Pakistan J. Zool., vol. 49(6), pp 2323-2325, 2017. **DOI**: http://dx.doi.org/10.17582/journal.pjz/2017.49.6.sc2

Short Communication

Effect of LED Lighting on Hatchability and Chick Performance of Chicken Eggs

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ABSTRACT

Using light generally during chicken eggs incubation has been shown to affect hatchability, but using light-emitting diode (LED) precisely has not been fully examined. This study aims to evaluate the effect of LED lighting during incubation of Fayoumi eggs on hatchability (period length, dead embryos and percentage) and hatch chick performance (weight, vitality). The experiment was carried out in two groups with total number of 1800 eggs (900 eggs for each group). Eggs were incubated 12 h of light (natural) then 12 h of complete darkness (G1); and 12 h of light (natural) then 12 h of LED lighting (G2). From the obtained results, there were no significant effects of complement LED lighting" after effect on hatchability percent and dead embryos. There were differences observed in chick performance between the two groups, chick weight at hatch was significantly heavier in group of eggs exposed to complement LED lighting during incubation (G2) with high vitality percent than the eggs of G1 (control). We could conclude that providing LED light during incubation can improve chick performance.

Article Information
Received 29 March 2017
Revised 12 May 2017
Accepted 07 July 2017
Available online 07 November 2017

Authors' Contributions
KE carried out the experiment design, participated in practical work and wrote the manuscript. MHK provided guidance for the research work and revised the manuscript..

Key words
Chicken's eggs, LED lighting, Hatchability, Chick quality.

Animal husbandry is animal branch responsible for care and raising of livestock. It is a reflection of the environment conditions. Hatchability is a process which refers to the production of new generation. It is affected by many environmental factors (Malik *et al*., 2017). To meet the high demand on poultry products, producers are adopting new technologies that will enable them to increase production at a reduced cost. Most of these production technologies focus on enhancing the environmental conditions surrounding the avian. These environmental conditions are critical elements during embryogenesis of avian well-being. By using light-emitting diode (LED), breeders can increase production and reduce mortality with lower energy consumption and longer life use than fluorescent or conventional incandescent lighting (Gongruttananun, 2011).

Generally, chicken's eggs are often incubated commercially in semi or complete darkness, but under natural conditions, avian embryos would certainly receive some light stimulation during development (Rogers, 1996). Avian embryos have a pineal gland sensitive for light that affects their growth (Zeman *et al*., 1992). During incubation, exposing eggs to light can increase the embryo's growth (Shafey, 2004) and decrease time of incubation (Fairchild and Christensen, 2000). However, numerous studies have shown the importance of exposing embryos to light, but few researches have exactly shown the LED lighting effects on hatchability and chick performance. Huth and Archer (2015) indicated that providing LED light during incubation can improve chick quality.

Therefore, the current study was conducted to investigate the effect of complement LED lighting during chicken's eggs incubation on hatchability and hatch chick performance.

Materials and methods

A total number of 1800 Fayoumi chicken (*Gallus Gallus domesticus*) eggs were randomly distributed into two groups (900 eggs for each group and each one was further divided into 9 replicates) and incubated in a commercial hatchery under the recommended conditions (37.5°C and 60% RH) with/without complement LED lighting as follows: the first group (control) was incubated under 12 h of light (natural) then 12 h of complete darkness (G1); the second group was incubated under 12 h of light (natural) then 12 h of LED lighting (yellow, 6 Watt, 540 Leumans) (G2).

Data of hatchability percent, embryo mortality [at 7th (early dead) and 18th (late dead) day of incubation] and chick performance (weight, vitality) at hatch were recorded. All the hatched chicks were weighted and examined in order to determine their vitality which including their activity,

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0030-9923/2017/0006-2323 $ 9.00/0

appearance, eyes, unhealed navel and weakness to stand. The chick performance levels were using a scale from 1 (poor quality) to 5 (high quality).

Data collected were subjected to ANOVA by applying the General Linear Model (GLM) procedure of SPSS Statistical Software (2011). Duncan's multiple range test was used to detect differences among means of the two groups.

Results

The effect of complement LED lighting during eggs incubation on hatchability and chick performance was presented in Table I. There was no significant effect (P≤0.05) on hatchability percent of eggs. Also, there was no significant effect (P≤0.05) of complement LED lighting on early and late dead embryos. Differences were observed between groups in incubation period, eggs of G2 (LED) had lower (P≤0.05) incubation time (hr) than G1 (control). Also, there was a difference observed in chick performance between the two groups, chick weight at hatch was significantly (P≤0.05) heavier in group of eggs exposed to complement LED lighting (G2) (7 %) with high vitality level than G1 (5.5 %).

Table I.- Hatching and chick performance (Means ± SE) of Fayoumi eggs as affected by LED treatment during incubation period.

Traits	Groups	
	G1 (control)	G2 (LED)
Hatchability (%)	59.02 ±0.33	60.23 ±0.40
Early dead embryo (n)	27.52 ±0.20	25.83 ±0.27
Late dead embryo (n)	23.85 ±0.13	21.90 ±0.11
Incubation period (hr)	518^{a} ±0.98	507^{b} ±0.81
Chick weight at hatch (g)	34.01^{b} ±0.18	36.65^{a} ±0.17
Chick vitality (%)	90.00^{b} ±0.50	95.60^{a} ±0.55

[a, b] Means in the same row with different superscripts are significantly different (P≤0.05). G1, eggs incubated under 12 h of natural light then 12 h of complete darkness; G2, eggs incubated under 12 h of natural light then 12 h of LED lighting.

Discussion

To reach high economical efficiency in hatchability, optimal incubation conditions must be providing. Light is one of these conditions that improves embryonic growth and hatchability performance of avian eggs (Shafey and Al-Mohsen, 2002). It can affect health of hatch chicks (Archer and Mench, 2014). Also, the type and amount of light could affect hatchability and chick performance (Shafey, 2004). LED lighting provides an approximation of daylight than the spectral gaps of other lightings. Therefore, we used LED lamps in this study by exposing the Fayoumi eggs to complement LED lighting during the incubation to test its impact. Fayoumi chickens have a good hatchability percent as a local strain (Khalil *et al*., 2016). In agreement with previous study of Archer *et al*. (2009), there was no significant effect of complement LED lighting on hatchability percent of eggs (Table I). Also, we observed that early and late dead embryos were not change between groups. This result corresponds to findings by Huth and Archer (2015). The eggs exposed to complement LED lighting were hatched before the control eggs; thereby, increasing productivity. It means that LED lighting affect the incubation period. It can also affect the hatch window of eggs. The earliness in the hatching time due to complement light providing may can be refer to accelerate embryonic development rate (Ghatpande *et al*., 1995). Eggs exposed to complement LED light (G2) showed an increase in hatch chick weight compared to G1 eggs (36.60 gm and 34.01 gm, respectively). Light regime helps to increase the embryonic plasma T3 levels which have a positive correlation with metabolic rate and development of chicken embryos (Decuypere *et al*., 2005; Lu *et al*., 2007). Moreover, lighting treatment regulated melatonin production at post hatch period, which in turn affects some physiological functions of chicks (Nelson and Demas, 1997). However, this result is in agreement with Farghly and Mahrose (2012) who reported that the eggs incubated under continuous lighting produced heavier chicks than those incubated in the dark. With similar trend, Farghly *et al*. (2015) reported that the highest value of embryo weight was observed under incubated light flashes. In contrast, Pandian *et al*. (2013) found that light had insignificant effect on chick weight.

Furthermore, the G2 chicks showed high vitality level than G1 (4.78 and 4.52, respectively). These results indicate that providing LED light during incubation can improve hatch chick performance. This result is in accordance with that observed by Khalil (2009), who revealed that chicks hatched under light regime incubation appeared to be more active when compared with those hatched under dark incubation. Huth and Archer (2015) indicated that providing LED light during incubation can improve chick quality. These improvements mainly related to the physiological and metabolic responses to light during embryonic development. On the other hand, Archer and Mench (2014) did not find that embryonic light stimulation affected overall activity levels of post hatch.

Conclusion

According to the results of current research, we found a significant association between the providing of complement LED lighting during chicken eggs incubation and the hatch chick performance. Light induced from

the LED lamps during incubation improved chick's performance. Therefore, we recommend that LED lighting could be applied during eggs incubation to have high hatch chick's performance. Further studies through expanded sampling and detailed studies will be required to provide obvious explanations.

Acknowledgment

The authors would like to thanks Eng. Mohamed Abdel Rahman, Director of Abdel Rahman Incubators for his kind assistance with this work.

Statement of conflict of interest

Authors have declared no conflict of interest.

References

Archer, G.S. and Mench, J.A., 2014. *J. Anim. Sci.*, **92**: 1753-1758. https://doi.org/10.2527/jas.2013-7129

Archer, G.S., Shivaprasad, H.L. and Mench, J.A., 2009. *Poult. Sci.*, **88**: 29-37. https://doi.org/10.3382/ps.2008-00221

Decuypere, E., Van As, P., Van Der Geyten, S. and Darras, V.M., 2005. *Rev. Domest. Anim. Endocrinol.*, **29**: 63-77. https://doi.org/10.1016/j.domaniend.2005.02.028

Fairchild, B.D. and Christensen, V.L., 2000. *Poult. Sci.*, **79**: 1627-1631. https://doi.org/10.1093/ps/79.11.1627

Farghly, M.F.A. and Mahrose, K.M.A., 2012. *Egypt J. Poult. Sci.*, **32**: 947-958.

Farghly, M.F.A., Mahrose, K.M.A. and Abou-kassem, D.E., 2015. *Asian J. Poult. Sci.*, **9**: 19-30. https://doi.org/10.3923/ajpsaj.2015.19.30

Ghatpande, A., Ghatpande, S. and Khan, M.Z., 1995. *Cell. Mol. Biol. Res.*, **41**: 613-621.

Gongruttananun, N., 2011. *Poult. Sci.*, **90**: 2855-2863. https://doi.org/10.3382/ps.2011-01652

Huth, J.C. and Archer, G.S., 2015. *Poult. Sci.*, **94**: 3052-3058. https://doi.org/10.3382/ps/pev298

Khalil, H.A., 2009. *Slovak J. Anim. Sci.*, **42**: 79-86.

Khalil, M.H., Shebl, M.K., Kosba, M.A., El-Sabrout, K. and Zaki, N., 2016. *Vet. World*, **9**: 806-810. https://doi.org/10.14202/vetworld.2016.806-810

Lu, J.W., Mcmurtry, J.P. and Coon, C.N., 2007. *Poult. Sci.*, **86**: 673-683. https://doi.org/10.1093/ps/86.6.1059

Malik, A., Abbas, G., Kalhoro, H., Kalhoro, L., Shah, S. and Kalhoro, H., 2017. *Pakistan J. Zool.*, **49**: 1049-1056. https://doi.org/10.17582/journal.pjz/2017.49.3.1049.1056

Nelson, R.J. and Demas, G.E., 1997. *Brain Res. Bull.*, **44**: 423-430. https://doi.org/10.1016/S0361-9230(97)00222-0

Pandian, C., Omprakash, A.V., Churchil, R., Sundaresan, A. and Babu, M., 2013. *Tamilnadu J. Vet. Anim. Sci.*, **9**: 285-288.

Rogers, L.J., 1996. *The development of brain and behaviour in the chicken*. CABI Publishing, Wallingford, UK.

Shafey, T.M., 2004. *Br. Poult. Sci.*, **45**: 223-229. https://doi.org/10.1080/00071660410001715821

Shafey, T.M. and Al-Mohsen, T.H., 2002. *Asian-Australas. J. Anim. Sci.*, **15**: 1702-1707. https://doi.org/10.5713/ajas.2002.1

SPSS, 2011. *Statistical package for the social sciences (SPSS) user's guide: Statistics,* Version 20.0 for Windows. Institute, Inc., Cary, NC, USA.

Zeman, M., Gwinner, E. and Somogyiova E., 1992. *Experientia*, **48**: 765-768. https://doi.org/10.1007/BF02124299