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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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The Effect of Shellac as Coating Material on the Internal Quality of Chicken Eggs

Tariq N. Musa[1], Wisam S. Ulaiwi[1] and Nadia N.A. Al-Hajo[2]
[1]Basic Science Section, College of Agriculture, University of Baghdad, Baghdad, Iraq
[2]Department of Animal Resource, College of Agriculture, University of Baghdad, Baghdad, Iraq

Abstract: The functional properties of foods can be preserved when they are coated with edible films, which are especially reduce the moisture loss and the transportation of O_2 and CO_2. The present research is conducted to study the effect of shellac as coating material and storage time on the internal quality of chicken eggs. 448 fresh chicken eggs were divided into 4 groups of treatments 0, 1, 3 and 5% shellac solutions and stored for 0, 10, 20 and 30 days at 40°C. There was a proportional relationship between the weight loss of eggs and the pH values of untreated eggs (control) during the storage time. A reverse relationship was appeared with coated chicken eggs. The Haugh unit (Hu) usually decrease with the time of storage, but this was limited with coated eggs. No bad changes were associated with internal quality of chicken eggs, so we recommend shellac solution as coating material.

Key words: Egg quality, shellac, coating, chicken, haugh unit, weight loss

INTRODUCTION

Eggs have been classified as natures original function of food (Hasler, 2000). Eggs have long been consumed in a daily diet throughout the world, being a rich source of high quality protein and other nutrients (Cook and Briggs, 1986). Grading of eggs is based on weight and the quality factors of shell and the internal portions such as egg white, yolk, the air cell and the possible abnormalities (Stadelman, 1986a). Several problems are encountered during the storage of eggs including weight loss and interior quality deterioration. The movement of CO_2 and moisture through the egg shell governs the changes in albumen, yolk and weight loss of eggs (Stadelman, 1986b). the coating advantages by using edible films can be justified science they are maintain the functional properties of foods by decreasing moisture loss and gas transportation (O_2 and CO_2), furthermore these edible films are delaying the volatilization of aromatic components (Kester and Fennema, 1986). The applications of coatings therefore reduce weight loss and also maintain the internal measurements of eggs such as Haugh units, yolk index and egg white pH.

Early studies were examined chicken eggs coated with zein-based, egg albumen, soybean protein isolate, wheat gluten, mineral oils, acrylonitril (Li *et al*., 1985), chitosan (Bhale *et al*., 2003) whey protein concentrate (Wong *et al*., 1996) and black seed oil (Al-Hajo *et al*., 2009).

Shellac is a natural organic resin that comes from insect *Laccifera lacca*. The bug secretes an amber colored resinous substance that is called " lac " (Jeff, 2009). Shellac as natural non-poison material used as coating material for solid pharmaceutical dosage form, confectioneries and food coatings (Pearnchob *et al*., 2003; Jeff, 2009). Shellac was approved by the FDA as food safe coating when dissolve in pure ethanol. Because of its FDA approval, shellac is used to coat apples and others fruits to make them shinier, its also used as moisture barrier to coat the inside of ice cream cones. Furthermore, shellac is used as sap sealer and protective coatings for wood and hats (Jeff, 2009).

The present work is to study the application of shellac as coating material to fresh eggs and watching the loss in egg weight and the internal factors of quality such as, Haugh unit, albumen pH, albumen and yolk heights and another sensory evaluations during 30 days at 40°C.

MATERIALS AND METHODS

Shellac was obtained from the local market. 1, 3 and 5% shellac solutions were prepared by dissolving 1, 3 and 5 gr. Of shellac flakes in a limited quantity of absolute alcohol and quantitively transferred to 100 ml volumetric flask (the volume was complete by using absolute alcohol). The prepared solutions were stirring and stored for 24 h at room temperature. The fresh chicken eggs were obtained by the assistance of the Research Center, State Board of Agriculture Research, Baghdad, Iraq. 448 of pre-weighed chicken eggs were used in this study, 112 eggs for each treatment (the control and 3 concentrations of shellac solution). The chicken eggs were selected to give an average weight between 48 to 67 gr. The eggs were sanitized by using 1% sodium hypochlorite solution for 30 sec (Alleoni and Antunes,

Corresponding Author: Nadia N.A. Al-Hajo, Department of Animal Resource, College of Agriculture, University of Baghdad, Iraq

2004). The eggs were dipping in 1, 3 and 5% shellac solutions and immediately drying by expose to air fan. The control and the treated (coated) eggs were stored for 10, 20 and 30 days at 40°C in a conditioned room. 28 eggs from each treatment were examined for weight loss and height and pH values of egg white by the end of each storage period. The white height (in mm) was measured precisely by using a micrometer in order to determine the Haugh unit, which is one of the factors that are reflecting the internal quality of eggs (Haugh, 1937).

$$Hu = 100 \log (H - 1.7 W^{0.037} + 7.57)$$

Where:
Hu = Haugh unit
H = White height (mm)
W = Egg weight (gr.)

Sensory evaluation: The taste panel was asked to evaluate the control (non-coated) and the coated eggs for surface smoothness, glossiness, odor and overall acceptability using a 9 - point hedonic scale (1 = dislike extremely and 9 = like extremely) (Prinyawiwatkul *et al*., 1997).

Statistical analysis: The data were analyzed using Complete Randomized Design. The calculation was performed by the SAS package programmers (SAS, 2001). LSD test was used to determine the less significant differences between the means.

RESULTS AND DISCUSSION

The weight loss percentages of chicken eggs depend on whether, there is a coating material or not and also how long the storage time was. As shown in Table 1, the percentages of weight loss increased as the time of storage of increases, but were restricted limitation factors reduce the excess loss in egg weight, that it is the concentration of shellac solution. The coated eggs with 5% shellac solution gave a significant reducing in weight loss percentages as compared with 0% (control), 1 and 3% shellac concentration. For example the weight loss percentages at 40°C were 25.27, 21.32 and 13.61 by using 0, 1 and 3% shellac solutions, while it was only 6.47% by using 5% after 30 days storage time.

Wong *et al*. (1996) measured 4.2, 6.5 and 9.2% weight losses in eggs coated with wheat gluten, soybean protein isolate and mineral oil after 28 days storage respectively. Alleoni and Antunes (2004) record that the weight loss was decreased by using whey protein concentrate as coating material after stored for 3, 7, 10, 14, 21 and 28 days at 25°C. Al-Hajo *et al*. (2009) found that the weight loss was decreased in coated chicken eggs by using black seed oil as coating material for 10, 20 and 30 days at 4°C.

Table 1: The effect of coating and storage (0, 10, 20 and 30) days on weight loss (%) in chicken eggs

Storage day	Control	1%	3%	5%	Mean
10	7.4139	6.42	4.32	2.67	5.17
20	15.7558	12.39	7.44	3.60	9.79
30	25.2700	21.32	13.61	6.47	16.67
Mean	16.1500	13.37	8.41	4.24	-

LSD values: Coated: 3.27*; Storage day: 4.80*; Coated x Storage: 7.93*; *(p>0.05)

Table 2: The effect of coating and storage (0, 10, 20 and 30) days on pH of chicken eggs

Storage day	Control	1%	3%	5%	Mean
0	9.52	9.52	9.52	9.52	9.52
10	9.13	9.24	9.31	9.39	9.27
20	8.89	9.02	9.14	9.30	9.09
30	8.24	8.39	8.54	8.73	8.47
Mean	8.94	9.04	9.13	9.23	-

LSD values: Coated: 0.421*; Storage day: 0.421*; Coated x Storage: 0.809*; *(p>0.05)

The albumen pH values for all storage periods (Table 2) were higher with coated chicken eggs as compared with non-coated. The pH values for non-coated ranging from 9.52 (one day old egg) to 8.24 (30 days old egg). Ahn *et al*. (1999) were found that albumen pH value was increased to be 9.27 after 7 days, but it was stable until 21 days at refrigerator temperature (5°C). Alleoni and Antunes (2004) reported that the albumen pH values were increased for both coated and non-coated eggs.

The pH values of eggs albumen that were coated with 5% shellac solution decreased from 9.52 (one day old egg) to 8.73 after 30 days of storage, that because the coating material reduce the loss of CO_2 (Burley and Vadehra, 1989). The albumen also formed a thin layer behaves as a primary barrier against gas diffusion, which is as a result preserve the albumen quality (Silversides and Scott, 2001). Silversides and Scott (2001) also declared that the albumen pH should be consider as one of the quality factors since it is not affected by the age or the line of the chickens, therefore, the shellac has an important role for preserving the chicken egg quality since, it is maintain the initial pH value of the fresh egg.

The Haugh unit which is depending on egg weight and albumen height is an expression refers to the albumen quality and hence to the egg quality, the higher Hu value, the better albumen quality of the egg (Stadelman, 1986a,b).

The variation of Hu units in coated chicken eggs (5% shellac) ranging from 110.65-87.42, while it were 110.65-75.54 after 30 days in non-coated chicken eggs, In studies carried out by Morais *et al*. (1997) and Li *et al*. (1985) showed that the Hu unit decreased from 72-60 for eggs coated by mineral oil and stored at refrigeration.

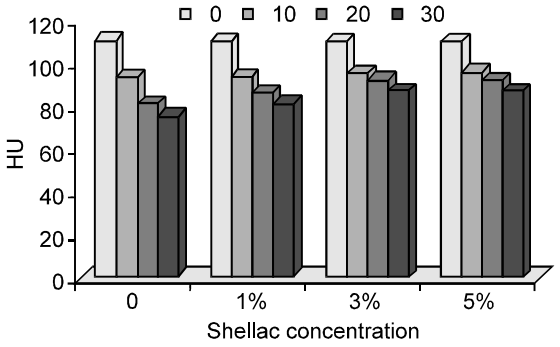

Fig. 1: HU in chicken eggs with and without coating as a function of storage time (0, 10, 20 and 30) day

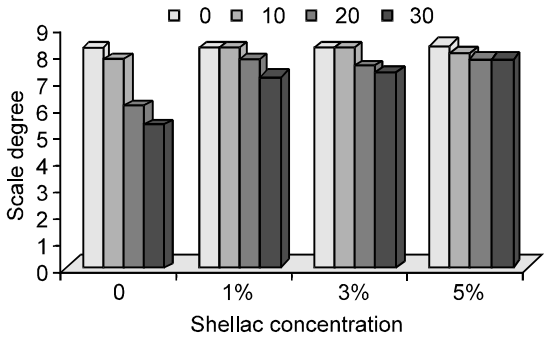

Fig. 2: Surface smoothness in chicken eggs with and without coating as a function of storage time (0, 10, 20 and 30) day

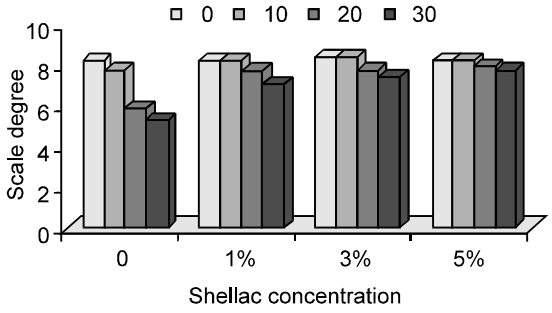

Fig. 3: Surface glossiness in chicken eggs with and without coating as a function of storage time (0, 10, 20 and 30) day

The sensory evaluation results were showed in Fig. 2, 3, 4 and 5. The shellac thin layer coating gives a shinny smooth surface as compared with non- coated, this situation increased the acceptability between the consumers (the taste panel). This preference was associated with all concentration of shellac solutions especially the higher one.

The beneficial aspects of shellac as coating material clearly warrant scale-up trials under the large production volume typical of commercial conditions.

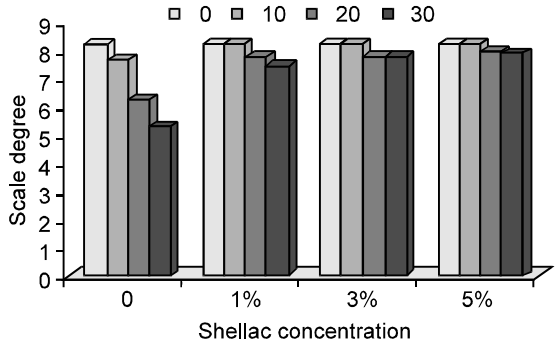

Fig. 4: Surface odor in chicken eggs with and without coating as a function of storage time (0, 10, 20 and 30) day

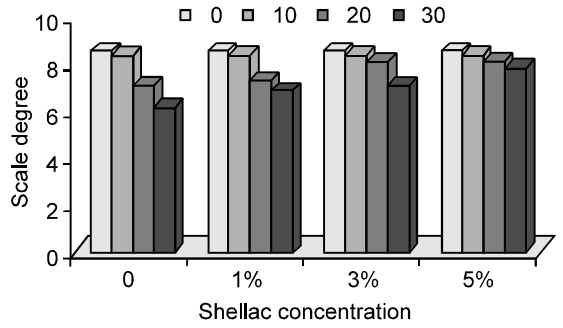

Fig. 5: Overall acceptability in chicken eggs with and without coating as a function of storage time (0, 10, 20 and 30) day

We can conclude from the present study that 5% shellac concentration can be used successfully to reduce the bad changes in eggs during a storage time up to 30 days at 40°C. We propose to experience higher concentration of shellac solution in the future.

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