Effect of Different Salting Treatments on Salted Egg's Sensory Properties

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Abstract. Salted egg is one of the traditional and popular preserved egg products. Therefore, this study aims to observe the characteristics change of salted chicken eggs at different methods (dry and wet) and different salt concentrations (20% and 30%) with two different durations, namely 16 days and 21 days. The results of this salted egg experiment were also compared with salted commercial and hedonic tests. Duo-trio tests and triangle tests were also carried out. Sensory analysis was also carried out in this experiment by appointing five panelists. The hedonic test showed that most of the panellists chose salted eggs made by the wet method for 16 days with a salt concentration of 20%. Meanwhile, from the duo-trio test, all panelists chosen eggs were made using the wet method for 16 days with a salt concentration of 20%. The results on the triangle show that all panellists chose salted eggs were made using the wet method for 21 days with a salt concentration of 20%.

Keyword: Salted Egg, Salted Commercial, Hedonic Tests, Sensory Analysis, Salt Concentration

1. INTRODUCTION

Due to their unique flavor, appetizing taste, and high nutrient content, salted eggs, a traditional Chinese egg product, are a favorite among Chinese customers and have gained tremendous popularity in other Asian nations. The yolk of the salted egg is what consumers enjoy most. The nutrition value present in salted eggs is 14%, 16.6% of fat, and 4.1% of carbohydrate (Ganesan et al., 2014). The egg whites are quite salty since they contain at least 7–10% sodium chloride, although they don't have a very appealing flavor or scent (NaCl) (Wang et al., 2015). The salted egg yolk is tastier and more nutritious than the salted egg white due to its soft and gritty qualities, scent, beautiful color, and plenty of nutrients, such as fat, protein, lecithin, carotenoids, vitamins, and minerals (Wang et al., 2015). Preservation of eggs aims to maintain quality and extend the shelf life of eggs. Increasing the consumption of salted eggs can be done by making salted eggs using wet or dry methods. The salted eggs' quality will depend on how long they are salted using the wet or dry method. Research on the effects of salting time on duck eggs' fat content, pH, NaCl content, and water

content, is required to determine this quality (Wibawanti, et al., 2014). The purpose of the experiments is to identify the ideal salting period and the salt concentration for the preservation of eggs and perform sensory analysis and tests to know if there is a significantly different between the salted egg produced and the commercial one.

2. LITERATURE REVIEW

Salted egg yolks are frequently used as a component in specialty foods or as a filling for classic Chinese dishes including mooncake, and egg yolk puffs. In order to develop the unique "fresh, fine, tender, loose, gritty and oily texture" features and superior storage properties, which are the result of a series of physicochemical changes, the production of salted eggs typically requires the treatment of fresh duck eggs with a high salt concentration. Although the salting procedure offers the eggs a number of exceptional qualities, it also adds a significant quantity of salt to the eggs; for example, the salt concentration in the egg whites can increase by 7% to 10% after salting (Xu et al., 2017). An imbalance in the sodium to potassium ratio brought on by a long-term high-salt diet can lead to diseases (e.g., hypertension). Additionally, a high salt diet can cause edema because it increases the quantity of extracellular fluid in the body (Wang et al., 2015).

The water content of the egg white and yolk gradually reduced, the water content of the egg yolk significantly fell, the viscosity of the egg white decreased, and the oil production of the egg yolk increased as the curing period was extended. The yolk particles become free as the yolk ball shrinks, and the flowing oil fills in the spaces between the yolk balls. According to Wang (2015), excessive salt penetration results in a significant difference in salt concentration between the inner and outside of the yolk, which seriously gelatinizes the eggs even when the oiling effect is outstanding when the curing period is too long (Li et al., 2022).

As pickling progresses, salted eggs' salt content and degree of dryness both rise gradually, giving rise to the thicker gel network structure of duck egg yolks with fewer holes. A high salt concentration causes the egg yolk to undergo demulsification, which causes the chemical bond to gradually strengthen and the gap between egg yolk particles to close, which causes the egg yolk's outer layer to gradually harden. The gradual conversion of insoluble ovomucin to soluble ovomucin in the egg white may be the cause of the lowered egg white viscosity in the presence of high salt concentration. The egg white's protein molecular structure is simultaneously stretched by sodium ions, which increases the probability that proteins will aggregate randomly and creates the rough texture that results from cooking. Compared to salted egg yolks made by simply configuring a certain concentration of pickling liquid, those made by gradually adding salt are sandier. The results show that salt content has a direct impact on the rate at which salt enters during pickling, and that rate is a significant factor influencing the texture of salted egg yolk sand (Li et al., 2022).

Through the panellists' senses of sight, smell, taste, touch, and hearing, the sensory analysis evaluates the qualities of a product or food (texture, flavor, taste, appearance, fragrance, etc.) (Ruiz-Capillas & Herrero, 2021).

Seven-point hedonic scales were employed in the hedonic test. With like and dislike on each end and a neutral point in the centre, these hedonic scales are bipolar scales.

Because it is effective at demonstrating differences in the degree of liking among products, the scale rapidly became the favored hedonic scaling method. It is currently perhaps the most commonly used measurement for this purpose (Heymann & Ebeler, 2017).

For the products that have a rather strong taste, smell, and/or physical impact that may impair sensitivity, the duo-trio test can be useful. The duo-trio test identifies whether product variations are related to variations in ingredients, processing, packaging, or storage. It also determines whether there are overall variations when no identifiable individual characteristic has been changed (Johnson, 2021).

A discriminating test known as the triangular or triangle test is primarily intended to determine if there is or is not a noticeable sensory difference between two items. In order to provide enough high-quality data for statistical analysis, it makes use of trial sizes and procedures. Informed information may be offered and solid conclusions can be drawn from these research studies to assist business choices to be made in the best possible way (Sinkinson, 2017).

3. MATERIALS AND METHODS

The materials used in this experiment were six chicken eggs, sea salt, water and ash. As for the methodology used, there are two, namely the dry method and the wet method.

In the dry method, first, the eggs were cleaned with water and dried. Then, 300 grams of ash were weighed and placed in a cup. 20% salt weighed from 300 grams of ash, and mixed evenly, as same for the 30% salt concentration. The egg was placed in the cup and made sure the entire surface of the egg was buried evenly and left the egg desired for a long time (16 days or 21 days). After 16 days or 21 days, the eggs were cleaned of ash and boiled for around 15 minutes with small heat, so the egg did not crack. The eggs could be rinsed, cooled, and ready to eat.

For the wet method, first, the eggs were cleaned with water without drying. Then, both of the food containers were filled with water to ¾ full. 20 grams was added and stirred in the first container and 30 grams of salt was added and stirred in the second container. The eggs were then placed in each container and weighed using plastic that has been filled with water, so that the eggs didn't float. 5. After 16 days or 21 days, the eggs are cleaned of ashes and boiled for about 15 minutes on a small amount of fire, so that the eggs did not break. Eggs can be rinsed, cooled and ready to eat.

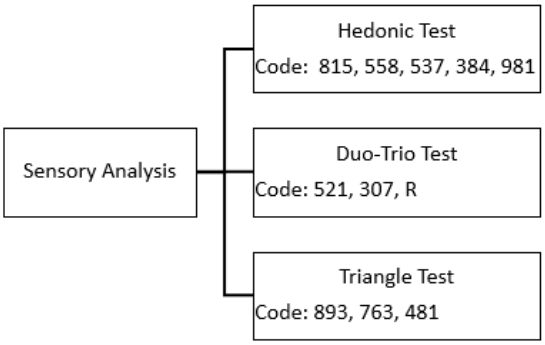

Figure 1. *Sensory Analysis Diagram*

Sensory analysis was conducted to analyze the result of the experiment. The sensory analysis is divided into three tests, hedonic test, duo-trio test, and triangle test. In the hedonic test, the result was compared based on the difference of method and salt concentration. Meanwhile, In the duo-trio test the panellists were provided with three samples, two coded with three-digit random codes and one labelled as reference or R. the panellists identified the sample that matches the reference (Heymann & Ebeler,

2017). The triangle test is the preferred method in balanced reference test bus in some circumstances. In the triangle test, three types of salted egg were served based on its method. The codes in the diagram above are explained in the table 1.

Table 1. *Sensory Analysis Test Code*

Concentration of Salt	Method	16 Days	21 Days	30 Days
20 %	Dry	384	893	-
	Wet	521, 815	307, R, 763	-
30 %	Dry	537	487	-
	Wet	558	-	-
Commercial duck egg, salting time directly rubbed with salt	Wet	-	-	981

4. RESULT AND DISCUSSION

In the experiment, 6 types of salted eggs were made with different methods, duration, and salt concentration. The methods used were dry and wet methods. In dry methods, the egg was buried inside salting media, which consist of a mixture of rice husk ash and salt. In the wet method, the egg was put into the salt water. The duration of each egg was also different with 16 and 21 days for both methods. For each method and duration, the egg was also categorized based on the salt concentration, which is 20% and 30% salt in the mixture of salt solution. All of the eggs used in making salted eggs were chicken eggs.

After all of the eggs were harvested, a sensory analysis test was conducted to describe the differences between all of the eggs qualitatively and quantitatively.

Table 2. *Physical Appearance of Salted Eggs*

Types of Eggs	Picture
Chicken Egg, dry method, 16 days, 20% salt	
Chicken Egg, dry method, 21 days, 20% salt	
Chicken Egg, dry method, 16 days. 30% salt	
Chicken Egg, wet method, 21 days, 20% salt	
Chicken Egg, wet method, 16 days, 20% salt	

Chicken Egg, wet method, 16 days, 20% salt	
Commercial Duck Salted Egg from Market, with wet method and 30 days salting time directly rubbed with salt	

4.1. QUALITATIVE

Qualitatively, eggs from each category can be distinguished by their physical appearance like color and moisture of their texture. The table below shows the picture of each egg.

4.1.1. COLOR

From the color it was very clear that the eggs using the wet method had a darker color than the eggs using the dry method. The reason behind this was because the eggs were soaked in salt water, the salt could easily penetrate the eggshell with the help of water, whereas in the dry method, the salt did not easily penetrate the eggshell. The science behind it was that egg shells were mainly made of calcium carbonate, which dissolves in salt solution and produces carbon dioxide, which was pretty much just gas. If the eggshell wants to be removed, vinegar can also be added in this wet method, but since the purpose was just to thin the shell enough to let the salt penetrate faster, that was why the yolk in the wet method had a darker color than its counterparts (Fatwa et al, 2020). On the other hand, the dry method was less affecting the color of the yolk, less because the salt itself was not easy to enter the eggshell without any help from water.

As can be seen from table 2, the duration of salting the egg also affects the color of the yolk. The longer the duration it takes under salt solution, the darker the yolk of the egg. It was because the salt solution had more time to penetrate into the yolk. In comparison, egg number 7 was a salted duck egg from the market. It is clearly to be seen that the yolk from the duck egg was far darker because of the longer duration of the salting process. Another factor is that the duck egg yolk was oilier, so it appears darker than the chicken counterpart. The duck egg has bigger pores on its shell, making the absorption of salt much better (Fatwa et al, 2020).

The next parameter that could be compared was the salt concentration in the solution, it appeared that the salt concentration was not affecting the color of the yolk. It seems that the 20% and 30% salt concentration was not distinct in yolk color.

4.1.2 TEXTURE

Physical appearance can also be compared to its texture. Very clearly from the pictures can be seen that the salted egg from the wet method had a moister texture than the salted egg from the dry method. It is pretty self-explanatory because the wet method uses water as a medium to transfer the salt inside the egg. Besides the difference in method, the difference in duration and salt concentration did not really seem to affect the texture of the yolk as well as the egg white.

4.2. QUANTITATIVE

In this experiment on the salted egg, sensory analysis was also conducted to collect data about the quantitative aspects of the various salted eggs made in this experiment. The panellists in this sensory analysis were 5 panellists and there were three types of tests conducted, which is the hedonic test, duo-trio test, and triangle test. The data from these three tests will be further explained below.

4.2.1. HEDONIC TEST

In the hedonic test, there were seven-point hedonic scales used. These hedonic scales are bipolar scales with like and dislike on each end and a neutral point in the middle. The scale quickly spread as the preferred hedonic scaling instrument because it works well in showing differences in the degree of liking among products and is still likely the most used scale for this purpose (Heymann & Ebeler, 2017).

In the hedonic test, the result was compared based on the difference in method and salt concentration. As a comparison, duck salted egg was also included in the test product, to compare the homemade chicken salted egg and duck salted egg on the market.

Table 3. *Hedonic Test Data*

	815	558	384	537	981
Panellist 1	6	5	2	1	7
Panellist 2	6	1	3	6	1
Panellist 3	4	3	5	6	2
Panellist 4	6	3	1	2	6
Panellist 5	5	4	1	2	6

1 – Strongly disliked
2 – Moderately disliked
3 – Slightly disliked
4 – Indifferent
5 – Slightly liked
6 – Moderately liked
7 – Strongly liked

From table 3 for the hedonic test, the 815 was the most liked salted egg for the panellists. There were total of 4 panellists stating that the egg with code 815, which was salted egg with the wet method and 20% salt concentration, had the right taste for a salted egg, not too salty nor too bland. It had more votes as more likable than the salted egg from the market. On the other hand, the 384 was the most disliked of all salted eggs, because it tasted just like a regular egg, hence not salty enough. If the most liked and most disliked were to be compared, it has a very significant difference in the method and also salt concentration. It was clear that the wet method can bring more salt inside the egg, as explained in the qualitative section above. That is why the egg from the dry method does not taste salty enough, in comparison with the most salted egg, which uses the wet method. In general, the wet method is the preferred method to use for salting eggs.

The salt concentration was also another factor to produce the right taste for the salted egg. Both of the eggs with a 30% salt concentration in their solution were slightly disliked by the panellists. The panellists preferred the salted egg with 20% salt concentration in its solution, except the

most disliked salted egg, which used a dry method. The panellists assumed using a 30% salt concentration was just too much, because it makes the egg too salty, especially when combined with a wet method.

From this hedonic test it can be assumed that the best way or the most preferred way to produce homemade salted egg using chicken egg is by using wet method and 20% salt concentration. In comparison with the salted egg from the market, the most liked salted egg even has the upper hand. It was more liked by the panellists by a small margin. The main reason was the saltiness. Some panellists disliked the duck salted egg because it was just too salty for their liking.

From this hedonic test, it can be assumed that the best way or the most preferred way to produce homemade salted egg using chicken egg is by using the wet method and 20% salt concentration. In comparison with the salted egg from the market, the most liked salted egg even has the upper hand. It was more liked by the panellists by a small margin. The main reason was the saltiness. Some panellists disliked the duck-salted egg because it was too salty for their liking.

To support the assumption of the hedonic test, an ANOVA test was conducted to see if there are real differences between the products. Analysis of Variance (ANOVA) is an analysis tool used in statistics that splits an observed aggregate variability inside a data set into two parts. The ANOVA was used to determine the influence that independent variables have on the dependent variable in a regression study. If no real difference exists between the tested groups, which is called the null hypothesis, the result of the ANOVA's F-ratio statistic will be less than the F-crit. From the table above, by using ANOVA single factor, the result of the F-ratio will be determined below (Setyaningsih, 2010).

Table 4. *ANOVA Test of Hedonic Test*

Source of variation	SS	*df*	*MS*	*F*	*P-value*	*F crit*
Between groups	19.3	4	4.825	1.3099	0.31097	3.05
Within groups	55.25	15	3.6833			
Total	74.55	19				

In table 4, the F-value is 1.3099 and the F-crit is 3.05. It is clearly to be seen that the F-value is lesser than F-crit, that means there is no real significant differences from the product tested in the hedonic test.

4.2.2. DUO-TRIO TEST

In the duo-trio test, the panellists were provided with three samples, two coded with three-digit random codes and one labelled as reference or R. the panellists identified the sample that matches the reference. The underlying concept is that if the panellists can perceive the difference between the two products, then they will correctly match the reference. However, if they cannot perceive the difference then they will randomly pick one of the samples as matching the reference and they would have a one in two chance of guessing correctly (Heymann & Ebeler, 2017).

Two types of salted eggs were served based on the differences in their salting duration between 16 days and 21 days in the duo-trio test. The salted egg served was using a wet method and had 20% salt concentration in

its media solution. So, the most preferred way to make a salted egg from the hedonic test was used for the salted egg in this duo-trio test. The reference was the salted egg with 21 days salting duration.

Table 5. *Duo-Trio Test Data*

521	307
~~IIII~~	-

From table 5, all of the panellists chose the 521 or the salted egg with 16 days of salting duration. This means that there was a major difference in saltiness level regarding the salting duration. The salted egg with code 307 was the same as the reference. The salted egg with 16 days of salting duration tasted less salty than the reference. The panellists all successfully choose the right salted egg, which is the one that is different from the reference. It was safe to assume that the salting duration can greatly affect the saltiness of the salted egg.

Table 6. *Table of Significance at Various Probability Levels for Duo-Trio Test*

Number of Panellist	Probability Levels		
	5%	1%	0.10%
5	5	-	-
6	6	-	-
7	7	-	-
8	8	8	-
9	8	9	-
10	9	10	-
11	10	11	11

In table 6, the minimum number of correct responses to reject the null hypothesis of "no difference" at selected significance levels with a total number of panellists was shown. In this test, 5 panellists chose the right product, therefore the probability significance level is 5% based on the table above. Thus, it fulfils the minimum number of correct responses to reject the null hypothesis of "no difference" by 5%. (Setyaningsih, 2010).

4.2.3. TRIANGLE TEST

The triangle test is the preferred method in balanced reference test bus in some circumstances, for example, when one product has limited availability or when the panellists are extremely familiar with one of the products, this triangle test can be used. In the triangle test, all three samples are coded with three-digit random codes and the panellist is asked to identify the odd sample between these three samples. Like in the duo-trio test, if the panellists can perceive the difference between the two products, then they will correctly identify the odd sample. However, if they cannot perceive the difference then they will randomly pick one of the samples as being odd and they would have a one in three chance of guessing correctly (Heymann & Ebeler, 2017).

In the triangle test, three types of salted eggs were served based on the method. The panellists were tasked to pick which sample had different flavors and aromas. The salted eggs used were salted for 21 days with 20% of salt concentration in its media solution. The data from this triangle test was going to be used to see if the difference in method, which is the dry and wet method, can have a major difference in the flavor and aroma of the salted egg.

Table 7. *Triangle Test Data*

	893	763	487
Flavor	-	IIIII	-
Aroma	-	IIIII	-

From table 7, all the panellists chose the 763 for the most different salted eggs served in the test. Based on its flavor and aroma, the difference in the method used to process salted eggs can distinguish the salted egg from one another. The salted egg using the wet method was clearly different and saltier than the other two samples from the dry method. All of the panellists also correctly chose the right answer, so it is safe to assume that the difference in the method can differentiate the flavor and aroma of the salted egg produced.

Table 8. *Table of Significance at Various Probability Levels for Triangle Test*

Number of Panellist	Probability Levels		
	5%	1%	0.10%
1	-	-	-
2	-	-	-
3	3	-	-
4	4	-	-
5	4	5	-
6	5	6	-
7	5	6	7

In table 8, the minimum number of correct responses was showed. In this test, 5 panellists chose the right product, therefore the probability significance level is 1% based on the table above. Thus, it fulfils the minimum number of correct responses to reject the null hypothesis of "no difference" by 1%.

5. CONCLUSION

The result of several sensory analysis showed that the method to produce a salted egg, salting duration, and salt concentration contained in the media have major influences on the characteristics of the salted egg. The wet method is preferred because it is easier to penetrate the eggshell with the help of water resulting in the duration of the salting process can be faster, hence more effective. However, the dry method is also a reliable method, just it takes more time than the wet method. This also explained the salting duration and salt concentration in the media. It is very clear that the longer the salting duration is, the saltier the egg becomes. Likewise, the more salt concentration inside the media used, the saltier the egg becomes.

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