EFFECTS OF USE OF DESALINIZED DUCK EGG WHITE ON TEXTURE AND SENSORY OF COOKED SLICED PORK HAM

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Abstract – Desalinized duck egg white (DSEW) was prepared by using ultra-filtration method. After desalinization, salt content of DSEW was decreased from 9.2 to 0.65% and the total desalted efficiency was 92.66%. The composition of desalinized duck egg white was similar to those of fresh duck egg white (FDEW). However, gel texture profiles (strength, hardness, elasticity) of DSEW decreased when compared to those of FDEW. In application, cooked sliced pork ham was added with 0, 1, 2 and 3% of DSEW powder, separately. The texture profiles and sensory evaluation were determined to seek an optimum level of DSEW in cooked sliced pork hams. The results showed that the textural profiles of slice pork hams were increased with level of DSEW. Meanwhile, the highest shear force, gel strength as well as the lowest tensile was found in the ham added with 3% of DSEW powder. Nevertheless, all sensory items of cooked sliced pork hams presented no significance difference among treatments.

Key Words –Duck egg white, Ultra-filtration, Desalinization, Sliced pork ham

I. INTRODUCTION

Salted duck egg has been an popular traditional egg product in Asia area such as Mainland China, Taiwan, and Thailand etc.. Traditionally, duck egg is pickled with laterite and salt or saline (20-24% salt) for 4-8 weeks. After pickling, cooked salted duck egg can be eaten as the whole egg. Salted yolk is widely utilized in moon cakes and glutinous rice dumplings in Taiwan and China (Chi and Tseng, 1998). Almost salted egg white (containing protein 9.5% and sodium chloride 6.5-9.2%) are discarded as waste due to a higher salt content and also resulted in serious environmental pollution. Several research groups reported that salted egg white can be utilized in frankfurters (Lin *et al*, 1996) and salted egg white powder (Huang *et al*., 1996). However, those results concluded that salted egg white is hard to widely utilization because of the high concentration of sodium chloride. Therefore, How to desalinize salted duck egg white as a good protein source is very important. The aim of this study was to evaluate desalinization efficiency on physico-chemical of salted duck egg white by use of ultra-filtration and also to seek an optimum level of desalinized duck egg white applied in cooked sliced pork hams.

II. MATERIALS AND METHODS

Salted duck Egg Collection

Salted duck egg white was collected by local egg processing factory in the south of Taiwan. Salted duck egg white were chilled at 2-4˚C for 12 hr. then took back to Laboratory and stored at 4˚C for further desalinization.

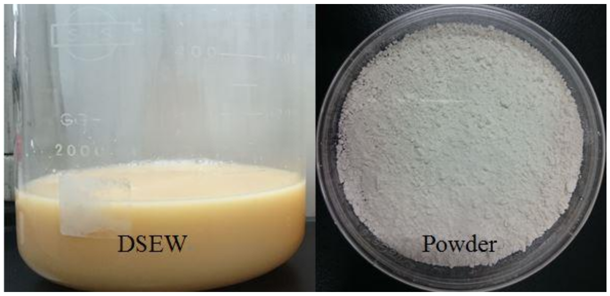
Desalted processing and spray drying

Salted duck egg white was diluted to 150% with de-ionized water and desalinized by continuous ultra-filtration concentrator. The optimum desalinization conditions were as followed: membrane area 0.37 m^2, flow rate 200 ml/min, average trans-membrane pressure 10 psi. Desalinized duck egg white were dried by spray dryer (B-191, BUCHI) and final powder of desalinized duck egg white will stored in desiccator for preparation of cooked sliced pork hams.

Proximate analysis and salt content

Moisture, crude ash, crude lipid, and crude protein of salted duck egg white, fresh duck white and desalinized duck egg white were determined as the method of A. O. A. C. (2000). Salt content in egg

Figure 2. Desalinized duck egg white and powder



samples were analyzed by an ion analyzer (DIGITAL SALT METER ES421, Tokyo, Japan).

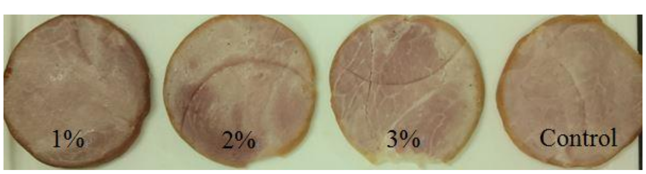
Determination of gel texture profiles

Gel texture profiles (gel strength, hardness and elasticity) of sample were determined as the method of Handa (1998). All egg white samples were stuffed into plastic casing (25 mm dia, TEN GENIUSES ENT Co., Ltd., Taipei, Taiwan). Samples were heated at 90˚C for 30 min in water bath. After heating, sample need be chilled to 25-30˚C. Egg white gels were cut into cylindrical samples (25 mm dia x 1 mm). A texture analyzer (Compact-100, Sun Rheo Meter, Japan) was applied to determine the texture parameter including gel strength, hardness and elasticity with a 10 kg load cell. A 50 % compression was performed using a flat disc (dia 3 cm) at crosshead speed 60 mm/min.

Preparation of cooked sliced pork ham

The visual fat of pork ham was completely trimmed then cut into 2x2x3 cm cubes for cooked slice pork hams. 70 % Pork ham cubes + 25 % water mixed with seasoning ingredients (including 5 % potato starch and other spices) and 0, 1, 2 or 3 % DSEW, separately for 30 min at 10˚C then cured at 4˚C for 48 hr. Total of 4 lots (control-0 % DSEW, 1 % DSEW, 2 % DSEW and 3 % DSEW) of ham mixture were prepared in this study. Each ham mixture was stuffed into cellulose fiber casing (diameter 10 cm) then dried and smoked at 60-70˚C for 2hr. Then cooked at 80-90˚C for 1hr. Final products need be chilled at 4˚C for 2 hr then sliced into 0.5 cm thickness sliced pork ham.

Figure 1. Appearance of pork ham



Texture and sensory evaluation of sliced ham

Texture profile analysis was conducted according to the methods of Wanangkarn (2012). Ham was cut into 2x2x0.5 cm^3 and texture profiles (including shear force, gel strength and tensile) were determined by Compact-100, Sun Rheo Meter (Japan). Sensory (including color, flavor, texture, juiciness and overall acceptability) of hams were evaluated using a 7 point hedonic system (1 and 7 representing extremely dislike and extremely like, respectively). Panelist team is consisted of 10 graduated students from meat Laboratory in Department of Animal science, National Chung-hsing University.

Statistical Analysis

Data were analyzed using the Statistical Analysis System program (SAS Institute, Inc. 2016). Analysis of variances was performed using the Sheffe's multiple range test to determine the significance of differences among samples at $P \leq 0.05$.

III. RESULTS AND DISCUSSION

Desalinized efficiency and chemical composition

In this study, a good desalinization was performed by continuous ultra-filtration concentrator. The salt content of initial salted duck white was 9.2% and the final desalinized duck egg white was 0.6%. The desalinized efficiency for salted duck egg white was 92.66%. Table 1 was showed the proximate analysis of various duck egg white. Analysis of the data from Table 1, salted duck egg white had lower crude moisture and higher ash than fresh duck egg white. The result might be caused by high salt content penetration into egg white during pickling. After desalinization, desalted duck egg white had similar concentration of moisture, ash and crude protein with fresh duck egg white except crude fat.

Table 1 The chemical composition of fresh, salted and desalinized duck egg white

	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
FDEW	87.04±0.09^{A}	10.92±0.09^{A}	0.27±0.07^{B}	0.67±0.01^{C}
SDEW	82.58±0.15^{C}	9.47±0.05^{C}	0.46±0.12^{B}	7.12±0.12^{A}
DSEW	86.35±0.10^{B}	10.04±0.10^{B}	0.95±0.28^{A}	0.87±0.05^{B}

means±S.D., n=6
A-C:Means within the same row without the same superscript are significantly (P<0.05)

Gel texture of desalinized duck egg white
The data of Table 2 show the gel strength, hardness and elasticity of various duck egg white. Based on analysis of the data, the heating gel of salted duck egg white and desalted duck egg white had lower strength, hardness and elasticity than those of fresh duck egg white. In general, desalinization resulted in the lowest gel properties in the heating gel of desalted duck egg white in this study. Woodward and Cotterill (1986) also concluded that increase of salt content in egg white caused aggregation of egg white protein which resulted in a coarser structure and a weakened gel network cross-linkage. However, the gel texture profiles of desalinized duck egg white were not significant difference with that of salted duck egg white.

Table 2 The gel texture of fresh, salted and desalted duck egg white

Sample	Gel strength (g)	Hardness (N)	Elasticity (dyn x10^{5})
FDEW	2000±125.1^{A}	19.61±1.22^{A}	10.66±0.78^{A}
SDEW	1323±58.2^{B}	12.90±0.52^{B}	6.86±0.39^{B}
DSEW	1215±47.9^{B}	11.94±0.49^{B}	6.21±0.39^{B}

means±S.D., n=6
A-B:Means within the same column without the same superscript are significantly different (P<0.05).

Texture profiles of cooked sliced pork ham
Table 3 presented the texture profiles of cooked sliced pork ham with various levels of desalinized duck egg white. Shear force of pork ham increased with % of desalinized duck egg white in cooked sliced pork ham and this result indicated that more egg white, higher shear force and also mean more egg white resulted in high hardness in pork ham. Use of High % of desalinized duck egg white was not only to increase shear force of cooked sliced pork ham also to improve gel strength in this study. However, higher % desalinized duck egg white have a negative action to tensile of products and also resulted in weaker binding ability between meat piece of cooked sliced pork ham.

Sensory evaluation of cooked sliced pork ham
The date of Table 4 showed sensory evaluation of sliced pork ham with various levels of desalinized duck egg white. In general, no significant differences in sensory evaluation were found among all treatments. This result also conducted that use of desalinized duck egg white didn't affect on the eating quality of cooked sliced pork ham. Based on the results of Table 3 and 4, therefore, although use of desalinized duck egg white resulted that lower binding ability of meat in cooked slice pork hams but actually, panelists exhibited higher sensory panel profiles for products in this study.

Table 3 The texture of sliced ham with 0 (c), 1, 2 and 3% of desalted duck egg white powder

	Shearing force (kgf/mm^{2})	Gel Strength (kg)	Tensile (kgf/mm^{2}x 10$^{5)}$
C	0.516±0.07^{D}	4.981±0.41^{C}	3.26±0.39^{A}
1%	0.879±0.12^{C}	5.925±0.41^{C}	2.65±0.19^{B}
2%	1.402±0.14^{B}	7.358±0.56^{B}	2.48± 0.25^{B}
3%	1.922±0.05^{A}	9.156±0.69^{A}	1.87±0.32^{C}

means±S.D., n=6
A-D:Means within the same column without the same superscript are significantly different (P<0.05).

Table 4 The sensory evaluation of sliced ham with 0 (c) , 1, 2 and 3% of desalted duck egg white powder

	Control	1%	2%	3%
color	6.10±0.94	6.25±0.60	6.10±0.37	6.20±0.47
flavor	5.65±0.69	5.70±0.90	5.60±0.60	5.70±0.76
texture	6.10±0.47	6.20±1.00	6.10±0.81	6.30±0.89
juiciness	5.80±0.73	5.60±0.50	5.60±0.94	5.85±0.73
overall acc.	5.70±0.47	5.65±0.18	5.70±0.68	5.85±0.74

means±S.D., n=10

IV. CONCLUSION

Although desalinization resulted in a softer gel texture for desalinized duck egg white, but it had not significantly influence on the sensory evaluation of cooked slice pork ham when high level of desalinized duck egg white was used in this study.

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REFERENCES

1. AOAC (2000). Official method of analytical chemists (17th ed.). Arlington: The association of Official Analytical Chemists Inc.
2. Campbell, L., V. Raikos and S. R. Euston. (2003). Modification of functional properties of egg-white proteins. Nahrung Food 47:369–376.
3. Handa, A., K. Takahashi, N. Kuroda and W. Glenn. (1998). Heat-induced Egg White Gels as Affected by pH. Journal of Food Science 63:403-407.
4. Huang, J. J., J. S. Tsai and B. S. Pan. (1999). Pickling time and electrodialysis affects functional porperties of salted duck egg white. Journal of Food Biochemistry 23:607-618.
5. Huang, J. J., J. S. Tsai and R. L. Cheng. (1996). The effect of drying methods on powder characteristics of salted duck egg white powder. Chinese Institute of Food Science and Technology 23:819-829.
6. Kaewmanee, T., S. Benjakul and W. Visessanguan. (2012). Effect of Acetic Acid and Commercial Protease Pretreatment on Salting and Characteristics of Salted Duck Egg. Food Bioprocess Technol 5:1502–1510.
7. Kaewmanee, T., S. Benjakul and W. Visessanguan. (2009). Changes in chemical composition, physical properties and microstructure of duck egg as influenced by salting. Food Chemistry 112: 560-569.
8. Lin, C.W., Y. N. Jiang, H. P. Su and H. L. Chen, (1996). Emulsifying characteristics of salted duck egg white and it’s application in frankfruters. Food Science (Chinese Inst. of Food Sci. Technol.) 23(2):244-254.
9. Wanangkarn, A., D. C. Liu, A. Swetwiwathana and F. J. Tan. (2012). An innovative method for the preparation of mum (Thai fermented sausages) with acceptable technological quality and extended shelf-life. Food Chemistry 135:515-521.
10. Woodward, S. A. and O. J. Cotterill. (1986). Texture and microstructure of heat-formed egg white gels. J. Food Sci. 51(2):333-332-339.
11. Zayas, J. F. and C. S. Lin. (1989). Emulsifying Properties of Corn Germ Proteins. Cereal Chem. 66(4):263-267.