Effect of salting on the antioxidant capacity of duck egg

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ABSTRACT: Antioxidant activities of duck eggs are mainly contributed by the amino acids and carotenoids that found in the egg white and egg yolks. In Thailand, the duck eggs are sold majorly as salted duck eggs. This study was aimed to evaluate the prolonged salting on the antioxidant activity of duck eggs. The prolonged salting (0, 7, 14, 21 and 28 days) of duck eggs was shown the increased salt level, amino acid contents (aspartic acid, asparagine, serine, glycine, threonine, arginine, alanine, tyrosine, tryptophan, methionine, phenylalanine and leucine) and slightly increased of zeaxanthin and decreased of lutein content in the eggs. The antioxidant activities were gradually increased during salting. The present study showed that salting had significantly influenced the antioxidant capacity of duck eggs.

Keywords: duck egg, salting, amino acids, carotenoids, antioxidant activities

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Introduction

Eggs are an essential part of the human diet, and they are readily available, very inexpensive and provide quality nutrition to wide varieties of consumers. Duck eggs are similarly nutritious as hen eggs and are most commonly eaten in Thailand especially, in the salted form and as well as pedan forms. Duck eggs supply a large amount of complete, high-quality protein (which contains all essential amino acids for humans), and provide significant amounts of several vitamins and minerals (Venkatachalam, 2018). Salting or curing is one of the most traditional and accessible techniques for preserving egg products. The customer anticipates higher value in egg yolk than in egg white. The desirable characteristics of salted egg yolk include orange color, oil exudation, and gritty texture. During pickling, the yolk gradually becomes solidified and hardened. The egg white loses viscosity and becomes watery (Chi and Tseng, 1998). Traditionally, salted eggs are produced by the coating method. Raw duck eggs were dipped in a mixture of clay, solar salt, and water. Duck eggs were covered with coating paste by dipping them for three times in the mixture to obtain a thickness of approximately 2 millimeters. Thereafter, coated eggs were covered with rice chaff ash.

Usually, the egg white of the salted duck eggs had a lower moisture content, pH value, emulsifying capacity, and emulsifying stability, but higher ash and salt content than the fresh eggs (Huang, 2011). Typically, apart from the essential nutritional benefits of duck eggs, they also contribute various critical biological activities including antimicrobial, antioxidant, antihypertensive, immunomodulatory and antiadhesive properties. Antioxidant activities are the most exciting bioactivity that is attracting considerable interest by many as it is capable of controlling various chronic diseases including heart disease and cancer. Though the antioxidant activities of duck eggs have been studied by several researchers, and mostly they have focused on the raw eggs. Egg proteins and derived peptides, amino acids, phospholipids, vitamin E, carotenoids and phosvitin are contributing the antioxidant activity in the duck eggs. The antioxidant activities are highly sensitive and may vary in the duck eggs depend on the types, processing and storage conditions. A very few studies have focused on the duck eggs antioxidant properties, and however, there are few or none on focusing on the antioxidant activity that influenced by the salting and cooking conditions. Therefore, the present study was aimed to investigate the effect of salting and cooking on the antioxidant activities of duck eggs.

Material and methods

Raw material preparation

The duck eggs (Khaki Campbell) were collected from a local egg producer in the Chaiya district, Surat Thani province. The eggs were collected in the different stages (0, 7, 14, 21 and 28 days) of the salting period and once the eggs have reached the laboratory, they were thoroughly washed of dirt and mud coating using tap water. Then, the eggs were racked and used for various quality measurements.

Quality measurements

For determination of salt content, the egg whites were separated from the yolk and follow the preparation and measurement of salt content using the method of Tan et al. (2016). The results were expressed in percentage. For determination of amino acid content, the eggs were freeze-dried, and then, 150 mg of freeze-dried eggs were extracted using the 6% trichloroacetic acid (1 ml) and then centrifuged at 6000 g for 20 min. then the supernatant was collected and measured of amino acids contents by HPLC analysis using the method of Ohkubo et al. (2006). The results were expressed as µg/g of the egg. For determination of carotenoids, duck yolks were used for carotenoid

measurements. Yolk samples were extracted and determined using the method of Schlatterer et al. (2006). Lutein and Zeaxanthin were measured in the yolk samples. The obtained results were expressed as µg/100g of egg yolk. For the determination of total antioxidant activity, oxygen radical absorbance capacity (ORAC) was used. The ORAC assay was conducted in the egg samples using the method of Nimalaratne et al. (2011). The results were expressed as µmol TE/g dried eggs.

Statistical analysis

All the experiments were conducted in triplicates. The data are shown in mean ± standard deviation. One-way ANOVA was applied to determine the significant differences ($P<0.05$) by using the SPSS software for windows. Duncan's multiple range test (DMRT) was applied to assess the significances of the mean differences.

Results and Discussion

The changes in salt, amino acid, carotenoids and antioxidant activities of prolonged salting of duck eggs are presented in Table 1. Salt content in the duck eggs was gradually increased as the salting period was extended. During the initial period, the salt content was 0.2% and whereas, the prolonged period was gradually increased to 5.12% (28 days). The salt infused mud coatings are the practical techniques for preparing the salted duck eggs. During treatment, the salt from the mud had gradually migrated from the outer eggshell to inner eggshell and consequently, it transferred to the egg white and yolk. Typically, saltiness of the egg white is more noticeable as compared to the egg yolks. Venkatachalam (2018) reported, prolonged salting of duck eggs was increased the salt content in the egg white and as well as it decreased the moisture content and water activity. Amino acid content in the duck eggs during the prolonged salting was found significant changes. Amino acids namely aspartic acid, asparagine, serine, glycine, threonine, arginine, alanine, tyrosine, tryptophan, methionine, phenylalanine, and leucine were found increasing during the prolonged salting and on the other hand, glutamic acid, glutamine, histidine, valine, isoleucine and leucine were found decreased. The changes in the amino acids of duck eggs are directly influenced by the total protein and their degradation during the salting period. The changes in the amino acid content exhibits that the prolonged salting period was significantly influence the protein content in the duck egg and causing the partial to complete aggregation and followed by degradation and thus leaching the small peptides and amino acids from the egg white and egg yolk (Ganesan et al., 2014). Carotenoids are the second major bioactive material after protein in eggs. Lutein and Zeaxanthin are the major carotenoids that found in the eggs. Normally the carotenoid contents in the eggs are directly linked to the feed that fed to the duck eggs. Nimalaratne et al. (2016) reported, the carotenoid content in the eggs were gradually decreased during the prolonged storage. In the present study, lutein content in the eggs were gradually decreased and whereas, the zeaxanthin was slightly increased. It might be the effect of lipid migration from yolk to the egg white, which could adversely have affected the carotenoid content in the egg yolk. Though, the differences in changes in these carotenoids had not widely affected. The total antioxidant activities of the duck egg during salting was significantly increased. It is in accordance with the results of amino acids and carotenoids as these are the direct contributors of the duck eggs antioxidant activities.

Table 1 Salt, amino acid, carotenoid and total antioxidant content of duck eggs during prolonged salting * Values were expressed as mean ± standard deviation (n=3), the different alpha-

Quality parameters*	Salting period (days)				
	0	7	14	21	28
Total salt	0.2±0.00^{a}	1.2±0.10^{b}	2.7±0.85^{c}	3.55±0.50^{d}	5.12±0.18^{e}
Amino acids (μg/g egg)					
Aspartic acid	511.2±59.5^{a}	559.7±41.1^{b}	589.1±1.45^{c}	598.5±5.6c^{d}	601.7±7.8^{cd}
Glutamic acid	1489±10de	1479.1±25.4^{d}	1441.5±5.6^{c}	1395.1±49^{b}	1377.2±22^{a}
Asparagine	380±26^{a}	382.8±18.9^{ab}	389.4±23^{ab}	396.3±40^{b}	404.5±48^{c}
Serine	695.5±13^{a}	701.1±45.1^{b}	711.4±39^{c}	715.8±35^{c}	710.6±29^{c}
Glutamine	401.9±24^{b}	399.5±11.4^{b}	387.9±43^{a}	385.4±48^{a}	385.4±17^{a}
Histidine	179.5±33^{a}	179.5±17.9^{a}	179.1±36^{a}	178.0±45^{a}	177.0±48^{a}
Glycine	214.5±29^{a}	224.3±11.5^{b}	225.3±20^{b}	227.8±15^{b}	232.4±27^{c}
Threonine	745.8±31^{a}	750.1±12.5^{b}	755.6±38^{bc}	759.1±22^{c}	762.1±10^{d}
Arginine	558.9±10^{a}	560.6±13.4^{b}	563.1±28^{b}	563.4±39^{b}	565.7±50^{b}
Alanine	278.7±46^{a}	280.1±18.4^{b}	282.3±19^{b}	285.3±44^{b}	290.0±32^{c}
Tyrosine	533.48±32^{a}	541.4±19^{b}	540.6±16^{b}	542.1±49^{b}	549.6±43^{c}
Tryptophan	81.2±17^{a}	82.9±11^{a}	84.5.9±14^{b}	91.7±30^{c}	95.6±11^{d}
Methionine	138.5±26^{a}	141.1±14.5^{a}	144.5±34^{b}	151.5±12^{c}	155.1±14^{d}
Valine	541.2±40^{c}	535.4±5.6^{b}	531.4±25^{b}	525.6±23^{a}	527.8±18^{a}
Phenylalanine	478.5±24^{a}	480.5±8.1^{b}	482.5±41^{b}	491.0±21^{c}	490.4±37^{c}
Isoleucine	411.4±42^{e}	399.8±40.1^{d}	387.9±50^{c}	380.9±27^{b}	373.8±45^{a}
Leucine	789.5±18^{a}	788.9±12^{a}	790.0±13^{a}	791.5±47^{a}	788.6±25^{a}
Lysine	944.8±35^{a}	945.4±45^{a}	955.4±37^{b}	958.1±11^{b}	960.1±41^{c}
Carotenoids (μg/100 g egg yolk)					
Lutein	1296±10^{c}	1288±15^{b}	1280±25^{b}	1214±5^{b}	1199±11^{a}
Zeaxanthin	789±7^{a}	799±11^{b}	801±5^{c}	805±10^{c}	811±13^{d}
Total antioxidant activity (μmol TE/g dried egg)	165±2.5^{a}	169±1.7^{b}	171±5.1^{c}	175±3.5^{d}	189±7.5^{e}

* Values were expressed as mean ± standard deviation (n=3), the different alphabet indicates the signifi cant difference.

Conclusion

The present study showed that prolonged salting of duck eggs could significantly influence the bioactive compounds in the duck eggs. Amino acids and carotenoids are the two essential chemicals that contribute to the egg's antioxidant activities. Amino acids and carotenoid contents were slightly influenced by the salting process. Though, it did not adversely influence the duck egg's antioxidant activities.

Acknowledgment

The author would like to thank Prince of Songkla University, Hatyai campus, and Surat Thani campus for the financial support through the Project grant no. SIT601320S. The author also would like to thank the Food Innovation and Product Development Laboratory for laboratory and equipment support.

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