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Evaluation of Some Parameters in Eggs Coated with Materials Prepared from Aloe Vera Gel and Chitosan

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Abstract
In this study, the effects of aloe vera gel and chitosan used as egg coating materials on egg weight loss, albumen pH, egg yolk color values (L*, a*, b*) and some microbiological properties (coliform bacteria and yeast-mold) were determined. Therefore, five different groups were formed with a total of 50 fresh (daily) and homogeneous eggs in terms of weight, one of which was control (C) and the other four (T-1, T-2, T-3, T-4) were experimental groups. No coating treatment was applied to eggs in group C. In the experimental groups, four different levels of chitosan (0.25, 0.5, 1 and 1.5 %) and aloe vera gel were used for coating by dipping method. All eggs were stored in egg viols for four weeks at room temperature. Egg weight loss was evaluated by weekly weighing. Albumen pH, egg yolk color values, coliform bacteria and yeast-mold counts were determined at the end of the experiment. There was no significant difference between the groups in terms of egg albumen pH and yolk color values ($P>0.05$). However, the effect of coating materials on weekly ($P<0.001$) and overall ($P<0.05$) weight loss of eggs was significant. Compared to group C, egg weight loss was lower in all experimental groups in all weeks ($P<0.001$). Moreover, although coliform bacteria were detected in the group without egg coating (group C), coliform bacteria were not detected in any of the experimental groups. The lowest yeast-mold count was in the T-4 group (2.657 log cfu g^{-1}). In conclusion, coating materials prepared from aloe vera gel and chitosan can be used effectively in preventing egg weight loss and improving some microbiological parameters.

Research Article

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1. Introduction

A thin layer called 'cuticle' is formed on the egg shell (Liu et al., 2016). It has been reported that this layer protects the egg from various factors by closing the pores on the egg shell (Wardy et al., 2010) and makes an important contribution to the preservation of egg quality by preventing the loss of some components (moisture, CO_2) in the egg (Yüceer, 2013). However, it is known that this layer formed during laying loses its effect over time (Cansız, 2006). Thus, it was stated that weight loss in eggs increases in parallel with the increase in storage time and some quality criteria such as Haugh unit, albumen index, yolk index, and albumen pH are negatively affected (Copur et al., 2008). To prevent all these, various preservation methods are used. Coating the eggs with different materials is one of these methods (Yüceer and Caner, 2014; Oliveira et al., 2020). Hence, there are many studies investigating different coating materials such as chitosan (Caner and Cansız, 2008; Wardy et al., 2011; Xu et al., 2018; Yang et al., 2019; Derelioğlu and Turgay, 2022; Ningrum et al., 2022), aloe vera gel (Mudannayaka et al., 2016; Mudannayaka et al., 2019), whey (Alleoni and Antunes, 2004; Caner, 2005; Ningrum et al., 2022), molasses (Seyrekoğlu and Kılınç, 2022), propolis (Şahinler et al., 2009), beeswax (Mudannayaka et al., 2016; Edirisinghe et al., 2017), pectin (Yuan et al., 2022), carnauba wax (Eyng et al., 2021), shellac (Musa et al., 2011) and various oils (Nongtaodum et al., 2013; Homsaard et al., 2021). Although there are studies (Adetunji et al., 2014; Gboyimde, 2019; Shah and Hashmi, 2020; Amin et al., 2021; Sree et al., 2022) in which aloe vera gel and chitosan were used in combination as coating materials in various fruits and vegetables, no study was observed in which they were used in combination in egg coating. The aim of this study was to determine the effects of coating materials prepared from aloe vera gel/chitosan on egg weight loss, albumen pH, egg yolk color values (L*, a*, b*) and some microbiological characteristics (coliform bacteria and yeast-mold) in eggs.

2. Material and Methods

2.1. Formation of groups

The chicken eggs used for this study were obtained daily (fresh) from hens fed with the same feed from Suluova Vocational School Poultry Experimental Unit. The homogeneity of the groups in terms of weight was tested by analysis of variance ($P>0.05$). In this study, a total of five groups were formed, one as control (C) and the other four (T-1, T-2, T-3 and T-4) as experimental groups (Table 1). A total of 50 eggs, 10 eggs in each group, were used.

Table 1. Groups and coating materials

Groups	Coating Materials	Chitosan Rate (%)
C	-	-
T-1	Aloe vera jel + Chitosan	0.25
T-2	Aloe vera jel + Chitosan	0.5
T-3	Aloe vera jel + Chitosan	1
T-4	Aloe vera jel + Chitosan	1.5

C: Control; T-1, T-2, T-3 and T-4 experimental groups

2.2. Preparation of coating materials

Firstly, four different ratios (0.25, 0.50, 1 and 1.5 %) of chitosan mixture were prepared with distilled water. To increase the solubility of chitosan, acetic acid was added at a concentration of 1% and stirred in a magnetic stirrer until the chitosan dissolved. These solutions were mixed with aloe vera gel in a 1:1 ratio and the preparation of the coating materials was completed.

2.3. Coating and storage of eggs

In the control group, no coating was applied. In the experimental groups, the eggs were coated with the prepared coating materials using the dipping method. The coated eggs were occasionally turned over to drain the excess solution. Then, all of the eggs were placed in viols and stored at room temperature for four weeks. The temperature and humidity level of the environment where the eggs were stored was controlled and recorded.

2.4. Determination of egg weight loss

At the beginning of the experiment and at the 1st, 2nd, 3rd and 4th weeks of the experiment, the eggs were weighed on a precision balance with a sensitivity of 0.001 g and their weights were recorded. From these values, weekly egg weight losses were determined as "%" by using the following formula (Bhale et al., 2003).

$$\text{Egg weight loss (\%)} = \frac{\text{Starting egg weight} - \text{Last egg weight}}{\text{Starting egg weight}} \text{ x } 100$$

2.5. Determination of egg albumen pH and yolk color values

After four weeks of storage, albumen pH and yolk color values (L*, a* and b*) were determined in seven eggs from each group. Albumen pH was measured using a pH meter and egg yolk color values were measured using a colorimeter.

2.6. Evaluation of some microbiological properties

Three eggs from each group were microbiologically analyzed for the presence of yeast-mold and coliform microorganisms. In microbiology analyses, each egg was kept in 50 ml ringer's solution for 2-3 minutes and then serial dilutions were prepared from this liquid. The inoculation was made on a medium containing Potato Dextrose Agar (PDA, Oxoid CM0139) for yeast-mold counting from appropriate dilutions. To determine the presence/absence of coliform bacteria, inoculations were made on Violet Red Bile Agar (VRBA, Oxoid CM 0107) by spread-plate method (Erkmen, 2007). After inoculation, the petri dishes were kept at 28 °C for 3-5 days in aerobic condition for yeast-mold counts and at 37 °C for 48 hours in anaerobic condition for coliform group counts. At the end of these incubation, colonies showing growth were evaluated. The results were given in log cfu g^{-1} (Halkman, 2005).

2.7. Statistical analysis

Analysis of the variance of the data was performed by one-way ANOVA. Duncan's Multiple Range Test test was used to compare the groups. SPSS (Statistical Package for the Social Sciences) 22.0 package program was used for these statistical evaluations (IBM Corp, 2011).

3. Results and Discussion

In this study, weight loss (%), albumen pH, egg yolk color values (L*, a* and b*) and some microbiological parameters (coliform bacteria and yeast-mold) were determined in eggs coated with materials prepared using aloe vera gel and chitosan.

3.1. Effect of aloe vera gel and chitosan on egg weight loss

The effects of aloe vera gel and chitosan used as a coating material on weekly (1st, 2nd, 3rd and 4th week) and overall (average of weeks) egg weight loss are given in Table 2. When Table 2 is examined, it is seen that there was a statistically significant difference ($P<0.001$) between the groups in terms of weekly (1st, 2nd, 3rd and 4th week) egg weight losses. Compared to group C, egg weight loss was lower in the experimental groups (T-1, T-2, T-3 and T-4) in all weeks.

The lowest egg weight loss during the weekly storage period (1^{st}, 2^{nd}, 3^{rd} and 4^{th} week) was determined to be in the group T-2 ($P<0.001$). When the overall egg weight

loss in the groups was evaluated, it was determined that egg weight loss was lower (P<0.05) in all groups compared to the control group. It is thought that the lower weight loss in the experimental groups is due to the fact that the coating materials prepared from aloe vera gel and chitosan limit moisture and CO_2 loss due to the closure of the pores in the egg shell. Musa et al. (2011) reported that edible films prevent moisture and CO_2 loss in eggs.

Table 2. Effect of coating materials on egg weight loss (%)

	Storage Times (Weeks)				
Groups	**1**	**2**	**3**	**4**	**1-4***
C	1.831^{a}	2.951^{a}	4.246^{a}	5.961^{a}	3.747^{a}
T-1	1.170^{bc}	2.050^{bc}	3.023^{bc}	4.347^{bc}	2.648^{b}
T-2	1.128^{c}	1.999^{c}	2.950^{c}	4.189^{c}	2.566^{b}
T-3	1.341^{bc}	2.377^{bc}	3.403^{bc}	4.827^{bc}	2.987^{b}
T-4	1.372^{b}	2.417^{b}	3.572^{b}	5.064^{b}	3.106^{b}
SEM	0.049	0.075	0.103	0.143	0.105
P	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**

a,b,c: Differences between means with different letters in the same column are significant (p<0.05).
C: Control; T-1 (Treatment-1): Aloe vera gel + 0.25% Chitosan; T-2 (Treatment-2): Aloe vera gel + 0.5% Chitosan; T-3 (Treatment-3): Aloe vera gel + 1% Chitosan; T-4 (Treatment-4): Aloe vera gel + 1.5% Chitosan; SEM: Standard error of mean

According to the literature review, no study was found in which aloe vera gel and chitosan were used together as egg coating materials. In many studies (Caner and Cansız, 2007; Kim et al., 2009; Torrico et al., 2011; Wardy et al., 2011; Yüceer and Caner, 2014; Caner et al., 2022; Derelioğlu and Turgay, 2022), chitosan has been reported to reduce weight loss in chicken/quail eggs. These results are in agreement with the present study. In another study, Mudannayaka et al. (2016) used beeswax, gelatin and aloe vera gel as egg coating materials. They reported that weight loss was lower in eggs coated with beeswax and gelatin.

3.2. Effect of aloe vera gel and chitosan on egg albumen pH and yolk color

The effects of aloe vera gel and chitosan on albumen pH and egg yolk color values (L*, a*, b*) are given in Table 3.

Table 3. Effect of coating materials on egg albumen pH and egg yolk color

Groups	Albumen pH	L*	a*	b*
C	10.29	54.70	20.20	55.15
T-1	10.31	54.96	20.72	58.71
T-2	10.26	55.53	20.06	59.13
T-3	10.37	54.00	19.53	54.71
T-4	10.33	56.05	21.42	61.01
SEM	0.014	0.274	0.384	0.827
P	0.098	0.153	0.618	0.060

C: Control; T-1 (Treatment-1): Aloe vera gel + 0.25% Chitosan; T-2 (Treatment-2): Aloe vera gel + 0.5% Chitosan; T-3 (Treatment-3): Aloe vera gel + 1% Chitosan; T-4 (Treatment-4): Aloe vera gel + 1.5% Chitosan; L*: Lightness; a*: Redness; b*: Yellowness; SEM: Standard error of mean

The effect of the coating materials used in this study on egg albumen pH and yolk color was statistically insignificant (P>0.05). Although not statistically significant, the lowest numerically albumen pH was determined in the T-2 group (P>0.05). In some studies (Caner and Cansız, 2008; Yüceer and Caner, 2014), it has been reported that albumen pH was lower in eggs coated with chitosan compared to the control group. In a study by Mudannayaka et al. (2016), it was determined that the pH of albumen in eggs coated with aloe vera gel was similar to the

control group. The result of the present study coincides with the result of this study. Besides, our results are in parallel with the study by Caner and Cansız (2008) who reported that chitosan used as egg coating material did not affect egg yolk color values (L*, a*, b*).

3.3. Effect of aloe vera gel and chitosan on some microbiological parameters

The mean values of yeast-mold count (log cfu g^{-1}) and coliform bacteria present/absent of aloe vera gel and chitosan used as coating material are given in Table 4.

Table 4. Effect of coating materials on some microbiological parameters in eggs

Groups	Coliform Bacteria (+/-)	Yeast-Mold (log cfu g^{-1})
C	+	3.435
T-1	-	2.958
T-2	-	2.743
T-3	-	2.674
T-4	-	2.657

C: Control; T-1 (Treatment-1): Aloe vera gel + 0.25% Chitosan; T-2 (Treatment-2): Aloe vera gel + 0.5% Chitosan; T-3 (Treatment-3): Aloe vera gel + 1% Chitosan; T-4 (Treatment-4): Aloe vera gel + 1.5% Chitosan; +/-: Present or Absent

Although coliform bacteria were detected in the uncoated group (group C), coliform bacteria were not detected in any of the experimental groups. Besides, the lowest yeast-mold count was in the group T-4 (2.657 log cfu g^{-1}). In the present study, coliform bacteria were not detected in eggs coated with chitosan and aloe vera gel and the low yeast-mold count is thought to be due to the antimicrobial properties of chitosan. Many studies have reported that chitosan is a potential preservative due to its antimicrobial activity (Dutta et al., 2009; Leleu et al., 2011; Hosseinnejad and Jafari, 2016). Yüceer and Caner (2013) reported that the difference in total aerobic mesophilic bacteria, *Enterobactericeae*, *Staphylococcus aureus* and mold-yeast counts in lysozyme-chitosan-based egg coating material group was statistically significant.

4. Conclusions

With the increase in storage time, quality losses occur in eggs. Moreover, microbiological deterioration occurs over time. One of the methods investigated to prevent these is the coating of eggs with different materials. In the present study, the effects of coating materials prepared from aloe vera gel and chitosan on egg weight loss, albumen pH, egg yolk color values (L*, a*, b*) and some microbiological properties (coliform bacteria and yeast-mold) were evaluated. It was determined that the coating materials had no significant effect on egg albumen pH and yolk color values, but reduced egg weight loss during storage. Moreover, coliform bacteria were detected in the group without egg coating (group C) but not detected in any of the experimental groups. Yeast-mold counts were numerically lower in the coating groups. In summary, it was determined that the coating materials used in the study made a significant contribution to the prevention of egg weight loss and the improvement of some microbiological parameters. As a result, it is thought that aloe vera gel and chitosan can be used effectively as coating materials to close the pores on the egg shell.

Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

References

Adetunji, C.O., Fadiji, A.E., Aboyeji, O.O., 2014. Effect of chitosan coating combined Aloe vera gel on cucumber (*Cucumis Sativa* L.) post-harvest quality during ambient storage. *Journal of Emerging Trends in Engineering and Applied Sciences*, 5(6): 391-397.

Alleoni, A.C.C., Antunes, A.J., 2004. Albumen foam stability and s-ovalbumin contents in eggs coated with whey protein concentrate. *Brazilian Journal of Poultry Science*, 6: 105-110.

Amin, U., Khan, M.K.I., Khan, M.U., Ehtasham Akram, M., Pateiro, M., Lorenzo, J.M., Maan, A. A., 2021. Improvement of the performance of chitosan—aloe vera coatings by adding beeswax on postharvest quality of mango fruit. *Foods*, 10(10): 2240.

Bhale, S., No, H.K., Prinyawiwatkul, W., Farr, A.J., Nadarajah, K., Meyers, S.P., 2003. Chitosan coating improves shelf life of eggs. *Journal of Food Science*, 68(7): 2378-2383.

Caner, C., 2005. Whey protein isolate coating and concentration effects on egg shelf life. *Journal of the Science of Food and Agriculture*, 85(13): 2143-2148.

Caner, C., Cansız, O., 2007. Effectiveness of chitosan-based coating in improving shelf-life of eggs. *Journal of the Science of Food and Agriculture*, 87(2): 227-232.

Caner, C., Cansız, Ö., 2008. Chitosan coating minimises eggshell breakage and improves egg quality. *Journal of the Science of Food and Agriculture*, 88(1): 56-61.

Caner, C., Coşkun, B.M., Yüceer, M., 2022. Chitosan coatings and chitosan nanocomposite to enhance the storage stability of fresh eggs during storage. *Journal of Food Processing and Preservation*, 46(7): e16642.

Cansız, Ö., 2006. Farklı organik asitlerle üretilen kitosan kaplama materyalinin yumurta raf ömrü ve kabuk mukavemetini geliştirmede etkinliğinin araştırılması. Yüksek Lisans Tezi, Çanakkale Onsekiz Mart Üniversitesi Fen Bilimleri Enstitüsü, Çanakkale.

Copur, G., Camci, O., Sahinler, N., Gul, A., 2008. The effect of propolis egg shell coatings on interior egg quality. *Archiv fur Geflugelkunde*, 72(1): 35-40.

Derelioglu, E., Turgay, Ö., 2022. Effect of chitosan coatings on quality and shelf-life of chicken and quail eggs. *African Journal of Food Science*, 16(3): 63-70.

Dutta, P.K., Tripathi, S., Mehrotra, G.K., Dutta, J., 2009. Perspectives for chitosan based antimicrobial films in food applications. *Food Chemistry*, 114(4): 1173-1182.

Edirisinghe, E.D.M.T., Jayasinghe, J.M.P., Himali, S.M.C., Abeyrathne, E.D.N.S., 2017. Effect of beeswax and gammalu (*Pterocarpus marsupium*) latex coating on internal and sensory attributes of chicken eggs stored at room temperature. *International Journal of Research in Agricultural Sciences*, 4: 76-81.

Erkmen, O., 2007. Basic Methods for the Microbilogical Analysis of Foods (1st Press). Nobel Publishing, Ankara.

Eyng, C., Nunes, K.C., Matumoto-Pintro, P.T., Vital, A.C.P., Garcia, R.G., Sanches, L.M., Junior, N.R., Tenorio, K.I., 2021. Carnauba wax coating preserves the internal quality of commercial eggs during storage. *Semina: Ciencias Agrarias*, 42(3): 1229-1244.

Gboyimde, P.M., 2019. Synergistic effects of chitosan and aloe vera gel coatings on tomato, orange and cucumber. PhD Thesis, Kwara State University, Nigeria.

Halkman, K., 2005. Gıda Mikrobiyolojisi Uygulamaları (1. Baskı). Başak Matbaacılık, Ankara.

Homsaard, N., Kodsangma, A., Jantrawut, P., Rachtanapun, P., Leksawasdi, N., Phimolsiripol, Y., Seesuriyachan, P., Chaiyaso, T., Sommano, S.R., Rohindra, D., Jantanasakulwong, K., 2021. Efficacy of cassava starch blending with

gelling agents and palm oil coating in improving egg shelf life. *International Journal of Food Science & Technology*, 56(8): 3655-3661.

Hosseinnejad, M., Jafari, S.M., 2016. Evaluation of different factors affecting antimicrobial properties of chitosan. *International Journal of Biological Macromolecules*, 85: 467-475.

IBM Corp, 2011. IBM SPSS Statistics for Windows, Version 20.0. IBM Corporation, Armonk.

Kim, S.H., Youn, D.K., No, H.K., Choi, S.W., Prinyawiwatkul, W., 2009. Effects of chitosan coating and storage position on quality and shelf life of eggs. *International Journal of Food Science & Technology*, 44(7): 1351-1359.

Leleu, S., Herman, L., Heyndrickx, M., De Reu, K., Michiels, C.W., De Baerdemaeker, J., Messens, W., 2011. Effects on Salmonella shell contamination and trans-shell penetration of coating hens' eggs with chitosan. *International Journal of Food Microbiology*, 145(1): 43-48.

Liu, Y.C., Chen, T.H., Wu, Y.C., Lee, Y.C., Tan, F.J., 2016. Effects of egg washing and storage temperature on the quality of eggshell cuticle and eggs. *Food Chemistry*, 211: 687-693.

Mudannayaka, A.I., Rajapaksha, D.S.W., Kodithuwakku, K.A.H.T., 2016. Effect of beeswax, gelatin and aloe vera gel coatings on physical properties and shelf life of chicken eggs stored at 30 ºC. Journal of World's Poultry Research, 6(1): 6-13.

Mudannayaka, A., Rajapaksha, D.S.W., Kodithuwakku, K.A.H.T., 2019. Effect of beeswax, gelatin and aloe vera gel coatings on functional properties and visual sensory attributes of chicken eggs stored under room temperature. *International Journal of Scientific and Research Publications*, 9(12): 96107.

Musa, T.N., Ulaiwi, W.S., Al-Hajo, N.N., 2011. The effect of shellac as coating material on the internal quality of chicken eggs. *International Journal of Poultry Science*, 10(1): 38-41.

Ningrum, A.S.H., Thohari, I., Al Awwaly, K.U., Apriliyani, M.W., 2022. The effect of using edible coating whey protein isolate and chitosan with the addition of 0.1% sodium tripolyphosphate on the quality of chicken egg. *International Research Journal of Advanced Engineering and Science*, 7(4): 201-205.

Nongtaodum, S., Jangchud, A., Jangchud, K., Dhamvithee, P., No, H.K., Prinyawiwatkul, W., 2013. Oil coating affects internal quality and sensory acceptance of selected attributes of raw eggs during storage. *Journal of Food Science*, 78(2): 329-335.

Oliveira, G.D.S., Dos Santos, V.M., Rodrigues, J.C., Santana, Â.P., 2020. Conservation of the internal quality of eggs using a biodegradable coating. *Poultry Science*, 99(12): 7207-7213.

Seyrekoğlu, F., Kılınç, G., 2022. Evaluation of weight loss and some sensory properties in quail eggs coated using different solutions (molasses, molasses+ agar, molasses+ glycerine, whey). *International Journal of Science Letters*, 4(2): 312-320.

Shah, S., Hashmi, M.S., 2020. Chitosan–aloe vera gel coating delays postharvest decay of mango fruit. *Horticulture, Environment and Biotechnology*, 61: 279-289.

Sree, K.P., Sree, M.S., Supriya, P., Samreen, Swamy, R., 2022. Effect of aloe vera gel coating combined with chitosan on postharvest quality of tomato during ambient storage. *The Pharma Innovation Journal*, 11(1): 260-265.

Şahinler, N., Guel, A., Copur, G., 2009. Chemical composition and preservative effect of Turkish propolis on egg quality during storage. Asian Journal of Chemistry, 21: 1877-1886.

Torrico, D.D., No, H.K., Sriwattana, S., Ingram, D., Prinyawiwatkul, W., 2011. Effects of initial albumen quality and mineral oil–chitosan emulsion coating on internal quality and shelf-life of eggs during room temperature storage. *International Journal of Food Science & Technology*, 46(9): 1783-1792.

Wardy, W., Torrico, D.D., No, H.K., Prinyawiwatkul, W., Saalia, F.K., 2010. Edible coating affects physico-functional properties and shelf life of chicken eggs during refrigerated and room temperature storage. International Journal of Food Science & Technology, 45(12): 2659-2668.

Wardy, W., Torrico, D.D., Jirangrat, W., No, H.K., Saalia, F.K., Prinyawiwatkul, W., 2011. Chitosan-soybean oil emulsion coating affects physico-functional and sensory quality of eggs during storage. *LWT-Food Science and Technology*, 44(10): 2349-2355.

Xu, D., Wang, J., Ren, D., Wu, X., 2018. Effects of chitosan coating structure and changes during storage on their egg preservation performance. *Coatings*, 8(9): 317.

Yang, K., Dang, H., Liu, L., Hu, X., Li, X., Ma, Z., Wang, X., Ren, T., 2019. Effect of syringic acid incorporation on the physical, mechanical, structural and antibacterial properties of chitosan film for quail eggs preservation. *International Journal of Biological Macromolecules*, 141: 876-884.

Yuan, X., Li, Y., Mo, Q., Zhang, B., Shu, D., Sun, L., Yang, H., Xie, X., Liu, Y., Zang, Y., 2022. A combined approach using slightly acidic electrolyzed water spraying and chitosan and pectin coating on the quality of the egg cuticle, prevention of bacterial invasion, and extension of shelf life of eggs during storage. *Food Chemistry*, 389: 133129.

Yüceer, M., 2013. Yumurtanın aktif ambalajlama ve yeni muhafaza yöntemleri ile raf ömrünün arttırılması. Yüksek Lisans Tezi, Çanakkale Onsekiz Mart Üniversitesi Fen Bilimleri Enstitüsü, Çanakkale.

Yüceer, M., Caner, C., 2013. Lisozim-kitosan bazlı antimikrobiyal kaplama uygulamasının taze yumurtanın mikrobiyolojik kalitesi üzerine etkisi. *Akademik Gıda*, 11(1): 40-45.

Yüceer, M., Caner, C., 2014. Antimicrobial lysozyme–chitosan coatings affect functional properties and shelf life of chicken eggs during storage. *Journal of the Science of Food and Agriculture*, 94(1): 153-162.

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