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# Proximate Quality of Low-Sodium Salted Egg

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**Abstract**: This study aims to determine the use of low-sodium salt for the proximate quality of salted eggs. The research method used a complete randomized design with P0 control treatment, 10% P1 low sodium salt treatment, 20% P2 low sodium salt treatment, and 30% P3 low sodium salt treatment. Analysis data was carried out on the contents of water, protein, lipid, and ash content. The data were analyzed using SPSS with a significance level of 0.05. The results indicated that the water content of egg whites and egg yolks was not significantly different from the treatment of ordinary salt and low sodium salt treatment. The lipid content was also not significantly different at all treatments. Protein content, ordinary salt treatment, and low sodium salt provided a noticeable difference in egg white protein content ($p<0.05$). Making salted eggs using low-sodium salt produces salted eggs with the similar proximate quality as the control with the lower sodium levels than the control treatment.

**Keywords:** Duck egg; Low-sodium; Salted egg

## Introduction

Salted egg is a popular processed product derived from duck farming in the community (Deng et al., 2022; X. Li et al., 2022; Su et al., 2021). Salted eggs are liked by people of all ages, including children, teenagers, and adults (Arthur, 2017; Benjakul et al., 2017; Chen et al., 2023). Salted eggs are produced by either soaking them in a salt solution or by adding a paste of salt and clay or ash, with the addition of salt over a specific period of time (Ruan et al., 2018; Yu et al., 2022). Salted eggs that are considered good by consumers are typically gave a firm yolk, a vibrant yellow color, and are oily (Sumekar et al., 2021; X. Wang et al., 2021; Xiao et al., 2023).

Salted eggs are a product of preserving eggs using salt (Liu et al., 2022; Ruan et al., 2018; Shi et al., 2021; Srisai et al., 2023). Salt is a food additive that can act as a preservative, forming a salty taste or improving the texture of food (Jiang et al., 2019). During the salting process which lasts for certain time, it results in changes in the chemical composition and texture of salted eggs (Kaewmanee et al., 2009). Salt is a chemical compound with the main composition being NaCl with impurities in the form of $CaSO_4$, $MgSO_4$, $MgCl_2$, and others (Guo et al., 2020; B. Li et al., 2019; T. H. Wang, 2017).

The use of salt as a salty taste in food makes salt a major requirement in various food industries, which makes salt consumption by some people considered excessive than physiological needs, making them susceptible to hypertension and cardiovascular complications (Ren et al., 2021). The WHO recommended salt consumption per person in each day is 5 grams/day, which is equivalent to sodium consumption of 2000 mg/person/day. According to the research by Prihatini et al. (2015), the average salt consumption of Indonesians is 2764 mg/day, which means it is above the WHO recommended limit. As a result, reducing salt consumption needs to be encouraged. It will have a positive impact on reducing blood pressure, reducing the incidence of hypertension, and is suitable for reducing the burden of cardiovascular events (Yao et al., 2023). Low salt consumption can be done by consuming foods with the low in sodium (B. Li et al., 2019; Ligen et al., 2022; Muchlis et al., 2019).

Low-sodium salt is known as healthy salt, namely salt that has a sodium content composition of 60% of ordinary salt. Low-sodium salt has the advantage of

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being able to balance blood pressure. In this regard, making salted eggs using low sodium salt has not been widely studied, making the researcher is interested to examine the relationship between the proximate quality of salted eggs using low sodium salt (Bao et al., 2021; Irmawaty et al., 2022; F. Li, 2023; Q. Li et al., 2023; Wongnen et al., 2023).

## Method

*Place and Time*

The research was carried out from May to July 2023 in the Laboratory of the Faculty of Animal Husbandry, Jambi University.

*Tools and Materials*

The tools used in this research included porcelain cups, crucible tongs, triangular wire, scales, oven, desiccator, Bunsen, electric furnace, Kjeldahl flask, measuring glass, volumetric flask, Erlenmeyer flask, filtering flask, Soxhlet, reflux cooler, Buchner funnel, and spatula. Analysis of sodium levels was carried out using the AAS method.

*Experimental Design*

The experimental design was carried out using a Completely Randomized Design (CRD) with treatments:
P0 = Using ordinary salt with a salt concentration of 30%
P1 = Using low Sodium salt concentration of 10%
P2 = Using low Sodium salt concentration of 20%
P3 = Using low sodium salt concentration of 30%

*Making Salted Eggs*

Salted eggs were prepared by immersion in salt solution according to the treatment for 14 days. Then, the eggs were analyzed for water content, protein content, lipid content, ash content, and sodium content. The experiment consisted of four treatments with four replications so that 16 experimental units were obtained. Each treatment consisted of 25 duck eggs. Statistical data analysis was carried out using SPSS, through the DMRT follow-up test (Cresswell, 2017; sugionno, 2019).

## Results and Discussion

The nutritional quality of food is often correlated with the number of basic compounds present in certain food products. The content of carbohydrates, lipids, and proteins in food products is often used as an indicator in assessing the importance of a food. Eggs contain water, protein, lipid, and minerals. However, the eggs also contain carbohydrates, minerals, amino acids and vitamins. During the immersion process in the salt solution, an osmosis process occurs between the mineral salts and water in the egg white and then migration to the egg yolk (Suretno et al., 2021).

*Salted Egg Water Content*

Eggs commonly contain high water. According to Xu et al. (2017), duck egg has a water content of 76.53% to 84.88%, which consists of egg whites and egg yolks. There is a process of reducing the water content during the process of making salted eggs (Irmawaty et al., 2022). In this study, the water content of salted eggs in the egg white averaged 85.11% and the yolk egg averaged 33.81%. Statistically, the treatment of ordinary salt and low sodium salt was not significantly different, which means it did not affect the water content of either the egg both white or the yolk parts. The analysis results of the water content of egg whites and yolks are shown in Figure 1.

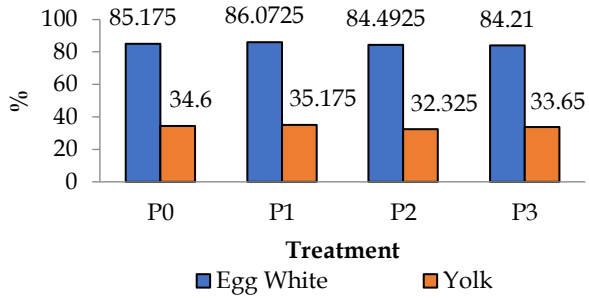


**Figure 1.** Water content of salted eggs P0 = control, P1 = 10% low sodium salt, P2 = 20% low sodium salt, P3 = 30% low sodium salt

The water content of salted eggs varies greatly. Research by Novia, 2016 mentioned that the water content of salted eggs is 70.96%, while according to Mangalisu et al. (2022) the water content of salted eggs is between 80.32–81.61%. The difference in the water content of salted eggs is influenced by the origin of the salted eggs, the process of making salted eggs, and the salt content used.

*Lipid Content*

The highest lipid content in eggs is found in the yolk, the lipid content of egg white in this study ranged from 1.0 - 1.3%, and the lipid content of egg yolks was 38.39 % - 45.39%. The results of statistical analysis of the lipid content of salted eggs in both the control salted eggs and low sodium salted eggs did not show a significant difference in either the egg white or egg yolk. The observation results are presented in Figure 2.

The lipid contained in egg yolk consists of lipoproteins, phospholipids, triacylglycerol, and cholesterol. According to Lilian et.al 2018, the lipid content in egg yolk is dominated by Low Density Lipoprotein (LDL). The amount of LDL in egg yolk is

68% and HDL is 16%. The dehydration process and increasing sodium (salt) levels in egg yolks cause protein denaturation, which changes the structure of LDL. This change results in the release of lipid from LDL micelles. Lipid exudation and protein denaturation cause salted eggs to be oily and salty. These two things have a very important role in determining the quality of salted eggs. In this study, the measured lipid content did not show a significant difference between regular salted eggs and low sodium salted eggs ($P < 0.05$). The lipid content of salted eggs ranges from 0.84% - 1.76% in egg white and 41.37% - 43.72 % in egg yolk.

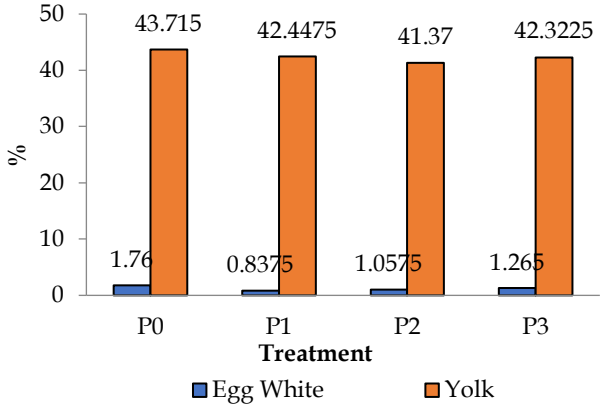


**Figure 2.** Lipid content of salted eggs P0 = control, P1 = 10% low sodium salt, P2 = 20% low sodium salt, P3= 30% low sodium salt

*Protein Content*

Suretno et al. (2021) reflects duck eggs as a source of high nutrition with the protein content in duck eggs around 13.1%. During the process of making salted eggs, a diffusion process of sodium ions occurred. The influx of sodium ions causes denaturation of the globular proteins which then formed salted eggs.

The treatment of salt and low sodium salt provided a significant difference in the protein content of egg whites ($p<0.05$). In the control process, the use of P0 ordinary salt (7.45 ± 0.70%) was not significantly different from the P3 treatment (8.49 ± 1.15%) and P1 treatment (8.86 ± 1.53%), but was different from the 20% low sodium salt treatment (P2) (9.86 ± 1.41%). The use of 20 % (P2) low sodium salt did not differ significantly in protein content with 10% (P1) and 30% (P3) low sodium salt treatment. The treatment with P0 salt and low sodium salt provide a significant difference in the protein content of the egg yolk ($p<0.05$). In P0 control, the use of 30% ordinary salt (P0) with a protein content of 14.49% ± 0.5 was not significantly different from the low sodium salt treatment of 10% P1 and 30% P3. However, the low sodium salt content of 20% (P2) was significantly different with P0 salt treatment (control) at 10% low sodium salt (P1), but was not significantly different from 30% low sodium salt content (P3). The results of protein analysis are presented in graphical form as shown in Figure 3.

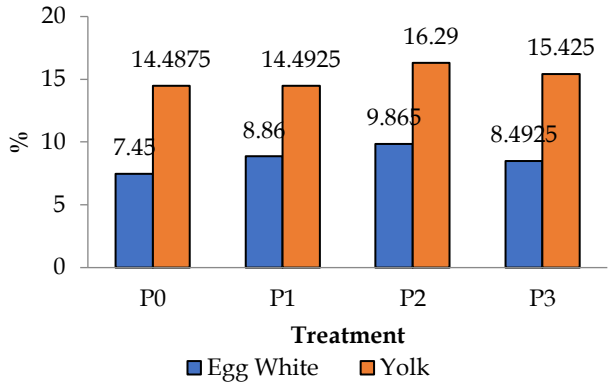


**Figure 3.** Salted egg protein content P0 = control, P1 = 10% low sodium salt, P2 = 20% low sodium salt, P3 = 30% low sodium salt

*Ash Content*

The ash content of an organic material reflects the mineral content contained in the organic matter. In this study, treatment with ordinary salt and low sodium salt had no effect on egg white and egg yolk ash contents at $p<0.05$. In the control treatment, the ash content of egg white was 1.62 ± 0.17%. The low sodium salt treatment of 10%, 20%, and 30% respectively was 1.64 ± 0.18%, 1.95 ± 0.10%, and 1.78 ± 0.32%, while for egg yolk respectively are: Control treatment 2.35 ± 0.12%, 10% low sodium salt treatment 2.5 ± 0.08%, 20% low sodium salt treatment 2.50 ± 0.17%, and 30% low sodium salt treatment 2.41 ± 0.16.

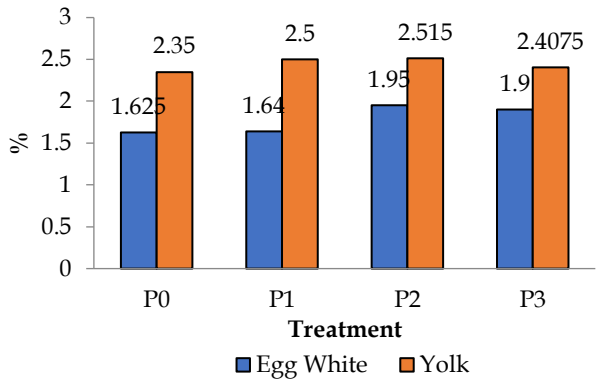


**Figure 4**. Salted egg ash content P0 = control, P1 = 10% low sodium salt, P2 = 20% low sodium salt, P3 = 30% low sodium salt

Ahmad et al. (2017) mentioned that ash content of fresh duck eggs is between 0.93 - 1.09%, while for salted eggs of the research results ranged from 1.62 - 2.50%. This value is not significant different from the research results by Sari et al. (2015), which was 1.19 - 2.53% but it was very different from research by Ganesan et al. (2014) which was 7.5%. This difference is related to the different length of the salting process.

*Sodium Levels*

The sodium content in eggs reflects the process of salt osmosis in eggs, which was influenced by the length of the soaking process and the sodium salt content (collogative properties of the solution) provided during the process of making salted eggs. The results of sodium analysis in this study are shown in Table 1.

**Table 1**. Sodium Analysis

| Treatment | Egg white % | Egg yolk % |
|---|---|---|
| P0 Control | 1.0963.50 a | 0.6074.25 a |
| P1 | 0.5492.75 b | 0.1733.00 b |
| P2 | 0.8995.00 c | 0.2606.50 c |
| P3 | 0.9144.75 c | 0.5751.25 d |

From the table above, it is found that the sodium content of the control salted eggs contained the highest salt of 1.096% for egg white and 0.607% for egg yolk. The control treatment was significantly different from the P1, P2, and P3. The P1 treatment was significantly different from P2 and P3, while P2 and P3 were not significantly different. In the control treatment of egg yolk, sodium levels are obtained at 0.607% which is the highest value and each treatment shows a significant difference at $P<0.05$.

During the salting process, NaCl enters the egg white solution and continues into the egg yolk. The control egg white NaCl level of 1.096% is much lower than the results of Rukmiasih's study, et al. 2015 by 3% for egg white, but the NaCl content in egg yolks in this study is higher than Rukmiasih et al. (2015) research, with 0.607%.

The entry of NaCl salts in the form of $Na^+$ ions and $Cl^-$ ions by diffusion into the egg causes the release of the fatty acid bonds in the lipoproteins which can be physically seen by the discharge of oil from the egg yolks. The release of lipoprotein fatty acids also has an impact on protein bonds forming the *masir* texture of the egg yolk.

## Conclusion

According to the result of this study, it can be concluded that making salted eggs using low sodium salt produces salted eggs with proximate quality similar to the control group but with a lower sodium content than the control.

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**Author Contributions**

Investigation, H.S and M.M; formal analysis, H.S and M.M; investigation, H.S and M.M; resources, H.S and M.M; data curation, H.S and M.M : writing—original draft preparation, H.S and M.M ; writing—review and editing, H.S and M.M: visualization, H.S and M.M ; supervision, H.S and M.M; project administration, H.S; funding acquisition, H.S and M.M. All authors have read and agreed to the published version of the manuscript.

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**Conflicts of Interest**

We certify that there is no conflict of interest with any financial, personal and other relationships with other peoples or organization related to the material discussed in the manuscript.

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