship between thyroid gland and lipid metabolism. Since increasing thyroid hormones lead to increase metabolic rate of lipids, thus, reduce level of plasma total lipids. Also, decrease of LDL was a result of decreasing of total lipids. These results are in agreement with those reported by Farghly (2014) found that total lipids, LDL and MDH were significantly lower in birds reared under light flashes programs for 9 hrs as compared to the other groups. In contrary , Jackson and Elsawa (2015) reported that plasma total lipids did not differ significant among different lighting groups. Moreover, Pereira et al.(1994) observed that thyroid hormones have effects on degradation and synthesis of the antioxidant enzymes. Furthermore, Torun et al. (2009) reported that MDH was elevated function of thyroid gland compared with control, while TAC levels show no significant difference between groups. Hassanzadeh et al. (2000) who observed higher levels of T4 probably result from exposing chickens to step-up photoperiod regimen. Irrespective of lighting regimens and iodine levels, the decrease of plasma total lipids , LDL and increasing of TAC for chickens of organic iodine group could be due to the increase of plasma T3 and T3/T4 ratio for the same group. Organic iodine transferred easily from intestinal to thyroid gland through blood stream and elevated concentration of plasma T3 and T3/T4 ratio. These results are in line with Lewis (2004) who observed that organic iodine play an essential role in metabolism regulation through its effect on thyroid gland hormones, which activates the metabolism of lipids. Our results were disagreement with those of Slupczynska et al. (2014) who mentioned that lipid metabolism indices were not influenced by the kind of diet or the iodine source. Regarding of levels of iodine, the previous results confirm the concept of the relationship between thyroid gland activity and lipid metabolism. The decreased levels of total lipids and MDH may be explained as a consequence of the high iodine level (2mg/kg diet) which could stimulate hyperthyroidism status. These results are in agreement with El-Nagar et al. (2001). Furthermore, Ibrahim et al.(2015) observed that dietary iodine supplementation, up to 2.4 mg/kg diet improved blood parameters.

White blood cells count's and Immunoglobulin indices in blood

Results of Table 5 showed white blood cells count's (WBC's) and Immunoglobulin of Mandarah laying hens representing two lighting regimens supplemented with different sources and levels of iodine. It appears from data that WBC's, lymphocyte (L) % and heterophil (H) % were not affected by lighting regimens. While, IgM and IgG were significantly ($P \leq 0.05$) increased for birds of Lr1 group compared with those of Lr2 group. Regarding sources of iodine, there were no significant differences between two sources of iodine with respect to WBC's, L % and H %. Whereas, feeding birds with organic iodine increased concentrations of IgM and IgG compared with inorganic iodine feeding. Irrespective of lighting regimens and sources of iodine, IL2 represented significantly increased for L, H% , H/L ratio and IgM compared to IL1. In addition, the highest ($P \leq 0.05$) values of interaction groups represented for Lr1 × S2 × 0.5 and Lr1 × S2 × 2 groups with respect to WBC's compared with Lr2 × S1 × 0.5 and Lr2 × S2 × 0.5 groups. Also, L1 × S2 × 2 group was significantly highest for L% and IgM compared to other interaction groups. While, the lowest value of interaction for H% was recorded with Lr2 × S1 × 0.5 group compared with all interaction groups. The highest ($P \leq 0.05$) interactions were detected in Lr1 × S1 × 0.5, Lr1 × S2 × 2 and Lr2 × S2 × 2 groups with respect to H/L ratio. Furthermore, plasma IgG concentrations was highest ($P \leq 0.05$) for Lr1 × S2 × 2 group compared with that of all interaction groups except to Lr2 × S2 × 0.5 group.

The results of effect lighting regimens on WBC's, (L) % and (H) % are in line with Olanrewaju et al. (2014) who mentioned that no significant main effects were observed for strain, lighting programs, or their interaction on WBC's, lymphocyte (%) and heterophil (%). While, Farghly et al. (2019) observed that broilers reared under the intermittent regimen × flashing light had the lowest H/L ratio. The increase of IgM and IgG for chickens receiving step-up photoperiod regimen may due to the effect of this regimen on thyroid gland activity. Regarding of sources of iodine, the significant increase of IgM and IgG for chickens fed organic iodine may be due to that organic iodine enhance metabolism of protein, immunity ,transport and absorption of trace minerals for chickens (Xiao et al.,2015). Moreover, yeast enriched with iodine being a rich source of readily digestible protein, vitamins B and some minerals, which have positive effect on animal health and production (Opaliński et al.,2012). While, organic iodine did not effect on the other parameters. These results are in agreement with those reported by Attia et al.(2010) and Ramos-Vidales et al. (2019). The increase of lymphocytes (L), Heterophils(H) % and H/L ratio for chickens of IL2 group due to iodine supplementation compared with IL1 group is confirms by different authors as Weetman et al.(1983) who reported that iodine exposure produced an increase in immunoglobulin synthesis by lymphocytes. Moreover, Ibrahim et al.(2015) mentioned that dietary iodine supplementation up to 2.4 mg/kg diet improved hematological traits(H%;L% and H/L ratio) without any significant effects on WBC's. Also, phagocytes are the lymphocyte subsets which express the higher level of iodine (Bilal et al.,2017). Thus, iodine supplementation reinforces immune response via strengthened antibody production and phagocytosis. Furthermore, Ali et al.(2018) observed that dietary iodine, in excess, could enhancing immune responses (H/L ratio). Furthermore, increasing concentration of iodine in the diet (2mg/kg diet) lead to increasing IgM. The increase of this trait may be due to the effect of increase dietary iodine as a component of thyroxin hormone which enhancing immune responses. Also, the observed increase of plasma IgM for IL2 group compared with IL1 group could be due to the increase of lymphocytes as found in this table. Several research workers have drawn the same conclusion as Islam et al. (2004) and Song et al. (2006) mentioned that dietary iodine, in excess, could increasing thyroid gland activity and enhancing immune response.

It can be concluded from the most interesting aspect of the present experiment that exposing Mandarah chickens to step-up photoperiod regimen from 8-22 wk was the most efficient in comparison with the constant-step up photoperiod. Moreover, enriching the diet of parents flock with 2mg/kg diet organic iodine during 8-36 weeks could be considered as double kicks for activating thyroid gland and improving the productive performance, hatching traits and may affect the immune response.

Table (1): Composition and calculated chemical analysis of the experimental diets.

Ingredients (%) / Diets	Grower	Laying
Yellow corn	63	63.14
Soybean meal (44%)	17.60	27.10
Wheat bran	15.68	--------
Dicalcium phosphate	1.25	1.50
Limestone	1.80	7.60
Salt (Nacl)	0.30	0.30
DL – methionine	0.07	0.06
Vit. and mineral (premix)[1] free from Iodine.	0.30	0.30
Total	100.00	100.00
Calculated analysis[2]:		
Metabolizable energy (Kcal/kg)	2707	2719
Crude protein %	15.56	17.28
Calcium %	0.97	3.22
Available phosphate %	0.39	0.44
Methionine % + cyctine %	0.54	0.57
Lysine %	0.73	0.89

[1]Supplied per kg of diet: Vit. A, 12000 IU; Vit.D3, 2200 ICU; Vit.E, 10 mg; Vit K3, 2 mg; Vit.B1, 1mg; Vit. B2 5mg; B6 1.5 mg; B12 10 mcg; Nicotinic acid 30mg; Folic acid 1mg, Pantothenic acid 10mg; Biotin 50 mcg; Choline 250mg; Copper 10mg; Iron 30mg; Manganese 60mg; Zinc50mg ; Selenium 0.1mg; Cobalt 0.1mg.[2]According to Feed Composition Tables for Animal and PoultryFeedstuffs Used in Egypt (2001).

Table (2): Effect of light regimens,sources and levels of iodine and their interactions on productive performance of Mandarah laying hens.

Traits	**Egg weight (gm)**	**Egg production (%)**	**Egg mass (gm/hen/day)**	**Feed consumption (gm/hen/day)**	**Feed conversion (gm feed / gm egg mass)**
Light regimens(Lr)					
Lr (1) *	48.86^{a}± 0.53	64^{a}± 0. 12	31.57^{a}±0.89	118.16^{b}±3.30	3.80^{b}±0.21
Lr (2)**	46.62^{b}±0.44	55^{b}± 0. 10	26.06^{b}±0.64	141.66^{a}±2.90	5.50^{a}±0.24
Sources (S)					
Inorganic iodine(S1)	46.68^{b}±0.53	57^{b}±0. 10	26.69^{b}±0.86	138.50^{a}±3.59	5.29^{a}±0.29
Organic iodine(S2)	48.80^{a}±0.47	63^{a}±0. 12	30.94^{a}±1.01	121.33^{b}±4.26	4.01^{b}±0.26
Iodine level(IL)					
IL1 (0.5 mg/kg diet)	46.9±0.45	58^{b}±0. 10	27.53^{b}±0.87	134.24^{a}±4.01	5.01^{a}±0.26
IL2 (2 mg/kg diet)	48.51±0.70	61^{a}±0. 10	30.1^{a}±1.35	125.58^{b}±5.32	4.28^{b}±0.40
(Interaction Lr*S*IL)					
Lr1*S1*0.5	47.02^{bc}± 0.07	58de± 0. 03	27.62^{de} ±0.05	132.66^{cd}± 1.45	4.80^{d}±0.04
Lr1*S1*2	48.34^{bc}±1.42	63^{c}±0. 09	30.52^{c}± 0.96	123.00 ^{e}±1.52	4.03^{e}±0.14
Lr1*S2*0.5	49.05^{ab}± 0.27	66^{b} ±0. 01	32.66^{b}± 0.16	112.66^{f}±1.45	3.44^{f}± 0.06
Lr1*S2*2	51.03^{a}± 0.08	69^{a}± 0. 06	35.49^{a}± 0.34	104.33^{g}±2.33	2.93^{g}± 0.03
Lr2*S1*0.5	44.77^{d} ± 0.87	51^{g}± 0. 10	22.94^{g} ±0.25	153.33^{a}±1.66	6.68^{a} ±0.02
Lr2*S1*2	46.59^{cd}± 0.45	55^{f}± 0. 04	25.68^{f} ±0.39	145.00^{b}± 2.88	5.64^{b}± 0.10
Lr2*S2*0.5	47.05^{bc}±0.61	57^{ef} ±0. 07	26.91^{ef}±0.29	138.33^{bc}±4.40	5.14^{c}±0.21
Lr2*S2*2	48.08 ^{bc}± 0.31	59^{d}± 0. 02	28.71^{d}±0.29	130.00^{de}±2.88	4.52^{d}± 0.08

$^{a, b, c, d, e, f, g}$ Means within the same column in the same trait with different superscripts are significantly different (P≤0.05) .

* Lr (1) ⟶ SUP Step-Up Photoperiod

**Lr(2) ⟶ C-SUP Constant – Step Up Photoperiod

Table (3): Effect of light regimens,sources and levels of iodine and their interactions on some hatching traits of Mandarah chicken strain.

Traits	**Macroscopic fertility (%)**	**Hatchability of fertile eggs (%)**	**Embryonic malposition %**	**Hatched chicks weight (gm)**	**Yolk sac (%)**	**Fabricious gland (%)**
Light regimens(Lr)						
Lr (1) *	$92.05^{a}\pm1.10$	$77.21^{a}\pm 1.89$	$4.57^{b}\pm 0.54$	$34.91^{a}\pm 0.41$	$5.06^{a}\pm0.28$	$0.06^{a}\pm0.008$
Lr (2) **	$85.23^{b}\pm 1.47$	$65.51^{b}\pm 1.80$	$8.20^{a}\pm0.60$	$32.83^{b}\pm0.47$	$3.91^{b}\pm 0.18$	$0.04^{b}\pm0.005$
Source(S)						
Inorganic iodine (S1)	$86.61^{b}\pm 1.43$	$67.11^{b}\pm2.13$	$7.98^{a}\pm 0.65$	$33.00^{b}\pm0.53$	$4.03^{b}\pm0.23$	$0.04^{b}\pm0.006$
Organic iodine (S2)	$90.68^{a}\pm1.64$	$75.60^{a}\pm2.29$	$4.78^{b}\pm0.61$	$34.75^{a}\pm0.41$	$4.95^{a}\pm 0.28$	$0.06^{a}\pm0.009$
Iodine level(IL)						
IL1 (0.5 mg/kg diet)	87.14± 1.53	69.65± 2.39	$7.37^{b}\pm 0.67$	33.33±0.44	$4.23^{b}\pm0.27$	$0.04^{b}\pm0.007$
IL2 (2 mg/kg diet)	90.14±1.75	73.06± 2.70	$5.40^{a}\pm0.90$	34.41±0.62	$4.74^{a}\pm0.31$	$0.05^{a}\pm0.008$
Interaction (Lr*S*IL)						
Lr1*S1*0.5	$87.69^{abcd}\pm2.39$	$70.16^{cd}\pm3.96$	$7.40^{d}\pm 0.05$	$33.66^{b}\pm0.88$	$4.21^{bcd}\pm0.16$	$0.05^{c}\pm0.01$
Lr1*S1*2	$92.69^{abc}\pm1.09$	$75.28^{abc}\pm2.11$	$4.85^{f}\pm0.02$	$34.66^{ab}\pm0.88$	$4.72^{abc}\pm0.46$	$0.06^{b}\pm 0.01$
Lr1*S2*0.5	$93.31^{ab}\pm1.04$	$80.26^{ab}\pm2.94$	$3.45^{g}\pm0.02$	$35.00^{ab}\pm0.57$	$5.41^{ab}\pm0.78$	$0.07^{a}\pm0.02$
Lr1*S2*2	$94.52^{a}\pm2.30$	$83.13^{a}\pm1.18$	$2.60^{h}\pm0.05$	$36.33^{a}\pm0.33$	$5.91^{a}\pm0.18$	$0.07^{a}\pm0.02$
Lr2*S1*0.5	$81.30^{d}\pm 1.87$	$60.77^{e}\pm2.22$	$10.75^{a}\pm0.14$	$31.00^{c}\pm0.57$	$3.24^{d}\pm 0.52$	$0.02^{e}\pm0.006$
Lr2*S1*2	$84.76^{cd}\pm0.08$	$62.24^{de}\pm2.18$	$8.95^{b}\pm 0.02$	$32.66^{bc}\pm0.88$	$3.95^{cd}\pm 0.36$	$0.04^{d}\pm0.005$
Lr2*S2*0.5	$86.27^{bcd}\pm4.59$	$67.41^{cde}\pm3.44$	$7.90^{c}\pm 0.05$	$33.66^{b}\pm0.88$	$4.09^{bcd}\pm0.08$	$0.04^{d}\pm0.01$
Lr2*S2*2	$88.61^{abcd}\pm3.04$	$71.62^{cd}\pm 3.60$	$5.20^{e}\pm 0.05$	$34.00^{b}\pm0.57$	$4.38^{bcd}\pm0.08$	$0.05^{c}\pm0.01$

a , b, c, d, e , f , g,h Means within the same column in the same trait with different superscripts are significantly different ($P\leq0.05$) .

* Lr (1) → SUP Step-Up Photoperiod

**Lr(2) → C-SUP Constant- Step Up Photoperiod

Table (4): Effect of light regimens,sources and levels of iodine and their interactions on some biochemical blood constituent, total antioxidant and thyroid hormones of Mandarah hens.

Traits	Total lipids (g/dl)	LDL (mg/dl)	HDL (mg/dl)	HDL/LDL ratio	Total Antioxidant (mg/dl)	Malondial-dhide (mg/dl)	T3 (ng/ml)	T4 (ng/ml)	T3/T4 ratio
Light regimens (Lr)									
Lr (1)*	5.70^{b} ±0.38	20.35^{b}±3.55	68.49^{a}±9.04	3.36^{a}±0.16	487.91^{a}±28.65	1.82^{b}±0.05	1.82± 0.14	10.12^{a}±0.46	0.18± 0.01
Lr (2)**	7.29^{a}±0.42	31.03^{a}±3.37	45.68^{b}±4.65	1.47^{b}±0.11	396.33^{b}±13.80	2.31^{a}± 0.10	1.70± 0.13	9.64^{b}± 0.39	0.17± 0.01
Sources(S)									
Inorganic iodine (S1)	7.08^{a}± 0.37	31.93^{a}± 4.26	47.09^{b}±2.99	0.67^{b}± 0.03	397.58^{b}±13.48	2.24±0.13	1.66^{b}±0.13	10.45^{a}±0.48	0.15^{b}±0.007
Organic iodine (S2)	5.91^{b}±0.47	19.44^{b}±2.35	71.38^{a}±9.59	0.27^{a}±0.17	486.66^{a}±27.25	2.07±0.08	1.86^{a}±0.13	9.316^{b}±0.30	0.20^{a}±0.01
Iodine level(IL)									
IL1 (0.5mg/kg diet)	6.88^{a}± 0.30	26.51± 3.36	52.52^{b}±5.12	2.27^{b}±0.12	430.16±23.19	2.16^{a}±0.13	1.51^{b}±0.13	9.77±0.41	0.15^{b}±0.008
IL2 (2 mg/kg diet)	6.11^{b}± 0.52	24.87±2.35	61.65^{a}±8.55	3.23^{a}± 0.14	454.08±25.44	1.96^{b}±0.13	2.01^{a}± 0.09	9.99±0.46	0.20^{a}± 0.01
Interaction (Lr*S*IL)									
Lr1*S1*0.5	6.65^{a}± 0.81	21.90^{c}±3.26	53.76^{bc}±5.9	2.45^{b}±0.12	408.00^{b}±6.92	2.03^{bcd}±0.02	1.67^{c}±0.07	11.20^{b}±0.17	0.15^{d}±0.01
Lr1*S1*2	6.42^{a}± 0.27	20.76^{c}±1.73	58.90^{bc}±2.3	2.83^{b}±0.02	418.66^{b}±45.83	1.81^{cd}± 0.09	2.33^{a}±0.10	11.96^{a}± 0.03	0.19^{c}± 0.008
Lr1*S2*0.5	5.67^{ab}±0.30	25.16^{b}±8.81	71.40^{b}±5.90	2.83^{b}±0.03	539.00^{a}±22.00	1.71^{d}± 0.15	1.13^{d}±0.04	9.16^{c}±0.26	0.12^{d}±0.003
Lr1*S2*2	4.06^{b}±0.11	13.60^{e}±1.00	89.90^{a}±15.	6.61^{a}±0.02	586.00^{a}±32.08	1.71^{d}±0.08	2.14^{ab}±0.03	8.16^{d}±0.14	0.26 ^{a}±0.008
Lr2*S1*0.5	7.96^{a}±0.48	42.16^{a}±4.09	34.50^{c}±5.67	0.81^{c}± 0.12	367.66^{b}±17.16	2.76^{a} ± 0.19	1.11^{d}± 0.06	7.86^{d}±0.14	0.14^{d}±0.005
Lr2*S1*2	7.31^{a}± 0.42	42.93^{a}±1.68	41.20^{c}±8.69	0.95^{c}±0.35	396.00^{b}±20.78	2.38^{b}±0.15	1.52^{c}±0.04	10.76^{b}±0.54	0.14^{d}±0.01
Lr2*S2*0.5	7.25^{a}±1.57	16.83^{d}±1.67	50.43^{bc}±2.2	2.99^{b}±0.44	406.00^{b}±28.00	2.14^{bc}±0.09	2.14^{ab}±0.11	10.86^{b}±0.08	0.19^{c}±0.008
Lr2*S2*2	6.66^{a}± 0.29	22.20^{c}±2.96	56.60^{bc}±11.	2.54^{b}± 0.06	415.66^{b}±26.84	1.95^{cd}±0.03	2.04^{b}± 0.14	9.06^{c}±0.14	0.22^{b}± 0.01

^{a,b,c} Means within the same column in the same trait with different superscripts are significantly different ($P\leq0.05$) .

* Lr (1) ⟶ SUP Step-Up Photoperiod

**Lr(2) ⟶ C-SUP Constant – Step Up Photoperiod

Table (5): Effect of light regimens,sources and levels of iodine and their interactions on white blood cells count,s and Immunoglobulin indices of Mandarah chicken strain.

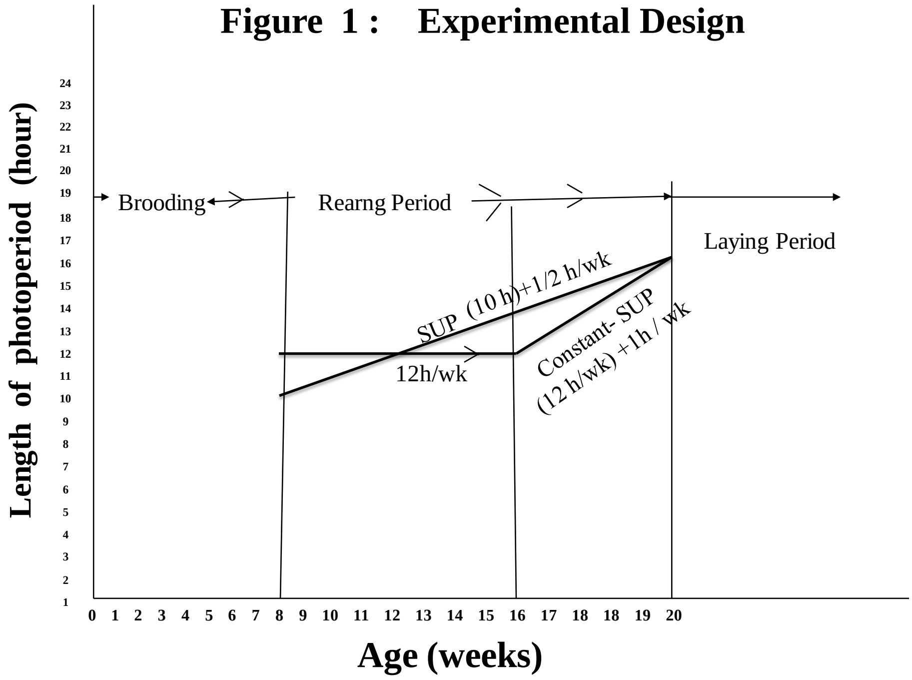
Traits	WBC's ($x10^3/mm^3$)	L (%)	H (%)	H/L ratio	IgM (mg/dl)	IgG (mg/dl)
Light regimens(Lr)						
Lr (1)*	22.87±0.21	42.33±1.64	26.75±1.69	0.66± 0.06	1.79^{a}±1.43	8.32^{a}± 8.94
Lr (2)**	21.60±0.44	41.58±1.52	26.58±1.63	0.66 ±0.06	1.05^{b}±1.59	5.12^{b}±7.37
Source(S)						
Inorganic iodine (S1)	21.95±0.38	41.91± 1.51	27.41± 1.66	0.68±0.06	1.13^{b} ±0.71	5.79^{b}± 8.45
Organic iodine (S2)	22.52±0.34	42.00±1.66	25.91±1.63	0.64± 0.06	1.72^{a}±1.73	7.65^{a}±8.80
Iodine level(IL)						
IL1 (0.5 mg/kg diet)	21.76±0.27	40.14^{b}±1.85	25.24^{b}±1.80	0.60^{b}±0.07	1.33^{b}± 0.53	6.54±8.32
IL2 (2 mg/kg diet)	22.70±0.27	43.74^{a}±1.27	28.08^{a}± 1.51	0.71^{a}± 0.05	1.51^{a}± 1.81	6.89 ±9.75
Interaction (Lr*S*IL)						
Lr1*S1*0.5	22.66^{ab}± 0.29	39.66^{c}±4.40	28.33^{a}±4.40	0.75^{a}±0.18	1.24^{cd} ±0.66	8.23^{c}± 3.75
Lr1*S1*2	22.33^{ab}± 0.65	43.00^{b}± 2.88	28.00^{a}±3.60	0.67^{b}±0.12	1.42^{c}±0.98	8.76^{bc}±4.17
Lr1*S2*0.5	22.89^{a} ± 0.52	42.66^{b}±2.90	27.66^{a} ±3.92	0.66^{b}± 0.13	2.04^{b} ±0.89	5.50^{d} ±5.00
Lr1*S2*2	23.60^{a}±0.15	47.33^{a}±2.33	29.33^{a}±2.66	0.76^{a}± 0.10	2.48^{a}±0.92	10.80^{a} ±1.73
Lr2*S1*0.5	20.43^{c}±0.29	39.33^{c}±2.40	21.33^{c}±1.85	0.45^{d}±0.06	0.93^{e} ±0.37	2.40^{f}±1.154
Lr2*S1*2	22.39^{ab}±0.95	42.33^{b}±3.28	25.66^{ab}±3.28	0.63^{b}± 0.13	0.92^{e}±0.90	3.76^{e}±4.33
Lr2*S2*0.5	21.08^{bc}±0.62	39.00^{c}±4.58	23.66^{b}±3.17	0.57^{c}±0.10	1.12^{ed}±0.75	10.06^{ab}±6.6
Lr2*S2*2	22.51^{ab} ± 0.30	42.33^{b}± 2.60	29.33^{a}±3.66	0.79^{a}± 0.16	1.25^{cd} ±0.90	4.26^{ed}±6.35

[a, b, c] Means within the same column in the same trait with different superscripts are significantly different (P≤0.05).

* Lr (1) → SUP Step-Up Photoperiod

**Lr(2) → C-SUP Constant – Step Up Photoperiod

Figure 1 : Experimental Design



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الملخص العربى

تأثير نظم الإضاءة و مصادر اليود فى العليقة على الأداء الإنتاجى و التناسلى لسلالة دجاج المندرة

إبتسام السيد إبراهيم عراقى ، على عبد الهادى البرلسى ، امينة شعبان السعدنى ،عفت يحى شريف ، هناء محمد خليل

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الهدف من التجربة الحالية هو دراسة تأثير نظم الإضاءة ومصادرومستويات اليود والتداخل بينهم على الأداء الإنتاجى وصفات الفقس و بعض قياسات الدم البيوكيميائية و هرمونات الغدة الدرقية لدجاج المندرة . استخدم فى هذه التجربة عدد 400 كتكوت مندرة عمر 8 أسابيع تم تربيتهم فى العنبر ذات النظام المغلق و تم توزيع الكتاكيت عشوائيا إلى مجموعتين متساويتين (200 كتكوت / مجموعة) . تعرضت المجموعة الأولى من الكتاكيت إلى نظام الإضاءة المتزايد : مدة الإضاءة تزداد تدريجيا من 10 ساعة/ يوم عند عمر 8 أسابيع بنصف ساعة كل إسبوع لتصل إلى 16 ساعة/يوم عند عمر 20 إسبوع (نظام الإضاءة الأول)، تعرضت المجموعة الثانية من الكتاكيت إلى نظام الإضاءة الثابت-المتزايد: تظل مدة الإضاءة ثابتة 12 ساعة / يوم من عمر 8 أسابيع حتى عمر 16 إسبوع و تزداد تدريجيا ساعة كل إسبوع لتصل إلى 16 ساعة/يوم عند عمر 20 إسبوع (نظام الإضاءة الثانى) . تم تقسيم الكتاكيت داخل كل نظام إضاءة إلى أربعة مجموعات إضافات غذائية (5 مكررات بكل مكررة 10 طيور)

كما يلى : العليقة المقارنة مضاف إليها 0,5 ملجم بوتاسيوم أيوديد (المجموعة الأولى ، كنترول) ، 2ملجم بوتاسيوم أيوديد (المجموعة الثانية) ، 0,5 ملجم خميرة غنية بالأيودين (المجموعة الثالثة) و 2 ملجم خميرة غنية بالأيودين (المجموعة الرابعة) /كجم علف. أظهرت النتائج خلال فترة إنتاج البيض حتى 36 إسبوع أن تعرض دجاج المندرة إلى نظام الإضاءة الأول حسن معنويا وزن البيض ،النسبة المئوية لإنتاج البيض ، كتلة البيض ، معدل الكفاءة التحويلية، نسبة الخصوبة ، نسبة الفقس ، وزن الجسم عند الفقس ، النسبة المئوية لكيس المح و لغدة الفبريشى بالمقارنة بنظام الإضاءة الثانى. بالإضافة إلى ذلك ، زاد معنويا محتوى بلازما الدم من الجلوبيولين المناعى (IgM,IgG) ، مضادات الأكسدة الكلية،الدهون عالية الكثافة ، معدل الدهون عالية الكثافة /الدهون منخفضة الكثافة و هرمون الثيروكسين لنظام الإضاءة الأول بالمقارنة بنظام الإضاءة الثانى .تغذية دجاج المندرة على 2 ملجم يود عضوى /كجم علف حسن معنويا أداء الدجاج البياض ، معدل الكفاءة التحويلية ، بلازما الجلوبيولين المناعى (IgM) ، الدهون عالية الكثافة ، معدل الدهون عالية الكثافة /الدهون منخفضة الكثافة ، هرمون ثلاثى يودوثيرونين و معدل تحويل هرمون ثلاثى يودوثيرونين إلى الثيروكسين بالمقارنة باليود الغير عضوى سواء 0,5 أو 2 ملجم /كجم علف . أيضا سجل التداخل بين (نظام الإضاءة الأول ×اليود العضوى×2) أعلى قيم معنوية لإنتاج البيض (%) ، كتلة البيض ، بلازما الجلوبيولين المناعى (IgM) ، الدهون عالية الكثافة، معدل الدهون عالية الكثافة /الدهون منخفضة الكثافة ، معدل تحويل هرمون ثلاثى يودوثيرونين إلى الثيروكسين و L (%)، بجانب تحسين معدل الكفاءة التحويلية بالمقارنة بالتداخلات الأخرى . ونستخلص من نتائج هذه الدراسة أنه من الممكن إستخدام برنامج الإضاءة المتزايد مشترك مع التغذية على 2 ملجم يود عضوى /كجم علف فى إدارة الدجاج البياض من عمر 8 -36 إسبوع لتحسين الأداء الإنتاجى و التناسلى ، صفات الفقس ،وزن الكتاكيت الفاقسة و الجهاز المناعى لدجاج المندرة.