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(Research Article)

Influence of edible oil coating on internal quality characteristics and shelf life of chicken eggs stored at room temperature

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Abstract

Freshness is a foremost contribution to the egg quality. The present study was conducted to find out the edible oil coatings on physico-functional properties and internal egg quality of chicken eggs during storage at room temperature in Sri Lanka. 300 eggs were randomly divided into five treatments were defined with three replications viz. ; Sesame oil coted eggs (T1), coconut oil coated eggs (T2), olive oil coated eggs (T3), mustard oil coated eggs (T4), and uncoated eggs (T5). Eggs weight loss (%), Haugh Unit (HU), Yolk index (YI), Albumen pH, Yolk pH and Air Cell depth were determined. The data were analyzed using Complete Randomized Design by making use of Statistical Analysis System (SAS 9. 4) and the Least S results proved that, olive oil coated eggs significantly maintained a lower Weight loss (%), lower albumen pH, lowest yolk pH and maintained a higher Yolk Index (%), highest Haugh Unit during the storage time at 32 °C than followed by T1, T2and T4. Uncoated eggs show significantly lower internal quality than other treatments. Therefore, it could be concluded that olive oil edible coating is most suitable to preserve eggs and extending the shelf life of eggs in Sri Lanka.

Keywords: Edible oil coatings; Haugh Unit (HU); Yolk index (YI); Albumen pH; Weight loss

1. Introduction

Chicken eggs are termed as "Incredible Edible eggs" (19) and known as complete foods to man (18) Animal protein requirement of the population can be met by consumption of eggs (13). And they are an economically viable source of high-quality protein and other nutrients.

Freshness is a foremost contribution to the egg quality. However, immediately after eggs are laid, Shell eggs undergo significant physical, chemical, structural and physiological changes and the internal quality of eggs begins to deteriorate due to loss of moisture and carbon dioxide via the eggshell pores (11). Hence; preservation of eggs is necessary to extend the shelf life of eggs. There are many methods have been practiced to preserve shelled eggs such as dry packing, immersing in liquids, oil coating and refrigeration etc, Among them surface coating is an alternative method to preserve egg quality, although it is cost effective than refrigeration method of preservation.

Previous studies have revealed that the use of coatings can help to maintain internal egg quality during storage for long periods by sealing pores and aid in preservation egg quality (4). Nevertheless, the information on interior quality and physico-functional properties of eggs after applying edible oil coatings is rare in Sri Lanka. Thus, the aim of the study was, therefore, to evaluate the effect of edible oil coatings Sesme oil coted eggs (T1), coconut oil coated eggs (T2), olive oil coated eggs (T3), mustard oil coated eggs (T4), on physico-functional properties and internal egg quality of chicken eggs during storage at room temperature of Sri Lanka and to find out the most effective edible oil that can be used as a coating for eggs during storage at room temperature in Sri Lanka.

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2. Material and methods

2.1. Collection of Materials

300 freshly laid (1-day-old), unwashed brown shell (from 37- weeks old Hyline breed brown hens), large size eggs (50g-60g) were collectesd from poultry farm batticaloa. All different types of oils were collected from super market in Batticaloa district.

2.2. Treatment of Eggs

300 eggs were randomly divided into five treatments; Sesame oil coted eggs (T1), coconut oil coated eggs (T2), olive oil coated eggs (T3), mustard oil coated eggs (T4), and uncoated eggs (T5), with three replicate per treatment. The eggs were dipped in the coating solutions individually by hand for 1 min (first layer of coating), then dipped again for 1 min (second layer of coating) and finally dried at ambient temperature for 24 hours. Uncoated eggs served as control. The eggs were placed in open molded plastic egg trays and stored under ambient laboratory conditions (32 °C with 78% relative humidity) for four weeks.

Eggs Weight (gram) was measured every a week using electronic balance and weight loss (%), Haugh Unit (HU), Yolk index (YI), Albumen pH, Yolk pH and Air Cell depth were determined. Egg weight loss was determined as the difference between successive weights of eggs at different weighing days. Yolk height and width (cm) was measured using a vernier caliper. Yolk index was estimated from ratio of yolk height to yolk width. The airspace was measured using a vernier caliper by placing the flattered side of the egg upward, and flashing light through the pointed end. Albumen pH and the Yolk pH were measured as described by Caner (2005). Haugh Unit was measured as described by Haugh (1937) and Yolk index (%) was calculated as described by Funk (1948) while the air cell was measured as described by Wickramasinghe *et al., (*2013).

2.3. Weight loss

Weight loss (%) was calculated weekly using a digital balance as described by Caner and Cansız (2008), using the following equation:

$$\text{Weight loss, \%} = \frac{(Final\ weight\ -\ Initial\ weight)}{Initial\ weight} \times 100$$

2.4. Yolk index

The yolk height and the yolk width were then taken using meter rule. The YI was then calculated using the formula below:

$$\text{YI} = \frac{\text{YH}}{\text{YW}}$$

where YI is the yolk index, YH, the yolk height (mm) andYW, the yolk width (mm)

2.5. Haugh Unit

$$HU = 100 \log \left[h - \frac{\sqrt{(30\text{W}0.37\ -\ 100)}}{100} + 1.19 \right]$$

where h is the thickness of albumen (mm) and W is the mass of the entire egg (g).

2.6. Albumen pH, Yolk pH

Albumen pH, Yolk pH of the egg albumen was determined using a standardized pH meter (Kirk & Sawyer, 1991). The Albumen pH, Yolk pH, were obtained from careful separation of Albumen and yolk, was then determined using the pH meter.

2.7. Statistical Analysis

The data were analyzed using Complete Randomized Design by making use of Statistical Analysis System (SAS 9. 4) and the Least Significant Difference (LSD) test was used to detect significant differences between the means.

3. Results and discussion

3.1. Effect of Edible Oil Coating on Quality Characteristics of Eggs

3.1.1. Weight loss (%)

In present study, results showed that, weight loss (%) of eggs has increased with the storage period (Table 1) at 32 °C. T5 showed significantly higher weight loss (%) during the storage period (p≤0. 05) with compared to T1, T2, T3 and T4. Further it was found that coconut oil, palm oil and sunflower oil revealed less weight loss than uncoated eggs (14). Evaporation water and loss of carbon dioxide through the porous shell might be the reason of weight loss of eggs. Among the treated samples, least reduction in weight was observed olive oil coated eggs (T3), (7. 13%), followed by mustard (8. 36%), oil coated eggs. It might be due to that different coating materials provided a more protective layer resulting from the coagulation of shell membrane, thus inhibiting porous passage of air in and out of the shell and minimize the weight loss, thus helping to extend shelf life.

Table 1 Mean values of weight loss (%) of coated and uncoated eggs during storage time at 32 °C

	Week 01	**Week 01**	**Week 01**	**Week 01**
Sesame oil coted eggs (T1)	5.89±0.69$^{a, y}$	7.88±0.19$^{a, z}$	7.98±0.25^{b}	10.13±0.15$^{a, z}$
coconut oil coated eggs (T2)	5.13±0.15$^{abc, y}$	6.13±0.15$^{abc, y}$	7.53±0.67$^{a, z}$	9.75±0.15
olive oil coated eggs (T3)	3.28±0.18$^{a, z}$	4.28±0.67^{b}	5.08±0.28^{b}	7.13±0.15^{b}
mustard oil coated eggs (T4)	4.86±0.25$^{a, y}$	5.96±0.24$^{a, z}$	6.86±0.25^{b}	8.36±0.25$^{a, z}$
uncoated eggs (T5)	6.73±0.15$^{abc, y}$	8.86±0.75^{b}	9.86±0.75^{b}	12.86±0.75^{b}

a, b Means with different superscripts in the same row are statistically different (P < 0. 05); $^{x–z}$ Means with different superscripts in the same column are statistically different (P < 0. 05); [1] Root mean square error = 0. 21; [2] Coating treatment × time interaction (P < 0. 0001) effect is significant

3.2. Haugh Unit

The Haugh unit is an expression relating egg weight and height of thick albumen. The higher the Haugh Unit, the better the albumen quality of the egg (19). The results showed that the Haugh unit significantly decreased with increasing storage period, The highest Haugh Unit was recorded in T3 followed by T1, T2and T4. The minimum Haugh Unit was recorded in T5 (Table 2). It might be due to the capability of the oil to block the pores of the shell-eggs, thereby preventing the flow of air in and out of eggs and degradation by microbes suchair may carry (15). Further it was reported that decrease of Haugh Unit for uncoated (86. 60-37. 80) and coated (85. 80-56. 50) shell eggs after 42 days of storage (1).

Table 2 Mean values of Haugh Unit and grades* of coated and uncoated eggs during the storage time at 32 °C

	Week 00	**Week 01**	**Week 02**	**Week 03**	**Week 04**
Sesame oil coted eggs (T1)	65.99±0.69$^{a, x}$	57.89±0.15$^{abc, y}$	56.73±0.05$^{a, z}$	55.98±0.25$^{ab, y}$	50.13±0.15$^{abc, y}$
coconut oil coated eggs (T2)	65.17±0.15$^{a, x}$	56.73±0.05$^{a, z}$	55.48±0.25$^{ab, y}$	50.53±0.67$^{a, y}$	47.75±0.15$^{a, y}$
olive oil coated eggs (T3)	65.68±0.18$^{a, x}$	64.28±0.67$^{abc, y}$	62.13±0.12$^{ab, y}$	60.08±0.28$^{ab, y}$	59.13±0.15$^{ab, y}$
mustard oil coated eggs (T4)	65.96±0.25$^{a, x}$	55.86±0.84$^{a, y}$	52.86±0.84$^{a, y}$	50.06±0.25$^{a, z}$	45.36±0.25$^{a, z}$
uncoated eggs (T5)	65.13±0.15$^{a, x}$	49.76±0.75$^{abc, y}$	30.06±0.25$^{a, z}$	39.86±0.75$^{abc, y}$	22.86±0.75$^{abc, y}$

a, b Means with different superscripts in the same row are statistically different (P < 0. 05); $^{x–z}$ Means with different superscripts in the same column are statistically different (P < 0. 05); [1] Root mean square error = 0. 21; [2] Coating treatment × time interaction (P < 0. 0001) effect is significant

3.3. Yolk Index (YI)

Yolk Index can be defined as the spherical nature of egg yolk (18). Yolk Index is a measure of egg freshness. It specifies a liquefaction of the yolk and deterioration of the vitelline membranes. In the present study, The YI of the uncoated eggs stored at ambient condition was significantly lower than all others after the first week of storage. T3 maintained a significantly higher Yolk Index (%) followed by T1, T2and T4 during the storage time at 32 °C. It might be due to the diffusion of water from albumen to yolk and increasing yolk width during long-term storage Coatings seem to be effective to diminish the water and CO2 loss from the albumen through the eggshell. Further it was reported that the combination of coating and refrigeration can preserve the yolk quality for as long as 9 weeks (4).

Table 3 Mean values of Yolk Index (YI) and grades* of coated and uncoated eggs during the storage time at 32 °C

	Week 00	Week 01	Week 02	Week 03	Week 04
Sesme oil coted eggs (T1)	49. 756%	41. 788%	28. 897%	27. 654%	26. 697%
coconut oil coated eggs (T2)	49. 856%	40. 654%	29. 786%	28. 781%	27. 879%
olive oil coated eggs (T3)	49. 955%	39. 457%	31. 873%	29. 908%	28. 977%
mustard oil coated eggs (T4)	49. 456%	40. 870%	32. 997%	29. 987%	25. 554%
uncoated eggs (T5)	49. 556%	40. 565%	22. 871%	19. 921%	10. 156%

a, b Means with different superscripts in the same row are statistically different (P < 0. 05); x–z Means with different superscripts in the same column are statistically different (P < 0. 05); 1 Root mean square error = 0. 21; 2 Coating treatment × time interaction (P < 0. 0001) effect is significant

3.4. Yolk pH

The loss of albumen and yolk quality can be influenced by the capacity of the coating to block the pores on the surface of the shell. In the present study results showed that the yolk pH varied (P < 0. 001) throughout the storage period (Table 4). After 4 week of storage, the pH of the yolk in coated eggs was lower than the control and the yolk pH of the uncoated eggs increased from 6. 01 to 6. 99., The lowest yolk pH was recorded in T3 followed by T1, T2and T4. The maximum yolk pH was recorded in T5 (Table 4). It might be due to the decrease in the rate of CO2 escape from the coated egg. Further it was found that a maximum increase in yolk pH in rice protein and essential oil coating eggs from 6. 0 to 6. 27(2) .the pH of the albumen increases during storage due to CO2 loss and migration of water from the albumen into the yolk during storage might be the reason for variation in pH of egg yolk(2) .

Table 4 Mean values of Yolk pH of coated and uncoated eggs during the storage time at 32 °C

	Week 00	Week 01	Week 02	Week 03	Week 04
Sesme oil coted eggs (T1)	$6.01^{ab, y}$	$6.44^{a, z}$	$6.55^{abc, y}$	$6.67^{a, z}$	$6.80^{abc, y}$
coconut oil coated eggs (T2)	$6.01^{ab, y}$	$6.28^{ab, y}$	$6.35^{abc, y}$	$6.47^{a, z}$	$6.65^{abc, y}$
olive oil coated eggs (T3)	$6.01^{a, y}$	$6.11^{abc, y}$	$6.25^{abc, y}$	$6.35^{abc, y}$	$6.47^{a, z}$
mustard oil coated eggs (T4)	$6.01^{a, y}$	$6.59^{a, z}$	$6.69^{a, z}$	$6.75^{abc, y}$	$6.85^{abc, y}$
uncoated eggs (T5)	$6.01^{a, y}$	$6.61^{a, z}$	$6.69^{a, z}$	$6.85^{abc, y}$	$6.99^{a, z}$

a, b Means with different superscripts in the same row are statistically different (P < 0. 05); x–z Means with different superscripts in the same column are statistically different (P < 0. 05); 1 Root mean square error = 0. 21; 2 Coating treatment × time interaction (P < 0. 0001) effect is significant

3.5. Albumen pH

The albumen pH of a newly laid egg is about 7. 6-8. 0 and the dissociation of carbonic acid (H2CO3), forming water and carbon dioxide are the reason for increase in albumin pH (6). The albumen pH increases with the storage period of the egg and can reach above 9. 5 with time since moisture and carbon dioxide in the albumen evaporate through the pores. In the present study, data showed that the albumen pH varied (P < 0. 001) throughout the storage period (Table 5). The initial albumen pH of the eggs was 7. 5 and this value increased to 9. 99 after four week in the uncoated eggs. With the time the albumen pH of all four treatments has increased. However, no significant difference observed in albumen pH between coated eggs during the storage time (p>0. 05). T3 maintained a lower albumen pH followed by T1, T2and T4 during the storage time at 32 °C. All the way through storage, CO2 escapes through the eggshell pores and a change in the bicarbonate buffer system. this might be the reason for high albumin ph observed in uncoated egg. It was revealed that different edible coatings materials were able to extend the shelf life of eggs in relation to albumen pH (5).

Table 5 Mean values of Albumen pH of coated and uncoated eggs during the storage time at 32 °C

	Week 00	Week 01	Week 02	Week 03	Week 04
Sesme oil coted eggs (T1)	$7.5^{a, xy}$	$7.67^{ab, z}$	$8.25^{ab, y}$	$8.79^{a, x}$	$9.26^{a, y}$
coconut oil coated eggs (T2)	$7.5^{a, xy}$	$7.60^{a, x}$	$8.06^{b, z}$	$8.76^{b, z}$	$9.17^{ab, y}$
olive oil coated eggs (T3)	$7.5^{a, xy}$	$7.01^{b, z}$	$8.02^{a, y}$	$8.64^{ab, y}$	$9.05^{ab, z}$
mustard oil coated eggs (T4)	$7.5^{a, xy}$	$7.71^{ab, z}$	$8.36^{a, y}$	$8.86^{b, z}$	$9.29^{ab, y}$
uncoated eggs (T5)	$7.5^{a, xy}$	$8.01^{ab, y}$	$8.86^{ab, y}$	$9.36^{ab, z}$	$9.99^{b, z}$

a, b Mens with different superscripts in the same row are statistically different (P < 0. 05); x–z Means with different superscripts in the same column are statistically different (P < 0. 05); 1 Root mean square error = 0. 21; 2 Coating treatment × time interaction (P < 0. 0001) effect is significant

Application of HmFE significantly (P<0. 05) influenced the dry weight of the leaves, stems and roots of cowpea. The maximum dry weight of leaves, stems androots were recorded in T3 (20%) followed by T2, T1 and the minimum in T4 (50%) and T5 (100%) (Table 5). Sutharsan et al. (2014) reported that an increase in leaf area leads to an increased dry matter accumulation of crops. HmFE contained several types of micro and macronutrients. This might affect to increase the dry weight of shoots. It was in agreement with Kazemi (2013) who reported that foliar application with micro elements such as Zn and Fe significantly influences dry weight of plants. Further, Asad and Rafique (2002) reported that application of micronutrients increased wheat dry matter content. Thus, there has been an ample supply of N to increase the dry matter content of Vigna unguiculata. These findings are in conformity with Dixit and Elamathi (2007). Phosphorus fertilizer enhanced root development of cowpea and also increased the dry matter at the harvest (Ali et al., 2010). Root growth could be influenced by gibberellins activity induced.

3.6. Air cell depth

In the present study, regardless of the treatment; all the four treatments showed an increase of the air cell with the time. T5 showed a significant increase (p0. 05) of air cell depth. The air cell depth values of all coated eggs in the 4th week were less than the value of T5 in 2nd week.

As the egg ages, the egg air cell size increases due to the loss of carbon dioxide and moisture through the shell pores(3) and due to physiochemical changes in the albumen and yolk (12). It was revealed that uncoated eggs showed high air cell depth with time during storage (16).

4. Conclusion

Results revealed that the effectiveness of edible oil coats (Sesme oil coted eggs (T1), coconut oil coated eggs (T2), olive oil coated eggs (T3), mustard oil coated eggs (T4)) for maintaining the quality of eggs during storage in several indices namely weight loss (%), Haugh unit, Yolk Index, albumen pH and air cell depth at 32 °C. Further results proved that, olive oil coated eggs significantly maintained a lower Weight loss (%), lower albumen pH, lowest yolk pH and maintained a higher Yolk Index (%), highest Haugh Unit during the storage time at 32 °C than other treatments. Therefore, it could be concluded that olive oil edible coating is most suitable to preserve eggs and extending the shelf life of eggs in in Sri Lanka.

Compliance with ethical standards

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References

[1] Almeida D, Schneider A, Yuri F, Machado B, Gewehr C. Egg shell treatment methods effect on commercial eggs quality. Ciencia Rural. 2016; 46 (2): 336-341.

[2] Biladeau A, K Keener. The effects of edible coatings on chicken egg quality under refrigerated storage. Poult. Sci. 2009; 88: 1266–1274.

[3] Bradley FA, King AJ. Egg basics for the consumer: packaging, storage, and nutritional information. ANR Publication 8154, University of California. 2004.

[4] Caner C. The effect of edible egg shell coatings on egg quality and consumer perception. Journal of Science and Food Agriculture. 2005; 85: 1897–1902.

[5] Caner C, M Yüceer. Efficacy of various protein-based coating on enhancing the shelf life of fresh eggs during storage. Poult. Sci. 2015; 94: 1665–1677.

[6] Figueiredo T, R Viegas, L Lara, N Baiao, M Souza, L Heneine, S Cancado. Bioactive amines and internal quality of commercial eggs. Poult. Sci. 2013; 92: 1376–1384.

[7] Funk EM. The relation of the yolk index determined in natural position to the yolk index, as determined after separating the yolk from the albumen. Poultry Science. 1978; 27: 367.

[8] Haugh RR. The Haugh unit for measuring egg quality. US Egg Poult. Magazine. 1937; 43: 552–555.

[9] Mine Y. Resent advances in the understanding of albumin protein functionality. Trends in Food Science and Technology. 1995; 6: 225-232.

[10] Mudau MS. Functional properties of microwave pasteurised and oil coated whole shell eggs. Dissertation, University of Pretoria, South Africa. 2007.

[11] Nongtaodum S, A Jangchud, K Jangchud, P Dhamvithee, HK No, W Prinyawiwatkul. Oil coating affects internal quality and sensory acceptance of selected attributes of raw eggs during storage. J. Food Sci. 2013; 78: 329–335.

[12] Okiki P, Ahmed O. Preservation of quality of table eggs using vegetable oil and sheabutter. International Letters of Natural Sciences. 2017; 63: 27-33.

[13] Onyenweaku E, Ene-Obong H, Williams M, Nwaehujor C. Comparison of nutritional composition of bird egg varieties found in Southern Nigeria. Food and Nutrition Sciences. 2018; 9: 868-879.

[14] Perera TMC, Wickramasinghe HKJP. Effect of edible oil coating on physico-functional properties and shelf life of chicken eggs stored at room temperature. 2016.

[15] Scott T, FG Silversides. The effect of storage and strain of hen on egg quality. Poult. Sci. 2000; 79: 1725–1729.

[16] Senadheera TRL, Vidanarachchi JK, Hewajulige I, Himali SMS. Effect of cashew (*Anacardium occidentale* L.) gum and chitosan coating on physico-functional properties and shelf life of chicken eggs stored at room temperature. 2014.

[17] Shittu TA, Ogunjinmi A. Effect of low cost shell coasting and storage conditions on the raw and cooked qualities of shell egg. J. of Food Sci. 2011; 9: 1-7.

[18] Stadelman WJ. The Incredibly Functional Egg. Poultry Science. 1999; 78: 807- 811.

[19] Wickramasinghe HKJP, Vidanarachchi JK, Himali SMC, Fernando PS. Effect of different packaging materials on quality characteristics of chicken eggs stored at room temperature in Sri Lanka. 13th ASEAN Food Conference, Singapore. 2003; 9-11.