The 6th International Seminar on Tropical Animal Production
Integrated Approach in Developing Sustainable Tropical Animal Production
October 20-22, 2015, Yogyakarta, Indonesia

The Characteristics of Salted Chicken and Duck Egg by Using Traditional Roasting

***Nurliyani[1], Anggi Hartawan[1], Yulianto Adi Nugroho[1], Indratiningsih[1]**

[1]Department of Animal Product Technology, Faculty of Animal Science
Universitas Gadjah Mada, Yogyakarta 55281, Indonesia
Corresponding email: nurliyani@yahoo.com

ABSTRACT: Salted egg is one of a traditional egg product that is usually using soil paste containing salt for coating. Further processing of fresh salted egg can be done by traditional method using roasting in heated sand medium. The purpose of this study were to study the effect of roasting and cooking on the characteristics of salted duck and chicken egg. Eggs were coated by a clay paste containing salt for 10 d, and then divided into two groups: 1) roasting group and 2) cooking group. After roasting or cooking, the eggs were analyzed the moisture and salt contents and also the total count of bacteria during storage at room temperature for 0; 7; 14 and 21 d. The data was analyzed statistically by ANOVA. The results showed that there were no significant differences in moisture content of yolk in roasted and cooked salted duck egg, but the moisture content of yolk in roasted chicken egg was lower than salted cooked egg. The moisture content in egg white of roasted was lower than cooked salted egg. During storage, moisture content of yolk in salted egg was increased, but moisture content of egg white was decreased. The salt content in roasted salted chicken egg was higher than cooked salted egg. The salt content of egg white at 21 d storage was higher than 0 d of storage.Total count of bacteria in roasted salted duck and chicken egg were lower than cooked salted egg. There were no significant differences in total count of bacteria in duck or chicken salted egg in 0 and 7 d of storage. However, after 7 d of storage the total count in salted egg was increased significantly. In conclusion, the salted egg by traditional roasting was recommended for processing method with shelf life for 7 day at room temperature.

Keywords: Roasted, Cooked, Salted egg, Moisture, Salt, Total count

INTRODUCTION

Preserved egg products includes salted and pidan duck eggs are one of the least expensive duck egg products which are widely consumed in most of the South East Asian countries such as, Thailand, Malaysia, Singapore and East Asian countries like China and South Korea (Ganesan *et al*., 2014). In Indonesia salted duck eggs are also very populair which can be found in some areas in a variety of products such as cooked, roasted, and smoked salted eggs with a variety of flavors.

Usually, salted egg can be made by brining eggs in saturated saline or by coating the egg with soil paste mixed with salt. Paste coating method produces were more pronounced dehydration and release of lipids in yolk increased with increasing salting time (Kaewmanee *et al*., 2009a). Salted eggs are rich in proteins, lipids, unsaturated fatty acids and minerals. The salted egg contains 14% of protein, 16.6% of fat, 4.1% of carbohydrate and 7.5% of ash, whereas the fresh duck egg contains a range of 9.30-11.80% of protein, 11.40-13.52% of fat, 1.50-1.74% of sugar and 1.10-1.17% of ash. Furthermore, salted duck egg needs to be heated by pan frying or boiling before consumption (Ganesan *et al*., 2014).

Salting resulted in an increase in weight proportion of egg white, but a decrease in yolk proportion (Kaewmanee *et al*., 2009b). After brining, part of the lipids in salted egg yolk became free due to the structural changes of low-density lipoprotein induced by dehydration and increase of salt content, and more free lipids in salted egg yolk were released after the cooking process (Lai *et al*., 2010).

In a previous study showed that roasted salted duck eggs in higher oven temperature have more shelf life compared with lower oven temperature, eventhough there were no differences in total count of bacteria (Novia *et al*., 2012). In addition, the roasting salted duck egg in marine sand after cooking showed that roasting for 5 min could increase the salt content of salted egg (Budiman *et al*., 2012). The purpose of this study were to evaluated the contents of moisture and salt , as well as the total count of bacteria in salted duck and chicken eggs by using traditional

roasting compared with cooked salted egg during 21 days of storage.

MATERIALS AND METHODS

Materials used in this study were fresh chicken and duck eggs, clay, salt, ash, clean sand, plate count agar (PCA), K_2CrO_7 5% and $AgNO_3$ 0.1 N.

Chicken and duck eggs were coated with paste of salt and clay (1:1), and then spreaded with ash. The 1000 g paste of clay and salt was prepared by adding of 500 g water. The coated eggs were incubate at room temperature for 10 day. After 10 d of incubation, the eggs were divided into two groups of processing: 1) traditional roasting with sand at 100°C for 1 h, and 2) cooking at 100°C for 1 h. Processed eggs in groups 1 and 2 were stored at room temperature for 0; 7; 14 and 21 days, and then analyzed the egg characteristics including moisture content, salt content and total count of bacteria. Replication of sample in this analysis was performed three times.

Moisture content of roasted and cooked salted eggs were analyzed by oven at 105°C (AOAC, 2000). Salt content in egg samples were also analyzed according to AOAC (2000). Egg samples for salt analysis were mashed and extracted with 50 mL hot water (70°C) for 15 min and filtered, then the filtrate was analyzed for salt content by titration with $AgNO_3$ 0.1 N using indicator K_2CrO_7 5% until the solution permanently pink colour (AOAC, 2000). The total counts of eggs was evaluated using plate count agar (PCA) (Merck) medium. To determine the total counts, the colonies formed were counted and expressed in log CFU/g (Rostita *et al*., 2011). The data was analyzed statistically by two way ANOVA using SPSS version 17.

RESULTS AND DISCUSSION

Moisture Content. The average of moisture content in roasting chicken and duck salted eggs were lower than cooked salted egg ($p<0.01$). This was due to in cooking process using water as heating medium, so the diffusion of water into the eggs causing water levels to be higher. On the contrary, the use of sand in roasting process so that no water diffuses into the egg. In the present study, moisture content in chicken roasted salted egg white at 0 and 21 d of storage were 54.00 and 52.29%, whereas in roasted duck salted egg white at 0 and 21 d of storage were 57.38 and 52.15%, respectively (Table 1). This result of this study near to a previous study by Novia *et al*. (2012), that moisture content of duck salted egg after heating in oven 90-100°C (6 h) at 0 and 25 day storage were 56.68-54.77% and 53.97-48.79%, respectively.

If water is unavailable for pathogenic or spoilage-causing bacteria to multiply, food is better preserved and has a longer shelf life, because bacteria cannot grow without water.

Table 1. Moisture content (%) of egg white and yolk of salted chicken and duck egg during storage

Salted egg	Processing	Storage (day)				Average
		0	7	14	21	
Chicken egg white	Roasting	54.00±0.84	54.11±1.58	52.04±2.32	52.29±2.33	53.11±1.99^{a}
	Cooking	57.45±1.35	56.44±1.31	55.05±0.65	54.90±1.25	55.96±1.53^{b}
Average		55.72±2.09^{p}	55.27±1.84^{p}	53.55±2.26^{q}	53.59±2.24^{q}	54.53±2.27
Duck egg white	Roasting	57.38±3.36	54.18±10.61	53.38±5.98	52.15±4.65	54.27±6.58^{a}
	Cooking	62.65±4.20	60.69±3.82	58.18±3.45	56.55±4.62	59.52±4.46^{b}
Average^{ns}		60.01±4.55	57.44±8.33	55.78±5.28	54.35±4.98	56.89±6.16
Chicken egg yolk	Roasting	21.42±1.05	20.07±1.04	21.48±0.56	23.03±0.63	21.50±1.33^{a}
	Cooking	22.82±0.44	22.98±1.14	24.01±0.90	24.24±0.96	23.51±1.05^{b}
Average		22.12±1.06^{pq}	21.52±1.84^{p}	22.74±1.50^{q}	23.64±1.00^{r}	22.51±1.56
Duck egg yolk	Roasting	17.32±3.54	15.30±1.42	14.74±2.09	14.39±1.13	15.44±2.39^{a}
	Cooking	18.54±2.58	16.87±3.17	15.16±2.22	15.71±1.18	16.57±2.60^{a}
Average		17.93±3.02^{p}	16.09±2.48^{pq}	14.95±2.07^{q}	15.05±1.30^{q}	16.00±2.53

Different letter in the same column (a, b) and the same row (p, q, r, s) indicated significant difference ($p<0.01$) for chicken egg white and yolk and also duck egg white and yolk, respectively.

Thus the water content has a significant effect on maintaining quality of the food. This explains why freezing, dehydration, or concentration of foods increases shelf life and inhibits bacterial growth (Vaclavik and Christian, 2014).

During storage, there were fluctuation in the levels of moisture content in salted eggs, whereas there were no significant differences in the levels of moisture content in duck egg white (Table 1). Moisture contents of both egg white and yolk decreased gradually with concomitant increases in salt and ash contents as the salting time increased. Changes in chemical composition, physical properties and microstructure of duck egg as influenced by salting (Kaewmanee *et al*., 2009b).

Salt Content. Roasting process could increase the salt content in salted chicken eggs, but could not increase in salted duck egg (Table 2). Chicken has a thinner eggshell than duck egg, then the water easy to evaporate from inner egg. Duck eggs are normally larger with a thicker eggshell and higher egg breaking strength than chicken eggs (Shen and Chen, 2003). The duck eggshell thickness from 0.349 to 0.364 mm (Kokoszynski *et al*., 2007). The area surrounding the blunt end was the tinnest (0.341 ± 0.025 mm), whereas the area surrounding the sharp end was the thickest (0.367 ± 0.023 mm). It was found that the thickness of the sharp end was the closest to the average thickness of the whole eggshell and could be considered as a valid measurement of eggshell thickness (Sun *et al*., 2012). Mineral content such as calcium, magnesium, sodium and potassium were significantly increased in pidan yolk irrespective of its cations in pickle solution in comparison to the fresh yolk. It confirmed the migration of minerals from the pickling solution to the egg (Ganesan *et al*., 2013). According to Ganesan *et al*. (2014), proteins, lipids, and ash contents are also found to be greatly enhanced during the pickling and salting process of salted duck eggs. During brining, the salt contents of albumen, exterior yolk (hardened portion), and interior yolk (soft or liquid portion) gradually increased accompanied by slight decreases in moisture content (Lai *et al*., 2010). According to Indonesian National Standard (SNI) (1996), the minimum salt content in salted egg was 2.0%. So that the salt content of salted egg white in the present study still within the standard range.

The salt content of salted egg at 21 d of storage was higher than 0 day (Table 2), due to evaporation of water during storage at room temperature. Long storage period significantly increased levels of NaCl salt (Amir *et al*., 2014).

Table 2. Salt content (%) of egg white and yolk of salted chicken and duck egg during storage

Salted egg	Processing	Storage (day)		Average
		0	21	
Chicken egg white	Roasting	2.69±0.03	2.69±0.03	2.69±0.03[a]
	Cooking	2.15±0.03	2.35±0.06	2.25±0.11[b]
Average		2.42±0.29[p]	2.52±0.18[q]	2.47±0.24
Duck egg white	Roasting	1.78±0.18	2.04±0.05	1.91±1.18[a]
	Cooking	1.92±0.06	2.09±0.03	2.01±0.10[a]
Average		1.85±0.14[p]	2.07±0.04[q]	1.96±0.15
Chicken egg yolk	Roasting	0.80±0.02	0.85±0.01	0.83±0.02[a]
	Cooking	0.58±0.01	0.61±0.02	0.59±0.02[b]
Average		0.69±0.11[p]	0.73±0.13[q]	0.71±0.12
Duck egg yolk	Roasting	0.69±0.00	0.65±0.02	0.67±0.02[a]
	Cooking	0.48±0.27	0.67±0.01	0.57±0.20[a]
Average[ns]		0.58±0.21	0.66±0.01	0.62±0.15

Different letter in the same column (a, b) and the same row (p, q) indicated significant difference ($p<0.01$) for chicken egg white and yolk and also duck egg white and yolk, respectively.
ns: not significant

Total Count of Bacteria. On Table 3, showed that total count of bacteria in egg white salted duck egg after roasted at 100°C (1 h) and stored at 0 d was 4.67 log CFU/g (4.67 x 10^4 CFU/g). However, after it stored at 21 d the increasing of total count was very high (11.17 log CFU/g) or

1.47 x 10^{11} CFU/g. This result different from a previous study that total count of salted duck egg after heating in oven at 90-100°C (6 h) at 0 and 25 d of storage were 6.29 - 9.22x10^4 CFU/g and 1.98 - 7.35 x 10^4 CFU/g, respectively (Novia *et al*., 2012).

Table 3. Total plate count (Log CFU/g) of egg white and yolk of salted chicken and duck egg during storage

Salted egg	Processing	Storage (day)				Average
		0	7	14	21	
Chicken	Roasting	4.75±0.11	5.00±0.06	10.06±0.08	11.19±0.02	7.75±2.96^a
egg white	Cooking	5.11±0.06	5.31±0.08	10.40±0.06	11.21±0.02	8.01±2.87^b
Average		4.93±0.20^p	5.16±0.18^q	10.23±0.18^r	11.20±0.02^s	7.88±2.89
Duck	Roasting	4.67±0.11	6.02±0.03	10.12±0.12	11.17±0.03	7.99±2.78^a
egg white	Cooking	5.05±0.07	6.11±0.01	10.38±0.06	11.23±0.02	8.19±2.71^b
Average		4.86±0.21^p	6.06±0.05^q	10.25±0.16^r	11.20±0.03^s	8.09±2.71
Chicken	Roasting	4.89±0.10	5.00±0.08	9.90±0.10	11.15±0.01	7.74±2.88^a
egg yolk	Cooking	5.28±0.04	5.36±0.06	10.46±0.38	11.24±0.01	8.09±2.84^b
Average		5.08±0.21^p	5.18±0.19^p	10.18±0.39^q	11.20±0.04^r	7.91±2.84
Duck	Roasting	4.84±0.10	5.99±0.03	9.78±0.12	11.15±0.01	7.94±2.65^a
egg yolk	Cooking	5.22±0.06	6.07±0.02	10.16±0.08	11.24±0.01	8.17±2.63^b
Average		5.03±0.21^p	6.03±0.04^q	9.97±0.22^r	11.19±0.05^s	8.06±2.61

Different letter in the same column (a, b) and the same row (p, q, r, s) indicated significant difference ($p<0.01$) chicken egg white and yolk and also duck egg white and yolk, respectively.

Differences this results due to differences in processing method and duration of heating after salting egg. In the present study after salting egg then roasted for 1 h in sand at 100°C, but in a previous study by heating in oven too long time (6 h), so there were many dead of bacteria. Thus, after 25 d storage the total count of bacteria was still lower than the present study. In salty condition the halophilic bacteria will be able to growth. According to Trongpanich and Dawson (1974), halophilic plate count of duck eggs held in salt brine up to two weeks, then held one month at 3°C were 4.2x 10^3 CFU/g. In a previous study showed that the average of total bacterial colonies in duck salted egg were 7.35 x 10^4 CFU/g with a shelf life of 38.80 days (Novia *et al*., 2012). However, the Thai Industrial Standard Institute (TISI, 2003) stated that the microbiological standard of salted egg including total aerobic plate count found is less than 10^4 CFU/g, and that there is no presence of *Salmonella* spp., *S. aureus* and *C. perfringens* in 25g, 0.1g, and 0.1 g of samples, respectively. Furthermore, microbiological quality of locally commercial salted eggs in Thailand were in around of 1.84 x 10^2 – 3.60 x 10^3 CFU/g (Wongvilairat, 2007).

CONCLUSIONS

The salt content of salted chicken and duck eggs were still a good quality according to Indonesian National Standard. However, the salted eggs exceed the maximum limit of total count of bacteria required by Thai Industrial Standard Institute. Thus, further study is required to determine the shelf life of salted egg in various heating time in various method of roasting with various storage temperature under hygienic conditions.

REFERENCES

Amir, S., S. Sirajuddin, and N. Jafar. 2014. Effect of salt concentration and long time storage for content of protein and content of salt salted egg. 2014. Program Studi Ilmu Gizi Fakultas Kesehatan Masyarakat Universitas Hasanuddin.

AOAC. 2002. Association of Official Analytical Chemists. Official Methods of Analysis. Standard Methods for the Examination (17th ed.), Washington, DC.

Budiman, A., A.Hintono, and Kusrahayu. 2012. The effect of "penyangraian" of salted eggs after boiling to the natrium chloride content, saltiness and elasticity. Animal Agriculture Journal. 1: 219-227.

Ganasen, P., S. Benjakul, and K. Hideki. 2013. Effect of different cations on pidan composition and flavor in comparison to the fresh duck egg. Korean J. Food Sci. An. 33: 214-220.

Ganesan, P., T. Kaewmanee, S. Benjakul, and B. S. Baharin. 2014. Comparative study on the nutritional value of pidan and salted duck egg. Korean J. Food Sci. An. 34: 1- 6.

Indonesian National Standard. 1996. Salted Egg Standard. SNI 01-4277-1996.

Kaewmanee, T., S. Benjakul, and W. Visessanguan. 2009a. Effect of salting processes on chemical composition, textural properties and microstructure of duck egg. J. Sci. Food Agr. 89: 625–633.

Kaewmanee, T., S. Benjakul, and W. Visessanguan. 2009b. Changes in chemical composition, physical properties and microstructure of duck egg as influenced by salting. Food Chem. 112: 560–569.

Kokoszynski, D., Z. Bernacki, and H. Korytkowska. 2007. Eggshell and egg content traits in peking duck eggs from the p44 reserve flock raised in poland. J Cent Eur Agr. 8 : 9-16.

Lai, K. M., W. H. Chung, C. L. Jao, and K. C. Hsu. 2010. Oil exudation and histological structures of duck egg yolks during brining. Poult Sci. 89: 738-744.

Novia, D., S. Melia, and N.Z. Ayuza. 2012. Study on the oven temperature to shelf life of salted eggs. Jurnal Peternakan Indonesia, 14: 263-269.

Shen, T. F. and W. L. Chen. 2003. The role of magnesium and calcium in eggshell formation in Tsaiya ducks and Leghorn hens. Asian-Aust. J. Anim. Sci. 16: 290-296.

Sun, C. J., S. R. Chen , G. Y. Xu, X. M. Liu, and N. Yang. 2012. Global variation and uniformity of eggshell thickness for chicken eggs. Poult Scie. 91: 2718–2721.

Roostita, L. B., G. H. Fleet, S. P. Wendry, Z. M. Apon, and L.U. Gemilang. 2011. Determination of yeasts antimicrobial activity in milk and meat products. Adv. J. Food Sci Technol. 3: 442-445.

TISI (Thai Industrial Standard Insititute). 2003.TISI Standard in Salted Egg. The Ministry of Industry, Thailand.

Trongpanich, K . and L. E. Dawson. 1974. Quality and acceptability of brine pickled duck eggs. Poult Scie. 53: 1129-1133.

Vaclavik, V. A. and E.W. Christian. 2014. Water. Essentials of Food Science, 4th Edition, Food Science Text Series, Springer, New York.

Wongvilairat, R. 2007. Quality and control of *Staphylococcus aureus* and *Clostridium perfringens* in salted egg production. NU Science Journal 4: 31 – 41.