Seyrekoğlu, F. and Kılınç, G. International Journal of Science Letters (IJSL). 2022. 4(2): 312-320
https://doi.org/10.38058/ijsl.1153229

Research Article

Evaluation of weight loss and some sensory properties in quail eggs coated using different solutions (molasses, molasses + agar, molasses + glycerine, whey)

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Abstract

This study was carried out to determine the effects of different coating materials on weight loss (%) and sensory properties of daily (fresh) quail eggs. For this purpose, quail eggs were coated with molasses, molasses + agar, molasses + glycerine and whey and they were stored at room temperature. No coating material was used in the control group. It was determined that there was a very significant difference between the groups in terms of egg weight loss at all storage times (1st week, 2nd week, 3rd week, 4th week) ($p<0.001$). It was revealed that egg weight loss was lower in all treatment groups compared to the control group. The lowest egg weight loss was observed in the molasses+glycerine group in the 1st, 2nd and 3rd weeks ($p<0.001$), and in the molasses+agar and molasses+glycerine groups at the 4th week ($p<0.001$). When the opinions of the panelists were evaluated, it was determined that the coated eggs were better than the uncoated eggs in terms of appearance, colour and surface smoothness ($p<0.05$). In terms of brightness, control and whey groups were similar, while the other groups had higher scores ($p<0.001$). The opinions of the panelists in terms of adhesiveness, smell and general taste were found to be statistically insignificant ($p>0.05$). When the purchasing attitudes of the panelists were examined, it was determined that the majority (62.5%) preferred molasses + glycerine coated eggs. As a result, it is thought that quail eggs can be coated with molasses, molasses+agar, molasses+glycerin and whey in order to prevent the economic loss caused by the increasing weight loss in parallel with the increase in storage time. Moreover, the fact that the consumption preference is not adversely affected and that some sensory properties are better in coated eggs reveals that quail eggs can be successfully coated with the coating solutions used.

Article History

Received 02.08.2022
Accepted 13.08.2022

Keywords

Coating,
Egg weight loss,
Molasses,
Quail egg,
Sensory properties,
Whey

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1. Introduction

A newly laid egg has a sticky layer called the cuticle on its shell (Yüceer, 2013). It is known that this layer, which surrounds the egg, protects the egg from external factors (Wardy et al., 2010) by closing the pores in the egg shell, limits the output of moisture and carbon dioxide (Yüceer, 2013). Therefore, it is important in maintaining egg quality. However, over time, this layer loses its feature (Cansız, 2006). In this case, in parallel with the increase in storage time, carbon dioxide and moisture loss from the pores in the shell occur and weight losses increase. Different coating methods are used to reduce weight loss and maintain egg quality.

There are studies on different coating materials such as beeswax (Mudannayaka et al., 2016; Mudannayaka et al., 2019; Rachtanapun et al., 2021); paraffin (Rachtanapun et al., 2021); chitosan (Ezazi et al., 2021; Caner et al., 2022); propolis (Ezazi et al., 2021; Güler et al., 2022); glycerine (Drabik et al., 2018; Pires et al., 2021); whey protein isolate (Caner and Yüceer 2015), whey protein concentrate (Caner and Yüceer 2015; Pires et al., 2021) in order to increase the quality and shelf life of eggs.

This study was carried out to evaluate some sensory properties (appearance, color, surface smothness, brightness, adhesiveness, smell, general taste, and purchase status of the product) and weight loss (%) of quail eggs coated using different coating solutions.

2. Materials and Methods

2.1. Providing Coating Materials

Molasses, whey, agar and glycerine were used in the preparation of coating solutions in this study. Molasses, a by-product of sugar beet, was obtained from Amasya Sugar Factory. Whey, on the other hand, was supplied as a concentrate from a private Milk and Food Products Industry and Trade Inc. Molasses, which were used as coating material, contains approximately 50% sugar. Moreover, the glycerine used was 87% pure and the Brix value of the whey was 30%.

2.2. Providing Quail Eggs

In this study, Japanese quail (*Coturnix coturnix japonica*) eggs were obtained daily (fresh) from a private quail farm. Eggs in homogenous shape and size were used in the study. Analysis of variance was performed in terms of egg weights and it was determined that there was no statistically significant difference between the groups.

2.3. Preparation of Coating Materials

In this study, a total of 5 groups were formed as control, molasses, molasses+agar, molasses+glycerine and whey. The molasses was diluted to 60% molasses+40% distilled water, while the whey was used as a direct concentrate without dilution. Eggs in the molasses group were coated with diluted molasses (60% molasses+40% distilled water). Eggs in the Molasses+agar group were covered with a solution prepared by adding agar into diluted molasses. Agar was prepared at 1% concentration before mixing with diluted molasses. In order to prevent agglomeration that may occur while dissolving agar in pure water, it was slowly added to the pure water and stirred at 1000 rpm in a magnetic heater mixer to form a solution. Eggs in the molasses+glycerine group were coated with a solution prepared by adding glycerine to the diluted molasses. Furthermore, glycerine was prepared with distilled water at a 3% concentration before mixing with diluted molasses. In the study, agar and glycerine were used as thickeners for better adhesion of the coating material to the shell.

2.4. Coating and Storage of Quail Eggs

In the study, a total of 150 quail eggs, 30 for each group, were used. Eggs were coated with different prepared solutions using the immersion method. Then, the eggs were turned several times to drain the solution remaining on the egg shells and left to dry. It was observed that a film layer formed on the surface of the coated eggs as desired. No coating process was performed in the control group.

Eggs were stored at room temperature for a total of 4 weeks. The temperature and humidity levels of the storage environment were routinely checked and recorded.

2.5. Determination of Egg Weight Loss

In the present study, weight loss was determined according to four different storage periods (1st week, 2nd week, 3rd week, 4th week). Egg weights were determined periodically using a precision scale with a sensitivity of 0.001 g, and the weight loss was calculated as % with the help of the formula below (Bhale et al., 2003).

Egg Weight loss (%) =

[(Starting egg weight) -(Last egg weight)]/ [Starting egg weight] x 100

2.6. Evaluation of Sensory Properties

In order to evaluate the sensory properties of coated and uncoated eggs, randomly selected eggs were submitted to the opinion of 16 people selected among Amasya University Suluova Vocational School Academic Staff. The panellists evaluated the eggs according to different criteria such as appearance, colour, surface smoothness, brightness, adhesiveness, smell, general taste and attitudes towards purchasing the product in the forms given to them. (According to the hedonic scale, 1: Extremely bad, 2: Very bad, 3: Bad, 4: Below average, above bad, 5: Fair, 6: Below good, above average, 7: Good, 8: Very good, 9: Excellent)

2.7. Statistical Analysis

Analysis of variance of the data obtained from the research was done with one-way ANOVA. Moreover, Duncan's test was used to compare the groups. SPSS (Statistical Package for Social Sciences) 22.0 package program was used for these statistical evaluations (IBM Corp., 2011).

3. Results and Discussion

In this study, weight loss (%) and some sensory properties (appearance, color, surface smoothness, brightness, adhesiveness, smell, general taste, panelists' attitude towards purchasing the product) of quail eggs coated with different solutions (molasses, molasses+agar, molasses+glycerine, whey) were evaluated.

3.1. Evaluation of Weight Loss in Stored Eggs

Weekly weight losses (1st week, 2nd week, 3rd week, 4th week) and general weight losses in quail eggs coated with different solutions are given (Table 1).

It was determined that the coating materials used in quail eggs significantly affected egg weight loss in all weeks ($p<0.001$).

When the egg weight loss after one week of storage was evaluated, it was determined that all the coated groups had lower weight loss than the uncoated (control) group. During this storage period, the lowest egg weight loss was in the molasses+glycerine group ($p<0.001$).

When the weight loss after two weeks of storage was examined, it was determined that the egg weight loss in all the coated groups was lower than the control group ($p<0.001$). Molasses+glycerine was the group with the lowest egg weight loss in two weeks of storage ($p<0.001$).

In the third and fourth weeks of storage, egg weight losses were lower in all coated groups compared to the uncoated control group ($p<0.001$). The group with the lowest egg weight loss in the third week was again molasses + glycerine ($p<0.001$). The groups with the lowest egg weight loss in the fourth week were molasses+agar and molasses+glycerine ($p<0.001$).

Table 1. Effect of coating materials on egg weight loss (%)

Coating	Storage Time (Week)				
	1	2	3	4	1-4*
Control	1.787^{a}	4.221^{a}	6.186^{a}	8.404^{a}	5.149^{a}
Molasses	1.447^{b}	3.175^{b}	4.464^{b}	5.773^{b}	3.714^{b}
Molasses + Agar	1.158^{bc}	2.820^{bc}	3.757^{bc}	4.684^{c}	3.105^{cd}
Molasses + Glycerine	0.961^{c}	2.279^{c}	3.120^{c}	4.544^{c}	2.726^{d}
Whey	1.403^{b}	3.135^{b}	4.305^{b}	5.571^{bc}	3.604^{bc}
SE	0.058	0.111	0.145	0.197	0.095
P	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

a, b, c, d: The averages with different superscripts in the same column differ significantly ($p<0.05$).
SE: Standard Error. *Overall weight loss

According to the previous studies, no study was found that investigated the effects of molasses on egg coating. In this study, it is thought that molasses reduced weight loss because it fills the pores of egg shells like other coating materials.

Most protein-based edible films have been reported to have excellent oxygen barrier properties (Dangaran et al., 2009; Jooyandeh, 2011). Pires et al. (2021) investigated the effects of egg coating on egg internal quality and shelf life with coating solutions prepared with egg whey protein concentrate together with glycerol, sorbitol, and propylene glycol. This study (Pires et al., 2021), which stated that uncoated eggs had higher egg weight losses than the others, is consistent with the results of our study. In another study, Caner and Yüceer (2015), in their study investigating the effects of coating eggs with whey protein isolate and whey protein concentrate on egg quality and egg shelf life, reported that weight loss was higher in uncoated eggs. The results of the current study overlap with the study of Caner and Yüceer (2015). The results of our study are also consistent with other studies investigating the effects of egg coating on egg weight loss with protein-based edible films such as whey protein isolate and whey protein concentrate (Alleoni and Antunes, 2004; Caner, 2005; Davalos-Saucedo et al., 2018; Soares et al., 2021).

Glycerine has plasticizing properties (Eser and Doğruer, 2022). In the present study, glycerine was used together with molasses as a plasticizer.

Drabik et al (2018), in their study investigating the effects of egg coating with glycerine solution on egg quality, emphasized that glycerin reduced egg weight loss and as a result, glycerine can be used in egg storage due to its safe, cheap and easy application.

3.2. Evaluation of Sensory Properties

It is seen that the scores given by the panelists to sensory properties in quail eggs are numerically average of minimum 4,250 (control group; adhesiveness) and average maximum of 8,250 (molasses+glycerine group; brightness) (Table 2).

Table 2. Effect of coating materials on sensory properties

Sensorial Properties	Coating						
	Control	Molasses	Molasses + Agar	Molasses + Glycerine	Whey	SE	P
Appearance	5.500^{c}	6.938^{ab}	7.125^{ab}	7.813^{a}	6.188^{bc}	0.209	**0.004**
Shell Colour	5.563^{b}	7.188^{a}	6.875^{a}	7.500^{a}	6.688^{ab}	0.201	**0.024**
Smoothness	5.250^{b}	6.625^{a}	6.688^{a}	7.375^{a}	6.875^{a}	0.183	**0.003**
Brightness	4.938^{b}	7.375^{a}	7.688^{a}	8.250^{a}	5.875^{b}	0.228	**0.000**
Adhesiveness	4.250	5.875	6.063	5.625	5.063	0.304	0.329
Smell	5.313	5.875	5.813	6.319	6.063	0.185	0.536
Acceptability	5.500	7.063	6.938	7.063	6.375	0.218	0.106

a, b, c: The averages with different superscripts in the same row differ significantly ($p<0.05$).
SE: Standard Error. Maximum: 9 points (excellent), Minimum: 1 point (extremely bad)

While the effects of coating quail eggs with molasses, molasses+agar, molasses+glycerin and whey on appearance ($p<0.05$), color ($p<0.05$), surface smoothness ($p<0.05$) and brightness ($p<0.001$) were significant, the effects on adhesiveness and smell were found to be insignificant ($p>0.05$). Besides, it was determined that there was no significant difference between the groups in terms of general taste ($p>0.05$).

According to the panelists' opinions, it was determined that the egg with the best appearance among the coated and uncoated quail eggs was molasses + glycerine. The groups that had the highest scores in terms of color and brightness were molasses, molasses+agar and molasses+glycerine coated groups. The groups that received the lowest score from the panelists in terms of surface smoothness were the control group.

When the attitudes of the panelists to buy coated eggs were examined, it was seen that the product that 10 out of 16 people (62.5%) marked as "I would definitely buy" was molasses + glycerine coated eggs (Table 3).

Table 3. Attitudes of the Panelists (Consumers) to purchase the product

Coating	Approach to Product					
	1*		2**		3***	
	N	%	N	%	N	%
Control	4	25.00	10	62.50	2	12.50
Molasses	9	56.25	6	37.50	1	6.25
Molasses + Agar	9	56.25	6	37.50	1	6.25
Molasses + Glycerine	10	62.50	4	25.00	2	12.50
Whey	7	43.75	7	43.75	2	12.50

* I would definitely buy, ** Maybe I would, *** I would definitely not buy

4. Conclusion

In parallel with the increase in the storage period, carbon dioxide and moisture loss occurs from the pores in the egg shell, and weight loss increases accordingly. Different coating methods and materials are being researched to reduce weight loss and maintain egg quality. Molasses, molasses+agar, molasses+glycerin and whey were used as coating material in this study. It was observed that the weight loss of quail eggs coated with these solutions decreased significantly during the 4-week storage period (1st week, 2nd week, 3rd week, 4th week). Considering the opinions of the panelists, the fact that consumption preferences are not adversely affected and that some important sensory properties are better in coated quail eggs supports the result of the study positively.

Therefore, it was determined that whey, which is a by-product of dairy products, and molasses, which is a by-product of sugar beet, can be used successfully as coating material. Besides, it was revealed that the use of molasses together with agar and glycerine gave better results in some parameters in the scope of the study compared to the use of molasses alone as a coating material.

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