



Internal Quality of Mojosari Duck Eggs by Soaking in Bandotan Plant Solution (*Ageratum Conyzoides* L) as a Natural Preservative

Aju Tjatur Nugroho Krisnaningsih^{1*}, Dwi Agus Setiawan¹, Henny Leondro¹

¹Faculty of Animal Husbandry, Universitas PGRI Kanjuruhan Malang, Malang, Indonesia

ABSTRACT. The purpose of this study was to determine the effect of soaking in a solution of Bandotan plants (*Ageratum conyzoides* L) on the quality of Mojosari duck eggs. This research method was a laboratory experiment with a Completely Randomized Design (CRD) consisting of five treatments and three replications. The concentration of egg soaking in a solution of Bandotan plants was 0% (T0), 10% (T1), 20% (T2), 30% (T3), and 40% (T4). The research data were analysed using Analysis of Variance (ANOVA), if there were differences between treatments, then continued with Duncan's Multiple Range Test. The results showed that soaking in a solution of Bandotan plants gave a significant difference ($P < 0.05$) to the shrinkage of egg weight, egg cavity height, egg yolk index, egg white index, haugh unit (HU). The value of egg weight shrinkage from the smallest to the largest as follows 6.87% (T2) and 12.14% (T0). Egg cavity height: 4.41 (T2) and 10.31 (T0). Egg yolk index: 0.12 (T0) and 0.46 (T2). Egg white index: 0.043 (T0) and 0.101 (T2). Haugh unit (HU): 52.20 (T0) and 80.37 (T2). Based on the results of this study, it can be concluded that soaking Mojosari duck eggs in a 20% solution of Bandotan (*A. conyzoides* L) for 12 hours was the most effective concentration for maintaining internal egg quality during 21 days of storage at room temperature.

Keywords: Bandotan, egg quality, natural preservatives

INTRODUCTION

Eggs are a source of animal protein produced from poultry and are widely favoured by the community (Obianwuna et al., 2022). One of the poultry that can produce eggs and also make a significant contribution to providing highly nutritious food besides chicken is ducks (Bello et al., 2022). Mojosari ducks are one type of local duck that is valuable as a genetic resource, playing an important role in increasing food nutrition and community income, especially in rural areas (Fitra et al., 2024) and producing high egg production (Henrik and Marhayani, 2020). Egg protein has a complete essential amino acid composition, in addition to having nutritional content including: fat, carbohydrates, several vitamins and minerals (Ebegbulem, et al., 2024; Siregar, A., Siregar, 2024). Although eggs have many advantages of complete nutrition, eggs have the nature of a food ingredient that is easily damaged (Zheng et al., 2021) and rotten (Jin et al., 2024). This damage can be caused by microbial contamination of the shell and evaporation of water and carbon dioxide (CO₂) (Wongnen et al., 2023). One way to store eggs for a long time is by preserving them (El-Azka et al., 2024). Preserving eggs is an effort to maintain the quality of eggs when stored for a long time. Eggs have a short shelf life of around 14 days (Quan and Benjakul, 2019) which are stored at room temperature, after which time the eggs will

deteriorate (Tan et al., 2022). Preservatives derived from natural ingredients can be used to maintain egg quality and are safe for consumption. Egg preservation is not only made into salted eggs (Noonim and Venkatachalam, 2021), but can also be in fresh form. The way to preserve fresh eggs is by tanning the egg shell (Sigar et al., 2020). The principle of egg preservation by tanning the shell is to prevent the evaporation process of water and CO₂ from inside the egg, and to prevent microbes from entering the pores in the shell. Natural preservatives that contain chemical compounds, namely tannins and saponins, can be used as tanners on egg shells (Umela and Nurhafnita, 2021), this is because tannin compounds will react with egg shell proteins.

Egg quality indicators can be determined by measuring the external and internal quality of eggs, including: Egg weight loss, white and yolk index, and Haugh units (HU). Research conducted by (Krisnaningsih et al., 2024) namely natural egg preservation using white turmeric solution has a very significant effect ($P < 0.01$) on the internal quality of eggs including: egg yolk color, egg white index, egg yolk index, and egg pH. One of the plants that has the potential as a natural egg preservative is by using the Bandotan plant (*Ageratum conyzoides* L).

The Bandotan plant (*A. conyzoides* L) is a weed plant (Fauzi et al., 2023) that grows wild and is easily found in Indonesia (Krishidaya et al., 2022). Bandotan (*A. conyzoides* L.) is an annual plant, which grows to a height of 30-90 cm. The Bandotan plant is empirically known to have

*Corresponding author: ajutjatur@unikama.ac.id

Received: 1 February 2025

Revised: 9 April 2025

Accepted: 7 July 2025

DOI: <https://doi.org/10.17969/agripet.v25i2.44413>



properties as a natural medicine used by some people in several areas (Putri and Fhatonah, 2021; Noonim and Venkatachalam, 2021; Harefa et al., 2022). The part of the Bandotan plant that is often used is the leaf part which is where photosynthesis takes place so it is thought to contain many chemical compounds, there are active compounds in the Bandotan plant in the form of terpenoids, phenols, saponins and alkaloids (Hilaliyah, 2021). Research conducted by Abi et al. (2021) and Purwanti (2022) obtained that the average concentration of flavonoids and tannins from Soxhlet extraction was 177.98 mg/g and 61.13 mg/g in Bandotan leaf extract (*A. conyzoides* L.). The purpose of this study was to evaluate the internal quality of Mojosari duck eggs by soaking in Bandotan plant solution (*A. conyzoides* L.) as a natural preservative.

MATERIALS AND METHODS

Materials

The materials used include 30 1-day-old Mojosari duck eggs weighing 71-75 grams, water, tissue, and Bandotan plants (*A. conyzoides* L.), especially the leaves. Mojosari duck eggs and Bandotan plants were obtained from Mr. Kusnan's laying duck farm and rice fields. The tools used in this study include digital scales, stoves, pans, plastic containers, petri dishes, egg yolk colour fans, calipers, plastic containers, egg trays.

Methods

The research method is a laboratory experiment using a Completely Randomized Design (CRD) with five treatments (T0, T1, T2, T3, and T4) and three replications. The treatment in this study is the percentage of Bandotan plant use as a natural preservative solution, as follows:

- T0 = Mojosari duck eggs without soaking in Bandotan plant solution.
- T1 = Mojosari duck eggs soaked in 10% Bandotan plant solution (10% x 1000 ml water = 100 grams of Bandotan plant);
- T2 = Mojosari duck eggs soaked in 20% Bandotan plant solution (20% x 1000 ml water = 200 grams of Bandotan plant);
- T3 = Mojosari duck eggs soaked in 30% Bandotan plant solution (30% x 1000 ml water = 300 grams of Bandotan plant);
- T4 = Mojosari duck eggs soaked in 40% Bandotan plant solution (40% x 1000 ml water = 400 grams of Bandotan plant).

Procedures

Making plant solutions

The Bandotan plant solution was prepared using mature leaves, specifically the third leaf from the top of the shoot, based on the method described by Akbar (2022). The selected leaves were washed under running water to remove any adhering dirt, and then air-dried. After drying, the leaves were chopped into approximately 0.5 cm pieces and weighed according to each treatment requirement.

For treatment T1, 100 grams of chopped leaves were boiled in 1000 ml of water until the colour turned brownish, indicating the release of chemical compounds. The boiled solution was then transferred into a labelled container and left to cool at room temperature (27–30°C) for 1–2 hours. The same procedure was carried out for the other treatment groups: T2 (200 g), T3 (300 g), and T4 (400 g), with the volume of water and boiling process kept constant.

Egg cleaning

Mojosari duck eggs in each treatment group were cleaned of dirt and attached microorganisms using tissue moistened with warm water. The eggs were then weighed to determine their initial weight and placed on an egg tray.

Egg Soaking

The duck eggs were soaked according to the treatment, with each container holding six eggs and sealed to prevent contamination from outside air during the soaking process. The soaking duration was 12 hours, following the procedure of Akbar (2022), to optimize the absorption of the chemical compounds from the Bandotan plant into the duck eggs.

Egg storage

After being soaked for 12 hours, the eggs were drained and wiped using tissue. Each egg was labelled according to the treatment group and placed on an egg tray with the blunt end facing upwards and the pointed end downwards. The eggs were stored for 21 days at room temperature (Abi et al., 2021).

Data Collection

Data collection was carried out after storage for 21 days. The eggs were weighed using a digital scale, then cracked, and their contents were placed in petri dishes for further measurement based on the research variables.

Research Parameters

Egg weight shrinkage

Egg weight shrinkage was calculated as the difference between the initial egg weight (g) minus the final egg weight (g) divided by the initial egg weight (g) expressed as a percentage. The formula used followed [Fanta et al. \(2023\)](#):

$$\text{Egg weight shrinkage} = \frac{\text{the initial egg weight (g)} - \text{the final egg weight (g)}}{\text{the initial egg weight (g)}} \times 100\%$$

Egg cavity height

The egg cavity height was obtained by measuring the height of the air cell located at the blunt end of the egg using a calliper, as described by [Akbar \(2022\)](#).

Egg yolk index (yolk)

The egg yolk index was calculated as the ratio between the height and the diameter of the egg yolk, following [Wijedasa et al. \(2020\)](#):

$$\text{Egg Yolk Index} = \frac{a}{\frac{1}{2}(b_1 + b_2)}$$

Description:

a = height of egg yolk (mm);

b1 = diameter of egg yolk 1 (mm);

b2 = diameter of egg yolk 2 (mm).

Egg white index (albumin)

The egg white index was calculated as the ratio between the height of the thick albumen and the average of the longest and shortest diameters of the thick albumen, according to [Riyanti et al. \(2021\)](#):

$$\text{Egg white index} = \frac{t}{\frac{1}{2}(D_1 + D_2)}$$

Description:

t = height of thick egg white (mm);

D1 = longest diameter of thick egg white (mm);

D2 = shortest diameter of thick egg white (mm).

Haugh unit (hu)

The Haugh Unit (HU), which represents the quality of the albumen in relation to egg weight, was calculated using the formula from [Wijedasa et al. \(2020\)](#):

$$\text{Haugh unit} = 100 \log (H + 7.57 - 1.7 W^{0.37})$$

Description:

H = height of thick albumin (mm);

W = egg weight (g).

Data Analysis

The collected data were analysed using Analysis of Variance (ANOVA) with SPSS software version 20. If significant differences were found among treatments, the analysis was followed by Duncan's Multiple Range Test (DMRT) to

determine specific differences between treatment groups.

RESULTS AND DISCUSSION

Internal Quality of Mojosari Duck Eggs by Soaking in Bandotan Plant Solution (*A. conyzoides* L.) as a Natural Preservative.

The results of the value of egg weight shrinkage, air cavity height, egg yolk index, egg white index and Haugh Unit (HU) of duck eggs after soaking in Bandotan plant solution (*A. conyzoides* L.) at concentrations of 0%, 10%, 20%, 30% and 40% are summarized in Table 1. Although the increased concentration of Bandotan solution (*A. conyzoides* L.) showed potential in improving the internal quality of eggs at concentrations of 10% (T1) and 20% (T2), observations at concentrations of 30% (T3) and 40% (T4) showed a decrease in several egg quality parameters. This can be caused at high concentrations, some of the active compounds in the Bandotan solution may not be optimally absorbed by the egg, or it may cause unwanted chemical reactions. This can reduce the effectiveness of preservation and affect the internal quality of the eggs

Egg Weight Shrinkage

The results of the study showed that the value of Mojosari duck egg weight shrinkage with soaking in Bandotan plant solution (*A. conyzoides* L.) at various concentrations was as follows: 12.14% for control (T0), 9.15% for 10% Bandotan solution (T1), 6.87% for 20% Bandotan solution (T2), and 10.74% for 30% Bandotan solution (T3) and 11.24% for 40% Bandotan solution (T4). (Table 1). The results of the analysis of variance showed that soaking in Bandotan plant solution (*A. conyzoides* L.) for 12 hours had a significant effect on the weight shrinkage of Mojosari duck eggs ($P < 0.05$) stored for 21 days at room temperature. Soaking eggs in a 20% Bandotan plant solution showed the lowest reduction in duck egg weight (6.87%), while the control had the highest reduction in duck egg weight (12.14%).

The significant difference in the value of duck egg weight shrinkage indicates that duck eggs soaked in 20% Bandotan plant solution for 12 hours have lower egg weight shrinkage compared to the control and other treatments. The results showed that soaking eggs with concentrations of 30% (T3) and 40% (T4) provided a reduction in egg weight compared to concentrations of 10% and 20%. Bandotan leaves contain bioactive compounds such

as alkaloids, saponins, and flavonoids. At high concentrations, these compounds can penetrate the eggshell and interact with the egg's components, causing changes in the egg's chemical structure and composition, leading to increased egg weight loss. The control treatment has the highest egg weight shrinkage value because it does not have a protective layer and only utilizes the cuticle layer. The cuticle layer will shrink slowly as the egg storage time increases, causing many shell pores to be directly exposed to air. The cuticle that clogs the air pores of the egg shell becomes dry and begins to shrink so that the size of the shell pores becomes

larger so that gas and water vapor from the egg are easier to escape and ultimately result in a decrease in egg weight (Yosi et al., 2019). Compounds in Bandotan plants (*A. conyzoides* L) have antimicrobial and antioxidant properties that can help protect egg shells from contamination by microorganisms that can damage eggs. By protecting the egg shell from bacteria or fungi, this herbal solution can maintain the integrity of the egg shell, prevent damage and minimize the evaporation process of the egg contents, so that the weight loss of the egg is lower compared to without a protective layer.

Table 1. Egg weight shrinkage value, air cavity height, egg yolk index, egg white index and haugh unit of duck eggs

Variable	Treatment				
	T0	T1	T2	T3	T4
Egg weight shrinkage (%)	12.14±1.13 ^c	9.15±1.50 ^{ab}	6.87±0.52 ^a	10.74±2.16 ^{bc}	11.24±1.36 ^{bc}
Air cavity height (mm)	10.31±0.64 ^d	6.23±0.55 ^b	4.41±0.22 ^a	8.30±0.88 ^c	8.57±0.66 ^c
Egg yolk index	0.12±0.01 ^a	0.32±0.0 ^d	0.46±0.03 ^e	0.27±0.01 ^c	0.20±0.0 ^b
Egg white index	0.043±0.002 ^a	0.078±0.001 ^c	0.101±0.009 ^d	0.057±0.007 ^b	0.049±0.002 ^{ab}
Haugh unit	52.20±3.53 ^a	75.43±1.71 ^c	80.37±0.87 ^c	64.39±4.67 ^b	59.43±3.49 ^b

Description: Superscripts (^{a, b, c, d, e}) with different letters on the same row indicate significantly different results ($P < 0.05$).

Synergy with the research results of Mutmainah and Atifah (2023) soaking eggs with 45% jackfruit leaf extract for 36 hours effectively inhibits the decrease in duck egg weight with an egg weight loss value of 1.571% at a storage period of 15 days at room temperature. Soaking eggs using 10%, 20% and 30% moringa for 24 hours did not have an effect ($P > 0.05$) on the decrease in duck egg weight with a value of around 3.15% at 21 days of storage, while storage periods of 7 days, 14 days, 21 days and 28 days had a significant effect on the decrease in duck egg weight. The results of Abuk et al. (2024), study of soaking eggs using red ginger extract at concentrations of 0%, 15%, 25%, 35% and 45% did not have a significant effect on egg weight loss with values of 5.28%, 4.47%, 4.42%, 4.46%, 3.97%, respectively. The egg weight loss in this study was higher than Aldila et al. (2023) where the weight loss of broiler chicken eggs during storage for 14 days ranged from 1.64-1.91%. Widyasworo and Esti (2022) research showed that the weight loss of chicken eggs ranged from 2.88-3.36%. The high weight loss of eggs is influenced by the length of storage period and environmental temperature. Egg weight loss can because by long storage because during the storage period there is an evaporation process of the liquid in the egg (Mukhlisah et al., 2021).

Damage to the cuticle can facilitate gas evaporation and the entry of bacteria into the contents of the egg. Bacteria that enter will degrade and damage compounds in the egg into compounds

with a distinctive odor in eggs that are damaged or have decreased quality (Noonim and Venkatachalam, 2021; Abi et al., 2021). In addition, the process of evaporation and gas release occurs continuously during the storage period, so that the longer the eggs are stored, the lower the egg weight will be. Krisnaningsih et al. (2023) reported that the longer the storage, the higher the decrease in egg weight due to the accumulation of organic matter from the egg resulting from degradation in the form of H₂O evaporation and the release of CO₂, NH₃, N₂, and H₂S gases.

Height of Air Cavity

The results of the study showed that the height of the air cavity of Mojosari duck eggs with immersion in Bandotan (*A. conyzoides* L) solution at various concentrations was as follows: 10.31 for control (T0), 6.23 for 10% Bandotan solution (T1), 4.41 for 20% Bandotan solution (T2), 8.30 for 30% Bandotan solution (T3) and 8.57 for 40% Bandotan solution (T4).

The results of the analysis of variance showed that immersion in Bandotan (*A. conyzoides* L) plant solution had a significant effect ($P < 0.05$) on the height of the air cavity of Mojosari duck eggs stored for 21 days. Based on the results of the Duncan further test, T2 was significantly different from other treatments. Treatments T3 and T4 were not significantly different, but significantly different from treatments T0, T1, and T2. The lowest air cavity height was obtained in the T2

treatment, which was 4.41 mm, and the highest in the T0 treatment, which was 10.31 mm.

Mojosari duck eggs in the T2 treatment had the lowest average air cavity height value compared to other treatments, which was 4.41 mm. This suggests that the Bandotan solution effectively reduced the evaporation rate of egg contents during storage. However, at higher concentrations (30% and 40%), the air cavity height increased again, indicating a potential compromise in the protective efficacy of the Bandotan solution at these concentrations. This phenomenon can be attributed to the concentration-dependent effects of the Bandotan solution. At optimal concentrations, the solution forms a protective layer on the eggshell, minimizing moisture and gas loss. However, at higher concentrations, the solution may alter the eggshell's permeability or interfere with the natural protective mechanisms, leading to increased evaporation and gas exchange, thereby increasing the air cavity size. The low air cavity height is thought to be because the eggs have a protective layer of Bandotan plant solution (*A. conyzoides* L.) on the shell. Compounds in the Bandotan plant (*A. conyzoides* L.) are able to minimize the evaporation process of egg contents. Tannin compounds cause proteins in the egg shell to coagulate and cover the pores so that they cannot penetrate or are impermeable to evaporation of egg contents and CO₂. In addition, the increase in the size of the air cavity in the egg is due to the decreasing weight of the egg due to the evaporation process and the release of gas during storage time (Abi et al., 2021).

Egg Yolk Index

The results of the analysis of variance showed that soaking in a solution of Bandotan plants (*A. conyzoides* L.) had a significant effect ($P < 0.05$) on the egg yolk index of Mojosari ducks stored for 21 days. The lowest egg yolk index was obtained in the T0 treatment, which was 0.12; and the highest in the T2 treatment, which was 0.46.

Mojosari duck eggs in the T2 treatment had an average egg yolk index value higher than the other treatments, which was 0.46. The high egg yolk index in the T2 treatment was thought to be due to the protective layer of the Bandotan plant solution (*A. conyzoides* L.) on the surface of the egg shell. The presence of tannin compounds in the Bandotan plant is able to protect the surface of the egg shell, thereby minimizing the decline in egg quality. This is in accordance with (Akbar, 2022) that tannin compounds are able to change the properties of the eggshell to become impermeable after reacting with the protein in the eggshell and

tanning of the eggshell occurs, so that the process of water evaporation, gases can be minimized, and microorganisms cannot enter the egg because of the shell tanning layer.

The egg yolk index in this study was within the range of the research results of Sandi et al. (2020), the treatment of Pegagan duck eggs soaked in a solution of starfruit leaf extract produced an egg yolk index value of 0.23-0.32. Research by Khan et al. (2020) on chicken eggs stored for 21 days produced an egg yolk index of 0.10. Meanwhile, research by Souza et al. (2021) on commercial chicken eggs stored for 28 days at a temperature of 20°C gave an egg yolk index of 0.36. However, compared to (SNI 01-3926:2008), the egg yolk index value is lower because the quality standard 1 ranges from 0.48-0.52. The low egg yolk index value in this study was due to the long storage period so that osmotic pressure could not be avoided.

Egg White Index

The egg white index indicator is the ratio of the height of the thick egg white to the width of the egg white (Sukaryani et al., 2021). The results of the analysis of variance showed that soaking in a solution of Bandotan plants (*A. conyzoides* L.) had a significant effect ($P < 0.05$) on the egg white index of Mojosari ducks stored for 21 days. The lowest egg white index was obtained in the T0 treatment, which was 0.043; and the highest in the T2 treatment, which was 0.101. The high value of the egg white index in this study was because the tannin compounds in the Bandotan plant were able to minimize the decline in egg quality. This is in accordance with the opinion of Aldila et al. (2023) that tannin compounds can slow down the work of enzymes outside the cell and the oxidation process in the contents of the egg.

Mojosari duck eggs in the T0 treatment tended to have a lower average egg white index value compared to the other treatments, which was 0.043. The low egg white index value in the T0 treatment was assumed to be due to the fact that the eggshells did not receive any tanning from the Bandotan plant solution, allowing the evaporation process and microbial contamination to occur more rapidly. In addition, long-term storage causes a decrease in egg quality. This is in accordance with the opinion of Tatali et al. (2022) that the egg white index is influenced by the length of storage time, increased pH, evaporation of gases, and damage to ovomucin fibers. The length of storage period results in an acceleration of the decrease in the height of the thick egg white layer and eventually

the decrease will slow down. Long storage times cause the pores to enlarge and the mucosal layer to become damaged. Water, gas, and bacteria can more easily pass through the shell without anything blocking it, so that the decrease in egg quality and freshness occurs more quickly. In addition, the decrease in the egg white index is caused by the loss of CO₂ and the breakdown of carbonic acid into CO₂, and causes the albumen to become thin because the mucin fibers lose their structure that provides a thick texture. The storage period causes an increase in egg pH and interaction activity between ovomucin and lysozyme occurs so that the egg white becomes thin. Therefore, the longer the storage, the lower the egg white index value.

Haugh Unit

The Haugh Unit (HU) value was used as an indicator to reflect the condition of the albumen and to assess the internal quality of eggs (Ramadhan et al., 2024). The results of the analysis of variance showed that soaking the eggs in *A. conyzoides* L (Bandotan) solution had a significant effect ($P < 0.05$) on the Haugh Unit of Mojosari duck eggs after 21 days of storage. The lowest HU was recorded in the T0 (control) treatment at 52.20, while the highest was found in the T2 treatment (20% Bandotan solution) at 80.37. The Haugh Unit values observed in this study were higher than those reported by Zheng et al. (2021) and Wang et al. (2023) where blue-shelled eggs stored for 21 days had HU values of 67.29. However, they were slightly lower than those observed in the study by Kumar et al. (2022) who recorded a HU of 82.88 in Aseel chicken eggs. The high HU value in the T2 treatment was thought to be due to the optimal effect of tannins in the Bandotan plant solution, which helped reduce moisture and gas loss from the egg by forming a protective coating on the eggshell. This protective layer minimized evaporation, maintained albumen viscosity, and preserved egg quality. According to Aldila et al. (2023), tannins play a role in reducing the permeability of the shell pores, which limits the release of CO₂ and water vapor from the egg.

Mojosari duck eggs in the T2 treatment tended to have a higher average haugh unit value compared to other treatments, which was 80.37. The high haugh unit value in the T2 treatment is thought to be due to the viscosity of the egg white and the decrease in egg weight can be minimized by the presence of tanning from the Bandotan plant solution on the egg shell. Tannins from the Bandotan plant prevent evaporation of egg contents by forming lumps in the pores of the egg shell.

Tannin compounds cause the protein in the egg shell to coagulate and cover the pores so that they cannot penetrate or are impermeable to evaporation of egg contents and CO₂. The loss of CO₂ and the breakdown of carbonic acid into CO₂ causes the albumen to become thin because the mucin fibers lose their structure which gives them a thick texture. The thicker the albumen viscosity indicates that the HU value is getting higher (Ayuti et al., 2022). Albumen viscosity is closely related to the ovomucin content in egg white. The thinning of the albumen is caused by damage to ovomucin, resulting in water transport from the egg white protein (Abi et al., 2021). The decrease in albumen viscosity is caused by changes in its gel structure due to physicochemical damage to the ovomucin fibers, causing them to come out of the networks that have been formed. The value of the Haugh unit is influenced by the weight of the egg and the height of the egg white (Ayuti et al., 2022). The quality of egg white decreases with the increasing shelf life of the egg. This decrease is characterized by a foul odor and thinning of the egg white (Santoso et al., 2022).

CONCLUSION

Based on the results of this study, it can be concluded that soaking Mojosari duck eggs in a 20% solution of Bandotan (*A. conyzoides* L) for 12 hours was the most effective concentration for maintaining internal egg quality during 21 days of storage at room temperature.

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HOW TO CITE

Krisnaningsih, A.T.N., Setiawan, D.A., Leondro, H. 2025. Internal Quality of Mojosari Duck Eggs by Soaking in Bandotan Plant Solution (*Ageratum Conyzoides* L) as a Natural Preservative. Jurnal Agripet, 25(2), 118-126. <https://doi.org/10.17969/agripet.v25i2.44413>