Shell thickness and weight shrinkage of duck eggs soaked with soursop leaf *Annona muricata* linn extract on different concentration and storage times

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**Abstract.** The objective of this study was to determine the effect of duck egg immersion with soursop leaf extract on eggshell thickness and egg weight shrinkage after being stored for several days. The experimental design used was a factorial complete randomized design. Factor A was the concentration of soursop leaf extract with levels 0, 2, and 4%. While factor B was the storage time with levels 7, 14, 21, 28, and 35 days. The result showed that the concentration of soursop leaves did not significantly (p>0.05) affect the thickness of the shell while the storage duration and interaction between the two factors significantly (p<0.05) affected the thickness of the shell. Then, the result for parameters of weight shrinkage of duck eggs showed that the storage time had a significant effect, while the concentration of soursop leaf (*Annona muricata* Linn) extract and the interaction of two factors very significantly (p<0.01) affected.

1. **Introduction**

Eggs are the one of food needed by the human being. Eggs from poultry, especially chicken eggs and duck eggs are very popular with the community. Between both, chicken eggs are most consumed so that their availability in the market quickly runs out. Different from duck eggs which are relatively long sold so the quality decreases. The decrease in duck egg quality is caused by the reduced thickness of the eggshell and the shrinking weight of the egg after being stored for several weeks. Preservation is needed to maintain the quality of duck eggs to remain good for a long time.

Preservation process that is safe and does not damage human health is that using natural ingredients, such as those derived from leaves. Soursop leaves are known as antimicrobial ingredients that are often used in the treatment of cancer and tumors. The use of soursop leaves in this study can provide information about other uses of soursop leaves in the food sector.

2. **Materials and methods**

The study was conducted from August 10 to September 18, 2017, at the Animal Husbandry Technology Laboratory of East Kutai Agricultural College, Sangatta, East Kalimantan, Indonesia. This study used a factorial Completely Randomized Design (CRD) with the first factor (storage time) with 7, 14, 21, 28, and 35 days, respectively. The second factor (concentration of soursop leaves) which was 0% (eggs without soaking with extract soursop leaves), 2% (Eggs soaked with soursop leaf extract 2%) and 4% (Eggs soaked with soursop leaf extract 4%) then soaking for 20 hours.
2.1. Treatment
The Stage of Making Soursop Leaf Extract was started with leaf selection including soursop leaves used are young leaves and no spots. The leaves are dried for 7 days in a room closed to room temperature. The dried leaves are weighed, torn into small pieces, and boiled with a temperature of 100 °C for 30 minutes [1]

Duck egg Selection by using new eggs that are less than 2 days old. Egg selection includes cleanliness and wholeness. The eggs are first cleaned using warm water and sterilized using 70% alcohol then cleaned using a tissue. Before soaking the eggs are coded on the shell surface using a pencil.

Egg Immersion begins with cold soursop leaf extract water is put into a container and the eggs are soaked for 20 hours. After soaking the egg then drained and dried using a tissue then placed on the egg tray (egg rack) with the position in the blunt section facing above. Eggs are stored for 7, 14, 21, 28, and 35 days at room temperature 22-31 °C, respectively. When storing put a thermometer hygrometer to measure the temperature and humidity of the storage space. Measurements were made on 7, 14, 21, 28, and 35 days.

2.2. Measurements
The percentage of shrinking egg weight is calculated by the initial weight of eggs (gram) before storage (A), reduced by the weight of eggs (gram) after being stored (B), divided by the initial weight of eggs (gram) before being stored (A), and then multiplied by 100% ((AB) / A) x 100%) [2] Eggshell thickness is measured using the formula: \[ TK = \frac{(T1 + T2 + T3)}{3} \] where TK = thick shells, T1, T2, and T3 = shell thickness at blunt, middle, and pointed ends respectively [3]

2.3. Data analysis
Data were analyzed by ANOVA with significance level of 5% using SPSS 16.0 software. Further test using Least Significant Difference Test.

3. Results and discussion
3.1. Temperature and relative humidity storage room
Ambient temperature ranges from 21 to 31.9 °C and relative humidity of 60 to 80%. Morning temperatures range from 21 to 26 °C and the maximum temperature during the day ranges from 31.9 °C. Temperature and humidity affect the decrease in egg quality during storage. Shelf life, eggshell texture, temperature, and humidity relative during storage are factors that influence the decrease in egg quality [4]

| Concentration of Soursop Leaf Extract | 7 days | 14 days | 21 days | 28 days | 35 days | Average |
|-------------------------------------|--------|--------|--------|--------|--------|---------|
| 0%                                  | 0.37 ± 0.03 | 0.38 ± 0.02 | 0.29 ± 0.01 | 0.33 ± 0.02 | 0.35 ± 0.01 | 0.34 ± 0.04 |
| 2%                                  | 0.37 ± 0.01 | 0.32 ± 0.03 | 0.45 ± 0.16 | 0.29 ± 0.01 | 0.33 ± 0.02 | 0.35 ± 0.09 |
| 4%                                  | 0.50 ± 0.19 | 0.33 ± 0.05 | 0.32 ± 0.01 | 0.30 ± 0.01 | 0.34 ± 0.01 | 0.36 ± 0.11 |

Different letters on the same row show significant effect (P <0.05) and the same letters in the same column show no significant effect (P > 0.05)
3.2. Thickness Of duck eggshell
The effect of duck eggs immersion in soursop leaf extract on the thickness of eggshell shown in table 1. The average thickness of the shell highest in 7 days storage time is 0.41 mm and highest in soursop leaf extract concentration of 4% that is equal to 0.50 mm. Based on ANOVA, the variation in shell thickness had a significant effect on storage time (P <0.05). The decrease in eggshell thickness was significantly different at 20 and 40 hours soaking time (P<0.01) [5]

Immersion eggs with soursop leaf extract 2% and 4% for 20 hours caused duck eggs are brown. It means that the eggshell has been coated with a layer of chocolate derived from a solution of soursop leaf extract covering the entire egg surface (figure 1). During storage, the egg undergoes porosity so that the brown egg layer fades and the pores of the egg open and cause evaporation. That causes the thickness of eggshell to decrease [5].

![Figure 1](image1.png)

**Figure 1.** Soaking eggs with soursop leaf extract

![Figure 2](image2.png)

**Figure 2.** (A) The soaked egg is brown, (B) The brown layer fades

Figure 2.A shown that eggs soaked with soursop leaf extract are dark brown with a layer derived from extracts of soursop leaf. But the brown color of the eggshell fades during the storage duration (figure 2.B). Based on the variance analysis in table 1, the concentration of soursop leaf extract on eggs during storage did not affect eggshell thickness (P > 0.05). This indicates that storage as a result of fluctuations in temperature and humidity causes the lining of soursop leaf extract on egg faded along with the storage duration and reduced eggshell thickness.

3.3. Shrinking duck eggs weight
The effect of duck eggs immersion in soursop leaf extract on the shrinkage of duck eggs weight shown in table 2.
Table 2. Shrinkage of duck egg Weight During Storage (%)

| Concentration of Soursop Leaf Extract | Duration of storage | Average |
|--------------------------------------|---------------------|---------|
|                                      | 7 days | 14 days | 21 days | 28 days | 35 days |        |
| 0%                                   | 1.78 ± 1.02 | 2.06 ± 0.62 | 1.52 ± 0.41 | 1.52 ± 4.00 | 5.39 ± 1.11 | 2.45 ± 2.35 |
| 2%                                   | 2.69 ± 1.64 | 2.65 ± 1.29 | 4.85 ± 0.68 | -2 ± 6.55 | 7.08 ± 2.63 | 3.05 ± 4.23 |
| 4%                                   | 1.30 ± 0.59 | 3.61 ± 0.98 | 4.44 ± 1.31 | 14.4 ± 5.70 | 5.56 ± 0.53 | 5.86 ± 5.18 |

Average 1.92 ± 1.19 a 2.77 ± 1.11 b 3.60 ± 1.75 c 4.64 ± 9.00 d 6.01 ± 1.66 e

Different letters on the same row show a significant effect (P < 0.05) and different letters in the same column show a very significant effect (P < 0.01).

The lowest shrinkage of egg weight is on 7 days of storage duration (1.92%) and the concentration of soursop leaf extract 4% (1.30%) (table 2). The low shrinkage of eggs at 7 days of storage is caused by the presence of a brown layer on the surface of the shell which prevents evaporation of water in the albumen. Soursop leaf extract layer increasingly fades with increasing storage duration causing egg evaporation. Soursop leaf extract layer contains mostly tannin, the rest are steroids, triterpenoids, alkaloids, flavonoids and quinines [6].

Based on ANOVA, storage time has a significant effect on egg weight shrinkage (p<0.05), while the concentration of soursop leaf extract and the interaction between the length of storage and the concentration of soursop leaf extract had a very significant effect on egg weight shrinkage (p<0.01). Eggs weight which decreases during storage duration was affected by environmental conditions. The ambient temperature at the time of measurement (12.00 am to 02.00 pm) ranges from 29 to 31.9 °C with a humidity of 60-80%. Shrinkage of eggs weight correlates almost linearly with storage duration in a constant environmental condition. Eggs weight shrinkage can be increased at relatively high temperature and humidity. Weight loss is mostly caused by evaporation of water, especially in the albumen, and a small part by evaporation of gases such as CO2, NH3, N2, and a trace H2S due to degradation of the organic component of the egg [7].

Egg weight shrinkage At 28 days of storage duration with 2% soursop leaf extract concentration showed a negative result (-2%). Egg weight increases because of the development of decomposing bacteria in the egg. Decomposing bacteria produce hydrogen sulfide gas. The relatively high temperature at the time of measurement, which is 31.9 °C resulted in enlarged eggshell pores. Gram-negative bacteria that can damage eggs into the egg through enlarged shell pores, such as Pseudomonas, Alcaligenes, Escherichia, and Salmonella. Salmonella can easily enter the albumen and then damage the egg yolk. Salmonella easy to grow under aerobic conditions and facultative anaerobic. Salmonella will damage proteins by changing proteins with protease enzymes into ammonia and hydrogen sulfide while fat is converted into ketone compounds. Both of these changes cause the eggs to become foul-smelling [8].

4. Conclusion

The storage duration and interaction between the concentration of soursop leaf extract with storage duration significantly affected to the thickness of duck eggshell and shrinkage of eggs weight (p<0.05). The concentration of soursop leaf extract very significantly affected to egg weight shrinkage (p<0.01), but didn’t significantly affected to the thickness of duck eggshell (p>0.05). The best treatment for maintaining duck egg quality is by soaking soursop leaf extract at a concentration of 4% and a storage duration of 7 days.

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