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APPLICATION OF FLASHED LIGHTING PROGRAM IN NAKED NECK CHICKENS (SHARKASI) MANAGEMENT

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ABSTRACT: The present study was undertaken to investigate the effect of application flash lighting program on performance and physiological status of naked neck chickens. Three hundred and sixty, four weeks old birds were randomly distributed into 6 experimental groups (3 replicates of 20 birds each) and housed in floor pens. The first group (control group, C), birds were maintained under 12 hrs and 16 hrs common light (CL) per day during the growing and laying periods, respectively. While, in the other groups, birds were exposed to light flashes for 10 minute/hour (T1), 20 minute/hour (T2), 30 minute/hour (T3), 40 minute/hour (T4) and 50 minute/hour (T5) for 12 and 16 hrs light/day during the growing and laying periods, respectively. Main results indicated that light flashes program significantly ($P \leq 0.05$) improved growth efficiency, carcass dressing percentage, breast percentage, abdominal fat percentage, egg laying rate, egg shell thickness, sexual parameters and healthy status. Also, estradiol hormone significantly ($P \leq 0.05$) increased by application of flash lighting program. However, long period of light flashes program recorded the worst values as in general performance and welfare (H / L ratio and tonic immobility values). Insignificant ($P > 0.05$) effect were observed in drumstick, femur, liver, heart, gizzard, most blood components, egg shape or yolk, Haugh units, leg problems, plumage conditions, bone lengths, age at sexual maturity, genital organs and hatchability percentages. From an economical point of view, it is observed that the birds exposed to light flashes periods for 10 to 30 minutes/hour were superior to that of birds in other groups. Using short periods of light flashes might be suitable as alternative light to continuous or common light for managing Sharkasi chicken in sight and stimulation of internal organs or hormones release without oppositely affecting the physiological response, healthy traits and welfare.

Keywords: Light flashes -Productive and reproductive performance - Sharkasi chickens.

INTRODUCTION

It is necessary, a considerable attention has been paid to apply unconventional recent trends such as some managerial and housing conditions in managing indigenous chickens to achieve a suitable efficiency of utilization and economic efficiency of production. Productive performance, immunity and health status are strongly affected by circadian rhythms and it is altered by the housing conditions, especially the light stimulation (Prescott et al., 2004). Thus, if lighting is managed in the proper system, then performance efficiency can be optimized and minimize productive costs (Lewis et al., 2010; Farghly 2014; Farghly et al., 2015 &2016 &2017ab). Housing light is basic to sighting and synchronizing many essential functions as stimulation of internal organs, hormone release and various metabolic actions (Olanrewaju et al., 2006). Birds receive light by pineal gland, which has the ability of light absorption and translate it to melatonin secretions that are necessary for regulating the cardiopulmonary, sexual, excretory, immunity, behavior and thermoregulatory (Li and Howland 2003; Navara and Nelson 2007).

Traditionally, chicken producers have used common constant or continuous light in flocks to increase feed consumption and maximize growth rate. However, optimal benefit is obtained by raising under a lighting with a minimum darkness of 6 or 8 hours (Prescott et al., 2003), because it decreases metabolic disorders, eye damage, physiological problems (Kliger et al., 2000; Campo and Da´vila, 2002). During the darkness, heat production decreased by 25 percent and this lowering may result from reduced activity and resting (Saiful et al., 2002). Nowadays, researches have focused on lowering or intermittent light programs to improve the productivity, because the activity is low during dark period and then energy or heat expenditure of any activity is remarkable (Olanrewaju et al., 2006; Farghly, 2014).

Apply of light program containing light flashes periods in poultry management to enhance growth rate and feed efficiency is an area of interest to poultry producers. Light flashes can be widely used to enhance productive efficiency and as a way to reduce electricity consumptions and then costs. Many previous attempts have been undertaken to improve the growth, feed conversion efficiency and reduce the cost by addition of light flashes (Farghly 2014; Farghly and Makled, 2015; Farghly et al., 2016; Farghly and Enas Ahmad 2017). It is not indicated that if light flashes stimulation as bio or intermittent light can makes positive difference compared to common light system that may be beneficial. Therefore, the aim of this experiment was to investigate the effect of applying light flashes as an alternative economical light source than common light for rearing Sharkasi chickens.

MATERIALS AND METHODS

The present study was undertaken at the Research Poultry Farm, Poultry Production Department, Agriculture Faculty, Assiut University. Three hundred and sixty (180 male and 180 female), four weeks old naked neck (Sharkasi) birds were randomly distributed into 6 experimental groups in 3 replicates (20 birds) and reared in pens on wheat straw litter floor. The first group (control group, C), birds were maintained under 12 hrs and 16 hrs common light (CL) per day during the growing and laying periods, respectively. While, in the other groups, chicks were exposed to light flashes for

10 minute/hour (T1), 20 minute/hour (T2), 30 minute/hour (T3), 40 minute/hour (T4) and 50 minute/hour (T5) for 12 and 16 hrs light/day during the growing and laying periods, respectively. Heavy black curtains were used to prevent any source of other light or natural lighting into house. Light intensity measured (20 cm above the floor) at the middle of the room ranged between 5-10 during growing period and 10-25 Luxes during laying period using incandescent bulbs. Light flashes (20 pulses /minute) were defined as flashing light with required intensity at bird level, that were produced by flasher apparatus which including dimmer and timer to justify the flash length and number by using incandescent lambs. Feed and tap water were available ad-libtum and all environmental and managerial conditions were the same during the experimental period. The composition and calculated analysis of the experimental growing (4-20 wks of age) and laying (21-36 wks of age) diets shown in Table (1).

*** Calculated according to NRC (1994).

Body weight (g) and feed consumption (g) were recorded, and then calculated monthly. Feed conversion ratio (feed/ gain) was calculated by dividing the feed consumed monthly (g/d/h) in a pen by the weight gained (g/d/h). At 16 weeks of age, 6 birds per experimental group were randomly chosen and slaughtered. The internal organs were removed, while the heart, liver, empty gizzard, breast, femurs and drumsticks, testes and ovary (including the yellow follicles) were weighed and calculated as percentage (transformed to Arcsin values). Blood samples were collected in heparinized tubes at slaughter day. Blood tubes were centrifuged at 3000 rpm for 15 min, and then plasma obtained and was stored at -20^{c}C. Plasma total protein, albumin, total cholesterol and transaminase enzymes activities (AST and ALT) were determined using available diagnostic kits made by Spectrum Company (Cairo, Egypt). The values of globulin were calculated by subtracting the albumin values from total protein values.

Egg weight (g) and number as hen-day egg production were counted and recorded monthly, from 24 to 36 wks of age. Age at sexual maturity was calculated as number of days at 50% egg number. During egg laying, 90 fresh-laid eggs were taken, monthly, from each group to study egg quality traits. Eggs were individually weighed to the nearest 0.1 g on the same day of eggs collection. Egg shape and yolk indexes were calculated for each egg according to Potts and Washburn (1983) and Wisley and Stadelman (1959), respectively. To calculate the Haugh unit, the following formula was used (Cotta, 1997): HU = 100 Log (h – 1.7 w + 7.6), in which HU = Haugh unit, h = albumen height (mm) and w = egg weight (g).

Yolk was separated from the albumen, then weighed and albumen weight calculated by subtraction, to the nearest 0.1 g. to estimate their percentages from the egg weight. Shell was dried and weighed individually to nearest 0.01 g. and shell thickness was measured using shell thickness apparatus (millimeters). At 16 wk, each male was individually checked intervals of 1 or 2 wk for onset of semen production by using manual massage. Onset of mature semen production was evaluated by eye and scored on a scale of 1 to 6 as follows: 6 = shrunken cloacal exit; 5 = extrusion of rudimentary penis (without semen production); 4 = seminal fluid production; 3 = yellow semen production; 2 = some indication of white semen; 1 = white semen production. Semen was collected into graduated tube to volume record /ejaculate with an accuracy of 0.05 ml. Sperm concentrations (millions/milliliter) were determined by hemocytometer apparatus (Thoma) method (Salisbury et al., 1985).

During laying period, one hatch was obtained monthly (Sex ratio as 1:10) by using Peterzime setter (automatic incubator). The following equations were used for calculating the fertility and hatchability percentages: Fertility = (Fertile eggs) x100/Total eggs set & True hatchability = (Viable hatched chicks) x100 /fertile eggs. Plumage conditions scores were measured at the end of experiment. Three areas in the body were measured (head- neck -back) using a scale from 1 (completely feather) to 5 (featherless). At 36 wk of age, cloacal body temperature was measured by thermocouple thermometer. Also, 15 birds/group were examined and scored for hock discoloration and foot pad burns as indicators for leg problems. Thirty birds were tested for tonic immobility, each individual was gently caught with both hands, held in an inverted manner, and carried to a separate room by gently restraining it for 15 s. on its right side and wings (The procedure modified and described by Benoff and Siegel, 1976). A stopwatch was started to record latencies until bird righted itself. Dead birds as percentage were recorded/day.

Feed cost/bird was estimated by multiplying feed consumption/bird by 1 kg cost of ration. Bird price was estimated by multiplying mean carcass weight by 1 kg price of carcass meat weight. The net revenue/bird was estimated as the difference between the total income/bird (body weight, table or fertile egg price) and the total costs of feed and light. Economic efficiency was calculated by dividing net revenue by total costs (feed and light).

Data collected were subjected to ANOVA by operating randomized complete block design using general linear models (GLM) procedure of SAS Institute (SAS, 2009). Duncan (1955) was used to detect differences among means of groups. All percentages of traits were transformed to Arcsin form for analysis. Significance was set at the 5 % level. The used model for analysis of variance was as follow: $X_{ij} = \mu + \alpha_i + \beta_j + \epsilon_{ij}$

Where: X_{ij} = observation (i = 1,…..,I; j= 1,……,j), μ = overall mean, α_i = replicates effect, β_j = treatments effect, ϵ_{ij} = experimental error.

RESULTS AND DISCUSION

1. Growth performance:

It could be notice that light flashes system had significant affect ($P \leq 0.05$) body weight at 12 and 16 weeks of age (Table, 2). Clearly, birds subjected to 20 minute/hour (T2) or 30 minute/hour (T3) exhibited higher body weight and gain than those reared under common light (C) and 10 or 40 or 50 flashes minute/hour (T1, T4 and T5). However, long light flashes period (40 or 50 flashes/minute/hour groups) significantly reduced body weight and gain as compared to control group at all studied ages, may be due to more physiological stress or activity pattern, which affect energy expenditure (Saiful et al., 2002). Short flashed light periods play a pivotal role as constant light in stimulation of internal organs and hormone release (Houser and Huber-Eicher 2004). In intermittent light program, birds eat to satiation during lighting and then do not expand much energy during darkness, causing greater growth (Ingram and

Hatten, 2000). So, use of light flashes may be a correction factor to bio or intermittent light. This result is supported by Rahimi et al., (2005), Bölükbasi and Emsen, 2006), Lewis and Gous (2006ab), Downs et al., (2006), Abbas et al., (2008), Mahmud, et al., (2011), Farghly (2014), Yang et al. (2015), Farghly and Makled, (2015), Farghly et al., (2016) and Farghly and Enas Ahmad (2017) who found that intermittent or flashed light had significant effect on body weight and gain weight. Lien et al., (2009), Lewis et al., (2009ab), Lewis et al., (2010) and Bayraktar et al., (2012) reported that growth rate was significantly reduced during long dark periods, but final weight and gain was insignificant by lighting regimen. On the other hand, Boon et al., (2000) reported that long photoperiods increased significantly weight gain values. Broilers raised under continuous lighting gained more weight than those subjected to intermittent or restricted lighting (Ingram and Hatten 2000 and Tuleun et al., 2010). Farghly et al., (2015) found that light flashes had insignificant affect body weight and gain rate.

Significant differences were observed in the overallmean of feed consumption values (Table 2). However, the overallmean of feed conversion values were significantly ($P \leq 0.05$) better for all groups except T4 group (40 flashes/minute/hour). Light: dark/day allows establishing rhythmicity and synchronizing many essential metabolic actions by melatonin that affects heat production, feed: water intake and digestion patterns (Aperdoorn et al., 1999 and Olanrewaju et al., 2006). It is well known that the decrease of activity during dark period may result in lowering heat production and higher feed conversion. Chicken do not feed or drink during a long dark period (Rahimi et al., 2005), although they may feed during short dark period (4-hour). Duve, et al., (2011) reported that birds modify their feeding behaviour according to light: dark program, so birds eat about 80% of their total feed intake during lighting and eat little during dark period and then affect feed intake, digestibility or metabolizability.

The present results are in partial agreement with Ohtani and Leeson (2000), Oyedeji and Atteh (2005), Rahimi et al., (2005), Onbasilar et al., (2007), Lewis et al., (2009ab), Mahmud, et al., (2011), Farghly (2014), Farghly and Makled, (2015), Farghly et al., (2015&2016&2017ab) and Farghly and Enas Ahmad (2017) who found that bio or intermittent light or flashed light significantly affect the feed consumption and conversion of chickens. Significant improvement in feed conversion ratio have been observed in broilers maintained under intermittent or flash light program compared to birds exposed to long period of light (Bölükbasi and Emsen, 2006; Gharib, et al., 2008; Lien et al., 2009; Farghly and Enas Ahmad 2017). Yang et al., (2015) reported that feed consumption and conversion of broilers were significantly affected by different photoperiod. The improvement in feed conversion under intermittent feeding system could be a result of decreasing the amount of spilled feed than those fed ad-libitum. However, some studies have illustrated that birds exposed to continuous light significant increased feed consumption than those given intermittent light (Shutze, et al., 1996). Also, Tuleun et al., (2010), Duve, et al., (2011) and Amakiri et al., (2011) reported that limited lighting had insignificant different in feed conversion compared to continuous program. Al-Homidan and Petchey (2000), Saiful et al., (2002), Gous and Cherry (2004), Oyedeji and Atteh (2005), Downs et al., (2006), Abbas et al., (2008) and El-Fiky et al., (2008) reported that chicks maintained under intermittent light showed insignificant differences in feed consumption and conversion comparison with those under continuous lighting program.

2. Carcass quality:

Results presented in Table 3 showed that dressed carcass, breast percentages and abdominal fat percentages were significantly ($P \leq 0.01$) increased in T2 and T3 groups (20 light flashes minute/hour and 30 light flashes minute/hour) compared to birds with control group. However, no significant differences for drumsticks, femurs, liver, heart and gizzard percentages among all groups. Reducing lighting/day by flashed light could be used as a tool for decreasing abdominal fat and enhancing carcass quality. This result reflected reduces in energy expenditure and change in metabolic process leanness due to lowering activity during darkness and better efficiency in nutrient utilization. Our findings are in agreement with Buyse et al., (1996), Rahimi, et al., (2005) and Farghly and Enas Ahmad (2017) who, reported that intermittent and flash light regimen decreased abdominal fat values. Also, Oyedeji and Atteh (2005) and Farghly et al., (2017a) reported that there was significant reduction in abdominal fat of broilers subjected to short photoperiod or flash program. Yang et al. (2015) reported that carcass weights in birds reared under intermittent light were significant higher than observed in broilers reared under continuous light. In contrast, Downs et al., (2006) illustrated that lighting had minimal effects on carcass or part yields. However, they found a remarkable effect for breast yield as affected by lighting. El-Fiky et al., (2008) found insignificant difference in abdominal fat among light programs. Al-Homidan and Petchey (2000), El-Fiky et al., (2008) and Lien et al., (2009) reported that carcass traits of chicks raised under intermittent light significantly improved. Similarly, Farghly (2014), Farghly and Makled (2015), Farghly et al., (2015&2016) and Farghly and Enas Ahmad (2017) found that insignificant differences for the percentages of liver, drumsticks, femurs, heart, and gizzard percentages among all groups as affected by light flashes program. However, the differences were significant ($P \leq 0.05$) for dressed carcass, breast and abdominal fat percentages. It was found that abdominal fat percentages were significantly lower under 3 CL+9 FL and 12 FL/day compared to 12 CL/day. El-Fiky et al., (2008) found that heart, liver and gizzard percentage were not affected by light programs. Similar results were obtained by Onbasilar et al. (2007) and Shariatmadari and Moghadamian (2007). Also, Chen et al., (2007) reported that photoperiod had insignificant effect on abdominal fat or breast muscle percentages. Lewis et al., (2009b) found that breast yield was unaffected by lighting in Cobb broilers.

3. Blood Parameters:

It can observe from the present blood results (Table 4) that insignificant differences were found for most constitutes (T protein, Albumin, Globulin, A:G ratio, T lipids, cholesterol, AST, ALT, testosterone, T3 hormones) of treated chickens and those of the control except estradiol hormone and H / L Ratio values. This may be due to no physiological stress or negative effect occurred after exposing birds to short flashed light treatments. It is well documented that continuous light program reduces the opportunity for resting or sleeping, thereby increase fear or physiological problems (Rozenboim et al., 1999), while restricted light decrease physiological stress, improved immunity, improve activity and bone metabolism (Classen et al., 2004). Melatonin is released during darkness, it associated with secretion of several lymphokines that are integral to normal immunity by acting through thyroid hormones (Apeldoorn et al., 1999, Kliger et al., 2000 and Abbas et al., 2007). Broilers maintained under intermittent light exhibited less stress, as indicated by corticosterone hormone than continuous light (Olanrewaju et al., 2006). Restricted light program tended to decrease fearfulness and psychological disorders (Bayram and Özkan 2010).

These results are in agreement with Moore and Siopes, (2000) and Abbas et al., (2008) who, reported that broilers raised under continuous light had a higher H / L Ratio and experienced greater fear reaction than birds raised under restricted light program. Ibrahim (2005) and Soliman et al., (2006) found that there were insignificant differences in blood constituents (T protein, albumen and globulin) among birds maintained under different light programs. Also, El-Fiky et al., (2008) found that total protein and cholesterol were not different among the different light programs, revealing no physiological stress. Similarly, Farghly (2014) and and Farghly and Enas Ahmad (2017) insignificant differences were observed for all blood parameters of light flashes treated chickens and those of the control, except that of the total lipids, AST and H/L Ratio, indicating that H/L Ratio was significantly decreased due to application of little house of light flashes. Also, Farghly and Makled (2015) and Farghly et al., (2017b) found that there was no change in plasma parameters (protein, cholesterol, AST and ALT) except total lipids values under flashed light regimen. Yang et al., (2015) reported that T protein level was distinctly higher in birds reared under intermittent light (4L:4D) than that in the 2L:2D programs, which illustrated that the 4L:4D programs might be optimal for broilers. Also, Farghly et al., (2015&2016) reported that insignificant differences in blood traits except cholesterol values. On the other hands, the current result disagrees with those of Campo and Da´vila (2002) and (Wang, et al., 2008), who found that H/L ratios was unaffected by a nearly continuous lighting programs (23L:1D). Onbasilar et al., (2007) found that H/L ratios, cholesterol and triglyceride concentrations did not differ significantly among various lighting schedules. Also, El-Neney (2003) and Farghly et al., (2017a) found that broilers raised under intermittent or flash light programs increased significantly plasma cholesterol values than those raised under continuous light programs.

4. Egg production (EP) and quality:

Table (5) presents significant differences ($P \leq 0.05$) in egg laying rate (HDP). While, no significant ($P > 0.05$) differences in egg weight values (EW). The HDP for birds maintained under flashed light programs of 10, 20 and 30 minute/hour (T1, T2 or T3) or 30 minute/hour and constant light (C) exceeded those of the 40 or 50 minute/hour (T4 or T5). Regarding egg quality, no significant differences

(P>0.05) in egg shape index (ESI), egg yolk index (EYI), Haugh Units (HU), albumen%, yolk%, shell% and egg problems (floor eggs- cracks and dirty) among all groups. However, there were significant differences (P≤0.05) in shell thickness (ST) values. The averages ST of C, T1 and T2 groups were significantly (P≤0.05) higher than other treatments (T3, T4 and T5 groups). Lighting plays a pivotal role in stimulation of internal organs, hormone release and affect laying hens' egg production and quality (Scheideler, 1990; Lewis and Gous, 2006ab). It is importance to know how period length of flash light must be given for hens to enhance egg production. Lewis et al., (1997) observed that photostimulation length affect egg weight and egg production. Pullets raised under light restriction programs produced significantly more eggs comparison with those raised under long lighting (Ingram, et al., 2007). The egg production results are in line with the findings of Wanga et al., (2002), Lewis, et al., (2004), Ciacciariello and Gous, (2005), Lewis, (2006), Lewis and Gous, (2006b) and Lewis et al., (2007) who, reported that light regimen significantly affect total egg production. Also, Li et al., (2008) found that intermittence lighting of 8L:4D:4L:8D improved egg production compared to the consecutive lighting periods (16L:8D). Hens subjected to 6:18, 8:16 and 10:14L:D program had significant higher HDP than those subjected to 4:20LD program. However, HDP was significantly higher for hens subjected to long photoperiod than those subjected to short photoperiod (Lewis et al., 2010). Contrary, Wanga et al., (2002) and Lewis et al., (2007) found that photoperiod had insignificant affect egg production. Also, Ingram et al., (2007) and Lewis et al., (2010) reported insignificant affect egg production due to lighting regimes. However, egg weight value was significantly affected by light program (Ciacciariello and Gous, 2005; Backhouse et al., 2004; Lewis, 2006; Lewis and Gous, 2006a,b). Farghly (2014) reported insignificant differences (P>0.05) in egg weight, egg number and hen day egg production among birds in the experimental groups. He found that overall mean of HDP for birds reared under light flashes program of 9 FL+ 3CL/day significantly (P≤0.05) exceeded those of the 12 CL, 3 FL+9CL/day, 6 CL+6FL/day and 12 FL/day regimes. However, Farghly et al., (2016) found that birds exposed to continuous common light program had significantly higher egg production rate. Similar findings reported by Farghly et al., (2017b).

The egg quality results are in agreement with Backhouse et al., (2004) who, reported that shell weight and thickness index reduced for every 1 hour increase in photoperiod. Also, Li et al., (2008) found that eggshell thickness and strength did not significantly differ among lighting programs. Intermittent lighting programs did not significantly affect egg size, eggshell and Haugh units (Leeson, et al., 1982). Backhouse et al., (2004) found that egg size increases and shell weight or thickness reduce with photoperiod lengthening. Lewis et al., (2010) reported that egg size was oppositely related to light length, while yolk quality was not significantly affected by light length. In contrast, Li et al., (2008) found that the birds reared under 16L:8D produced eggs had higher Haugh units and albumen heights. Shorter photoperiods were correlated with floor egg and cracked and dirty eggs%. Lewis, et al., (2004), Lewis and Gous, (2006a,b), Lewis et al., (2007), Lewis et al., (2010) found lighting treatments significant affects in the proportion of floor eggs and number of cracked and dirty eggs. Farghly (2014) reported that no significant differences in egg shape index, Haugh Units and shell strength among all groups as affected by light flashes program. However, He reported significant differences (P≤0.05) in egg yolk index and shell thickness values. Farghly et al., (2016) and Farghly et al., (2017b) found that birds exposed to continuous common light program significantly increased most egg quality traits. While, shell percentage and thickness (mm) for hens exposed to flash light had lower values than those in common light type.

5- Reproductive performance:

The reproductive results (Table, 6) indicated that there are significant differences (P≤0.05) for follicle number, sperm-cell concentration and fertility among all experimental groups, while there were insignificant differences (P>0.05) in age at sexual maturity (female, male), oviduct, ovary, testes and hatchability percentages. It is importance to know how period length of flash light must be given to pullets before age at sexual maturity. Physiologically, lighting stimulation induces activation in pituitary gland, which controls the release of FSH and LH hormones and then stimulates gonadal development resulting in sexual maturity and reproductive performance (Olanrewaju et al., 2006; Ingram, et al., 2007). Singh and Haldar, (2007) found that there is a relation between melatonin (darkness) and gonadal development or age at sexual maturety. Therefore, light restriction is utilized. The present results are in agreement with Boon et al., (2000), Wanga et al., (2002), Lewis et al., (2004), Gous and Cherry, (2004), Ciacciariello and Gous, (2005), Lewis, (2006), Lewis et al., (2007) and Chen et al., (2007), who reported that photoperiod significantly effect on value of age at sexual maturity. Also, Wanga et al., (2002) reported that the fertility was enhanced for those reared under 14L and 18L regimes. However, Shanawany (1993) observed that fertility and hatchability improved by long photoperiods. Also, Hawes et al., (1991) and Ciacciariello and Gous (2005) stated that intermittent light programs had no affect fertility and hatchability. On the other hand, Lewis et al., (1997) indicated that long photoperiods stimulate sexual maturity in birds. Farghly (2014) and Farghly et al., (2017b) found significant differences (P≤0.05) for the age at sexual maturity (female and male), fertility, genital organs (ovary, testes percentages and follicle number) and semen quality (semen volume and sperm-cell concentration) among the experimental groups as affected by light flashes. However, there were no significant differences (P>0.05) in oviduct length, oviduct percentage, semen color & pH, reaction time and hatchability percentage among the birds in the different experimental groups. Also, Farghly et al., (2016) reported that birds exposed to continuous light program had significantly higher most semen quality traits than those in flash lighting treatment. Also, they found continuous common light program improved significantly (P≤0.05) fertility and hatchability percentages.

Gous and Cherry, (2004) indicated that females require an increment in light period to stimulate suitable gonadal development. Chen et al., (2007) found that long or short photoperiod can effect on reproductive and sexual development in hens. Also, they reported that photoperiod had little effect on ovarian follicle number, while the photoperiod strongly affected ovary and oviduct development. Photostimulation is associated by increased LH and FSH level, which initiates testicular developing and Leydig cells proliferation (Henare, et al., 2011). In semen production, males subjected to continuous or intermittent lighting programs had minor differences in process of LH or testosterone secretion (Bacon et al., 2000). Lewis et al., (2009b) demonstrated that testicular development was significantly affected by light period. However, Noirault et al., (2006) observed that males reared under different photoperiods had similar reproductive performance. Intermittent light programs enhance semen quality and production in turkeys (Bacon et al., 1994). As well as, Tyler et al., (2011) found that photoperiodic did not affect sperm concentration and volume. Male turkeys subjected to a short photoperiod (6L:18D) and followed by a long (16L:8D) had remarkable increases in LH or testosterone levels, consequently, increasing in testis size, but not in semen production (Yang et al., 1998).

6- Healthy and welfare traits:

In Table (7), it could be observed that there were insignificant differences ($P>0.05$) in bone measurements, leg problems, plumage conditions and mortality rate among experimental groups. Six hours are a minimum dark period for birds, which related to poultry welfare traits (Prescott et al., 2003). Restricted lighting have lower physiological stress, improved immunity, increased activity and improve in bone metabolism or leg health (Classen et al., 2004). It was found that the body temperature and tonic immobility were significantly lower due to short light flashes period programs (10, 20, 30 light flashes minute/hour) compared to birds with control group and other treatments groups. Light programs can affect the physical activity or energy expenditure, thereby stimulate bone strength development and improve leg health (Saiful et al., 2002, Olanrewaju et al., 2006). Sanotra et al., (2002) reported that the light program manipulations reduce leg problems and chronic fear response. Kristensen et al., (2006) found that the light programs did not affect leg abnormalities. However, some studies found that lighting programs decrease the incidence of leg problems in broilers (Renden et al., 1996; Lewis et al., 2009a; Schwean-Lardner et al., 2012&2013). Also, Tuleun et al., (2010) found that continuous light significantly increased incidence of leg disorders and chronic fear. Ingram and Hatten (2000) and Hester et al., (2011) repored that shank length was significantly reduced by light restriction. However, keel bone length was not significantly affected. Similarly, Farghly (2014) and Farghly et al., (2017b) who found that the flashed lighting did not affect leg problems. Farghly and Makled (2015) reported that intermittent flashed light significantly ($P\leq0.05$) affected mortality rate and leg problems, while there were no significant differences ($P>0.05$) for bone measurements. Yang et al., (2015) reported that intermittent light (4L:4D) or (2L:2D) significantly affected leg abnormalities am bone elastic modulus of birds.

In many literatures, intermittent lighting have shown to improve immune system by enhancing both humoral and cell-mediated response, thereby reduce mortality rate and decrease metabolic disorders such as ascites, which is associated with sudden death syndrome and skeletal problems and improved (Onbasilar et al., 2007). Birds maintained under long dark period are better welfare and health than long light period (Farghly et al., 2017a). Similarly, Ciacciariello and Gous, (2005), Lewis and Gous, (2006a) and Lewis et al., (2006&2007) reported that light treatments affect mortality rate. Lower mortality has been recorded in birds maintained under intermittent lighting compared to long lighting (Rahimi, et al., 2005, Shariatmadari and Moghadamian 2007, Abbas et al., 2008, Lewis et al., 2009b and Gharib, et al., 2008).

7. Economic efficiency (EE)

It is illustrated in Table (8) that the addition of short light flashes period might be beneficial in reducing the electricity, thereby productive costs. The economic efficiency of the T3 group exceeded the C group by 12.60%. However, the T4 and T5 groups decreased by 18.75 and 12.02% compared to C group during the growing period. The economic efficiency of the T1, T2, T3 and T4 groups exceeded the C group by 10.03, 20.58, 13.02 and 16.88 as well as by 12.82, 20.35, 15.65 and 11.53% for table egg and fertile egg production, respectively. The results study indicated that the short light flashes period programs enhances economic efficient, this could be attributed to the superiority in immunity and production performance. Also, it reduces the electricity cost and house temperature. However, continuous light seems to be a stressful program, which induces elevation of tonic immobility or H/L ratio. Intermittent light flashes findings have economic factors on poultry production due to lower feed intake and electricity consumption, thereby a significant saving in expenses of lighting (Wang et al., 2008). In contrast, Oyedeji and Atteh (2005) found insignificant interactions between cost factors to benefit ratio. In addition, Tuleun et al., (2010) found that continuous lighting might decrease feed cost.

CONCLUSION

From the present results, it could be concluded that inclusion of short flash lighting periods (10, 20, 30 minute/hour) in photoperiod recorded the highest percent of economic efficiency (expressed as % net revenue/feed cost) compared with control diet. This could be attributed to the superiority of T1, T2 and T3 in growth performance, egg production, shell thickness and livability, also having adequate fertility. From the practical point of view, light flashes program of 10, 20 and 30 minute/hour for growing and laying period is highly recommended.

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

Ingredients	Growing (%)	Laying (%)
Yellow corn	64.8	69.5
Soybean meal (44%)	25.5	15.0
Concentrate	8.0*	8.0**
Salt	0.20	0.10
Minerals	0.20	---
Premix	0.30	--
Bone meal	----	0.4
Limestone	----	7.0
Total	100	100
Calculated analysis***		
Protein (%)	21.0	17.4
ME (KCal/ Kg diet)	2893	2867
Calcium (%)	1.20	3.10
Available phosphorus (%)	0.55	0.37

* Broiler concentrate (52% CP, ME 2416 kcal/ kg diet) ** Layer concentrate (51% CP, ME 2400 kcal/ kg diet)

Table (2): Effect of light flashes program on growth performance.

Traits	Age (wks)	Treatments						SEM	P value
		C	T1	T2	T3	T4	T5		
Body weight (g)	4	168.13	168.66	169.53	171.30	167.37	169.75	13.8	0.6995
	8	377.72	379.16	375.77	366.75	361.81	355.55	31.7	0.2143
	12	947.74 ^{ab}	959.35 ^{a}	925.67 ^{bc}	922.21 ^{c}	924.74 ^{bc}	908.02 ^{c}	63.9	0.0001
	16	1319.98 ^{a}	1342.27 ^{a}	1333.43 ^{a}	1286.02 ^{b}	1181.06 ^{d}	1222.54 ^{c}	70.0	0.0001
Body weight gain (g/bird/day)	4 - 8	7.49	7.52	7.37	6.98	6.94	6.64	1.10	0.2891
	8 - 12	20.36 ^{a}	20.72 ^{a}	19.64 ^{b}	19.84 ^{b}	20.10 ^{ab}	19.73 ^{b}	1.84	0.0105
	12 - 16	13.29 ^{b}	13.68 ^{b}	14.56 ^{a}	12.99 ^{b}	9.15 ^{d}	11.23 ^{c}	2.36	0.0001
	Mean	13.71 ^{a}	13.97 ^{a}	13.86 ^{a}	13.27 ^{b}	12.07 ^{d}	12.53 ^{c}	0.78	0.0001
Feed consumption (g/bird/day)	4 - 8	27.67	27.03	26.93	25.331	26.33	23.67	2.52	0.4613
	8 - 12	39.00 ^{a}	38.33 ^{a}	37.00 ^{ab}	35.34 ^{bc}	34.67 ^{dc}	33.00 ^{d}	1.87	0.0150
	12 - 16	55.33	55.67	55.50	54.33	53.67	54.33	2.45	0.8882
	Mean	40.67 ^{a}	40.34 ^{a}	39.81 ^{a}	38.34 ^{ab}	38.22 ^{ab}	37.00 ^{b}	1.29	0.0297
Feed conversion (g feed/g gain)	4 - 8	3.70	3.60	3.66	3.63	3.80	3.47	0.36	0.9185
	8 - 12	1.92 ^{a}	1.85 ^{a}	1.88 ^{a}	1.78 ^{ab}	1.73 ^{ab}	1.66 ^{b}	0.10	0.0562
	12 - 16	4.16 ^{b}	4.08 ^{b}	3.81 ^{b}	4.18 ^{b}	5.96 ^{a}	4.42 ^{b}	0.42	0.0005
	Mean	3.26 ^{b}	3.18 ^{b}	3.12 ^{b}	3.20 ^{b}	3.83 ^{a}	3.18 ^{b}	0.21	0.0102

a-----d Means within row followed by different superscripts are significantly different ($P \leq 0.05$).

Table (3): Effect of light flashes program on carcass and meat quality.

Traits	Treatments						SEM	P value
	C	T1	T2	T3	T4	T5		
DressedCarcass,%	69.92 ^{a}	70.10^{a}	68.82^{ab}	69.81 ^{a}	68.75^{ab}	67.32^{b}	1.14	0.0346
Drumsticks, %	11.12	11.18	11.40	10.88	11.00	10.69	0.89	0.4825
Femurs, %	11.90	12.00	11.84	11.60	11.75	11.68	1.00	0.1256
Breast, %	14.26^{ab}	15.35^{a}	15.28^{a}	13.95^{ab}	13.55^{b}	13.62^{b}	0.98	0.0528
Heart, %	0.79	0.81	0.83	0.78	0.84	0.78	0.09	0.4682
Liver, %	3.26	3.55	3.41	3.29	3.52	3.33	0.52	0.3554
Gizzard, %	3.79	3.65	3.74	3.52	3.68	3.53	0.61	0.6325
Abdominal fat, %	1.92 ^{a}	1.89 ^{a}	1.51 ^{b}	1.73 ^{ab}	1.48 ^{b}	1.46 ^{b}	0.41	0.0431

a-----c Means within row followed by different superscripts are significantly different ($P \leq 0.05$).

Table (4): Effect of light flashes program on blood constitutes.

Traits	Treatments						SEM	P value
	C	T1	T2	T3	T4	T5		
Total proteins (g/dl)	5.09	4.98	5.13	5.33	5.42	4.95	0.25	0.3272
Albumin (g/dl)	2.89	2.83	2.87	3.02	3.11	2.94	0.31	0.5126
Globulin (g/dl)	2.20	2.15	2.26	2.31	2.31	2.01	0.24	0.6238
Albumin: globulin ratio	1.31	1.32	1.27	1.31	1.35	1.46	0.15	0.7325
Cholesterol (mg/dl)	134.15	134.21	128.24	129.12	130.11	126.20	6.15	0.4537
AST U/I	30.25	29.34	27.91	26.11	28.94	30.62	3.61	0.7636
ALT U/I	13.00	12.31	11.82	11.65	12.71	12.95	0.91	0.6121
T3 (ng/ml)	3.19	3.13	3.22	3.04	2.92	2.75	0.38	0.3182
Testosterone (ng/ml)	3.11	3.14	3.06	3.12	2.96	2.88	0.28	0.4518
Estradiol-17b, E2 (pg/ml)	157.33 ^{a}	158.25 ^{a}	157.45 ^{a}	155.28 ^{ab}	149.82^{b}	144.85^{c}	3.06	0.6435
H / L Ratio	0.41^{ab}	0.46 ^{a}	0.34 ^{b}	0.40^{ab}	0.47^{a}	0.48^{a}	0.03	0.0352

a----c Means within row followed by different superscripts are significantly different (P≤ 0.05).

Table (5): Effect of light flashes program on egg production and quality traits.

Traits	Treatments						SEM	P value
	C	T1	T2	T3	T4	T5		
Egg production:								
HDP (%)	67.06^{ab}	68.74^{a}	69.04^{a}	67.00^{ab}	66.78^{ab}	64.54^{b}	3.12	0.0416
Egg weight (g)	48.04	47.92	48.31	47.68	47.54	47.12	2.66	0.8241
Egg quality:								
Egg shape index (%)	77.61	77.58	77.34	77.56	76.98	76.84	3.11	0.5243
Egg yolk index (%)	52.15	52.22	52.41	52.36	51.86	52.00	2.82	0.6454
Haugh units	83.26	83.32	83.52	83.28	82.65	82.78	3.84	0.9631
Shell thickness (x 0.01 mm)	32.74^{a}	32.75^{a}	32.88^{a}	32.79^{a}	30.58^{b}	30.56^{b}	1.42	0.0436
Egg components (%):								
Albumen	57.10	56.90	56.82	57.10	57.05	56.96	2.33	0.6051
Yolk	31.90	32.00	32.16	32.00	32.12	32.16	1.72	0.7823
Shell	11.00	11.03	11.00	10.92	10.85	10.82	1.14	0.5316
Egg problems (%):								
Floor eggs	4.00	3.10	3.82	4.11	4.81	5.24	1.40	0.8216
Cracks and dirty	5.21	5.00	6.00	6.31	6.56	6.88	1.53	0.7635

a---b Means within row followed by different superscripts are significantly different ($P \leq 0.05$).

Table (6): Effect of light flashes program on reproductive performance.

Traits	Treatments						SEM	P value
	C	T1	T2	T3	T4	T5		
Genital organs:								
Testes, %	1.65	1.66	1.72	1.68	1.71	1.62	0.42	0.6282
Ovary, %	3.52	3.68	3.76	3.54	3.58	3.46	0.49	0.2617
Oviduct, %	2.72	2.69	2.74	2.66	2.56	2.63	0.38	0.6942
Oviduct length, cm	60.00	58.90	60.38	59.72	58.80	58.66	2.42	0.7815
Follicle number	7.05^{a}	6.56^{ab}	7.10^{a}	6.66^{ab}	5.10^{b}	5.00^{b}	0.56	0.0346
Sexual maturity:								
Female (50% egg production)	156.42	158.20	156.00	156.32	155.84	155.00	4.88	0.8135
Male (semen production)	161.00	160.82	162.16	161.22	161.00	160.02	2.38	0.7425
Semen quality:								
Reaction time (sec.)	35.25	38.22	32.62	29.21	28.65	25.44	2.42	0.4567
Semen volume (ml)	0.45	0.43	0.44	0.42	0.41	0.39	0.09	0.4172
Sperm-cell con. (SC$(10)^{9}$/ml)	4.59^{ab}	4.94^{a}	4.90^{a}	4.56^{ab}	4.19^{b}	4.23^{b}	0.26	0.0168
Incubation traits:								
Fertility, %	90.85^{ab}	92.00^{a}	91.75^{a}	91.55^{a}	88.21^{b}	88.00^{b}	2.25	0.0364
Hatchability, %	74.53	75.12	73.92	73.68	72.92	73.00	3.26	0.8536

a---b Means within row followed by different superscripts are significantly different ($P \leq 0.05$).

Table (7): Effect of light flashes program on conformations, plumage and mortality rate.

Traits	Treatments						SEM	P value
	C	T1	T2	T3	T4	T5		
Shank (cm)	5.92	5.88	5.91	5.80	5.72	5.66	0.41	0.5861
Keal bone (cm)	9.44	9.41	9.82	9.76	9.72	9.55	0.46	0.3675
Body depth (cm)	14.35	14.16	14.71	14.88	14.36	14.22	0.93	0.6124
Leg problems (%)	2.16	2.00	1.88	2.00	1.88	2.16	0.35	0.8123
Body temperature (C°)	41.72^{a}	41.39^{ab}	40.14^{b}	40.11^{b}	41.44^{ab}	41.61^{a}	0.29	0.0516
Plumage conditions	2.48	2.00	1.62	1.90	2.60	2.60	0.56	0.3826
Tonic immobility	1.88^{a}	1.62^{b}	1.59^{b}	1.64^{b}	1.76^{ab}	1.87^{a}	0.084	0.0256
Mortality rate (%)	3.33	4.44	2.22	2.22	0.00	4.44	3.66	0.7261

a---b Means within row followed by different superscripts are significantly different ($P \leq 0.05$).

Table (8): Economical efficiency for chickens as affected by flash light program.

Items	Treatments					
	C	**T1**	**T2**	**T3**	**T4**	**T5**
Economical efficiency for growing						
Total costs/ bird/L.E (Electricity + Feed costs)	13.25	13.04	12.78	12.22	12.08	11.60
Selling price of bird at 20 weeks of age (L.E)	19.33	19.74	19.22	18.68	16.73	17.01
Net revenue/ bird/L.E	6.08	6.70	6.45	6.46	4.65	5.41
Economical efficiency/bird (EE)	0.48	0.53	0.52	0.54	0.39	0.47
Relative economical efficiency/bird (REE)	100.00	111.08	108.27	112.60	81.25	87.98
Economical efficiency for table eggs						
Total costs/ bird/L.E (Electricity + Feed costs)	27.27	26.66	25.80	25.45	24.85	24.49
Selling price as table egg/hen/L.E	48.71	49.81	50.43	48.30	48.00	45.98
Net revenue/ bird/L.E	21.44	23.14	24.63	22.85	23.15	21.49
Economical efficiency/bird (EE)	0.81	0.89	0.98	0.92	0.95	0.89
Relative economical efficiency/bird (REE)	100.00	110.03	120.58	113.02	116.88	99.61
Economical efficiency for fertile eggs						
Total costs/ bird/L.E (Electricity + Feed costs)	27.27	26.66	25.80	25.45	24.85	24.49
Selling price as fertile egg/hen/L.E	51.18	53.12	53.21	51.52	49.48	47.71
Net revenue/ bird/L.E	23.91	26.46	27.40	26.07	24.63	23.21
Economical efficiency/bird (EE)	0.90	1.02	1.09	1.05	1.01	0.96
Relative economical efficiency/bird (REE)	100.00	112.82	120.35	115.65	111.53	94.13

Cost of 1 kg of dressed carcass = 24.00 L.E. Price of 1 kg table egg = 18.0 L.E Price of one fertile egg = 0.100 L.E
Price of 1 kg of growing ration = 3.70L.E Price of 1 kg of laying ration = 3.10 L.E L.E = Egyptian pound.
*Constant costs=25% include: housing, labour, heating, cooling and treatment regimens.

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الملخص العربي

تطبيق برنامج اضاءة الوميض فى رعاية الدجاج عارى الرقبة (الشركسى)

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أجريت هذه الدراسة لتطبيق برنامج الومضات الضوئية فى مساكن الدجاج الشركسى كبديل اقتصادى للاضاءة العادية خلال فترتى النمو ووضع البيض. 360 كتكوت من دجاج الشركسى عمر 4 أسابيع قسمت إلي ستة مجاميع (3 مكررات ، 20 طائر لكل مكررة) و ربيت كل الكتاكيت على الأرض. تم تعريض المجموعة الأولى كمجموعة مقارنة لفترة 12 و 16ساعة أضاءه صناعية عادية/يوم خلال مرحلتي النمو والبياض على التوالي، أما مجاميع المعاملات الأولى، الثانية، الثالثة و الرابعة و الخامسة، عرضت الطيور فيها للومضات الضوئية لمدة 10 دقائق لكل ساعة ، 20 دقائق لكل ساعة، 30 دقائق لكل ساعة، 40 دقائق لكل ساعة، 50 دقائق لكل ساعة لفترة 12 و 16ساعة أضاءه صناعية عادية/يوم خلال مرحلتي النمو والبياض على التوالي. أظهرت النتائج الرئيسية ان اضافة فترات قصيرة الومضات الضوئية لبرنامج الاضاءة العادية حسن معنويا ($P\leq0.05$) كلا من كفاءة النمو، نسبة التصافى للذبيحة، ونسب الصدر و دهن التجويف البطنى، معدل وضع البيض، سمك القشرة، الصفات الجنسية (الاعضاء، العمر عند النضج الجنسي، حجم وتركيز السائل المنوي، نسبة الخصوبة) و الحالة الصحية. ايضا انها زودت معنوياهرمون الاستروجين. بينما برنامج فترات الومضات الضوئية الطويلة سجلت اسوء القيم فى الاداء هموما و الاسترخاء (اختبار الخوف، H/L). ولم يكن له تأثير معنوي على نسب الدبوس و الفخذ، الكبد، القلب، القانصة، معظم مكونات الدم (بروتين كلى و قسميه، اللبيدات، كولسترول، إنزيم AST, ALT ، التستسترون، هرمون T3)، شكل البيضة، وحدات جودة البيض و الصفار، مشاكل الأرجل، ودرجة تلف الريش، تكوين العظام، وزن المبيض و الخصية و نسبة الفقس. من دراسة الكفاءة الاقتصادية لوحظ أن الطيور المعرضة لفترات الومضات الضوئية (10-30 دقيقة ومضات ضوئية /ساعة) كانت متفوقة اقتصادياً عن المجاميع الاخرى. استخدام فترات قصيرة من الومضات الضوئية يمكن ان يكون مناسب كبديل للإضاءة العادية او الثابتة اللازمة لرعاية دجاج الشركسى فى الرؤية و التنبيه الهرموني او الاعضاء الداخلية بدون اى تأثير سلبي على الأداء الفسيولوجى و الصفات الصحية أو الإراحة.