EFFECT OF TEMPERATURE AND LENGTH OF STORAGE ON pH OF INTERNAL CONTENTS FOR CHICKEN TABLE EGG IN HUMID TROPICS

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Abstract
All foods have limited shelf life which will vary depending on the food and storage conditions. Eggs are perishable food and storage temperature is an important factor that affects the shelf life of table egg. In tropical countries like Nigeria, eggs are usually preserved under ambient condition due to erratic power supply, which reduces the efficiency of refrigeration system. The aim of the present study was to examine the effects of storage periods, temperature and their interaction on the pH of chicken egg internal properties (yolk, albumen and whole egg). Fresh chicken table eggs were randomly allotted to three treatments of storage temperatures; refrigerator ($4^0C \pm 2$), laboratory ($32^0c \pm 4$), and poultry store room ($37^0C \pm 4$). Eggs were assigned to treatments in a 3 x 8 factorial design, and each treatment was replicated thrice. The pH was measured daily for each of the storage period in all treatments. Storage temperature and periods had significant effect on pH of measured parameters with no significant interaction. The pH values increased with storage temperature and period between treatments. The rate of pH increase is significantly higher in ambient as compared to refrigerator temperature. In this study, only the refrigerator storage has pH values within the range for fresh table eggs. At storage period above three weeks, pH values increased beyond the range for fresh egg. It is validated that storage temperature and period affected egg shelf life, the rate of freshness reduced with increased temperature, thus, storage beyond three weeks of ambient temperature is not advisable in humid tropics.

Keywords: Humid tropics, chicken eggs, yolk, albumen, pH and temperature

Introduction

The eggs are a common food and one of the most versatile ingredients used in cooking. They are important in many branches of the modern food industry, laid by females of many different species, including birds, reptiles, amphibians and fish but the most often consumed by humans is the chicken egg . Chicken eggs provide a good source of nutrients for man of all ages. Chicken egg, whole and hard-boiled, contains 12.6 g/100 g protein, 10.6 g/100 g fat, 1.12 g / 100 g carbohydrate, and 647KJ (155Kcal) /100 g energy . Egg yolks and whole eggs store significant amounts of protein and choline, and are widely used in cookery. Due to its high protein content, the United States Department of Agriculture categorizes eggs as Meats within the Food Guide Pyramid. Despite the nutritional value of eggs, there are some potential health issues arising from egg quality, storage, and individual allergies .

The most important external and internal egg quality traits have been shown to be egg weight, egg shape, shell thickness, breaking strength, specific gravity, air cell, pH, albumen height, and weight, and yolk index . Egg quality can be affected by the environmental conditions such as temperature and humidity of storage time, gaseous environment and storage time. Storage can modify some characteristics of the egg including loss of water, carbon dioxide and a subsequent increase in the pH (Decuypere *et al.*, 2001).

Studies have shown that storage of eggs in refrigerator at (4^0 C ± 2) will retain its nutritional value and wholesomeness for about five weeks (Faris *et al.*, 2011, Nadia *et al.*, 2012). However, in tropical countries like Nigeria, egg preservation is a serious problem. The common practice is to store under ambient condition due to inadequate refrigeration facilities, resulted from erratic power supply. To the best of our knowledge little is known about interaction of time, temperature and rate of deterioration. Therefore, the aim of the present study was to examine effects of storage period and temperature on pH of some internal qualities of egg.

Materials and Methods

Five hundred and four (504) of freshly laid eggs were obtained from Isa brown hens at the poultry unit, teaching and research farm, Bowen University, Iwo, Nigeria. All the eggs were weighed using digital weighing scale (model: AX 1000) and the weight of each egg was recorded. The eggs were separated into 24 groups of 21 eggs each; poultry store room ($37^0c \pm 4$), refrigerator ($4^0c \pm 2$), and laboratory ($32^0c \pm 4$), with eight (8) length of storage (3 x 8) factorial design. Three eggs were selected randomly from each group

daily to measure egg internal content parameters. The weight of whole egg, yolk and albumen was taken, using a digital weighing scale (model: AX 1000).

Chemical analysis: The yolk was separated from the albumen and both were distributed into three replicates of glass beakers. The pH of the albumen and the yolk were measured with a pH meter (Electronic Instrument Ltd). About 2.0 g of the sample was homogenised in 20.0 ml of de-ionised water in a beaker. The pH meter was first standardised using buffer solution of pH 4.01 and 9.20. The electrode was then rinsed with de-ionised water and dipped into the homogenate allowing sufficient time for stabilisation before taking reading. The yolk and albumen were then mixed thoroughly for each egg sample, and the pH reading was recorded.

Statistical analysis: All data recordings and calculated values were computed using Microsoft Excel 2010 and Sharp Model ELW53H Scientific Calculator. A regression analysis was done on all data recorded and slopes were compared with ANOVA in a two way factorial arrangement. Bonferroni and LSD was used to test for the significance of variance ($p<0.05$) for all recorded and calculated data between different treatments using XLSTAT version 2015.

Results and Discussion

The results of the effects of storage temperature on pH of yolk, albumen and whole egg are presented in Table 1. The study conducted over eight weeks period showed that storage temperature had significant effect ($p<0.05$) on the pH of yolk, albumen and whole egg. The pH values of fresh table egg internal properties measured before storage are yolk (6.05), albumen (7.10) and whole egg (7.21). All values increased with storage temperature over the study period. The yolk pH increased significantly ($p<0.05$) as the storage temperature increased. As reported in table 2, storage periods had significant effect ($p<0.05$) on pH of measured internal properties. The pH values increased significantly ($p<0.05$) with storage period. A rapid increase in albumen pH towards alkalinity scale was observed as compared to yolk after the 1st week, and a slower rate of increase throughout the remainder of the storage period. The pH of whole egg for 1st – 4th week only differed significantly ($p<0.05$) as compared to 5th – 8th week. No significant interaction between the storage treatments and period of measured pH parameters. The egg stored under ambient condition has a higher pH when compared to those that were refrigerated. These findings are in agreement with the results reported by other researchers (Silversides and Villeneuve, 1994, Scot and Silversides, 2000, Lapao *et al.*, 2009). The rise in the pH of the eggs may be caused by the loss of carbon dioxide and moisture from the egg through the pores in the shell. In contrast, Samli *et al.*, (2005); Akyurel and Okur, (2009) found that increases in yolk pH were significantly affected by storage time, but not by temperature.

The results for albumen were in agreement with findings reported by Silversides and Villeneuve, (1994). Freshly laid eggs contain 1.44 to 2.05 mg CO2/g of albumen (Keener *et al.*, 2001; Biladeau and Keener 2009) and have an albumen pH value of 7.6 to 8.7 (Rhim *et al.*, 2004;Waimaleongora-Ek *et al.*, 2009; . In this study, only refrigerated storage had albumen pH range within the freshness category after eight weeks of storage, while deterioration started after 4weeks storage period. However, Walsh *et al.*, (1995), and Lapao *et al.*, (1999) reported that neither temperature nor storage time influenced albumen pH. The decrease in albumen pH may be due to the continuing breakdown of the constituents of the egg white and/or a change in the bicarbonate buffer system due to loss of carbondioxide and moisture during storage at temperature above 4°c (Biladeau& Keener, 2009.

Staldelman and Cotteril (2007) stated that pH of fresh eggs should be 7.5 – 7.6, only storage temperature (4°c ± 2) with pH (7.57) is within this range at the end of the study. However, pH of whole egg increased beyond this range after three (3) weeks.

Table 1: Effect of temperature on pH of internal egg contents

Treatments				
pH	Refrigerator ($4^0c \pm 2$)	Laboratory ($32^0c \pm 4$)	Poultry ($37^0c \pm 4$)	SEM
Yolk	6.37^c	6.90^b	7.06^a	0.05
Albumen	7.72^b	9.01^a	9.09^a	0.11
Whole egg	7.57^b	8.65^a	8.80^a	0.15

Table 2: Effect of storage period on pH of internal egg contents

	Period (Weeks)								
pH	1	2	3	4	5	6	7	8	SEM
Yolk	6.42^{e}	6.53^{de}	6.68^{cd}	6.73^{c}	6.84^{bc}	6.92^{b}	7.00^{ab}	7.11^{a}	0.04
Albumen	7.33^{b}	8.60^{a}	8.67^{a}	8.72^{a}	8.80^{a}	8.86^{a}	8.90^{a}	8.97^{a}	0.11
Whole egg	7.50^{b}	7.59^{b}	7.64^{b}	7.78^{b}	8.70^{a}	8.80^{a}	8.93^{a}	9.13^{a}	0.12

Conclusion

This study has demonstrated that storage temperature and period had significant effect on pH values of yolk, albumen and whole egg. The pH values increased with storage period and temperature. Refrigerator storage temperature (4^{0}c ± 2) had pH values within the range for internal quality of fresh table eggs, while storage period above three (3) weeks had pH values beyond the range for fresh table eggs.

References

Akyurek, H. and A. A. Okur. 2009. Effect of storage time, temperature and hen age on egg quality in free-range layer hens. *J. Anim. Vet. Adv.* 8:1953-1958

Biladeau AM, Keener KM. 2009. The effects of edible coatings on chicken egg quality under refrigerated storage. *Poult Sci* 88:1266–74.

Decuypere, E.k, Tona, V, Bruggeman and F.Bamelis 2001. The day-old chick: A crucial hinge between breeders and broilers. *World's Poult. Sci. J.*,57: 127 – 139.

Ekc, M.O., Olaitan, N.I. & Ochefu, J.H. 2013. Effect of Storage Conditions on the Quality Attributes of Shell (Table) Eggs. *Nigerian Food Journal.* 31(2):18–24.

Faris, A.A. Shahrasad, M.J., Al-Shadedi and Rasheed, H.A. 2011. Quality, chemical and microbial characteristics of table eggs at retail stores in Baghdad. *International Journal of Poultry Science* 10(5):381–385.

Lapao C,GamaT. L, Chaveiro Soares M. 1999. Effects of broiler breeder age and length of egg storage on albumen characteristics and hatchability. *Poultry Science* 78:640–645.

Keener KM, LaCrosse JD, Babson JK. 2001. Chemical method for determination of carbon dioxide content in egg yolk and egg albumen. *Poult Sci* 80:983–7.

Nadia, N.A.A., Bushra, S.R.Z., Layla, A.F. and Fira, M.A. 2012. Effect of coating materials (gelatin) and storage time on internal quality of chicken and quail eggs under refrigeration storage. *Poultry Science* 32(1): 107–115

Rhim JW, Weller CL, Gennadios A. 2004. Effects of soy protein coating on shell strength and quality of shell eggs. *Food Sci Biotechnol* 13:455–9.

Ryu, K.N., No, H.K. & Prinyawiwatkul, W. 2011. Internal Quality and Shelf Life of Eggs Coated with Oils from Different Sources. *Food Sci Biotechnol* 76(5):325–329.

Walsh, T. J., R. E. Rizk, and J. Brake. 1995. Effects of temperature and carbon dioxide on albumen characteristics, weight loss, and early embryonic mortality of long stored hatching eggs. *Poult. Sci.* 74:1403–1410.

Samli, H.E., Agma, A. & Senkoylu, N. 2005. Effects of Storage Time and Temperature on Egg Quality in Old Laying Hens. *The Journal of Applied Poultry Research.* 14(3):548–553.

Scott, T. A., and F. G. Silversides. 2000. The effect of storage and strain of hen on egg quality. *Poult. 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 FG, Scott TA. 2001. Effect of storage and layer age on quality of eggs from two lines of hens. *Poult Sci* 80:1240–5

Stadelman, W.J. and Cotterill, O.J. (2007). Egg Science and Technology, 4th Edition, Haworth Press Inc. New York.

Wikipedia 2009. Egg (Food). The Free Encyclopedia. Wikimedia Foundation Inc.. 2009. Egg (food). 1–17.

Waimaleongora-Ek P, Garcia K, No HK, Prinyawiwatkul W, Ingram D. 2009. Selected quality and shelf-life of eggs coated with mineral oil with different viscosities. *J Food Sci* 74:S423–9.