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KADAR AIR, KADAR LEMAK, DAN DERAJAT KEASAMAN TELUR ASIN ASAP DENGAN PERLAKUAN PENAMBAHAN JAHE DAN KUNYIT

WATER CONTENT, FAT CONTENT, AND ACIDITY DEGREE OF SMOKED SALTED EGGS WITH THE ADDITION OF GINGER AND TURMERIC

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Abstract. *Duck eggs contain high levels of protein but are easily damaged, so preservation is necessary. One method of preservation is salting, either through the wet method by salt soaking or dry by salt wrapping. This process aims to preserve eggs, reduce the fishy smell, and provide a distinctive taste. In addition, salted eggs can also be preserved through smoking, which can extend their shelf life and can be enriched with herbal ingredients such as ginger and turmeric. Research on the effects of turmeric and ginger is expected to improve the quality, durability, and nutritional content of salted eggs. This study aims to examine the effect of adding ginger and turmeric on the water content, fat content, and pH of herbal smoked salted eggs, and to determine the optimal concentration of the two herbal ingredients that can affect the water content, fat content, and pH of herbal smoked salted eggs. The study was conducted using a completely randomized design (CRD) method, involving 4 treatments and 5 replications. The treatments applied in this study were variations in the addition of herbal ingredients, namely 0%, 7.5% turmeric, 7.5% ginger, and a combination of 7.5% turmeric with 7.5% ginger. The results showed that the addition of herbal ingredients with different concentrations significantly affected the water content and fat content of herbal smoked salted eggs (P<0.01), but did not significantly affect the pH value (P>0.01). The addition of 7.5% ginger and a combination of 7.5% ginger + 7.5% turmeric produced the best water content, while the best fat content was obtained from a combination of 7.5% ginger + 7.5% turmeric.*

Keywords : *herbs, ginger, salted eggs, smoking, turmeric.*

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INTRODUCTIONS

The livestock sector is a very important part in meeting the need for animal protein, especially through the provision of products such as eggs, milk, and meat. Duck eggs, in particular, have a much higher protein content than chicken eggs, which is certainly very beneficial for the human body in supporting various biological functions. However, duck eggs have weaknesses in terms of shelf life because they are susceptible to damage, both physically, chemically, and micro-

biologically, which can affect their quality and durability. To reduce egg spoilage and extend their shelf life, preservation methods are needed (Prisilia and Syahbanu, 2023). The simplest and most widely used egg preservation method by the community is by salting or making salted eggs. The process of making salted eggs makes eggs last longer because salt not only provides a salty taste but also functions as a preservative. The salt that penetrates the eggs acts as an antiseptic and controls microorganisms that can cause decay (Li *et al.*, 2022).

Duck eggs have thicker shells compared to chicken eggs, and they also taste better, making them very suitable for processing into salted eggs. Another advantage of duck eggs is the larger pores in their shells, which allows the absorption of salt into the albumen (egg white) and yolk to take place more effectively. The salting process aims to preserve eggs, reduce the fishy smell that is usually found in poultry eggs, and create a distinctive taste that is very much liked by many people. Table salt is used as the main preservative in this process because it has the ability to prevent egg rot, thus increasing the shelf life of eggs for a longer period of time. There are two common salting methods used in the egg preservation process, namely the wet method, which involves soaking the eggs in a salt solution, and the dry method, which is done by wrapping or wrapping the eggs with salt dough mixed with ash.

In addition to the salting process, salted eggs can also be further processed by smoking, which is one way to preserve eggs so that they can last longer. This smoking process serves to cover the pores in the eggs, so that it can extend their shelf life (Jaelani and Zakir, 2018). Smoking salted eggs can enrich the taste, especially if spices such as ginger and turmeric are added. Ginger *(Zingiber officinale)* is a very popular spice in Indonesia, which contains high antioxidants such as gingerol, shogaol, and zingerone, which have various health benefits. Turmeric (*Curcuma domestica* Val.) is also an equally important spice, which contains curcumin, a compound that gives turmeric its yellow color and has anti-inflammatory and antioxidant properties. Turmeric is often used in traditional medicine to treat digestive problems, inflammation, and as a supplement to improve body health. Therefore, further research on the effect of adding ginger and turmeric in smoking salted eggs is very important to determine their impact on the quality of salted eggs, especially in terms of water content, fat content, and pH, all of which affect the shelf life and nutritional quality of these herbal smoked salted eggs.

Friska and Daryono (2017) reported that ginger is an abundant, readily available herb that has seen an increase in production and exports. Ginger contains bioactive compounds such as gingerol, shogaol, and zingerone, which act as antioxidants and antimicrobials, making it a potential natural preservative. The addition of red ginger to salted eggs is an innovation designed to enhance the product's appeal while inhibiting oxidation, reducing rancidity, and extending the shelf life of the food product. Additionally, turmeric contains curcuminoids, particularly curcumin, which exhibit antioxidant, anti-inflammatory, and antimicrobial activities. These compounds have the potential to inhibit the

growth of microorganisms responsible for fishy odors and spoilage in salted eggs. However, its effectiveness is influenced by the condition of the eggs, the salting process, and the concentration of curcuminoids used (Pratama *et al.*, 2025). These two ingredients have never been used as herbal ingredients in the production of salted eggs. This research is expected to provide deeper insight into the benefits of natural spices in improving the taste, shelf life, and nutritional content of salted eggs, so that it can produce healthier, more nutritious, and longer-lasting products.

MATERIALS AND METHODS

1. Materials

In the process of making herbal smoked salted eggs, the ingredients used include 100 Cihateup duck eggs from Sukanagalih Village, Tasikmalaya, The turina-2 variety of turmeric and elephant ginger were obtained from Rajapolah Traditional Market, Tasikmalaya, salt, ash, bricks, coconut fiber, coconut shells, and water. Some of the equipment needed include sandpaper, basins, stoves, pans, spatulas, measuring cups, digital scales, jars, smoke machines, knives, plates, spoons, trays, pens, and notebooks. As for chemical test analysis, the equipment used includes measuring cups, cups, beaker glasses, Erlenmeyer flasks, ovens, HCl solutions, distilled water, desiccators, pH meters, filter paper, fat flasks, Soxhlet apparatus, electric heaters, analytical scales, and fat-free cotton.

2. Making Herbal Smoked Salted Eggs

The process of making salted eggs begins by cleaning the eggs using sandpaper to open the pores of the shell. After that, the eggs are coated with a mixture made of 500 grams of salt, ash, bricks, and additional herbs that are adjusted to different treatments, namely P0 (without adding herbs), P1 (7.5% Turmeric), P2 (7.5% Ginger), and P3 (7.5% Turmeric + 7.5% Ginger). After the mixture is evenly mixed, make sure the eggs are tightly coated without any parts missing. The eggs that have been coated with the mixture are then put into a jar according to the sample and treatment applied. The eggs are then incubated for 21 days. After being incubated, the eggs are harvested and boiled in boiling water at a temperature of 90°C for 30 minutes. After boiling, the eggs are cooled, and put back into the jar. The next step is smoking, using coconut fiber and shells as fuel. The eggs are arranged on the rack of the smoking machine, and the machine is tightly closed. The bottom of the machine is turned on to produce smoke that will enter the top where the eggs are. The smoking process is carried out for 5 hours until the eggs turn brown. After smoking is complete, the eggs are removed, cooled, and stored back in the jar.

3. Data Analysis

The obtained data will be analyzed using a one-way ANOVA, and if the results indicate a highly significant difference ($P < 0.01$), a post hoc test specifically Duncan's Multiple Range Test (DMRT), will be conducted The mathematical model of the Completely Randomized Design (CRD) is expressed as:

$$Yij = \mu+\alpha i+\varepsilon ij$$

Description:

Yij	=	Measurement results on treatment i and repetition j
μ	=	Overall average value
Ai	=	Impact of treatment i
εij	=	Effect of experimental error from treatment i on repetition j
I	=	Treatment (1, 2, 3, and 4)
j	=	Repetition (1, 2, 3, 4, and 5)

RESULTS AND DISCUSSION

1. Water Content

The results of the ANOVA test analysis conducted in this study related to the effect of adding ginger and turmeric on the water content of herbal smoked salted eggs are presented in Table 1.

The addition of herbal ingredi-ents to the water content of herbal smoked salted eggs showed a highly significant difference ($P < 0.01$). The average water content value obtained in this study in treatments P0 - P3 ranged from 22.03-32.66%. The results of the Duncan test at a significance level of 1% showed that the P0 treatment was not significantly different from P1, with water content values of 22.03-23.35% respectively. This shows that P0 and P1 obtained lower water content compared to P2 and P3, which had water content in the range of 31.58-32.66%. The increase in moisture content in herbal smoked salted eggs containing ginger and turmeric is not caused by the direct addition of water by carbohydrates, but rather by the physicochemical properties of the bioactive compounds they contain. Ginger and turmeric contain polysaccharides and phenolic compounds that are hydrophilic, enabling them to attract and bind water molecules via hydroxyl groups (–OH), which leads to increased water retention within the egg matrix (Mao *et al.*, 2019).

Additionally, the compounds in ginger and turmeric possess high water-binding capacity. Free water in salted eggs can transform into bound water due to interactions with these components, resulting in an apparent increase in moisture content upon analysis. This phenomenon is common in food products enriched with plant-based bioactive compounds due to enhanced water-holding capacity (Tinello and Lante, 2020). Furthermore, interactions occur between the active compounds and the proteins and structure of the egg. Curcuminoids from turmeric and gingerol from ginger can interact with egg proteins, causing changes in the protein matrix structure, making it more porous or better able to retain water. This interaction enhances water stability within the system, thereby increasing moisture content without the addition of external water (Li *et al.*, 2024).

Previous research results stated that the optimal water content in salted eggs to achieve a mashed texture is in the range of 30% to 35% (Triono *et al.*, 2022). In this study, the optimal water content was obtained by adding 7.5% ginger and 7.5% ginger + 7.5% turmeric in the P2-P3 treatment, which produced a water content of 32.66–31.56. This range is considered capable of providing a balance between softness and dryness, thus producing a product that is liked by consumers and has better storage stability. Water content is one of the important parameters in making salted eggs, because it directly affects the quality of texture, taste, and shelf life of the product. Excessive water content can cause the egg texture to become soft and accelerate

Table 1. Average analysis of the water content of herbal smoked salted eggs

Treatments	Water Content (%)
P0 (Without added herbs)	22.03 ± 2.26^{B}
P1 (7.5% Turmeric)	23.35 ± 4.45^{B}
P2 (7.5% Ginger)	32.66 ± 3.00^{A}
P3 (7.5% Ginger and 7.5% Turmeric)	31.58 ± 5.37^{A}

Note: Superscripts with different letters indicate very significant differences in each treatment (P<0.01).

Table 2. Average analysis of Fat content of herbal smoked salted eggs

Treatments	Fat Content (%)
P0 (Without added herbs)	15.13 ± 0.03^{C}
P1 (7.5% Turmeric)	9.87 ± 0.02^{D}
P2 (7.5% Ginger)	25.77 ± 0.02^{A}
P3 (7.5% Ginger and 7.5% Turmeric)	22.61 ± 0.01^{B}

Note: Superscripts with different letters indicate very significant differences in each treatment (P<0.01).

the proliferation of microorganisms, while water content that is too low can cause the egg to have a hard or dry texture (Triono *et al.*, 2022). Therefore, the optimal water content is needed to produce salted eggs with sandy-textured namely a soft texture, not wet, and easily disintegrated in the mouth.

2. Fat Content

The results of the ANOVA test analysis conducted in this study related to the effect of adding ginger and turmeric on the water content of herbal smoked salted eggs are presented in Table 2.

The addition of herbal ingredients to salted eggs showed a very significant difference (P <0.01) in fat content. The average fat content obtained in treatments P0 - P3 was 9.87-25.77%. Duncan's test results at the 1% level showed that each treatment had different values where P1 had the lowest fat content and the treatment with the highest fat content was P2. The average fat content in this study was lower than that of Engelen *et al.*, (2017), which had an average value of 21.14-37.74%, while the average fat content in this study was 9.87-25.77%. This statement is in line with Kusbiantoro (2018) who stated that turmeric contains around 1-3% fat which can reduce fat content. Meanwhile, according to Verenzia et al. (2022) stated that the fat content in ginger reaches 11.23%, which shows that ginger has a higher fat content than turmeric.

The fat content in turmeric does not directly reduce fat levels in eggs, but rather acts through an indirect mechanism related to its bioactive properties. Curcuminoids, particularly curcumin, possess antioxidant activity capable of inhibiting lipid oxidation, thereby maintaining fat stability and preventing degradation during processing (Jasim *et al.*, 2024). Additionally, turmeric may interact with lipid components or affect fat extraction efficiency during analysis, causing measured fat content values to shift without a corresponding actual reduction in fat within the egg

(Ligen *et al.*, 2022). This may be due to the salting process, which can alter lipid distribution as salt diffusion affects the structure of the egg yolk membrane, thereby facilitating fat redistribution. Meanwhile, smoking at certain temperatures can trigger protein denaturetion and the melting of some lipid fractions, making the lipid composition more susceptible to changes. The addition of ginger and turmeric helps maintain lipid stability because antioxidants such as gingerol and curcumin can inhibit lipid degradation during the process (Xu *et al.*, 2017, Wibawanti *et al.,* 2017).

During the smoking process, exposure to heat and oxygen can accelerate lipid oxidation, characterized by the formation of peroxide compounds and rancidity. However, the bioactive compounds in ginger and turmeric possess antioxidant activity that can scavenge free radicals and slow down lipid oxidation reactions. Additionally, smoking can trigger lipid migration from the egg yolk to other parts due to changes in osmotic pressure, but the presence of herbal compounds can help stabilize this system (Draszanowska *et al.*, 2022). Phenolic compounds from ginger and turmeric can interact with lipids and lipoproteins in eggs through hydrophobic and hydrogen bonds. These interactions can form more stable complexes, thereby reducing lipid damage and enhancing resistance to oxidation. Curcumin and gingerol are also known to inhibit lipid peroxidation reactions by donating hydrogen atoms to free radicals, thus preserving the quality of fats in smoked salted eggs (Harlina *et al.*, 2023).

Previous studies have shown that the optimal fat content in salted egg yolks is in the range of 13.60% to 25.04% (Engelen *et al.*, 2017). In this study, the addition of 7.5% ginger + 7.5% turmeric in the P3 treatment showed the best results, with a fat content range of 22.61. This variation is influenced by several important factors, such as the salting method, type of additional ingredients and duration of egg incubation (Engelen *et al.*, 2017). Higher fat content generally provides a more savory taste and a more brittle egg yolk texture (Wibawa *et al.*, 2024). Therefore, the selection of salting methods and additional ingredients should be adjusted to production objectives and consumer preferences, both in terms of taste, texture, and nutritional content. This approach will help produce salted eggs with balanced sensory and nutritional quality.

3. Acidity Degree

The results of the ANOVA test analysis conducted in this study related to the effect of adding ginger and turmeric on the water content of herbal smoked salted eggs are presented in Table 3.

The results of statistical analysis in this study showed that the treatment with the addition of ginger and turmeric herbs did not have a significant effect ($P > 0.01$) on the pH of herbal smoked salted eggs. The average pH value ranged from 7.32-7.54. The highest average value was 7.54 in treatment P1 and the lowest average was 7.32 in treatment P3. This is in line with the research of Nurmila *et al.,* (2023) which showed that the addition of herbs had no significant effect on the pH levels of salted eggs, the pH results in the study ranged from 6.54-7.24.

Table 3. Average pH analysis of herbal smoked salted eggs

Treatments	pH
P0 (Without added herbs)	7.48 ± 0.25
P1 (7.5% Turmeric)	7.54 ± 0.29
P2 (7.5% Ginger)	7.53 ± 0.21
P3 (7.5% Ginger and 7.5% Turmeric)	7.32 ± 0.20

Description: There was no significant difference between each treatment (P>0.01).

Previous research has shown that the pH levels of salted eggs can vary depending on the salting method, the type of ingredients used, and the length of storage. In general, the pH value of salted eggs is in the range of 6.1 to 7.91 depending on the combination of these factors (Cahyono *et al.*, 2022).

The results of the pH levels in this study were in the range of 7.32 to 7.54, so it can be said to be in a good category for smoked salted eggs, because it is in the optimal pH range to maintain product quality and durability. Maulana *et al.* (2024) stated that salted eggs with a lower pH tend to have fewer bacteria, which contributes to better egg quality and a longer shelf life. This is in line with research by Pratiwi *et al.* (2023), which found that increasing pH in salted eggs can cause an increase in water content, which risks accelerating the rotting process.

The moisture content of salted eggs is primarily influenced by the osmosis process during salting, in which salt draws water out of the egg's tissue, resulting in water movement and changes in its distribution. Additionally, processing steps such as heating or smoking can cause protein denaturation and water evaporation, which result in a decrease or redistribution of moisture content within the egg. Meanwhile, pH does not directly affect moisture content, but it can alter protein structure; these changes can affect the proteins' ability to bind water, thereby indirectly influencing water retention within the system (Xu *et al.*, 2017). Higher pH values tend to make the protein in eggs more easily degraded, so that the texture and aroma of the eggs can change more quickly during storage. Therefore, the pH range obtained in this study, namely 7.32 to 7.54, shows that the smoked salted egg product produced is in the standard quality category. This is important to ensure that the product remains safe to consume and has a quality that meets the expected standards.

CONCLUSION

Based The addition of herbal ingredients with different concentrations in the manufacture of herbal smoked salted eggs significantly affects the water and fat content, but does not significantly affect the pH value. The results showed that the addition of 7.5% ginger and a combination of 7.5% ginger + 7.5% turmeric as herbal ingredients produced the best water content, while the combination of 7.5% ginger + 7.5% turmeric produced the best fat content.

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