Egypt. Poult. Sci. Vol. (42) (III): (331-353) (2022) **(2208-1214)**

Egyptian Poultry Science Journal

http://www.epsj.journals.ekb.eg/

ISSN: 1110-5623 (Print) – 2090-0570 (Online)

EFFECT OF LIGHTING REGIMENS,LEVELS AND SOURCES OF DIETARY IODINE ON SEMEN QUALITY, YOLK IODINE CONTENT AND CHICKS QUALITY TRAITS OF MANDARAH CHICKENS STRAIN

Ebtsam E.E.Iraqi;A.A.EL-Prollosy; Amina S. EL-Saadany; Effat Y. Shreif and Hanaa M. Khalil

Anim.Prod.Res.Inst., Agric.Res.Center, Egypt

Corresponding author: Ebtsam E.E.Iraqi Email: ibtisam.iraqi.h@gmail.com

Received: 14/08/2022 Accepted: 20 /09/2022

ABSTRACT: A total of 400 females and 400 males of Mandarah strain at 6 weeks old were transferred to an environmentally controlled light proof house. The controlled house are divided inside into four separate partition. They were distributed to the partitions according to the photoperiod regimen, since female chicks were placed in the first and third partition, while the males were placed in the second and fourth partition (200 chicks / partition with two sources of iodine (organic, inorganic) inside each source two levels (0 .5 , 2) with 5 replicate for each treatment with 10 chicks in each replicate). Chicks in the first and second partition 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 16-h/d at 20 wk of age. While, the chicks in the third and fourth partition exposed to Constant step-up photoperiod (CSUP): 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 . Chicks in each lighting regimen are divided equally into four groups (50 birds with 5 replicate) to receive one of the following dietary experiment : basal diet supplemented with 0 .5 (T1), 2 (T2) mg inorganic iodine (Potassium iodide) / Kg diet , 0 .5 (T3) , 2 (T4) mg organic iodine (I-enriched yeast) / Kg diet. Results showed that SUP regimen (Lr1) increased ($P \leq 0.05$) egg weight,eggshell thickness,haugh units, iodine content in egg yolk , semen quality, fertility, hatchability (%), chick quality traits, corticosterone and testosterone hormones compared with CSUP (Lr2). Also, organic iodine enhanced ($P \leq 0.05$) egg weight,eggshell thickness,haugh units, iodine content in egg yolk , semen quality, fertility, hatchability (%), chick quality traits, T3,T3/T4 ratio, corticosterone and testosterone hormones compared with inorganic iodine. Moreover, 2mg iodine/kg diet increased ($P \leq 0.05$) iodine content in egg yolk , thyroid hormones and decreased concentration of corticosterone hormone.

In conclusion, providing SUP regimens for closed houses from 8-20 weeks birds age with 2mg organic iodine/kg diet could increased egg quality traits, the iodine content of yolk eggs, semen quality, chick quality traits, thyroid, corticosterone and testosterone hormones .

Key words: lighting regimens,iodine,semen quality,yolk iodine content,chick quality

INTRODUCTION

Lighting is one of the important factors. It is perceived by a deep brain photoreceptor and long day-induced thyrotropin (TSH) from the pars tuberalis of the pituitary gland causes local thyroid hormone activation within the mediobasal hypothalamus . The locally generated bioactive thyroid hormone, T3,regulates seasonal gonadotropin-releasing hormone secretion, and hence gonadotropin secretion (Ikegami and Yoshimura, 2012).

It has been established that the eyes are not necessary for the photo-sexual response since the photoperiodic response of blinded and sighted birds are similar. Light energy pass through the skull to stimulate photoreceptors in the hypothalamus rather than the eye (Feldkaemper and Schaeffel ,2013).

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 and optimum semen production for cocks (Gharahveysi et al., 2020).

To more understand light manipulation, it can be classified into four major components:1) the wavelength and source, 2) the light intensity,3) the photoperiod length and distribution and 40 time of photostimulation (Capar Akyuz and Onbasilar, 2018).

Males are greater sensitivity to photoperiod than females. To maintain normal levels of reproductive performance, the photoperiod must be maintained above minimal photoperiod during the production period this minimum amount of light for males is generally about 12h/d (Megan, H. M., 2008).

Nutrition of laying hens can be precisely divided into different phases according to the genetic and productions of birds at different climate conditions. Iodine acts as a necessary microelement in the feed industry as an additive whether organic or inorganic forms. Inorganic iodine is relatively expensive (Nollet et al., 2007)., while organic iodine is easier to absorb than inorganic source(Bhoyar, 2015).In addition, organic iodine easily transfers from feed to eggs (Bakhshalinejad et al., 2018).

Iodine plays an important role as it enters into the synthesis of thyroid hormones, which in turn perform many physiological functions in the body such as metabolism and affect fertility, hatchability and semen characteristics (Gaurav *et al.*, 2021)..

Yeast is a rich source of protein, vitamin B and most important minerals such as iodine. Also, yeast is good for animal health , can improve performance and internal egg quality (Yalcin et al., 2010).

This study was undertaken to find out the best lighting regimen with the most appropriate level and source of dietary iodine and their effect on egg yolk iodine content, semen quality and chicks quality traits of Mandarah chickens strain.

MATERIALS AND METHODS

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

Experimental design

A total of 400 females and 400 males of Mandarah strain at 6 weeks of old were weighted and transferred from brooder house to an environmentally controlled light proof house in floor pens (2.0 m × 1.2 m × 2.0 m) . The controlled house are divided inside into four separate partition, each partition had the same hygienic measurement . At 8 weeks chicks old, they were distributed to the partitions according to the photoperiod regimen, since female chicks were placed in the first and third partition , while the males were placed in the second and fourth partition (200 chicks / partition with two sources of iodine (organic, inorganic) inside each source two levels (0 .5 , 2) with 5 replicate for each treatment with 10 chicks in each replicate). Chicks in the first and second partition 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 16-h/d at 20 wk of age. While, the chicks in the third and fourth partition exposed to Constant step-up photoperiod (CSUP): 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 . The scheme of design is illustrated in figure (1) , and chicks in each lighting regimen are divided equally into four groups (50 birds with 5 replicate) to receive one of the following dietary experiment :

1.basal diet supplemented with 0 .5 mg inorganic iodine (Potassium iodide) / Kg diet (control, T1)

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

3.basal diet supplemented with 0 .5 mg organic iodine (I-enriched yeast) / Kg diet (T3) 4.basal diet supplemented with 2 mg organic iodine (I-enriched yeast) / Kg diet (T4)

The light intensity during the rearing period was ~10 lux and was increased to ~20 lux during the laying period.

The ingredient profiles and nutrient composition of the experimental diets according to the recommendation of Animal Production Research Institute are shown in (Table 1) . Feed and water were provided *ad libituim* during the experimental period (8- 40 wk).

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

Measurments

Egg quality traits and iodine content in egg yolk

At 36 weeks of age, three eggs from each replicate were randomly taken from the same days of production and subjected to measure egg quality characteristics. Shell with membranes thickness was measured by a micrometer to the nearest 0.01 mm. Haugh unit was calculated according to the method of Haugh (1937) on the basis of the individual egg weight and the albumen height which was measured using tripod micrometer reading to the nearest 0.01 mm. Shell , Albumen and yolk percent were determined by dividing each previous item by the egg weight and multiplyed by 100 . Yolk samples from each replicate were separated and extracted , after that the samples of egg yolk were digested in Teflon vessels with 5 ml of HNo_3 – $HClo_3$ to determine the iodine concentrations by using inductively coupled plasma mass spectrometry (Shimadzu, ICPMS-2030) according to (Benkhedda et al.2009) .

Semen quality and fertility (%)

120 cocks (15 cocks / treatment (4) / lighting regimen(2)) at 40 weeks of age were used to evaluate semen quality. Semen samples were collected from cocks of each group once weekly by abdominal massage technique. Physical semen parameters were evaluted ejaculate volume(ml), sperm concentration ($X10^9$/ml) was measured using haemocytometer according to the procedure described by Bratton et al.(1956), total sperm out put ($X10^9$/ Ejaculate), motility (%) , Livability (%) . Macroscopic fertility was estimated as a

percentage of fertile eggs out of the number of eggs set .

Hatch time, Hatchability (%) and Chick quality traits.

Nine hundred and sixty hatching eggs (120 / Treatment (4)/ lighting regimen (2)) 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 18^{th} 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. Beginning at 465 hr of incubation and at 6 hr intervals thereafter the hatcher was opened. hatch time was monitored every 6 hours after the hatch of first chick. At hatch , Baby chicks were collected and chick lengths was measured. Also, chick quality parameters as activity, clean appearance, retracted yolk, closed navel were recorded according to observation reported by Tona *et al.* (2004) .

Hormonal assay

At 36 wk of age, blood samples were withdrawn from the bronchial vein from 24 cocks taken randomly (3 cocks/ dietary group / photoperiod regimen) in heparinized tubes at 9:00 AM before access to feed and water. Plasma samples were obtained Triiodothronine T3, thyroxine T4 , Cortrticosterone and Testosterone were assayed by radioimmunoassay (RIA).

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 l^{th} sample

μ = overall mean

A_j = a fixed effect of the i^{th} iodine level (i=1 to 2)

L_j = a fixed effect of the j^{th} light (j=1 to 2)

S_k = a fixed effect of the k^{th} iodine source (k=1 to 2)

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

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

LS_{jk} = an interaction between light and source

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

RESULTS AND DISCUSSION

Egg quality traits and iodine content in egg yolk

The effect of lighting regimens, iodine levels and sources and their interactions on egg quality traits and iodine content in egg yolk are illustrated in Table 2. Irrespective iodine sources and levels, exposing birds to lighting regimen 1(Lr1) increased ($P \leq 0.05$) egg weight (gm), eggshell thickness(mm) , Haugh unit and iodine content in egg yolk compared with lighting regimen 2 (Lr2). While, there was no significant differences between Lr1 and Lr2 in egg components %. With respect to iodine sources, organic iodine increased ($P \leq 0.05$) egg weight, eggshell thickness , Haugh unit and iodine concentration in egg yolk compared to inorganic iodine. Whereas, egg components % were not affected by iodine sources. Also, there were no significant differences between iodine level 1 (IL1) and iodine level 2 (IL2) in all previous mentioned parameters of egg quality. While, addition 2 mg iodine/kg diet gave a raise ($P \leq 0.05$) in egg yolk iodine content compared to 0.5 mg iodine/kg diet. Interaction of Lr1 × S2 × 2 represented highest significant values for egg weight and eggshell thickness compared with the other interactions except of Lr1 × S2 × 0.5 and Lr1 × S1 × 2. Also, values of Haugh unit were highest ($P \leq 0.05$) for interaction of Lr1 × S2 × 2 and Lr1 × S2 × 0.5 compared to other interaction groups. Whereas, the interactions among (Lr × S × IL) did not influence shell , albumen and yolk (%).Moreover, the highest ($P \leq 0.05$) values in egg yolk iodine content was observed for Lr1 × S2 × 2 compared to all values of the interactions.

Conflicting results of egg quality traits due to lighting regimens are cited in the literatures. El-Prollosy, (2006) reported that exposing Gimmizah pullets to step-up photoperiod regimen from 6-22 weeks of age improved shell quality and interior egg quality compared with other lighting regimens. In addition, one researcher mentioned that there are improvement in the eggshell thickness of Japanese quail eggs when exposing to lighting program (15h L /9h D) (Molino et al.,2015). However, several researches found non-significant differences on egg shape index and Haugh units (Yuri et al., 2016 and Farghly et al., 2019). Furthermore, the observed increase in iodine content in egg yolk for Lr1 compared to Lr2 could due to stimulate the light to secretory patterns of several hormones and metabolic processes that facilitate feeding and digestion (Olanrewaju *et al.*, 2006).Also, Gumulka and Rozenboim,(2015) mentioned that the augment in T3 concentration leads to rise in luteinizing hormone, which is responsible for oviposition and ovulation. Regarding of sources of iodine, there are positive effect of organic iodine on egg quality traits. Gheisari et al.(2011) and Yenice et al. (2015) found improvements associated with an increase in shell quality with respect to organic trace minerals. In addition, yeast enriched iodine supplementation in poultry feeding can improve internal egg quality (Yalcin et al., 2010). In contrary, Opaliński et al.(2012) observed that egg quality parameters were not significant different with I-yeast (2mg/kg). Increaseing the iodine content in egg yolk for birds that fed organic iodine compared to inorganic iodine due to improve the transport and absorption of organic minerals (Zhang et al., 2016). Additionally, Opaliński et al. (2012) found that I- enriched yeast as the organic form of iodine was found to be more effective than $Ca(IO3)2$ in increasing the level of iodine in the egg compartments.

Irrespective of lighting regimens and sources of iodine, the differences of egg quality parameters between levels of iodine were disappeared. This conclusion is keeping with previous reports by Lichonikova et al. (2003) who revealed that no effects of concentration of iodine in the diets on egg quality, even if iodine supplemented with 5.20 mg/Kg (Yalcin et al., 2004). It should be mentioned that the increase in yolk iodine for birds fed 2mg iodine /Kg diet compared to 0.5 mg iodine/kg diet was associated with increasing iodine concentration in the diet of hens. Some researchers came to the same conclusion, as Yalcin et al. (2004) indicated that increasing I levels in hen diets (3 to 24 mg/kg) caused a noticeable increase in I content both in egg albumen and egg yolk. Rottger et al. (2012) also assayed progressive increases in I accumulation in yolk (425–3,373 μg/ kg) as a response of laying hens to increasing I supplementation of diets. Moreover, many researchers have concluded that the mineral composition of egg can be enriched through manipulating the diet (Abd El-Hack *et al.*, 2020; Macit *et al.*, 2021; Rattanawut *et al.*, 2021). Also, Aghdashi et al. (2021) observed that the use of iodine salt supplements increased the egg content, including iodine. Generally, with respect to interaction between (Lr × S × IL) , the results recorded that egg weight, eggshell thickness, Haugh units and iodine content in egg yolk could be improved with Mandarah chickens under step- up photoperiode with supplementation 2mg organic iodine /Kg diet.

Semen quality and fertility (%)

Table (3) summarizes the effect of lighting regimens, sources and levels of iodine and their interactions on semen quality and fertility (%). Exposing the cocks of Mandarah breed to step-up photoperiod (Lr1) ($P \leq 0.05$) improved ejaculate volume, sperm concentration, total sperm out put, motility (%) , livability (%) and fertility (%) compared with those for constant-step up photoperiod (Lr2). Concerning the effect of iodine sources, the above-mentioned semen quality traits and fertility (%) improved ($P \leq 0.05$) for cocks that fed on organic iodine compared with those for inorganic iodine. Regardless of lighting regimens and iodine sources, levels of iodine did not possess any significant influences on semen quality and fertility (%). The interaction between Lr1 × S2 × 2 and Lr1 × S2 × 0.5 represented the highest ($P \leq 0.05$) ejaculate volume compared with all studied interactions. Furthermore, sperm concentration significantly increased for Lr1 × S2 × 2 compared with all values of the interaction except Lr1 × S2 × 0.5, Lr1 × S1 × 0.5 and Lr2 × S2 × 2 . Also, Lr1 × S2 × 2 interaction recorded the highest total sperm out put compared with the other interactions except Lr1 × S2 × 0.5. The interaction of motility (%) showed the highest significant values in Lr1 × S2 × 2 compared with Lr2 × S1 × 0.5 , Lr2 × S1 × 2 and Lr2 × S2× 0.5. In addition to, livability (%) has been significantly increased for cocks of interaction group of Lr1 × S2 × 2 compared with all other values of the interaction except Lr1 × S2 × 0.5 and Lr1 × S1 × 0.5. Respecting fertility, the highest ($P \leq 0.05$) interactions of fertility for group of Lr1 × S2 × 2 compared with Lr2 × S1 × 0.5, Lr2 × S1 × 2 and Lr2 × S2 × 0.5 .

Step-up photoperiod (Lr1) improved semen quality and fertility, which could be attributed to increasing levels of thyroid hormones (T3,T4) and testosterone (Table 5). Several research workers have drawn the same conclusion as Abu Zeid et al. (2017) who observed that the increase of semen ejaculate volume and sperm cell concentration was related to the effect of testosterone level on growth and secretary activity of the testis and the accessory sex glands of bucks. Also, thyroid hormones are one of factors affecting testis development and their action, when untimely, produces profound effects on the developing testis, affecting spermatogenesis, steroidogenesis, testis size, reproductive hormones and fertility . Altered thyroid hormone states can also change the epigenetic information of the male germ line, with phenotypic consequences for future generations (Hernandez and Martinez, 2020). Moreover, Fouda et al., 2021 indicated that application of short light period (8L: 16D) can be used as alternative and beneficial strategy to rabbit producers for improving semen quality, antioxidative capacity and fertility of bucks. While, Dominchin et al. (2014) showed that after 5 wk of short day exposure (8L:16D photoperiod), males significantly reduced plasma testosterone in comparison with photo-stimulated males exposed to long day (14L:10D photoperiod).

The observed improvements of semen quality and fertility (%) for organic iodine group compared with inorganic iodine might related to that organic iodine consists of organic compounds such as amino acid(s), protein, or organic acid. Also, it is more stable due to their organically bound structure with better digestion and absorption in intestine (Ammerman et al., 1998), which in turn increase their bioavailability and assimilability (Bhoyar, 2015) and consequently reduce the fecal and urinary excretion (Wang et al., 2019b). Also, Wang et al. (2019a) stated that replacement of Inorganic iodine with organic iodine enhanced the mineral retention in tissues and beneficial for reproductive performance of broiler breeder with reduced mineral excretion. These results are coincided with the results reported by Abaza et al. (2006) who concluded that the addition of *Saccharomyces cerevisiae* to diet of layer breeders improved semen traits. Moreover, Ahmed et al. (2012) mentioned that the use of yeast as a food additive in the diet decreased sperm abnormalities in rats and hence alter male fertility. This improvement in semen quality was attributed to the role of yeast as an antioxidant ,as it reduces the reactive oxygen species and other aqueous peroxyl radicals detrimental to sperm function and quality. Van Dorland et al.(2016) suggested that the addition of yeast product increased the antioxidant capacity in the semen and thus improved semen properties in horses .

There isn' t any information in the literature respecting of the effect of iodine levels on semen quality. Moreover, exposing males of Mandarah strain for step-up photoperiod regimen beside feeding on 2mg organic iodine /kg diet could be used as effective way to improve semen quality,Thus, improve fertility .

Hatch time, Hatchability (%) and chick quality traits

Data of hatch time, hatchability of fertile eggs (%), hatched chicks weight (gm) and chick quality traits are displayed in Table 4. Results indicated that the chicks produced from eggs of birds exposing to lighting regimen 1 (Lr1) were hatched ($P \leq 0.05$) earlier than those for lighting regimen 2 (Lr2). Also, Lr1 recorded the highest significant percentages of hatchability for fertile eggs compared to Lr2. Furthermore, body weight at hatch for chicks of Lr1 group increased ($P \leq 0.05$) compared with those for Lr2 group. Moreover, highest significant ($P \leq 0.05$) length of baby chicks was recorded for Lr1 group compared with those for Lr2 group. The best ($P \leq 0.05$) records of chick's activity , Clean appearance, retracted yolk and closed navel were observed for chicks of Lr1 group compared with Lr2 group. Regarding iodine sources, the chicks of organic iodine group (S2) were hatched ($P \leq 0.05$) earlier than those for inorganic iodine (S1). Furthermore, highest significant ($P \leq 0.05$) records of percentages of hatchability for fertile eggs, hatched chicks weight and all previous mentioned traits of chick quality were noticed for (S2) compared to (S1). Regardless of lighting regimens and iodine sources, chicks produced from eggs of birds fed on diet with 2 mg iodine/Kg diet (IL2) were numerically hatched earlier than those for IL1. Moreover, Supplementation the diet with high level of iodine (IL2) numerical increased hatchability of fertile eggs % compared with IL1 (0.5 mg I/Kg diet). While, there were no significant differences amonge IL1 and IL2 groups with respect to hatched chicks weight and chick quality traits. In addition to, the chicks of Lr1 × S2 × 2 and Lr1 × S2 × 0.5 groups were hatched($P \leq 0.05$) earlier than those for other interaction groups. The highest value of interaction for hatchability of fertile eggs % and hatched chicks weight were observed for group of Lr1 × S2 × 2 compared with the other interactions except Lr1 × S2 × 0.5 and Lr1 × S1 × 2 groups. Moreover, the highest ($P \leq 0.05$) chick length and retracted yolk were recorded for chicks of Lr1 × S2 × 2 compared with all values of the other interactions except Lr1 × S1× 0.5 and Lr1 × S2 × 0.5 groups . Also, the chicks of Lr1 × S2 × 2 group represented highest value for activity and clean appearance compared to all values of the interactions except Lr1 × S2 × 0.5 group.

It sould be mentioned that hatch time was earlier for eggs of chickens exposing to Lr1 than Lr2. This could due to many physiological factors are integrated at the time of hatching in precocial avian species (Dewil et al.,1992). One critical factor in the integration of physiological functions is the onset of thyroid function in the embryo and the initial appearance of the biologically active of thyroid hormone, T3 (McNabb et al., 1993). Thyroid hormones of maternal origin are thought to play a role in early embryonic development (Prati et al.,1992) and this reflected on early hatch time in our results (Table 5). The significant increase in hatchability (%) of Mandarah eggs for Lr1 group might due to that Step-up photoperiod stimulate increase secretion of thyroid hormones ,insulin and gonadotropin releasing hormone. These hormones contributes to the growth and enhancing of the reproductive function of birds (Lewis et al.,2004). Similar results were reported by Kyere et al.(2020) who reported that a lighting programme of 16L:8D improves hatchability compared with 12L/12D. Moreover, the increase in chick weight at hatch might be due to existence a positive relationship between egg weight and chick weight (Correa *et al.*, 2011 and Santos et al. 2015). In addition to, The improvement in chick quality traits for Lr1 group compared to Lr2 group could due to the early hatching of chicks of this group . Also, Step-up photoperiod might caused a rise in thyroid hormones (T3,T4) at internal pipping in the newly hatched chicks. Supporting to this finding, Decuypere and Bruggeman, (2007) suggested that the large hatchling length was due to hormone levels, blood metabolites levels and better T3: T4 hormone concentration. Also, Bergoug et al. (2015) showed that the delay in hatching chicks led to poor quality chicks compared to the chicks that hatched early at take-off, and the quality of the chicks decreased for the late chicks in hatching due to wet plumage, poor activity, inflammation of the navels and not giving enough time to heal the navels and dry it. A lighting programme of 16L/8D significantly improved chick length at hatch indicating improved chick quality (Shah and Özkan, 2022).

Early hatched, increased hatchability (%), hatched chicks weight and chick quality traits for organic iodine group might due to that organic iodine can be better absorbed by animals , Thus increasing iodine in the egg. Supporting to results and interpretation herein, Górniak et al. (2018) showed that microelements in organic form can be better absorbed by animals, improving the quality of products obtained from them. Also, Sarlak et al. (2020) observed that ethylenediamine dihydroiodide as the organic form of iodine was found to be more effective than calcium iodate in increasing the level of iodine in the egg compartments.

Supplementation 2mg iodine /kg diet decreased hatch time and improve hatchability (%). This result could be due to increased concentration of iodine in eggs and transferred to embryos, thus, increased levels of thyroid hormones, which accelerate embryonic development leading to a shorter duration of incubation. These results are in line with Czarnecki,(1991) who mentioned that maternal dietary iodine may affect the embryo plasma thyroid hormone concentration by depositing more iodine or iodohormones into the egg prior to oviposition. Increased embryonic plasma thyroid hormone concentrations may then affect carbohydrate metabolism and basal metabolic rate of the developing embryo (Davis et al., 2000). Also, Chen et al. (2016) and Zhang et al. (2017) reported that good nutritional condition of the parents is vital for transferring of required nutrients for development of the embryo.

In conclusion, the interaction values showed that the application of step up photoperiod regimen accompanied with enriched the diet of parent flocks with 2 mg organic iodine (I-enriched yeast) /Kg diet is a good and highly recommended tool for improving the hatching rate , hatched chicks weight and the quality of the resulting chicks with a decrease in hatching time.

Thyroid, Corticosterone and Testosterone hormones

Data of thyroid, cortcosterone and testosterone hormones as affected by combination of light regimens, sources and levels of iodine for Mandarah males are presented in Table 5. Results indicated that there are no differences in values of T3,T4 and T3/T4 ratio of Lr1 group compared with those of Lr2 group, besides, males of the same group (Lr1) had highest ($P \leq 0.05$) value ot testosterone hormone compared to Lr2 group. On the other hand, corticosterone hormone was decreased ($P \leq 0.05$) for Lr1 group compared with those of Lr2 group. In regard to the sources of iodine, males that fed on organic iodine recorded highest ($P \leq 0.05$) values of T3 , T3/T4 ratio and testosterone hormones and lowest ($P \leq 0.05$) value of corticosterone hormone compared to inorganic iodine. In spite of lighting regimens and sources of iodine, plasma T3 and T4 hormones concentrations were highest ($P \leq 0.05$) for IL2 group compared with that of IL1 group , besides, IL1 and IL2 groups did not represent statistical difference in T3/T4 ratio and testosterone hormone. Wherease, 2mg/Kg diet iodine (IL2) reduced plasma corticosterone hormone compared with IL1. Apparently from the interaction (Lr × S × IL) that the highest value of plasma T3 was observed for Lr1 × S2 × 2 group compared with the other interactions except that for Lr1 × S2 × 0.5, Lr2× S1 × 2 and Lr2 × S2 × 2. Also, T4 plasma increased ($P \leq 0.05$) for Lr1× S2 × 2 compared to all values of the interactions except Lr1 × S1 × 2 and Lr2 × S1 × 2. Moreover, the interaction Lr2 × S2 × 0.5 increased T3/T4 ratio ($P \leq 0.05$) compared to Lr2 × S1 × 2, Lr2 × S2 × 2 and Lr1 × S1 × 0.5. Plasma corticosterone was reduced ($P \leq 0.05$)

for Lr1 × S2 × 2 and Lr1 × S1 × 2 compared with Lr1 × S1 × 0.5, Lr2 × S1 × 0.5 and Lr2 × S1 × 2. In addition, the interaction between Lr2 × S1 × 0.5 and Lr2 × S1 × 2 showed lowest value of testosterone hormone compared to other interactions. Also, the highest value was for Lr1 × S2 × 2 compared to all the interaction in the same trait.

The increase of testosterone hormone of Lr1 group could due to that step up light regimen stimulate testicular activity,Thus, increasing testosterone plasma levels. These results are in agreement with those reported by Biswas et al. (2007) and Busso et al.(2013). However, Dominchin et al. (2014) detected that plasma testosterone significantly reduced for males after 5 wk of short day exposure (8L:16D photoperiod) in comparison with photo-stimulated males exposed to long day (14L:10D photoperiod). In addition, the decrease in plasma corticosterone for males of Lr1 due to the effect of light on hypothalamic-pituitary- adrenal axis (Saito et al., 2005).

The enhanced in some of plasma hormones (T3, T3/T4 ratio ,testosterone, corticosterone) for organic iodine group could be due to that I-enriched yeast (organic iodine) consists of soluble sugars and organic acids to produce biomass with high protein and its production is easy to manage (Esmaeili et al.,2012). Furthermore, El-prollosy et al.(2020) reported that supplementation of dietary organic iodine (I-enriched yeast) increased significantly plasma T3 and T3/T4 ratio compared with the values for the groups supplied with inorganic iodine. Also, using organic forms of minerals can help maintaining high reproductive performance of poultry and farms animals reared under commercial conditions (Surai et al., 2002).

In addition, the current results of the effect of iodine level 2 in increasing plasma thyroid hormones and reducing corticosterone hormone for males is confirmed by Eila et al. (2012) who demonstrated that supplementation of iodine at levels of 0.74, 1.48, 2.22 and 2.96 mg/kg increased T4 concentrations during grower period in broilers. Also, Arzour-Lakehal et al. (2013) reported that Blood T4 concentration was increased by increasing dietary iodine levels for 0 to 5 mg/kg. Moreover, Ibrahim, et al. (2015) found that dietary iodine supplementation, up to 2.4mg/kg diet improved T3 level . However, Maroufyan and Kermanshahi (2006) was proved that the addition of iodine at levels 0.35, 0.75 and 1.05 mg/kg had no significant effect on the concentrations of T3 and T4. Behroozlak et al. (2019) observed that T3 concentration in blood was not changed by any level of iodine.

From results of the interaction between Lr × S × IL, it could be concluded that exposing males of Mandarah strain to SUP regimen, beside, fed these males on the second level of organic iodine (2mg iodine /Kg diet) improved thyroid, corticosterone and testosterone hormones.

CONCLUSION

From the results and discussion, it appears that the exposure of the females of the Mandarah breed to a SUP regimen with feeding on organic iodine at a concentration of 2mg/kg diet (from 8-36 weeks of age) is a good way to increase the concentration of iodine in the egg yolk and chick quality traits. Also,exposure of cocks to the same lighting regimen and nutritional supplement (from 8 - 40weeks of age) is a sound tool for improving semen quality,fertility and hormones causing this improvement (T3,T4,Testosterone)

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) *free from Iodine.	0.30	0.30
Total	**100.00**	**100.00**
Calculated analysis:		
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

*Composition of premix in 3 kg is : Vit. A, 10.000 IU ; Vit . D3, 100.000 IU ; Vit E , 10.000 mg ; Vit. E,10.000 mg; Vit. K3,1.000 mg; Vit . B1 , 1 mg ; vit . B2 , 4 mg ; Vit B6 ,1.5 mg ; Vit . B12 , 10 mcg ; Niacin , 20.000 mg ; Pantothenic acid 10.000 mg ; Folic acid , 1 mg ; Biotin , 50 mg ; Choline chloride , 500 mg ; Copper , 4 mg ; Iron , 30 mg ; Manganese , 40.000 mg ; Zinc , 45.000 mg ; Cu , 3.000 mg ; Selenium , 0.1 mg ; Cobalt , 0.1 mg .

Table (2): Effect of lighting regimens, levels and sources of dietary iodine and their interactions on egg quality traits and iodine content in egg yolk of Mandarah laying hens.

Traits	**Egg weight (gm)**	**Egg shell with membranes thickness (mm)**	**Haugh unit**	**Egg components %**			**Iodine concentration (μg / 100 g of egg yolk)**
				Shell	**Albumen**	**Yolk**	
Lighting regimen (Lr)							
Lr (1)*	48.66^{a}± 0.4	36.33^{a}±0.4	93.98^{a}±1.6	10.11± 0.16	60.57±0.4	29.31±0.4	79.79^{a}±8.69
Lr (2)**	46.58^{b}±0.3	34.50^{b}±0.4	85.61^{b}±1.0	9.84± 0.19	61.63±0.4	28.52±0.4	77.61^{b}±8.23
Sources(S)							
Inorganic iodine (S1)	46.75^{b}± 0.4	34.58^{b}± 0.3	86.74^{b}±1.1	9.88±0.20	61.31 ±0.4	28.80±0.4	51.28^{b} ± 0.55
Organic iodine(S2)	48.50^{a}±0.5	36.25^{a} ± 0.5	92.85^{a} ±2.0	10.07±0.15	60.88 ±0.5	29.03±0.4	106.12^{a} ± 2.58
Iodine level(IL)							
IL1 (0.5mg/kg diet)	47.16±0.4	35.08± 0.5	88.43±1.7	9.97±0.19	61.28±0.5	28.73±0.5	73.91^{b} ± 7.25
IL2 (2 mg/kg diet)	48.88±0.6	35.74±0.5	91.15±1.9	9.98±0.17	60.91±0.4	29.10±0.4	83.49^{a} ± 9.31
Interaction Lr*S*IL)(							
Lr1*S1*0.5	47.33^{bcd}±0.6	35.00^{bc} ±0.5	86.28^{c}±1.6	10.12± 0.54	60.36±1.4	29.50±1.6	49.43^{f} ± 0.40
Lr1*S1*2	48.00^{abc}±1.1	35.66^{abc}±0.6	91.94^{b}±1.1	9.86±0.25	60.86± 0.4	29.27±0.6	53.60^{e} ± 1.18
Lr1*S2*0.5	49.00^{ab} ±0.5	36.66^{ab} ±0.3	98.37^{a} ±0.2	10.00 ±0.12	60.67 ±0.3	29.31± 0.4	100.46^{c} ± 0.31
Lr1*S2*2	50.33^{a} ±0.8	38.00^{a} ±0.5	99.33^{a} ± 0.2	10.44 ±0.33	60.38 ±1.4	29.17± 1.1	115.66^{a} ± 0.34
Lr2*S1*0.5	45.33^{d} ±0.6	33.66^{c}± 0.3	83.47^{c}± 0.4	9.86 ± 0.51	62.14± 0.7	27.98±0.3	50.40^{f} ± 0.34
Lr2*S1*2	46.33^{cd}±0.3	34.00^{c} ±0.5	85.26^{c}± 1.5	9.66±0.46	61.89 ±0.7	28.43± 1.1	51.70^{ef} ± 0.51
Lr2*S2*0.5	47.00^{bcd}±0.5	35.00^{bc} ±1.7	85.61^{c}± 2.1	9.90 ±0.45	61.96± 1.4	28.12 ±1.4	95.36^{d} ± 0.63
Lr2*S2*2	47.66^{bcd}±0.8	35.33^{bc} ±0.3	88.10^{bc}± 3.2	9.94 ± 0.33	60.52±0.7	29.52 ±0.6	113.00^{b} ± 1.73

a , b, c , d , e and f means within the same column in the same trait with different superscripts are significantly different ($p<0.05$) .

* Lr (1) $\longrightarrow$ SUP Step-Up Photoperiod

**Lr(2) $\longrightarrow$ CSUP Constant Step-Up Photoperiod

Table (3): Effect of lighting regimens, levels and sources of dietary iodine and their interactions on semen quality of Mandarah cocks .

Traits	Ejaculate volume (ml)	Sperm concentration ($X10^{9}$/ml)	Total sperm out put ($X10^{9}$/ ejaculate)	Motility(%)	Livability (%)	Fertility (%)
Lighting regimen						
Lr (1)*	$0.68^{a} \pm 0.03$	$2.76^{a} \pm 0.20$	$1.94^{a} \pm 0.19$	$91.75^{a} \pm 1.05$	$90.75^{a} \pm 1.47$	$91.16^{a} \pm 2.14$
Lr (2)**	$0.37^{b} \pm 0.03$	$1.60^{b} \pm 0.17$	$0.67^{b} \pm 0.13$	$81.87^{b} \pm 1.929$	$79.50^{b} \pm 1.46$	$83.91^{b} \pm 1.90$
Sources(S)						
Inorganic iodine (S1)	$0.42^{b} \pm 0.04$	$1.78^{b} \pm 0.21$	$0.87^{b} \pm 0.17$	$83.12^{b} \pm 2.08$	$81.50^{b} \pm 1.89$	$84.16^{b} \pm 2.12$
Organic iodine(S2)	$0.63^{a} \pm 0.04$	$2.58^{a} \pm 0.22$	$1.74^{a} \pm 0.23$	$90.50^{a} \pm 1.38$	$88.75^{a} \pm 1.78$	$92.72^{a} \pm 2.04$
Iodine level(IL)						
IL1 (0.5mg/kg diet)	0.52 ± 0.04	2.10 ± 0.22	1.23 ± 0.22	86.56 ± 1.75	84.81 ± 2.10	85.9 ± 1.15
IL2 (2 mg/kg diet)	0.53 ± 0.05	2.26 ± 0.26	1.38 ± 0.24	87.06 ± 2.23	85.43 ± 2.02	89.43 ± 1.47
Interaction Lr*S*IL)(						
Lr1*S1*0.5	$0.62^{b} \pm 0.02$	$2.53^{abc} \pm 0.49$	$1.619^{bc} \pm 0.38$	$91.25^{ab} \pm 1.25$	$92.00^{ab} \pm 2.41$	$86.40^{abcd} \pm 1.77$
Lr1*S1*2	$0.55^{b} \pm 0.02$	$2.22^{bcd} \pm 0.26$	$1.21^{cd} \pm 0.14$	$88.75^{ab} \pm 3.14$	$82.75^{c} \pm 1.70$	$91.93^{abc} \pm 1.70$
Lr1*S2*0.5	$0.75^{a} \pm 0.02$	$2.95^{ab} \pm 0.36$	$2.23^{ab} \pm 0.31$	$92.50^{ab} \pm 1.44$	$92.50^{ab} \pm 1.84$	$92.05^{ab} \pm 1.09$
Lr1*S2*2	$0.82^{a} \pm 0.04$	$3.34^{a} \pm 0.44$	$2.70^{a} \pm 0.25$	$94.50^{a} \pm 1.65$	$95.75^{a} \pm 0.47$	$95.16^{a} \pm 2.10$
Lr2*S1*0.5	$0.32^{c} \pm 0.02$	$1.29^{ed} \pm 0.22$	$0.43^{e} \pm 0.10$	$77.50^{c} \pm 2.50$	$76.25^{d} \pm 1.49$	$80.14^{d} \pm 2.45$
Lr2*S1*2	$0.20^{d} \pm 0$	$1.08^{e} \pm 0.25$	$0.21^{e} \pm 0.05$	$75.00^{c} \pm 2.04$	$75.00^{d} \pm 0.81$	$83.21^{cd} \pm 1.52$
Lr2*S2*0.5	$0.40^{c} \pm 0.04$	$1.64^{cde} \pm 0.04$	$0.66^{de} \pm 0.07$	$85.00^{b} \pm 2.04$	$78.50^{cd} \pm 1.50$	$85.01^{bcd} \pm 2.16$
Lr2*S2*2	$0.57^{b} \pm 0.02$	$2.39^{abc} \pm 0.42$	$1.38^{c} \pm 0.27$	$90.00^{ab} \pm 3.53$	$88.25^{b} \pm 1.25$	$87.44^{abcd} \pm 4.19$

a , b, c , d and e means within the same column in the same trait with different superscripts are significantly different ($p<0.05$) .

* Lr (1) $\longrightarrow$ SUP Step-Up Photoperiod **Lr(2) $\longrightarrow$ CSUP Constant Step-Up Photoperiod

Table (4): Effect of lighting regimens, levels and sources of dietary iodine and their interactions on hatch time and chick quality traits for Mandarah hatched.

Traits	Hatch time (hrs.)	Hatchability of fertile eggs (%)	Hatched chicks weight (gm)	Chick length (cm)	Activity (%)	Clean Appearance (%)	Retracted Yolk (%)	Closed Navel (%)
Lighting regimen (Lr)								
Lr (1)*	$488.75^{b} \pm 1.49$	$75.67^{a} \pm 2.01$	$35.60^{a} \pm 0.51$	$14.45^{a} \pm 0.16$	$89.33^{a} \pm 1.11$	$94.41^{a} \pm 0.88$	$96.58^{a} \pm 1.06$	$96.91^{a} \pm 0.74$
Lr (2)**	$496.50^{a} \pm 1.01$	$64.66^{b} \pm 2.31$	$33.10^{b} \pm 0.20$	$13.53^{b} \pm 0.16$	$84.00^{b} \pm 0.75$	$88.33^{b} \pm 1.12$	$88.83^{b} \pm 1.26$	$91.50^{b} \pm 1.23$
Sources(S)								
Inorganic iodine (S1)	$495.75^{a} \pm 1.19$	$66.67^{b} \pm 2.08$	$33.38^{b} \pm 0.33$	$13.65^{b} \pm 0.19$	$84.58^{b} \pm 0.97$	$88.91^{b} \pm 1.14$	$89.91^{b} \pm 1.51$	$92.25^{b} \pm 1.17$
Organic iodine (S2)	$489.50^{b} \pm 1.67$	$74.10^{a} \pm 1.99$	$35.54^{a} \pm 0.44$	$14.33^{a} \pm 0.18$	$88.75^{a} \pm 1.16$	$93.83^{a} \pm 1.14$	$95.50^{a} \pm 1.32$	$96.16^{a} \pm 1.15$
Iodine level(IL)								
IL1 (0.5mg/kg diet)	493. 5± 1.66	68.09± 1.50	33.72±0.61	14.04±0.18	86.50±1.01	91.25±1.17	92.91±1.51	94.41±1.29
IL2 (2 mg/kg diet)	491.75±1.79	72.04± 1.45	34.64±0.38	13.94±0.24	86.83±1.43	91.50±1.53	92.50±1.77	94.00±1.30
Interaction Lr*S*IL								
Lr1*S1*0.5	$494.00^{bc} \pm 1.15$	$67.98^{cd} \pm 3.01$	$34.12^{b} \pm 0.77$	$14.46^{abc} \pm 0.12$	$88.33^{bc} \pm 1.66$	$93.00^{bc} \pm 0.57$	$96.66^{ab} \pm 0.88$	$97.33^{ab} \pm 0.66$
Lr1*S1*2	$491.00^{cd} \pm 1.73$	$73.67^{abc} \pm 1.81$	$35.46^{ab} \pm 0.7$	$13.73^{cde} \pm 0.37$	$85.66^{cde} \pm 1.76$	$91.33^{bc} \pm 1.33$	$91.00^{cd} \pm 0.57$	$93.33^{bcd} \pm 0.88$
Lr1*S2*0.5	$486.00^{de} \pm 3.46$	$78.12^{ab} \pm 2.82$	$35.80^{ab} \pm 0.7$	$14.66^{ab} \pm 0.17$	$90.00^{ab} \pm 1.73$	$95.33^{ab} \pm 1.45$	$98.66^{a} \pm 0.33$	$98.00^{ab} \pm 1.15$
Lr1*S2*2	$484.00^{e} \pm 1.15$	$81.12^{a} \pm 2.00$	$37.13^{a} \pm 0.29$	$14.93^{a} \pm 0.23$	$93.33^{a} \pm 1.66$	$98.00^{a} \pm 0.57$	$100.00^{a} \pm 0$	$99.00^{a} \pm 0.57$
Lr2*S1*0.5	$500.00^{a} \pm 1.15$	$60.51^{e} \pm 1.95$	$30.89^{c} \pm 0.50$	$13.43^{de} \pm 0.23$	$83.00^{de} \pm 0.57$	$87.00^{de} \pm 1.52$	$87.33^{de} \pm 1.45$	$90.66^{de} \pm 1.76$
Lr2*S1*2	$498.00^{ab} \pm 1.15$	$62.68^{de} \pm 2.41$	$32.05^{bc} \pm 0.4$	$12.96^{e} \pm 0.08$	$81.33^{e} \pm 0.66$	$84.33^{e} \pm 0.88$	$84.66^{e} \pm 2.60$	$87.66^{e} \pm 0.88$
Lr2*S2*0.5	$496.00^{abc} \pm 1.15$	$65.78^{cde} \pm 2.49$	$34.10^{b} \pm 0.60$	$13.60^{de} \pm 0.30$	$84.66^{cde} \pm 0.88$	$89.66^{cd} \pm 2.33$	$89.00^{d} \pm 1.00$	$91.66^{cde} \pm 3.28$
Lr2*S2*2	$492.00^{c} \pm 1.15$	$70.81^{cd} \pm 2.78$	$35.13^{b} \pm 0.55$	$14.13^{bcd} \pm 0.29$	$87.00^{bcd} \pm 1.52$	$92.33^{bc} \pm 1.20$	$94.33^{bc} \pm 0.66$	$96.00^{abc} \pm 1.00$

a , b, c , d and e 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) → CSUP Constant Step-Up Photoperiod

Table (5): Effect of lighting regimens, levels and sources of dietary iodine and their interactions on thyroid , corticosterone and testosterone hormones of cocks of Mandarah strain.

Traits	T_3 (ng/ml)	T_4 (ng/ml)	T_3/T_4 Ratio	Corticosterone (ng/ml)	Testosterone (ng/dl)
Lighting regimen (Lr)					
Lr (1)*	1.82±0.20	10.09±0.51	0.17±0.01	7.21^{b}±0.83	445.83^{a}± 3.13
Lr (2)**	1.57±0.18	9.64±0.38	0.16±0.01	9.09^{a}±0.52	410.83^{b}± 7.78
Sources(S)					
Inorganic iodine (S1)	1.36^{b}±0.16	9.52±0.40	0.14^{b}±0.01	9.20^{a}±0.80	413.41^{b}± 8.71
Organic iodine(S2)	2.03^{a}±0.17	10.20±0.48	0.19^{a}±0.01	7.10^{b}±0.52	443.25^{a} ± 2.35
Iodine level(IL)					
IL1 (0.5mg/kg diet)	1.38^{b}±0.17	8.92^{b}±0.27	0.18±0.01	9.03^{a}±0.66	428.66 ±7.10
IL2 (2 mg/kg diet)	2.01^{a}± 0.17	10.80^{a}±0.43	0.15± 0.01	7.27^{b}± 0.73	428.00 ± 7.793
Interaction Lr*S*IL)(					
Lr1*S1*0.5	1.33^{cd}±0.38	8.90^{bc}± 0.23	0.13^{bcd} ± 0.01	11.18^{a}±1.66	445.00^{a}± 8.89
Lr1*S1*2	1.43^{bcd}± 0.20	10.40^{ab}±0.46	0.15^{abcd}± 0.04	5.63^{c}±0.83	438.66^{a}± 7.58
Lr1*S2*0.5	2.00^{abc}±0.45	8.90^{bc}±0.34	0.20^{abc}±0.00	6.92^{bc}±0.11	446.66^{a}±2.39
Lr1*S2*2	2.52^{a}±0.25	12.16^{a}±1.35	0.22^{ab}± 0.04	5.12^{c}± 0.57	453.00^{a}±4.41
Lr2*S1*0.5	0.90^{d}±0.05	7.90^{c}±0.28	0.16^{abcd}± 0.03	9.81^{ab}± 1.20	390.00^{b}± 14.71
Lr2*S1*2	1.80^{abcd}±0.45	10.90^{ab}± 0.69	0.11^{d}± 0.01	10.19^{ab}±0.60	380.00^{b}±8.16
Lr2*S2*0.5	1.30^{cd}±0.05	10.00^{b}± 0.57	0.23^{a}±0.008	8.21^{abc}± 0.56	433.00^{a} ±2.48
Lr2*S2*2	2.30^{ab}± 0.05	9.76^{bc}±0.08	0.13^{cd}±0.01	8.16^{abc}±1.49	440.33^{a}± 2.46

a , b, c and d 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) → CSUP Constant Step-Up Photoperiod

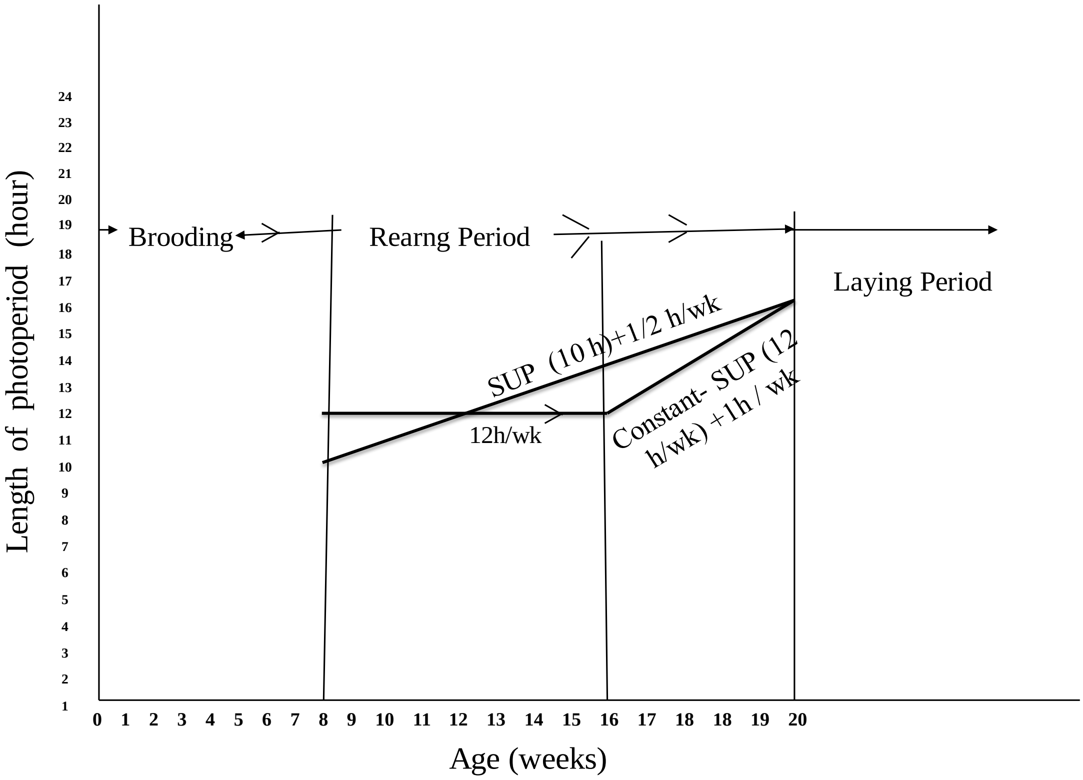

Figure 1 : Experimental Design

REFERENCES

Abaza, I. M.; Shehata, M. A.; and Shoieb, M. S.2006. Evaluation of some natural feed additive in layer diets. Egypt. Poult. Sci.,26:891-909.

Abd El-Hack, M.E.; Alagawany, M.; Chaudhry, M.T.; Saeed, M.; Ahmad, E.A.M.; and El-Sayed, S.A.A. 2020. Does the gradual increase in dietary zinc oxide supplementation can affect egg quality, serum indices, and productive performance of laying hens?. Trop. Anim. Health Prod., 52: 525-531.

Abu Zeid, E.H.; Alam, R.T.M.; and Abd El-Hameed, N.E. 2017. Impact of titanium dioxide on androgen receptors, seminal vesicles and thyroid hormones of male rats: possible protective trial with aged garlic extract. Andrologia. 49:e1265.

Aghdashi, M.N.; Nobakht, A.; and Mehmannavaz, Y. 2021. Effects of dietary trace element supplementation on performance of laying hens and mineral content of egg yolk. S. Afr. J. Anim. Sci., 51 (No. 5).

Ahmed, E. S.; Booles, H. F; Farag,I.M.; ANada, S.;and Fadel. M. 2012. Study of Therapeutical role of Chromium-Enriched Yeast (*Saccharomyces cerevisiae*) on genetic alterations and sperm abnormalities in Streptozotocin-Induced hyfperglycemic Rats. World Appl. Sci., J. 16:39–51.

Ammerman, C. B.; Henry, P. R.; and Miles, R. D. 1998. Supplemental organically bound mineral compounds in livestock nutrition. Pages 67–97. in P. C. Garnsworthy and J. Wiseman eds. University Press, Nottingham.

Arzour-Lakehal, N.; Siliart, B.; and Benlatreche, C. 2013. Relationship between plasma free thyroxine levels and some biochemical parameters in two strains of broiler chickens. Global, Veterinaria, 10: 243–249.

Bakhshalinejad, R.; Hassanabadi, A.; Nassiri-Moghaddam, H.; and Zarghi, H. 2018. The effects of dietary calcium iodate on productive performance, egg quality and iodine accumulation in eggs of laying hens. J. Anim .Physiol. Anim Nutr., 102:746–754.

Behroozlak,M.; Daneshyar,M.; and Farhomand,P. 2019. The effects of dietary iodine and its consumption duration on performance, carcass characteristics, meat iodine, thyroid hormones and some blood indices in broiler chickens. J. Anim. Physiol .Nutr., 104:876–885.

Benkhedda,K.;Robichaud,A.;Beraldin, S.T.; and Kevin, A. 2009. Determination of totyal iodine in food samples using inductively coupled plasma mass spectrometry. J. inter., 92:1720-1727.

Bergoug, H.; Guinebretière,M.; Roulston,N.; Tong,Q.; Romanini, C.E.B. ; Exadaktylos, V.; McGonnell,I.M.; Demmers, T.; Garain, P.; Bahr,C.; Berckmans, D.; Eterradossi, N.; and Michel,V. 2015. Relationships between hatch time and egg weight, embryo sex, chick quality, body weight and pododermatitis severity during broiler rearing. Europ,.Poult.Sci., 79., ISSN 1612-9199, © Verlag Eugen Ulmer, Stuttgart. DOI: 10.1399/eps.2015.93.

Bhoyar, A., 2015. High quality trace minerals support improved breeder hen longevity. Inter. Hatch. Pract., 29:25–27.

Biswas, A.; Ranganatha, O. S.; Mohan, J.; and Sastry. K. V. H. 2007. Relationship of cloacal gland with testes, testosterone and fertility in different lines of male Japanese quail. Anim. Reprod. Sci., 97:94–102.

Bratton, R. W.; Foote,K.; and Shipman, K. 1956. Procedure for counting bovine sperm with a heamocytometer and calibration ofperation used of photometer to estimate sperm count by optical density. Anim. Breed. Lab. Procedure. No. 40, Cornell Univ. Thaca. N.Y., USA.

Busso, J. M.; Dominchin, M. F.; Marin, R. H.; and Palme, R. 2013. Cloacal gland, endocrine testicular, and adrenocortical photoresponsiveness in male Japanese quail exposed to short days. Domest. Anim. Endocrinol., 44:151–156.

Capar Akyuz,H.; and Onbasilar,E.E. 2018. Light wavelength on different poultry species. World's poult.Sci.J.,74:79-88.

Chen, F.; Jiang ,Z.; Jiang, S.;Li, L.; Lin, X.; Gou, Z.; and Fan, Q. 2016. Dietary vitamin A supplementation improved reproductive performance by regulating ovarian expression of hormone receptors, caspase-3 and Fas in broiler breeders. Poult Sci., 95:30-40.

Correa, A.B.; Silva, M.A.; Correa, G.S.S.; Santos, G.G.; Felipe, S.; Wenceslau, R.R.; Souza, G.H. ; and Campos, N.C.F.L. 2011. Efeito da interaçao idade da matriz x peso do ovo sobre o desempenho de codornas de corte. Arquivo. Brasileiro. de Medicina .Veterinária, e Zootecnia., 63:433-440.

Czarnecki,C.M. 1991. Influence of exogenous T4 on body weight,feed consumption, T4 levels, and myocardial glycogen in Furazolidone-fed Turkey poults.Avian Dis.,930-936.

Davis, A. J.; Brooks, C. F.; and Johnson, P. A. 2000. Estradiol regulation of follistatin and inhibin alpha-and beta(B)-subunit mRNA in avian granulosa cells. General and Comparative Endocrinol., 119:308-316.

Decuypere, E.; and Bruggeman . V. 2007. The Endocrine Interface of Environmental and Egg Factors Affecting Chick Quality. Poult. Sci., 86:1037–1042.

Dewil,E.; Decuypere,E.; and Kuhn,E.R. 1992. The hatching process and the role of hormones. In: Avian Incubation, S.G.Tullett,ed.,Butterworth-Heinemann, London. 239-255.

Dominchin, M. F.; Marin, R. H.; Palme, R. ; and Busso, J. M. 2014. Temporal dynamic of adrenocortical and gonadal photoresponsiveness in male Japanese quail exposed toshort days. Domest. Anim. Endocrinol., 49:80–85.

Eila, N.; Asadi, H.;Shivazad, M.; Zarei, A.; and Akbari, N. 2012. Effect of different calcium iodate levels on performance, carcass traits and concentration of thyroid hormones in broiler chickens. Annals. Biologi. Res., 3: 2223–2227.

El-Prollosy, A. 2006. Effect of different lighting regimens on some physiological and productive traits in Gimmizah and Silver Montazah strains. M.Sc.Thesis, Faculty of Agric.(Damanhour), Alexandria University.

El-Prollosy, A.A.; Farag, M.E.; Abou-Shehema, B.M.; Ebtsam E.E.Iraqi, Amal M. EL-Barbary, Effat Y. Shreif ; and Hanaa M. Khalil., 2020. Effect of iodine sources and dietary energy levels on productive, physiological and immunological performance of Bandarah laying hens . Egypt. Poult. Sci., 40: 303-324 .

Esmaeili, S.; Khosravi-Darani, K.; Pourahmad, R.; and Komeili, R. 2012. An experimental design for production of selenium-enriched yeast. J. World. Appl. Sci., 19:31-37.

Farghly,M.F; Mahrose,K.M.; Rehman,Z.U.; Shengqing, Y.u.; Abdelfattah,M.G.; and El-Garhy,O.H. 2019. Intermittent lighting regime as a tool to enhance egg production and eggshell thickness in Rhode Island Red laying hens. Poult. Sci., 98:2459–2465.

Feldkaemper,M.;and Schaeffel,F. 2013. An updated view on the role of dopamine in myopia. Experimental eye Res.,114 :106-111.

Fouda, S.F.; El-Raghi,A.A.; Abdel-Khalek E. Abdel-Khalek.; Mahmoud A. Hassan, and Ibrahim Talat El-Ratel. 2021. Impact of lighting regimes on reproductive performance and sperm ultrastructure in rabbit bucks under very severe heat stress conditions**.** Livestock, Sci., https://doi.org/10.1016/j.livsci.2021.104780

Górniak,W.;Cholewinska,P.; and Konkol,D. 2018. Feed additives produced on the basis of organic forms of micronutrients as a means of biofortification of food of animal origin. J. hindawi.com-chemistry-Review article.https://doi.org/10.1155/8084127 .

Gaurav, K.; Yadav, S.; Kumar, S.; Mishra, A.; Godbole, M.M.; Singh, U.; and Mishra, S.K. 2021. Assessment of iodine nutrition of school children in Gonda, India, indicates improvement and effectivity of salt iodization. Pub. Health Nutr., 1-18. DOI: 10.1017/s1368980021001956

Gharahveysi, Sh.; Mehrdad, I.; Taher, A.K.; and Kanyaw, I.M. 2020. Effects of colour and intensity of artificial light produced by incandescent bulbs on the performance traits, thyroid hormones, and blood metabolites of broiler chickens. Ital. J. Anim. Sci., 19:1–7. https://doi.org/10.1080/1828051X.2019.1685916.

Gheisari,A.A.; Sanei,A.; Samie,A.; Gheisari,M.M.; and Toghyani, M. 2011. Effects of diets supplemented with different levels of manganese, zinc and copper from their organic or inorganic sources on egg production and quality characteristics in laying hens. Biological Trace Element Res.,3:557-571.

Gumulka,M.;and Rozenboim,S. 2015. Breeding period-associated changes in semen quality,concentration of LH,PRL,gonadal steroid and thyroid hormones in domestic goose ganders (Anser anser f.domesticus). Anim. Reprodu.Sci., 154:166-175.

Haugh, R.R. 1937. The haugh units for measuring egg quality. Poult. maga., 43: 552-575.

Hernandez,A.; and Martinez,M,E. 2020 . Thyroid hormone action in the developing testis: intergenerational epigenetics. J. Endocrinol., 244: 33–46.

Ibrahim, A. F.; Beshara, M. M.; and Hanan, S. M. 2015. Effect of iodine supplementation low energy diets on productive and reproductive performance in laying hens of local Sinai strain. J. Anim. and Poul. Production, Mansoura Univ., 6:122-158.

Ikegami,K.; and Yoshimura,T. 2012. Circadian clocks and the measurement of daylenght is seasonal reproduction. Mol.Cell.Endocrinol., 349:76-81.

Kyere,C.G.;Korankye,O.;Duodu,A.;Twumasi,G.; and Dapaah,P.K. 2020. Effect of different lighting regime on growth and reproductive performance of the Guinea fowl (Numida meleagris). World J. Advanced Res., 7 :294-302.

Lewis,P.D.; Ciacciariello,M.;Ciccone,N.A.;Sharp ,P.J.; and Gous,R.M. 2004. Lighting regimens and plasma LH and FSH in broiler breeders. Bri. poult. Sci.,. 46.:210-222.

Lichonikova, M.; Zeman, L.; and Cermakova, M. 2003. The long-term effects of using a higher amount of iodine supplement on the efficiency of laying hens. Br. Poult. Sci., 44: 732-734.

Macit, M.; Karaoglu, M.; Celebi, S.; Esenbuga, N.; Yoruk, M. A. ; and Kaya, A. 2021. Effects of supplementation of dietary humate, probiotic, and their combination on performance, egg quality, and yolk fatty acid composition of laying hens. Trop. Anim. Health Prod., 53: 1-8. DOI: 10.1007/s11250-020-02546-6.

Maroufyan, E.; and Kermanshahi, H. 2006. Effect of different levels of rapeseed meal supplemented with calcium iodate on performance, some carcass traits, and thyroid hormones of broiler chickens. Inter.J. Poul.Sci., 5: 1073–1078. https ://doi. org/10.3923/ijps.2006.1073.1078

McNabb,F.M.A.; Dunnington,E.A.; Siegel,P.B.; and Suvarna,S.1993. Perinatal thyroid hormones and hepatic 5 deiodinase in relation to hatching time in weight-selected lines of chickens.Poult.Sci.,72:1764-1771.

Megan,H.M. 2008. The effect of photoperiod after photostimulation on male broiler fertility. M.Sc.Thesis, Faculty of Agric.(School of Agricultural Sciences and Agribusiness), University of KwaZulu-Natal Pietermaritzburg.

Molino, A.; Garcia, E.; Santos, G.; Vieira Filho, J.; Baldo, G.; and Almeida Paz. I. 2015. Photostimulation of Japanese quail. Poult. Sci., 94:156–161.

Nollet, L.; Van der klis, J. D.; Lensing, M.; and Spring, P. 2007. The effect of replacing inorganic with organic trace minerals in broiler diets on productive performance and mineral excretion. J. Appl. Poult. Res., 16:592–597.

Olanrewaju,H.A.;Thaxton,J.P.;Dozier, W.A.;Purswell,J.; Roush,W.B.; and Branton,S.L. 2006. A review of lighting programs for broiler production. J.Poult.Sci.,5:301-308.

Opaliński, S.; Dolińska, B.; Korczyński ,M.; Chojnacka, K.; Dobrzański, Z.; and Ryszka, F. 2012. Effect of iodine-enriched yeast supplementation of diet on performance of laying hens, egg traits, and egg iodine content. Poult. Sci., 91:1627–1632.

Prati, M.; Calvo, R.; and Escobar, G. M. 1992. L-thyroxine and 3, 5, 3′-triiodothyronine concentrations in the chicken egg and in the embryo before and after the onset of thyroid function. Endocrinol., 130: 2651–2659.

Rattanawut, J.; Pimpa, O.; Venkatachalam, K.; and Yamauchi, K. E. 2021. Effects of bamboo charcoal powder, bamboo vinegar, and their combination in laying hens on performance, egg quality, relative organ weights, and intestinal bacterial populations. Trop. Anim. Health Prod., 53: 1-7. DOI: 10.1007/s11250-020-02527-9

Rottger, A. S.; Halle, I.; Wagner, H.; Breves, G.; Danicke, S.; and Flachowsky,G. 2012. The effects of iodine level and source on iodine carry-over in eggs and body tissues of laying hens. Arch. Anim. Nutr., 66:385–401.

Saito,S.;Tachibana,T.;Cho,Y.H.; Denbow,D.M.; and Furuse,M. 2005. ICV CRF and isolation stress differentially enhance plasma corticosterone concentrations in layer- and meat-type neonatal chicks. Comparative Biochemistry and Physiology part A : Molecular and Integrative Physiol., 141:305-309.

Santos, T.C.; Murakami, A.E.; Oliveira, C.A.L.; Moraes, G.V.;Stefanello, C.; Carneiro, T.V.; Feitosa, C.C.G.; and Kaneko, I.N. 2015. Influence of European Quail breeders age on egg quality, incubation, fertility and progeny performance. Brazilian, J. Poult.Sci.,17:49-56.

Sarlak,S.; Tabeidian,S.A.; Toghyani,M.; Shahraki,A.D.; Goli,M.; and Habibian,M. 2020. Supplementation of two sources and three levels of iodine in the diet of laying hens: effects on performance, egg quality, serum and egg yolk lipids, antioxidant status, and iodine accumulation in eggs, Italian ,J. Anim. Sci., 19: 974-988, DOI: 10.1080/1828051X.2020.1810142.

SAS. 2001. Users Guide: Statistics. Version 8.2. Cary, North Carolina: SAS Institute Inc. USA

Shah, T.; and Özkan, S. 2022. Effect of thermal manipulation and photoperiodic lighting during incubation on hatching performance, hatching time, chick quality and organ growth. Ege. Univ. Ziraat. Fak. Derg., 59:17-31, https://doi.org/10.20289/zfdergi.938921.

Surai, P. F.; Fujihara, N. ; Speake, B. K. ; Brillard, J. P. ; Wishart, G. J.; and Sparks, N. H. C. 2002. Polyunsaturated fatty acids, lipid peroxidation and antioxidant protection in avian semen. Asian-australas. J. Anim. Sci., 14:1024–1050.

Tona, K.; Onagbesan, O.; De Ketelaere, B.; Decuypere, E. ; and Bruggeman, V. 2004. Effects of age of broiler breeders and egg storage on egg quality, hatchability, chick quality, chick weight, and chick posthatch growth to forty-two days. J. Appl. Poult. Res., 13:10–18.

Van Dorland, A.; Bruckmaier, R.; Wach-Gygax, L.; Jeannerat, E.; Janett, F.; Sieme, H.; and Burger,D. 2016. Variability of antioxidant capacity of stallion semen during feed supplementation with a yeast product. J. Equine. Vet. Sci., 43:S81–S82.

Wang, G.; Liu, L.; Wang, Z.; Pei, X.; Tao, W.; Xiao, Z.; Liu, B.; Wang, M.; Lin, G.; and Ao, T. 2019b. Comparison of inorganic and organically bound trace minerals on tissue mineral deposition and fecal excretion in broiler breeders. Biol. Trace. Elem. Res., 189:224–232.

Wang,G.;Liu,L.J.;Tao,W.J.;Xiao,Z.P.; Pei,X.;Liu,B.J.;Wang,M.Q.;Lin,G.;and AO,T.Y. 2019a . Effects of replacing inorganic trace with organic trace minerals on the production performance,blood profiles, and antioxidant status of broiler breeders. Poult. Sci.,98:2888-2895.

Yalcin, S.; Kahraman, Z. ; Yalcin, S. S.; and Dedeoglu. H. E. 2004. Effects of supplementary iodine on the performance and egg traits of laying hens. Br. Poult. Sci., 45:499–503.

Yalcin, S.; Yalcin, S. ; Cakin, K.; Onder, E.; and Dagasan. L. 2010. Effects of dietary yeast autolysate (*Saccharomyces cerevisiae*) on performance, egg traits, egg cholesterol content, egg yolk fatty acid composition and humoral immune response of laying hens. J. Sci. Food Agric., 90:1695–1701.

Yenice,E.;Mizrak,C.;Gultekin,M.;Atik, Z.; and Tunca,M. 2015. Effects of organic and inorganic forms of manganese, zinc,copper, and chromium on bioavailability of these minerals and calcium in late-phase laying hens. Biol.Trace Elem.Res.,167:300-307.

Yuri, F. M.; Souza, C. D.; Schneider, A. F.; and Gewehr, C. E. 2016. Intermittent lighting programs for layers with different photophases in the beginning of the laying phase. Cienc. Rural., 46:2012–2017.

Zhang, L.; Wang, Y.; Xiao, X. ; Wang, J.; Wang, Q.; Li, K. ; Guo, T.; and Zhan. X. 2017. Effects of zinc glycinate on productive and reproductive performance, zinc concentration and antioxidant status in broiler breeders. Biol. Trace Elem. Res., 178:320–326.

Zhang,L.;Lu,L.;Zhang,L.; and Luo,X.G. 2016. The chemical characteristics of organic iron sources and their relative bioavailabilities for broilers fed a conventional corn-soybean meal diet. J.Anim.Sci., 94:2378-2396.

الملخص العربى

تأثير أنظمة الاضاءة و مستويات و مصادر اليود الغذائى على جودة السائل المنوى و محتوى يود الصفار و صفات جودة الكتكوت لسلالة دجاج المندرة

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

مصر --الجيزة الزراعية البحوث مركز -الحيواني الانتاج بحوث معهد

تم نقل ٤٠٠ أنثى و ٤٠٠ ذكر من سلالة المندرة عند عمر ٦ أسابيع الى العنبر المغلق المتحكم فيه ضوئيا و بيئيا . العنبر من الداخل مقسم الى أربعة أجزاء منفصلة ووزعت الكتاكيت وفقا لنظام الاضاءة ، حيث تم وضع اناث الكتاكيت فى الجزء الاول و الثالث بينما تم وضع الذكور فى الجزء الثانى و الرابع (٢٠٠ كتكوت /جزء تم توزيعها على مصدرين لليود (عضوى و غير عصوى) و بداخل كل مصدر ٢ مستوى من اليود (٠,٥ و ٢ ملجم يود / كجم علف) ولكل معاملة ٥ مكررات و داخل كل مكررة ١٠ كتاكيت) . الكتاكيت فى الجزء الأول و الثانى تعرضت لنظام الاضاءة المتزايد حيث أن فترة الإضاءة تزداد تدريجيا من ١٠ ساعة/ يوم عند ٨ أسابيع بمعدل نصف ساعة اسبوعيا لتصل إلى ١٦ ساعة/يوم عند عمر ٢٠ إسبوع ، بينما تعرضت الكتاكيت فى الجزء الثالث و الرابع لنظام الإضاءة الثابت-المتزايد حيث أن فترة الإضاءة ثابتة ١٢ ساعة / يوم من عمر ٨ أسابيع حتى عمر ١٦ إسبوع و تزداد تدريجيا ساعة كل إسبوع لتصل ١٦ ساعة/يوم عند عمر ٢٠ إسبوع . تم تقسيم الكتاكيت فى كل نظام اضاءة بالتساوى الى أربع مجموعات (٥٠ طائرا / مجموعة) لتلقى احدى العلائق الغذائية التالية : العليقة المقارنة مضاف إليها ٠,٥ (T1) ، ٢ (T2) ملجم يود غير عضوى (أيوديد بوتاسيوم) /كجم علف ، ٠,٥ (T3) ، ٢ (T4) ملجم يود عضوى (خميرة غنية بالأيودين) /كجم علف. أظهرت النتائج أن نظام SUP (Lr1) أدى الى زيادة ($P \le 0.05$) وزن البيض، سمك قشرة البيض ، وحدات هوف ،محتوى اليود فى صفار البيض ، نسبة الفقس ، صفات جودة الكتكوت . أيضا أدى الى تحسين جودة السائل المنوى ، الخصوبة ، هرمونات الكورتيكوستيرون و التستوستيرون مقارنة مع CSUP (Lr2) . كما أدى اليود العضوى الى تحسين وزن البيض ، سمك قشرة البيض ،وحدات هوف ، محتوى اليود فى صفار البيض ، نسبة الفقس ، صفات جودة الكتكوت ،تحسين جودة السائل المنوى ، الخصوبة ، نسبة T3,T3/T4 ، هرمونات الكورتيكوستيرون و التستوستيرون مقارنة باليود غير العضوى . علاوة على ذلك ، أدى مستوى اليود ٢ملجم يود /كجم علف الى زيادة محتوى اليود فى صفار البيض ، وهرمونات الغدة الدرقية و قلل من تركيز هرمون الكورتيكوستيرون .

بناء على ذلك ، فان توفير أنظمة SUP للعنابر المغلقة من ٨-٢٠ أسبوع من عمر الطيور مع ٢ ملجم يود عضوى /كجم علف يؤدى الى زيادة محتوى اليود فى صفار البيض و صفات جودة البيض ، و جودة السائل المنوى و صفات جودة الكتكوت وهرمونات الغدة الدرقية و الكورتيكوستيرون و التستوستيرون .