

EFFECT OF EGG STORAGE TEMPERATURE AND HOUSING ON EGG QUALITY

Sati N. M^{1@}, Sam Etop², Emennaa P. E¹, Nwamo A.C.¹, Sanani Ponfa¹, Ejidara A.¹, Oche Grace³, and Oshibanjo D.O³

National Veterinary Research Institute, Vom Jos Plateau State Nigeria¹

Department of Animal Science, University of Ibadan, Ibadan Oyo State Nigeria²

Department of Animal Production, University of Jos, Jos Plateau State Nigeria³

@Corresponding author: E-mail: snancykefas@yahoo.com

080269287711

ABSTRACT

This study was aimed at evaluating the effect of egg storage temperature and housing on egg quality. A total of 300 Lohmann brown hen eggs of 50 weeks old from a battery cage and deep litter housing system were collected from the Poultry Division of National Veterinary Research Institute, Plateau State (NVRI) at once for this study. Out of the 300 eggs, (150 eggs from each housing system), 30 were picked at random for determination of egg quality characteristics in a 2 x 2 factorial arrangement in a Completely Randomized Design. The storage methods were room temperature (ambient) range from 26.6 - 29.4 °C and refrigeration at 5°C. External and internal quality characteristics of eggs were taken. Data were analyzed using ANOVA at $\alpha_{0.05}$. Yolk height was greatly affected by storage days and temperature. Refrigerator temperature had high impact on yolk height for both the battery cage and deep litter (14.57 and 14.83mm) respectively, index (42.61 and 40.74%) and diameter from egg in cage and deep litter system (while lower values are obtained in yolk height, index and diameter from egg in battery cage system (13.17mm, 35.09% and 34.37mm). Albumen height, length, pH, index and Haugh unit was greatly affected by temperature with room temperature having the following values (6.30mm, 85.70mm 8.58, 7.20% and 72.25%) respectively. Eggs can be kept up to day 10 in both room and refrigerator temperature without any adverse effect on the egg quality.

Keywords: Egg quality, Storage days, Storage temperature, Housing system, Haugh unit

INTRODUCTION

The most important consumer criteria of eggs quality is their freshness ([Karoui et al., 2006](#)), which can be characterized by numerous traits related to shell or content parameters. Egg production and eggshell quality traits are affected by modified the conventional cages and deep litter systems ([Abrahamsson and Tauson, 1995](#); [Abrahamsson et al., 1995](#); [Abrahamsson and Tauson, 1998](#)). However, characteristics of egg content can be modified by many factors such as temperature and storage duration. As time of storage increases, the overall egg quality as measured by conventional grading standards declines. The longer the storage time, worse will be the egg internal quality because carbon dioxide transfer through egg shell is favoured by temperature and humidity ([Oliveira and Oliveira, 2013](#)).

Therefore, this study seeks to evaluate the egg quality changes with day 0 to 10 as affected by storage day and temperature.

MATERIALS AND METHODS

Experimental Site: This experiment was conducted at the Animal Products and Processing Laboratory, Department of Animal Production, University of Jos, Jos-North Local Government Area (LGA) of Plateau State.

Collection of experimental material: A total of 300 eggs from battery cage and deep litter housing system were collected from Poultry Division of National Veterinary Research Institute, Plateau State (NVRI) at once for this study. Eggs were obtained from Lohmann brown hen, at 50 weeks of age to evaluate egg quality characteristics. Out of the 300 eggs (150 eggs from each housing system), 30 were picked at random after the following storage days (0, 5 and 10 respectively) for determination of egg quality characteristics. The storage methods were room temperature (ambient) range from 26.6 - 29.4 °C and refrigeration at 5°C.

Evaluation of Egg Quality

The internal parameters measured were done according to the method describe by Grashorn, M. (2016):

Yolk Width: Measured as the widest horizontal circumference with a vernier caliper.

Yolk Height: Measured as the height of the yolk at mid-point with a tripod micrometer.

Albumen Height: Measured as the height of the thick albumen.

Albumen Width: Measured as the widest horizontal circumference and,

Albumen Weight: Calculated as the difference in weight of the egg and weight of the yolk plus shell.

Yolk Index: Calculated as the yolk height divided by the yolk width (cm).

Albumen Index: calculated as the ratio of the albumen height to egg width.

Haugh unit was determined using the formula below:

$$HU = 100 \log (H + 7.5 - 1.7W^{0.35})$$

Where HU= Haugh unit

H= Height of the thick albumen (mm)

W= Egg weight (grams)

Experimental design

A 2 x 2 Factorial arrangement in a Completely Randomized Design was used.

Statistical Analysis

Data collected were analyzed using Assistat version 7.7, where statistical variations are observed, means were separated using Turkey's

RESULTS AND DISCUSSIONS**Results**

Table 1 shows the main effect of storage temperature and housing unit on egg qualities. It was observed that storage temperature had no effect on the external egg qualities. Yolk weight was affected by housing system. The deep litter had the highest yolk weight than the battery cage while Yolk height and index were greatly affected by refrigerator temperature with higher values obtained than those that were stored at room temperature for both eggs obtained from battery cage and deep litter systems. Storage temperature had no effect on albumen weight for both eggs obtained from battery cage and deep litter systems while albumen height, Index and Haugh Unit was significantly influenced by refrigerator temperature for both eggs obtained from battery cage and deep litter systems. Albumen pH and length was favoured by room temperature than refrigerator temperature for both the battery cage and deep litter systems.

Table 1: Main effect of storage temperature and housing unit on egg qualities

Parameters	Battery cage		Deep litter		SEM
	Room Temperature	Refrigerator Temperature	Room Temperature	Refrigerator Temperature	
Egg weight (g)	58.8	56.73	58.6	59.9	3.33
Weight loss (%)	1.33	0.95	1.06	0.87	0.05
Egg length (mm)	54.63	52.77	54.8	55.5	3.3
Egg width (mm)	43.13	42.77	43.2	43.13	1.12
Shape index (%)	78.98	78.61	78.85	77.8	1.94
Yolk weight (g)	13.17 ^b	12.90 ^b	14.30 ^a	14.47 ^a	0.72
Yolk height (mm)	13.17 ^b	14.57 ^a	13.77 ^b	14.83 ^a	0.71
Yolk diameter (mm)	37.83 ^{ab}	34.37 ^c	38.73 ^a	36.47 ^b	1.45
Yolk ratio (%)	22.56 ^c	22.85 ^{bc}	24.50 ^a	24.26 ^{ab}	1.6
Yolk index (%)	35.09 ^b	42.61 ^a	36.10 ^b	40.74 ^a	2.71
Yolk:Albumen ratio	0.38 ^{bc}	0.37 ^c	0.41 ^{ab}	0.43 ^a	0.01
Yolk colour	7.17 ^a	7.46 ^a	6.37 ^b	6.90 ^{ab}	0.61
Yolk pH	6.21	6.27	6.27	6.11	0.21
Albumen weight (g)	35.63	35.43	35.17	34.03	2.84
Albumen height (mm)	6.30 ^b	8.10 ^a	5.97 ^b	7.60 ^a	0.7
Albumen length (mm)	85.70 ^a	72.37 ^c	85.47 ^a	77.40 ^b	4.84
Albumen pH	8.58 ^a	7.65 ^b	8.28 ^a	7.53 ^b	0.51
Albumen ratio	60.51 ^{ab}	62.51 ^a	59.93 ^{ab}	57.10 ^b	3.67
Albumen index (%)	7.70 ^c	11.25 ^a	7.20 ^c	10.00 ^b	0.1
Haugh unit (%)	77.05 ^b	90.60 ^a	72.25 ^b	86.70 ^a	4.19
Egg surface area	471.05 ^a	454.5	463.45	479.87	26.69

^{a, b, c, d} means with different superscripts on the same column differ significantly ($P < 0.05$);

SEM means: standard error of mean

DISCUSSION

Although, there were no significant differences in the main and interaction effect in egg weight between housing system, storage days and temperature in the present study which corresponds with the findings of Vlcková *et al.* (2009) and Yilmaz Dikmen *et al.* (2017). The rate of egg weight loss best describes the ability of the egg to maintain its freshness for as long as possible during storage. Faster internal quality changes, i.e., quality of albumen and yolk, occur with higher egg weight loss (Grashorn, 2016). Yolk weight, diameter, ratio, yolk:albumen index and colour were significantly higher at day 10 of storage with least values obtained at day 0. The yolk height, index and pH, were all affected by the storage days. As the storage days increased, yolk height, index and pH decreased with highest values obtained at day 0. Most of the yolk quality indices are greatly affected by storage temperature. The refrigerator temperature favoured the yolk weight, height, diameter, index and colour. This result obtained is in line with the report of Vivian Feddern *et al.*, (2017). But eggs stored at room temperature did not meet 0.45 as standard reference (Mertens *et al.*, 2011) of a good yolk index. Also, according to Oliveira and Oliveira (2013), Yolk index must be 0.39 - 0.45. Once yolk index is related to height and diameter, as egg gets older, these characteristics are affected, demonstrating quality loss. Giampietro-Ganeco *et al.*, (2015) observed that yolk index decreased with increasing storage time. The influence of pH on egg quality is closely related to its freshness. It has been confirmed (Garcia *et al.*, 2010) that albumen and yolk pH increased as a function of storage time and storage temperature but this statement was in contrast to the results obtained in this study. The increase in pH observed in yolk was not as large as in albumen, and it differed from 5.75 - 6.08 during 10 days of storage at 29°C. As for the yolk colour, the storage days and temperature with both housing systems did not have any effect. These results are in line with the report of Ferrante *et al.*, (2009), Đukić-Stojčić *et al.*, (2009) and Krawczyk (2009). The albumen quality indices were greatly

affected by storage days, temperature and housing systems. In this study, as the storage days increased, the albumen weight, height, ratio, index and haugh unit decreased. Refrigerator temperature favoured the albumen height, index and the Haugh Unit more than room temperature. Although albumen length and width showed an increase with storage time, increasing storage time caused a decrease in albumen height and albumen index. During storage time height of egg albumen showed a decreasing trend ([Scott and Silversides, 2000](#); [Tilki and Saatci, 2004](#)).

CONCLUSION

The results obtained in this study reveals that both the storage days and temperature had great influence on the egg quality. Eggs can be kept up to day 10 in both room and refrigerator temperature without any adverse effect on the egg quality.

REFERENCES

- Abrahamsson, P. and R. Tauson, (1995). Aviary systems and conventional cages for laying hens effects on production, egg quality, health and bird location in 3 hybri. *Acta Agriculture Scandinavica Section A-Animal Science* 45, 191-203.
- Abrahamsson, P. and R. Tauson, (1998). Performance of egg quality of laying hens in aviary system. *J. Applied Poultry Res.* 7, 225-232.
- Abrahamsson, P., R. Tauson and M. C. Appleby (1995). Performance of 4 hybrids of laying hens modified and conventional cages. *Acta Agriculture Scandinavica Section A- Animal Science* 45, 286-296.
- Dukić-Stojčić, M., L. Perić, S. Bjedov. and N. Milošević (2009). The quality of table eggs produced in different housing systems. *Biotech. Anim. Husb.* 25, 1103-1108.
- Ferrante, V., Lolli, S., Vezzoli, G. and Cavalchini, L.G. (2009) Effects of two different rearing systems (organic and barn) on production performance, animal welfare traits and egg quality characteristics in laying hens. *Italian Journal of Animal Science* 8: 165-174.
- Garcia, E. R. M., Orlandi, C. C. B., Oliveira, C. A. L., Cruz, F. K., Santos, T. M. B., & Otutumi, L. K. (2010). Qualidade de ovos de poedeiras semipesadas armazenados em diferentes temperaturas e períodos de estocagem. *Revista Brasileira de Saúde e Produção Animal*, 11(2), 505-518
- Giampietro-Ganeco, A. *et al.*, (2015) Quality assessment of eggs packed under modified atmosphere. *Ciência e Agrotecnologia*, 39(1):82-88. [[Links](#)]
- Grashorn, M. (2016). Effects of storage conditions on egg quality. *Lohmann Information*. 50:22–27.
- Karoui, R., B. Kemps., F. Bamelis., B. Ketelaere de., E. Decuyper and J. Baerdemaeker de, (2006). Methods to evaluate egg freshness in research and industry: A review. *Eur. Food Res. Technol.* 222, 727-732.
- Krawczyk, J. (2009) Quality of eggs from Polish native Greenleg Partridge chicken-hens maintained in organic vs. backyard production systems. *Animal Science Papers and Reports* 27 (3): 227-235.
- Mertens, K. *et al.*, (2011). Advances in egg defect detection, quality assessment and automated sorting and grading. In: NYS, I.; BAIN, M.; VAN IMMERSEEL, F. (Eds.). *Improving the safety and quality of eggs and egg products*. Volume 1: Egg chemistry, production and consumption. 1. ed. Cambridge: Woodhead Publishing Limited, pp.209-241. [[Links](#)]
- Oliveira, B. L. de; Oliveira, D. D. de (2013). *Qualidade e Tecnologia de Ovos*. 1. ed. Lavras, MG: UFLA, 2013. 223p. [[Links](#)]
- Scott, T. A. and Silversides F. G. (2000). The effect of storage and strain of hen on egg quality. *Poultry Sci.* 79, 1725-1729
- Silversides, F. G. and P. Villeneuve. (1994). Is the Haugh unit correction for egg weight valid for eggs stored at room temperature? *Poult. Sci.* 73:50–55.
- Silversides, F. G. and T. A. Scott (2001). Effect of storage and layer age on quality of eggs from two lines of hens. *Poultry Sci.* 80, 1240-1245.
- Tilki, M. and M. Saatci, (2004). Effects of storage time on external and internal characteristics in partridge (*Alectoris graeca*) eggs. *Revue Med. Vet.* 155, 561-564.

- Vlcková J. Třumová E., Míková K., Englmaierová M., Okrouhlá M. and Chodova D. (2019). Changes in the quality of eggs during storage depending on the housing system and the age of hens. *Poultry Science* 98:6187–6193 <http://dx.doi.org/10.3382/ps/pez401>
- Yilmaz Dikmen, B., A. Ipek., Ü. Sahan., A. Sözcü and S. C. Baycan. (2017). Impact of different housing systems and age of layers on egg quality characteristics. *Turk. J. Vet. Anim. Sci.* 41:77–84.