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Research Article

PHYSICAL AND CHEMICAL PROPERTIES OF SALTED EGG WITH ADDITION OF CORIANDER SEED EXTRACT (*Coriandrum sativum* L.)

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ABSTRACT

The research aimed to determine the physical and chemical properties of salted egg with the addition of coriander extract. This research used a Factorial Completely Randomized Design (RALF) with two factors. The first factor (A) was the methods of making salted egg (coating and immersing) and the second factor (B) was the time of salting (0, 3, 6, 9, 12, 15 and 18 days). The analysis of variance showed that the method and time of salting as well as as their interactions had a significant effect on NaCl content of cooked egg white and yolk. The highest NaCl content of cooked egg white and yolk was found in the treatment of immersing method for 28 days with the value of NaCl content was 5.88% and 1.12% respectively .

INTRODUCTION

Egg is one of animal products that contain highly nutritious, tasty and affordable. Eggs are suspectible to damage caused by microorganism or chemical contamination (Belitz *et al*., 2009). Salted egg is one of the most popular preserved egg products in the world. Generally Indonesian people made salted eggs by two methods, namely the coating and immersing.

Research on adding spices to the production of salted eggs has been done including using garlic and basil leaves (Harlina *et al*., 2015; Evanuarini *et al*., 2017). The addition of these spices can increase the antioxidant activity and antibacterial of the salted eggs. Antioxidants are chemical compounds that can contribute one or more electrons to free radicals that they can inhibit, delay or prevent lipid oxidation. One of the kitchen herbs that contain antioxidants is coriander.

Coriander is one of the spices that are often used by the people of Indonesia. Linalool is the most essential type of essential oil contained in coriander seeds at 58 to 80.37%, antioxidants contained in coriander seeds include β-carotene, ascorbic acid (0.287 mg/ g), total polyphenols (18.7 mg/ g) and quercetin (0.608 mg/ g) (Bhulyan *et al*., 2009; Guerra *et al*., 2005; Anita *et al*., 2014).

This study examines the effect of salting method and the addition of coriander seed extract to the physical and chemical characteristics of the salted eggs.

MATERIALS AND METHODS

Egg materials

Fresh eggs of duck were derived from the farm of Sembawa, Banyuasin district, South Sumatera, Indonesia. Duck egg with weight range from 68 to 72 g were obtained within 2 days after laying. All of the eggs were washed up with tap water, left dry and the surface of the shell were rubbed by sandpaper.

The making of coriander extract

The coriander seed were derived from Palembang market, South Sumatera, Indonesia. The coriander seed were ground and passed through an 80 mesh sieve. The coriander flours mixed with water at 50°C and stirred for 8 minutes. The ratios of water and coriander flours were 1:1.

Preparation of salted duck egg

Fresh duck egg (A-Factor) were separated into 2 groups. The first group was coating paste (A1) (mixture of brick : ash : salt : coriander extract : water, 2:1:1:2:2.5) (w/w). The second group (A2) was immersing in the brine solution (mixture of water : salt : coriander extract, 5.5:1:2) (w/w). The ratios of media and

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eggs were 1.5:1. Duck eggs of both groups were stored at room temperature and taken every 3 days during salting up to 28 days (B-Factor). Salted egg prepared by coating and brining method were also washed with water and heated in boiling water for 10 minutes after water boiled. For each treatments 3 cooked egg white and yolk were manualy separated as samples. The data obtained were statistically analyzed by using analysis of variance (ANOVA) and honestly significant difference test (HSD) at the 5% level.

The physical and chemical analysis

Determination of salt contents of cooked egg white and yolk was measured by Sudarmadji *et al*. (1997). The physical analysis included water content, lightness (L*), redness (a*) and yellowness (b*) of cooked egg yolk. The lightness (L*), redness (a*) and yellowness (b*) of yolk salted egg was measured by using a Konica Minolta CR-10 Chromameter.

RESULTS

The NaCl content that were examined in salted egg as well as tabulated in Table 1. The average of lightness (L*), redness (a*) and yellowness (b*) value on salteg egg yolk as shown in Table 2.

Table 1 NaCl content and moisture content of cooked egg white and yolk

Treatments	NaCl content (%)		Moisture content (%)	
	Egg white	Egg yolk	Egg white	Egg yolk
A1B1	0.63 ± 0.03^{h}	0,40 ± 0.01^{f}	88.17 ± 0.07^{a}	44.20 ± 1.01^{a}
A1B2	1.45 ± 0.02^{g}	0.68 ± 0.06^{e}	87.17 ± 0.25^{a}	43.73 ± 1.12^{ab}
A1B3	2.45 ± 0.05^{f}	0.75 ± 0.01^{de}	84.32 ± 1.30^{abc}	40.95 ±0.40^{abc}
A1B4	2.86 ± 0.01^{de}	0.81 ± 0.07^{cd}	81.21 ± 2.01^{cde}	37.91 ± 3.06^{cd}
A1B5	2.95 ± 0.04^{de}	0.83 ± 0.01^{cd}	78.96 ± 1.63^{de}	37.11 ± 1.56^{cd}
A1B6	3.71 ± 0.12^{c}	0.88 ± 0.03^{bc}	74.77 ± 1.01^{fg}	34.07 ± 0.62^{d}
A1B7	5.75 ± 0.04^{a}	1.05 ± 0.01^{a}	72.30 ± 1.40^{g}	33.37 ± 0.69^{d}
A2B1	0.63 ± 0.03^{h}	0.40 ± 0.01^{f}	88.17 ± 0.07^{a}	44.20 ± 1.01^{a}
A2B2	1.59 ± 0.05^{g}	0.68 ± 0.04^{e}	87.11 ± 1.22^{a}	43.4 ± 0.52^{ab}
A2B3	2.52 ± 0.03^{ef}	0.80 ± 0.01^{cd}	86.33 ± 2.29^{ab}	41.06 ± 0.62^{abc}
A2B4	2.99 ± 0.04^{d}	0.87 ± 0.03^{bc}	82.87 ± 2.14^{bcd}	39.31 ± 2.73^{bc}
A2B5	3.16 ± 0.05^{d}	0.92 ± 0.01^{b}	79.87 ± 1.44^{de}	38.09 ± 1.88^{cd}
A2B6	4.94 ± 0.05^{b}	0.96 ± 0.01^{b}	77.87 ± 1.44^{ef}	36.36 ± 2.61^{cd}
A2B7	5.88 ± 0,11^{a}	1.12 ± 0.02^{a}	73.65 ± 0.48^{g}	33.73 ± 1.09^{d}

Value followed by the different letter is significantly different, according to Tukey’s at the probably level of 5%

Statistical analysis shown that factor A (methods of making salted egg), factor B (time of salting) and their interactions had a significant effect on NaCl content of cooked salted egg white and yolk. NaCl content increased up to days 28. There was a correlation between NaCl content and moisture content of cooked white and yolk salted egg.

Table 2 The lightness (L*), redness (a*) and yellowness (b*) of yolk salted egg

Treatments	L*	a*	b*
A1B1	82,50 ± 2.18^{a}	8,57 ± 2.66^{e}	40,67 ± 1.16^{a}
A1B2	81,97 ± 1.02^{ab}	8,97 ± 0.40^{de}	40,17 ± 2.28^{a}
A1B3	78,60 ± 0.89^{abc}	12,47 ± 1.32^{cd}	38,87 ± 0.75^{ab}
A1B4	76,97 ± 0.15^{bcd}	15,13 ± 0.81^{abc}	3,60 ± 4.00^{abc}
A1B5	71,57 ± 1.97^{de}	15,97 ± 0.42^{abc}	30,20 ± 1.70^{cde}
A1B6	68,40 ± 2.85^{e}	17,13 ± 0.35^{a}	26,47 ± 1.60^{efg}
A1B7	51,70 ± 1.51^{g}	17,97 ± 0.25^{a}	23,17 ± 1.94^{fg}
A2B1	82,50 ± 2.18^{a}	8,57 ± 2.66^{e}	40,67 ± 1.16^{a}
A2B2	80,03 ± 0.91^{abc}	9,03 ± 0.96 ^{de}	40,13 ± 1.88^{a}
A2B3	78,67± 1.18^{abc}	13,27 ± 1.26^{bc}	35,80 ± 0.87 ^{abc}
A2B4	78,20 ± 1.05^{abc}	15,93 ± 0.25^{abc}	33,90 ± 2.51^{bcd}
A2B5	75,93 ± 3.31^{cd}	16,17 ± 0.47^{ab}	28,77 ± 0.21^{def}
A2B6	62,33 ± 2.51^{f}	18,00 ± 0.79^{a}	24,93 ± 0.57^{efg}
A2B7	50,97 ± 0.31^{g}	18,40 ± 0.46^{a}	21,87 ± 3.12^{g}

Value followed by the different letter is significantly different, according to Tukey’s at the probably level of 5%.

Statistical analysis showed that factor A (method of making salted egg) had a significant effect on the value of $b*$, factor B (time of salting) had a significant effect on the value of $L*$, $a*$ and $b*$. The interaction between factor A and B had significant effect on the value of $L*$ and $a*$. The longer of salting time, the lower value of $L*$ and $b*$ yolk.

DISCUSSIONS

The treatment of A2 (immersing method) has a higher NaCl content than the NaCl content in the treatment of A1 (coating method). During salting time, there is a difference concentration of salt exterior and interior of egg, it affected NaCl migrated until it reaches an isotonic (Kaewmanee, 2011). NaCl from the salting media migrated into egg white through the pores on the surface of the eggshell. The shell layer closest to egg white is called the membrane layer. The exterior of the cell is an cell membrane composed of lipids and proteins that function as channels (channels for solutes) and carriers (transport of substances that pass through the membrane) (Guyton and Hall, 2014). The coeffisient diffusion of NaCl into the yolk was slower than that of egg white because it has to pass through the eggshell and egg white and most components of the yolk consist of fat (Chen *et al*., 1998).

The kind of treatments and boiling using a temperature of 100^{o}C for 15 minutes caused a physical change of egg white from liquid to solid (coagulation). The ovomucin and mucin of egg whites play a role in the gel formation process. Egg white contains mucin was khalaza. Khalaza functions as a barrier to keep the yolk in the middle/center of the egg (Yuwanta, 2010; Romanoff and Romanoff, 1963). Therefore, the location of boiled salted egg yolk is no longer in the middle of the egg, but closer to the shell.

In addition, boiling treatment can increase the lipid exudation of egg yolks by 65.78%. During salting there is an increase in free ions in the egg yolk caused free fatty acids to separate from the lipoproteins. High temperatures will increase the transfer of molecules and ions and affected lipid in lipoprotein break away from apolipoprotein (Yang *et al*., 2016).

In accordance with the statements of Hudson (1997), NaCl contents which migrated into egg yolk affected LDL aggregation became harder. The vitelin membrane consists of keratin and very important during the process of making salted eggs because it prevents water migrated to the egg yolk, but pushing NaCl into the yolk (Romanoff and Romanoff, 1963).

At the third week, the yolk undergoes hydration because the vitelin membrane has been denatured. The reduction of water content in egg white caused the structure of LDL (Low Density Lipoprotein) turns into oil exudation (Schultz, 1968). The reduction of water content in salted egg yolk is greater while compared to egg white. Diffusion of NaCl into eggs causes reduced water content and egg yolk becomes harder (Chi and Tseng, 1998; Kaewmanee *et al*., 2009; Lai *et al*., 2010).
Decreased water content of yolk also resulted of gel formation due the interaction between the protein and the NaCl content.

The result was in agreement with Hudson (1997) which states that 1 g of protein can bind/ trap 10 g of water. The lower of water content of yolk, the higher of strength of the yolk gel.

Granules that bind with NaCl cause bonding in the yolk granules and the lipid break away from protein bond. The separated proteins will coalesce and form polyhedral granules and enhanced gritty texture (Chi and Tseng, 1998; Kaewmanee *et al*, 2009). The results was in agreement with Lai (1999), the migration of NaCl into egg yolk caused denatured proteins in LDL, lipid in LDL no longer binds to protein/ free. Therefore boiled salted egg yolks have a lot of oil compared to boiled eggs without salting.

The longer of salting, the more NaCl levels diffuse into the yolk, where the increase in NaCl levels affects the value of a^* boiled salted egg yolk. The yolk was composed of five layers brightly colored and five layers darker colored. The outermost layer of salted egg yolk has a higher a^* value compared to the inner layer because the outermost layer contains higher levels of NaCl and it became darker (Grosch, 2009).

Decreasing the value of L^* and b^* boiled salted egg yolk is associated with water content of boiled salted egg yolk. The characterization of hygroscopic NaCl causes of reduced water content in the yolk and make that color became darker following values of L^* and b^* become lower. In accordance with Kaewmanee (2009) which states that the color change in egg yolk during salting due to reduced water content, increased salt levels and the amount of free fat on the surface of the yolk.

CONCLUSIONS

The addition of coriander extract into making salted egg had a significant effect on the physical and chemical properties of the products. The immersing method in cooked salted egg resulted in higher NaCl content and moisture content. NaCl content on white and yolk egg had a signifficant effect on the average of L^*, a^* and b^* value on salted yolk egg.

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