The Effect of Eggshell Dipping with Various Types of Oils and Storage Duration on The Weight Loss and Shell Thickness of Table Eggs

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Abstract. Preserving eggs is very important to retain egg quality and increase shelf life, egg preservation is crucial. Eggs may be preserved by immersing them in several kinds of vegetable oil. The purpose of this research is to investigate the effects of dipping eggs in various types of oil and the duration of preservation on the shell thickness and weight loss of table eggs. The research material includes 45 chicken eggs, pure coconut oil, palm oil, maize (corn) oil, a screw micrometer, and a scale. The method utilized was experimental, employing factorials with a completely randomized design in a 3x5 factorial pattern and three (3) replications. Treatment A consists of oil types (A1 is pure coconut oil, A2 is palm oil, and A3 is maize (corn) oil), and treatment B: the storage duration of eggs at room temperature (including: 25 days for B1, 30 days for B2, 35 days for B3, 40 days for B4, and 45 days for B5). The variables that were noticed were the egg weight loss and shell thickness. Data were analyzed using analysis of variance and further analyzed using the Duncan Multiple Range Test (DMRT), utilizing SPSS version 16.0. The results suggest that the interaction between the kind of oil and storage length didn't have significant consequences ($P>0.05$) egg weight loss and shell thickness. The type of oil significantly affects ($P<0.05$) shell thickness. The storage duration at room temperature significantly affects ($P<0.05$) on the egg weight loss and shell thickness. In conclusion, the best treatment for dipping eggs is using pure coconut oil and storing them at room temperature for up to 40 days.

1 Introduction

Eggs are the primary products of poultry that have not undergone fortification and are utilized as animal food for humans. Eggs are known as an affordable, readily available animal food that is highly nutritious, thus supporting human health [1, 2]. As a source of animal food, eggs have a nutrient composition that is beneficial for human cell growth, making them recommended for daily consumption. Essential lipids, proteins, vitamins (B1, B2, B12,

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niacin, biotin, choline, pantothenic acid, A, E, K, and D), bioactive substances, and minerals (Se, I, Zn, Mn, and Fe) are among the nutrients found in consuming eggs [3, 4].

78 kcal of energy, 6.29 g protein, 0.56 g carbohydrate, and 5.3 g total fat of which 1.6 g is saturated, 2.0 g is monounsaturated, 0.7 g is polyunsaturated, and 186 mg is cholesterol are included in a medium-sized cooked egg (weighing 50 g). In terms of micronutrients, eggs are rich in zinc, potassium, sodium, calcium, iron, magnesium, phosphorus, potassium, and sodium as well as most vitamins (vitamin C excluded) including thiamin, riboflavin, niacin, B6, folate, B12, A, E, D, and K. Zinc, vitamin A, vitamin D, and vitamin E are among these nutrients. The strain, age, diet, and environmental factors all affect the nutritional makeup of chickens' eggs [4].

The complex nutrient content in eggs makes them susceptible to spoilage because various spoilage microorganisms utilize these nutrients to grow. Egg internal and shell quality can be influenced by a variety of circumstances. Haugh Units are said to be impacted by a wide range of factors, including storage conditions, hen age, bird strain, nutrition (dietary protein and amino acid content, such as lysine, methionine, feed enzymes, grain type/protein source), disease (IB), supplements (ascorbic acid, vitamin E), artificial ammonia exposure, induced moult, and medication [5]. The egg mass loss, egg white quality, and yolk color were all significantly impacted by the length of the storage period. [6]. Commercial eggs can only be stored at room temperature for a maximum of 14 days [7]. Therefore, there is a need for egg preservation processes to prevent egg spoilage.

Egg preservation can be carried out in various ways, such as coating with glass water, using a lime solution, and preserving with vegetable oil [8]. Eggs covered with roselle calyx ethanol extract, slaked lime solution, and 33.33% pure coconut oil can lower the amount of water evaporation and CO2 gas loss from the eggs over a 30-day storage period [7]. Cleaned, sanitized, and oil-coated chicken eggs show very minimal weight loss compared to eggs that are neither cleaned nor coated [9] . Vegetable oil is an alternate preservative that may be used to stop eggs from spoiling. Previous research has not found a comparison of three types of oil (coconut, palm and corn) on egg quality. Therefore, in the study, we compared the three types of vegetable oil (coconut, palm and maize (corn)) regarding the weight loss of egg and shell thickness with storage time. The purpose of this research is to investigate the effects of dipping eggs in various types of oil and the duration of preservation on the shell thickness and weight loss of table eggs.

2 Materials and Methods

This research was conducted in the Food Laboratory, Faculty of Animal Husbandry, University of Islam Malang.

2.1 Materials

The materials in 45 chicken eggs, pure coconut oil, palm oil, and maize (corn) oil were used in this study. A digital scale and a micrometer screw were employed by the apparatus.

2.2 Methods

This study used an experimental design using a completely randomized design (CRD) in a 3x5 factorial pattern and each sample was repeated three times. Factor A consists of 3 types of oil, pure coconut oil (A1), palm oil (A2), and maize (corn) oil (A3). Factor B was storage duration at room temperature (25-27°C), including: 25 days for B1, 30 days for B2, 35 days for B3, 40 days for B4, and 45 days for B5.

2.3 Research procedure

Egg dipping process
The egg dipping process involves immersing the egg in oil according to treatments A1, A2, and A3 for 5 seconds until the entire eggshell surface is coated with oil. Placing the eggs on an egg tray and storage at room temperature according to treatments B1, B2, B3, B4, and B5. Conducting parameter testing.
Testing Egg Weight Loss
Weighing the eggs on day 0 as the initial weight (a). Coating the eggs with oil according to the treatment. Storing the eggs at room temperature as per the treatment. Re-weighing as the final egg weight (b).

The formula for egg weight loss is: $\left(\frac{a-b}{a}\right)$x100%

Testing Shell Thickness
Measuring the shell at the top, middle, and blunt end using a micrometer screw gauge. The data results are expressed in millimeters (mm).

2.4 Research variables

The variables studied in this research are egg weight loss and shell thickness.

2.5 Data analysis

The data collected is examined using analysis of variance or (ANOVA). If there is an influence, it is followed by the Duncan test, utilizing SPSS version 16.0.

3 Results and discussion

The following Tables 1 and 2 display the research's data:

Table 1. The weight loss of egg (%) with dipping difference oil and storage duration

A (Type of oil)	B (Storage duration)					Average (A)
	B1 to (25 days)	B2 to (30 days)	B3 to (35 days)	B4 to (40 days)	B5 to (45 days)	
A1 (pure coconut oil)	0.54^{ns}	1.75^{ns}	1.13^{ns}	1.13^{ns}	1,77^{ns}	0.78^{ns}
A2 (palm oil)	0.55^{ns}	0.00^{ns}	1.63^{ns}	1.72^{ns}	2,19^{ns}	1.21^{ns}
A3 (corn oil)	0.51^{ns}	0.00^{ns}	0.00^{ns}	1.64^{ns}	1,74^{ns}	1.26^{ns}
Average B	0.53^{a}	0.58^{a}	0.92^{ab}	1.49^{ab}	1.89^{b}	

Note: ns: not significant (P>0.05), there is a substantial difference when various superscripts lowercase letters appear in the same row (P<0.05) between treatments B.

Table 2. The shell thickness (mm) of egg with dipping differences oil and storage duration

A (Type of oil)	B (Storage duration)					Average (A)
	B1 to (25 days)	B2 to (30 days)	B3 to (35 days)	B4 to (40 days)	B5 to (45 days)	

A1 (pure coconut oil)	0.34 ^{ns}	0.33^{ns}	0.34^{ns}	0.33^{ns}	0.33^{ns}	0.32^{a}
A2 (palm oil)	0.31 ^{ns}	0.32^{ns}	0.33^{ns}	0.33^{ns}	0.34^{ns}	0.33^{ab}
A3 (corn oil)	0.31^{ns}	0.32^{ns}	0.33^{ns}	0.33^{ns}	0.33^{ns}	0.33^{b}
Average B	0.32^{a}	0.33^{ab}	0.33^{b}	0.33^{b}	0.33^{b}	

Note: ns: not significant (P>0.05), a major difference is shown in the same column by various superscripts lowercase letters (P<0.05) between treatments A, distinct superscripts lowercase letters in the same row signify a significant difference (P<0.05) between treatments B.

3.1 Weight loss

The analysis of variance or (ANOVA) results showed that there was not any interaction. (P>0.05) the impact of oil type and storage duration on egg weight reduction. This is because factor A (types of oil) had no effect on weight loss. All eggs in the study were dipped in three types of vegetable oil.

According to Table 1, the choice of oil had no discernible impact on the table eggs' weight decrease (P>0.05). This is because all 45 eggs used in this study were coated with various types of vegetable oils (pure coconut oil, palm oil, maize (corn) oil). All three types of oils served as preservatives effectively. Oil coating on table'egg no significant difference in weight loss during 5 week of storage. Oil coating reduced weight loss of egss (<0.8%) [10].

Oil can cover the entire eggshell surface, minimizing gas exchange. Egg preservation can be achieved in various ways, such as coating with mineral oil, using lime solution, and preserving with vegetable oil [8]. Egg preservation has made extensive use of vegetable and mineral oils, with varying degrees of effectiveness documented. It has been said that oils are effective for preserving eggs. The capacity of oil to obstruct the egg shells' air holes, preventing air from entering and exiting the eggs and from being degraded by any pollutants that the air may contain [9, 11].

The least weight loss on eggs with oil coating may be related to the fact that the coating plugs the pores on the shell, reducing the evaporation of moisture and gas [9]. Aside from the oil covering the egg pores, the fatty acid content of vegetable oils plays a crucial role in egg preservation. Coating table eggs with vegetable oil and shea butter can help retain their freshness, especially when they are not refrigerated. [12, 13]. Vegetable oil contains antibacterial compounds, which can cover the pores to reduce evaporation and prevent bacteria from entering through the eggshell pores [14].

The duration of storage at room temperature significantly affected (P<0.05) the table egg's weight loss. Table 1 showed that during storage time, egg weight loss increases. This is because, as the storage time increases, the eggshell pores become larger, making gas exchange from inside the eggs much easier. With longer storage, the percentage of weight loss of eggs increases. Significant weight loss occurs with four weeks of room temperature storage. This is due to the enlarging eggshell pores, resulting in the loss of CO2 gas from inside the eggs, thinning of the egg white, and becoming watery and this results in loss of weight of eggs [15]. Egg quality gradually decreases when eggs are stored at room temperature. Before storing eggs in the refrigerator, washing and oiling them significantly slowed down their weight loss [16].

3.2 Eggshell thickness

The analysis of variance or (ANOVA) results indicated that there was no interaction (P>0.05) between eggshell thickness and oil kind and storage duration. The analysis of variance or (ANOVA) the kind of oil was significantly (P<0.05) on eggshell thickness. This is because

eggs are dipped in various types of oil causing the shell thickness not decrease because the oil covers the pores in the egg shell. Oil can cover egg pores so that the thickness of the eggshell is not reduced significantly. The egg is still thick because the CO2 contained in the egg does not escape due to its presence applying oil so that the precursors for eggshell formation do not occur subtraction [21].

The analysis of variance (ANOVA) indicated that the storage duration was substantially ($P<0.05$) on eggshell thickness. Table 2 demonstrated that longer storage periods result in a drop in eggshell thickness and, in turn, a decrease in eggshell weight. The egg's contents evaporating might cause the eggshell's thickness to degrade. The longer the storage causes more evaporation of gas, resulting in the degradation of the eggshell [17].

During storage, there was a reduction in eggshell thickness. The eggshell thickness at the beginning of storage on day 0 was 0.37±0.0008, and on day 3 of storage, it decreased to 0.33±0.01 [18]. The effect of egg storage length on shell thickness was discovered to be considerable, resulting in a reduction in shell thickness with longer storage periods [19, 20].

4 Conclusion

Raw coconut oil, oil from palm trees, and maize (corn) oil can be used to preserve table eggs. Dipping eggs in pure coconut oil-maintained egg weight loss and eggshell thickness over 40 days of room temperature storage.

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