



The Effect of Adding Black Tea Extract (*Camellia sinensis*) in Soaking Salted Eggs on Moisture Content, Salt Content, Water Activity (A_w), and the Color of Egg Yolk in Salted Eggs

Rismarini Hapsari¹, Dedes Amertaningtyas^{2,*}, Anif Mukaromah Wati¹, Eka Nurwahyuni¹, and Rischa Amalia Saleha²

¹ Department of Animal Product Technology, Faculty of Animal Science, PSDKU Universitas Brawijaya, Kediri 64111, Indonesia

² Department of Animal Product Technology, Faculty of Animal Science, Universitas Brawijaya, Malang 65145, Indonesia

*dedesfptub@ub.ac.id

Abstract. The study aims to investigate the impact of incorporating black tea extract (*Camellia sinensis*) into salted eggs using the wet technique on their moisture level, salt content, A_w , and egg yolk color. The research used a Completely Randomized Design (CRD) with four treatments and four replications in a laboratory experiment for data collection. Data analysis utilized Analysis of Variance (ANOVA), and any differences were evaluated using Duncan's Multiple Range Test (DMRT). The treatments included T1 (no black tea), T2 (25% black tea), T3 (50% black tea), and T4 (75% black tea). Water activity (A_w), salted egg yolk color, moisture content (%), and salt content (%) are some of the variables examined. Research findings demonstrated that the inclusion of black tea extract did not have a significant impact ($P > 0.05$) on the moisture content, salt content, A_w , and salted egg yolk color. Adding black tea extract to salted eggs did not affect the egg's moisture content (61.39%–66.31%), salt content (1.08–1.51%), A_w (0.91–0.97), or yellow color (L 75.30–76.85, a^* 3.88–5.23, b^* 41.75–43.65).

Keywords: Black Tea, Egg, Salted Egg, Tannin, Wet Method.

1 Introduction

Eggs are a food ingredient rich in protein, affordable, easy to find on the market, have good nutritional content, and taste good so that many people like them. East Java is the province with the highest egg production in 2022, as much as 1,314,114.93 tons [1], while the consumption of chicken eggs in Kediri City, East Java Province reached a per capita consumption figure of 2,597 kg per week [2]. This number is still very low, so domestic egg consumption still needs to be increased. One effort that can be made to increase egg consumption is to diversify products by creating a variety of food products while increasing their nutritional content. Chicken eggs are cheaper and

© The Author(s) 2025

I. Novianti et al. (eds.), *Proceedings of the 5th International Conference on Environmentally Sustainable Animal Industry (ICESAI 2024)*, Advances in Biological Sciences Research 45,

https://doi.org/10.2991/978-94-6463-670-3_4

easier to get in the market than other eggs, so cheaper raw materials are obtained for making salted eggs. There are two methods of making salted eggs, namely wet salting and dry salting. Making salted eggs using chicken eggs in a salt solution (wet salting) is an easier and more practical way than making salted eggs by coating them with salt dough (dry salting), but sometimes the results are not as good as salted eggs with salt dough coating [3]. Evaporation of water from chicken eggs soaked in tea solution can be reduced so that microorganisms have difficulty entering the eggs. The shelf life of eggs can also be extended up to 1 month because tea contains catechins which function to inhibit the oxidation process [4].

Salted eggs are products from livestock that have been preserved through salting to enhance their shelf life and impart a salty flavor. Egg salting can be performed using two methods, such as the dry method, where eggs are wrapped in salt dough, and the wet method, where they are immersed in a salt solution. Wet salting involves immersing them in a salt solution within a container for 7–10 days before incubating them in a secure location. Using chicken eggs in a salt solution to make salted eggs is a simpler and more practical method, though the results might not always match those of salted eggs encased in salt dough [3]. Consequently, extra ingredients are required to enhance the quality of salted chicken eggs.

Caffeine, theobromine, theaflavin, flavonoids, thearubigin, tannins, polyamines, catechins, antioxidants, polyphenols, and essential oils are all found in black tea [4]. It is possible to minimize the evaporation of chicken eggs soaked in tea solution, making it more difficult for germs to access the eggs. Tea contains catechins, which work to prevent oxidation, extending the shelf life of eggs by up to one month [5]. Compared to boiled duck eggs without treatment (68.00%), the moisture content of boiled duck eggs in the black tea (62.72%) and green tea soaking treatments (58.75%) is lower [6]. Compared to green tea, black tea has a lower tannin concentration, which results in less denatured protein. According to the preceding statement, the purpose of this study was to ascertain how soaking salted eggs with tea extract affected moisture content, salt content, A_w , and yolk color.

2 Materials and Methods

The research took place at the Animal Product Technology Laboratory, Faculty of Animal Science, Universitas Brawijaya for making salted eggs and testing of moisture content and the Food Quality and Safety Testing Laboratory, Faculty of Agricultural Technology, Universitas Brawijaya for testing salt content, A_w , and egg yolk color.

Completely Randomized Design (CRD) of 4 treatments and 4 replications. Data were analyzed by analysis of variance (ANOVA), and if differences were found, continued with Duncan's Multiple Range Test (DMRT). The treatments given were T1 (without adding black tea), T2 (25% black tea), T3 (50% black tea), and T4 (75% black tea). Black tea solution is made with a ratio of 1:50 between black tea and water. The black tea (*Camellia sinensis*) used is the Dandang black tea brand tea bag type as much as 120 grams which is dissolved in 6,000 ml of water for 16 samples. Variables include moisture content (%), salinity (%), water activity (A_w), and the

color of salted egg yolk. Method of making salted eggs [7], testing moisture content with the oven method [7], testing salt content with a mortar, beaker glass, filter paper, and magnetic stirrer [8], Aw testing with Aw meter Testo 650 [9], color testing ($L^* a^* b^*$) of salted eggs with Color Reader Model: Konica Minolta CR-10 [10].

3 Results and Discussion

Table 1 presents the result of an experiment on salted chicken eggs using black tea extract.

Table 1. The average value of salted chicken eggs with the addition of black tea extract.

Treatment	Moisture content ± SD	Salt content ± SD	Water activity ± SD	Average color ± SD		
				L*	a*	b*
T1	62.90 ± 3.01	1.50 ± 0.44	0.91 ± 0.3	75.30 ± 2.23	3.88 ± 0.76	41.75 ± 5.01
T2	66.31 ± 2.30	1.51 ± 0.50	0.92 ± 0.3	75.93 ± 1.13	4.35 ± 1.06	43.65 ± 2.40
T3	61.39 ± 3.52	1.25 ± 0.11	0.92 ± 0.4	76.85 ± 0.72	5.03 ± 0.35	42.80 ± 1.13
T4	62.76 ± 3.50	1.08 ± 0.13	0.97 ± 0.3	75.60 ± 2.27	5.23 ± 1.80	43.18 ± 6.43

Description: The moisture content, salt content, Aw, and yolk color ($L^*a^*b^*$) of salted eggs were not significantly affected ($P > 0.05$) by the addition of black tea extract

3.1 Moisture Content

The results of this study showed that the moisture content of salted eggs was not significantly impacted ($P > 0.05$) by the addition of black tea extract. Salted eggs with an average moisture content of T1 (62.90%), T2 (66.31%), T3 (61.39%), and T4 (62.76%) ranged from 61.39% to 66.31%. This study's average value was lower than that of a study [11] that found that chicken eggs treated in a saturated salt solution for seven days with cherry leaves (*Muntingia calabura L.*) added had a moisture content ranging from 63.07 to 71.68%. Because salted eggs with a lower moisture content have a longer shelf life, it's preferable to salted eggs with a higher moisture content. Foods with a high moisture content are particularly susceptible to bacterial and fungal contamination, which can compromise their quality and perhaps cause damage while being stored [12]. Foods with a high moisture content are not as good as those with a low moisture content since it have a shorter shelf life.

With an average value of 66.31%, T2 (25% black tea extract) had the highest percentage of moisture content, whereas T3 (50% black tea extract) had the lowest percentage of water content (61.39% on average). Although the wet method of processing salted eggs contributes to the product's high moisture content, the amount of salt added during the treatment may also be a contributing factor. Because the viscosity of the soaking solution had comparatively little effect on the rate of diffusion and osmosis, cherry leaves (*Muntingia calabura L.*) at 0%, 10%, 20%, and 30% were added to salted chicken eggs with no difference in moisture content [11]. Tanning can

coat the eggshell's pores and inhibit microbe growth to preserve the egg's longevity. Black tea extract has a tannin concentration of about 7.44% [6]. This indicates that the tannin in black tea extract is still insufficient to seal the eggshell's pores and stop the moisture content of salted eggs from rising. Other sources of tannin that can be used to make salted eggs are herbal ingredients (sapang wood, garlic, and bay leaves) in salted duck eggs showing a moisture content value of 35.63–43.40% [24], lower than the results of this study, possibly because this study only used one type of ingredient, namely black tea extract. Ingredients containing tannins, essential oils, flavonoids, and eugenol have a better taste in salted eggs [25].

3.2 Salt Content

The results of the study showed that the treatment of adding black tea extract did not have a significant effect ($P > 0.05$) on the salt content of salted eggs. Based on the results of the analysis of variance, the average salt content of salted eggs was obtained, namely T1 (1.50%), T2 (1.51%), T3 (1.25%), and T4 (1.08%). The salt content value with the highest percentage was in treatment T2 (25% black tea extract) with an average of 1.51%, while the percentage of salt content in treatment T4 (75% black tea extract) with an average value of 1.08%. The addition of black tea extract in making salted eggs was known to have no significant effect, but the average salt content of salted eggs given black tea extract showed a significant decrease in each treatment. The salt content of salted eggs in this study did not require the criteria of SNI 01-4277-1996, which is a minimum of 2%. The addition of basil leaves (*Ocimum basilicum L.*) with concentrations of 5, 10, 15, and 20%) affects the salt content of salted duck eggs, with an average value of 2.75%–4.33% [13]. The difference in salt content of salted eggs is caused by the soaking ingredients, namely basil leaves (*Ocimum basilicum L.*) and black tea extract (*Camellia sinensis*) and different types of eggs. This shows that making salted eggs using chicken eggs soaked in black tea extract has a lower salt content than using duck eggs with the addition of basil leaves (*Ocimum basilicum L.*).

It is known that the increase in the concentration of black tea extract added during the processing of salted eggs is what caused the decrease in salt content, which ranged from 1.08 to 1.51% on average. The high concentration of basil leaves (*Ocimum basilicum L.*) added may also have contributed to the decrease in salt content because they contain flavonoids and tannins [14], which slow down the osmosis diffusion process and cause the salt content value to decrease. With an average value of 2.75–4.33%, the addition of basil leaves (*Ocimum basilicum L.*) at varying concentrations (5%, 10%, 15%, and 20%) significantly changed the amount of salt in duck salted eggs [14]. Using varying quantities of tanning chemicals and salt may have contributed to the discrepancy between the two research' results. This study's higher percentage of black tea extract was known to lower the salt content of eggs.

3.3 Water Activity (A_w)

The A_w value describes the size of the availability of water used in various activities and microbial growth in food ingredients [9]. The results showed that the treatment of adding black tea extract did not have a significant effect ($P > 0.05$) on the A_w value of salted eggs. The average A_w value of salted eggs was T1 (0.91), T2 (0.92), T3 (0.92), and T4 (0.97). The A_w value with the highest percentage was in treatment T4 (75% black tea extract) with an average value of 0.97, while the lowest percentage of A_w value was in treatment T1 (0% black tea extract) with an average value of 0.91. The provision of black tea extract showed that it could not affect the A_w of salted eggs because the treatment with the addition of black tea extract was not much different from the treatment without the addition of black tea extract. The use of low salt in the treatment is thought to result in moisture content not having a significant effect, so that it indirectly affects A_w .

Similar to previous studies, the average A_w value ranged between 0.91 and 0.97. The A_w of salted duck eggs that had 30%–60% white turmeric (*Curcuma zedoaria*) added ranged between 0.94 and 0.97. This is known to have no discernible impact due to the high moisture content, and the compounds in white turmeric (*Curcuma zedoaria*) are believed to be unable to lower the A_w of salted duck eggs. Low moisture content in an ingredients can preserve the shelf life of food goods, while high moisture content food additives can impact the high A_w [14]. It is known that the moisture content of the black tea extract, which is added when making salted eggs, contributed to the high A_w value in this investigation. The amount of water in salted eggs can be influenced by the amount of salt used. The moisture content may decrease depending on how much salt is applied during the salting procedure. The principle of salting eggs is the osmosis diffusion process, which is the process by which an ingredients of moisture content is decreased by injecting it with a high concentration solution [11]. Salt concentration and soaking time can affect the decrease in water content and water activity. The mechanism occurs because the salt solution enters the egg through the pores of the shell. The salt solution that enters the white part goes to the yolk. Salt is broken down into sodium ions (Na^+) and chlorine ions (Cl^-). Chlorine ions (Cl^-) will absorb water (H_2O), so that the water content is reduced and a sandy texture is obtained [22].

3.4 Color of Egg Yolk

L^* (lightness). The results of the study showed that the treatment of adding black tea extract did not have a significant effect ($P > 0.05$) on the color intensity L^* (lightness) of salted eggs. The average value of the color intensity L^* (lightness) of salted chicken eggs was between 75.30–76.85. The average value of the color intensity L^* (lightness) in each treatment was known to be almost the same, this shows that the addition of a higher concentration of black tea has not been able to significantly affect the color value of L^* salted egg yolks. The type of egg, steaming time and the added red galangal extract affect the color L^* (lightness) of the egg [16].

T3 (50% black tea extract) had the highest percentage of L* color intensity value (lightness), with an average value of 76.85. T1 (0% black tea extract) had the lowest percentage, with an average value of 75.30. With a yellow L* color value ranging from 55.06 to 65.42, the results of this study are known to be superior to those obtained when ginger flour (*Zingiber Officinale*) is added during the preparation of salted chicken eggs [17]. The protein in chicken eggs may be the reason for the variation in yolk color. This protein level, which is derived from the livestock's protein ration, is crucial to the egg yolk's quality. The type and quantity of carotenoid pigment that cattle consumes is the primary determinant of egg yolk pigmentation. The color of the egg yolk is significantly influenced by carotenoid pigments, which can give yellow, orange, or red hues [18].

a* (redness). The results showed that the treatment of adding black tea extract did not have a significant effect ($P > 0.05$) on the intensity of the a* (redness) color of salted eggs. The average value of the a* (redness) color intensity of salted eggs ranged from 3.88–5.23. The highest percentage of a* color intensity value was in T4 (50% black tea extract) with an average value of 5.23, while the lowest percentage value was in T1 (0% black tea extract) with an average value of 3.88. The addition of black tea extract in the manufacture of salted eggs was known to have no significant effect on the a* color of salted eggs, but the average value of each treatment showed a significant increase, T1 (3.88), T2 (4.35), T3 (5.03), and T4 (5.23). Based on these average values, it can be seen that the higher the concentration of black tea extract added, the more the red component in salted eggs will increase.

While the a* color value of salted duck eggs with the addition of basil leaves (*Ocimum basilicum L.*) ranged from 19.98 to 23.95 [13], the average a* color intensity (redness) of salted eggs ranged from 3.88 to 5.23. It is speculated that dark-colored essential oils contribute to this decline and make the egg yolk more like to greenish yellow. Black tea, which yields a dark red solution when brewed, was used in this investigation. Some of the catechins in black tea will be broken down during the fermentation process into the yellow-colored aflavin and reddish-brown-colored arubigin chemicals [19].

b* (yellowness). The results showed that the treatment of adding black tea extract did not have a significant effect ($P > 0.05$) on the color intensity b* (yellowness) of salted eggs. Based on the data in Table 1, the average value of the color intensity b* (yellowness) of salted chicken eggs ranged from 41.75–43.65. The color intensity value b* with the highest percentage in T2 (black tea extract 50%) with an average value of 43.65, while the lowest percentage value was in T1 (black tea extract 0%) with an average value of 41.75. The color value b* (yellowness) in this study was higher than the addition of Potassium Iodate (KIO₃) b* (yellowness) color of salted duck eggs ranged from 25.17–32.33 [20]. This is thought to be due to the loss of water content in the yolk of salted chicken eggs. Water content can affect the concentration of pigments, so that the change in yellow color is related to the reduction of water and fat from the yolk. The water content of boiled duck eggs is 68.06%, decreasing to

67.45% after salting, so it is concluded that the water content decreases to 6.7% lower [21].

The results of this study show that the greater black tea concentration does not affect the salted egg yolks b^* color value. No color change occurs when any extract is applied during the cooking of salted eggs. The yolk of a salted egg turns orange when the salt content is substituted for the salting content [22]. The water content of salted chicken eggs will drop, and the yolk's color will turn orange due to the high salt concentration [23]. Adding 15% pandan leaves (*Pandanus amaryllifolius Roxb*) to salted eggs can increase the antioxidant activity and IC50 values. Likewise, organoleptic attributes include color, taste, texture, and aroma [26].

4 Conclusion

After implementing the wet method for making salted chicken eggs, the inclusion of black tea extract had no effect on the salted egg's water content (61.39%–66.31%), salt content (1.08–1.51%), Aw (0.91–0.97), or color (L^* 75.30–76.85, a^* 3.88–5.23, b^* 41.75–43.65).

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

References

1. Central Statistics Agency. Production of Laying Hen Eggs by Province (Tons), 2020–2022. Jakarta: Central Statistics Agency. (2022)
2. Central Statistics Agency. Average Per Capita Consumption Per Week According to Egg and Milk Groups Per Regency/City (Commodity Unit), 2022. Jakarta: Central Statistics Agency. (2022)
3. S. Handayani, Q. Munawwaroh. Increasing Business Income through Product Innovation (Case Study on Salted Egg Business “Yekti Waluyo Wonodadi” Blitar East Java). National Conference on Economic Education. 1425–1452. (2016)
4. H. Silondae, A. Ulpah. Improving the Eggs Quality to Maintain on Tea Solution. Jurnal Penelitian Pascapanen Pertanian. **12**(3), 124–128. (2015)
5. I.R.D. Anjarsari. Cultivation Engineering and Post-Harvest Handling to Improve the Quality of Indonesian Tea as a Functional Beverage Rich in Antioxidants. *Kultivasi*. **21**(2), 152–158. (2022)
6. D. Kurniati, V.P. Bintoro, B. Dwiloka. The Effect of Soaking in Green Tea and Black Tea on Water Content, Fat Content, Protein Content, and Hedonic Quality of Boiled Duck Eggs. *Journal of Nutrition Collage*. **9**(3), 197–201. (2020).
7. A. Engelen, S. Umela, A.A. Hasan. The Effect of Salting Time on Making Salted Eggs Using the Wet Method. *Jurnal Agroindustri Halal*. **3**(2), 133–141. (2017)
8. A. Budiman, A. Hintono, K. Kusrahayu. The Effect of Roasting Time of Salted Eggs After Boiling on NaCl Content, Saltiness Level and Elasticity Level. *Animal Agriculture Journal*. **1**(2), 219–227. (2012)

9. T. Ulfah, Y. Pratama. V. P. Bintoro. The Effect of Basil Proportion on Water Activity (Aw) and Water Content of Raw Basil Crackers. *Jurnal Teknologi Pangan*. **2**(1), 55-58. (2018)
10. A. Engelen. Sensory and Color Analysis in Making Salted Eggs Using the Wet Method. *Jtech*. **5**(1), 8-12. (2017)
11. D.A. Pratiwi, D. Septinova., R. Sutrisna, R. Riyanti. The Effect of Adding Cherry Leaf Solution on Water Content, Protein Content, and Fat Content in the Process of Making Low Sodium Salted Eggs. *Jurnal Riset dan Inovasi Peternakan*. **7**(4), 572-579. (2023)
12. G. Bidura. *Technology in the Feed Industry*. Denpasar: Udayana University Press. (2017)
13. P. Ramadhani, I. Thohari, H. Evanuarini. The Effect of Adding Basil Leaves (*Ocimum basilicum* L.) in Making Salted Eggs on Salt Content, Fat Content, Free Fatty Acid (FFA) Content and Egg Yolk Color. *Repository Universitas Brawijaya*. (2017)
14. E. Kasi, G.E.M. Malelak, H. Armadianto, G. Oematan. The Effect of Adding White Turmeric (*Curcuma zedoaria*) on Water Activity, Total Plate Count (TPC), *Staphylococcus aureus* and *Escherichia coli* in Salted Eggs. *Jurnal Nukleus Peternakan*. **9**(1), 113-117. (2022)
15. National Standardization Agency. *Salted Egg*. SNI 01-4277-1996. Jakarta: National Standardization Council. (1996)
16. A.E. Lestary, I. Thohari, F. Jaya. The Effect of Addition Red Galangal (*Alpinia purpurata* K. Schum) Concentrated on Moisture content, Salt Content, pH, and Color of Egg Yolk on Salted Egg. *Repository Universitas Brawijaya*. (2015)
17. D.A. Pundiswara, J. Sumarmono, S.S. Sentosa. The Effect of Adding Ginger Flour (*Zingiber Officinale*) to the pH and Color Salted Chicken Eggs. *ANGON: Journal of Animal Science and Technology*. **3**(3), 233-241. (2021)
18. Y. Astriana, P. Widiyaningrum, R. Susanti. Yellow Color Intensity and Omega-3 Levels of Quail Eggs Due to the Provision of Sea Ants. *Life Science*. **2**(2), 105-110. (2013)
19. F.S. Rejeki, D. Puspitasari, E.R. Wedowati. Addition of Tea Extract to the Characteristics of Wet Noodles. *Journal of Research and Technology*. **4**(2): 103-112. (2018)
20. S.P.U. Yudho, I. Thohari, A. Susilo. The Effect of Adding Potassium Iodate (KIO₃) on Iodine Content, Water Content, pH, and Egg Yolk Color in Salted Eggs. *Maduranch: Jurnal Ilmu Peternakan*. **2**(2), 59-66. (2017)
21. H. Oktaviani, N.K.T. Martuti, N.R. Utami. Effect of Salting on the Nutritional Content of Duck Eggs Given Shrimp Waste. *Life Science*. **1**(2), 106-112. (2013)
22. Y. Triono, N. Hidayah, M.H. Septian. Organoleptic Properties and Water Content of Salted Egg Yolk of Magelang Duck with the Addition of Secang Wood Extract (*Caesalpinia sappan* L.). *JITP*. **10**(1), 11-17. (2022)
23. T. Yassa, Tamrin, W. Rahmawati, Warji. Studying the Effect of Temperature and Concentration of Salt Solution on the Content of Salted Chicken Eggs. *Jurnal Agricultural Biosystem Engineering*. **2**(2), 321-324. (2023)
24. R. Fauzi, P.D. Wulansari, A. Kusmayadi. Differences in Concentration of Herbal Ingredients on Acidity Level, Water Content and Fat Content of Herbal Salted Eggs. *Bulletin of Applied Animal Research*. **4**(2), 47-52. (2022)
25. Nur'aini, N. Suningsih, M. Hakim. Organoleptic Test of Salted Eggs with Addition of Herbal Plants. *Indonesian Journal of Agricultural Research*. **3**(3), 171-178. (2020)
26. Khatima, N. Nahariah, W. Pakiding. Antioxidant Activity, Organoleptic Quality of Salted Eggs with Pandan Leaves Addition. *Hasanuddin J. Anim. Sci*. **6**(1), 47-59. (2024)

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

