APPLICATION OF BINDERS CONSTITUTED WITH PIG PLASMA, WHEY PROTEIN CONCENTRATE AND EGG WHITE POWDER IN RESTRUCTURED PORK CHOPS

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Abstract – The purpose of this study was to evaluate the quality of restructured pork chops with four binders constituted with non meat proteins includes pig plasma(PP), whey protein concentrate (WPC), and egg white powder(DE), then sorted as (E) 80PP+10WPC+10DE, (F) 60PP+20WPC+20DE, (G)40PP+30WPC+30DE and (H)20PP+40WPC+40DE. The results showed there were clear and significant polymers in SDS-PAGE for myosin and four binders with pig plasma after incubated at 37℃ for one hour. The crude protein of restructured pork chops with four binders were significantly higher than the control (P<0.05). The other chemical contents and pH were not significantly different among treatments. Cooking loss and shrinkage of all treatments were better than the control but no significant differences. The hardness, chewiness and shear value of restructured pork chops with four binders were significantly higher than those of the control. In sensory panel, binding and juiciness scores of restructured pork chops with binder G and H had better score in all treatments and the control. In conclusion, the better quality and binding of a low salt restructured pork chop could be prepared by binders G(40PP+30WPC+ 30DE) and H (20PP+40WPC+40DE) in this study.

Key Words – non meat protein, polymer, binding.

I. INTRODUCTION

In pig plasma exists transglutaminase which can format a cross linkage between proteins by acyl-transfer reaction called ε-(γ-glutamyl)lysine [7], resulting in modification of the protein structure and enhancement of the binding ability of meat [8,11]. Terrell *et al.*and Lu and Chen indicated that high acceptability and binding occurred when egg white was added into pork flakes as a binder [10,13]. Colmenero *et al*. and Dawson *et al*. concluded that egg white had good water holding and emulsifying capacity, better heating stability and better color and flavor in final products, and so are usually minced meat products to improve the quality [2,3]. Many scientific reports also showed that whey protein concentrate can significantly improve the emulsifying stability and texture (binding, hardness and elasticity) of meat products such as sausages, patties, hot dog , and lunchmeat etc. [4, 5, 9, 14].

However, few scientific studies have been conducted examining a complex binder with the three non meat proteins. The purpose of this study, thus, was to understand the polymer formation and viscoelastic properties of myosin and four binders constituted with non meat protein and in restructured pork chops.

II. MATERIALS AND METHODS

Pig plasma, whey protein concentrate and egg white powder were purchased from a local additive company. Four binders were designed with pig plasma(PP), whey protein concentrate (WPC) and egg white powder (DE) then sorted into (E) 80PP+10WPC+10EW, (F)60PP +20WPC+20EW, (G)40PP+30WPC+30EW and (H)20PP+40WPC+40EC. The solution samples (2% protein, w/v) were prepared as described by Hines and Allen [6] for viscoelastic properties testing, which were performed by rheological instrument (Rheolograph-Sol , Toyoseiki, Japan) in this study. The polymer formation of the four binders was determined by SDS-PAGE electrophoresis.

Pork boneless ham without skin and fat was cubed and mixed with 10% ice, 0.5% salt, 0.05% polyphosphates and 2% binder. After vacuum tumbling for 4 hr at 4℃, ham was then stuffed into a mold container and frozen at -20℃ for 24 hr. The restructured pork molds were re-tempered to -5-6 ℃ and then sliced (thickness : 2.0 cm) using a slice machine(LWS 330 model, Taiwan). Chemical content and pH of restructured pork chops were determined according to AOAC' s method[1]. Rheological properties of cooked restructured pork chops also were performed by Sun Rheo Meter (Model Compac-100, Sun Rheo Meter, Japan) according

to the steps of Pietrasik and Shand [12]. A sensory panel of 15 panelists familiar with meat assessed the pork slices for appearance, binding, flavor, juiciness, texture and overall acceptance. A 7 Hedonic scale test method is adopted as 1: absolutely don't like, 2: don't like, 3: a bit dislike, 4: not particularly like or dislike, 5: like it a bit, 6: like and 7: very like. The general linear model (GLM) program in SAS (2003) was used to analyze all data in this study.

III. RESULTS AND DISCUSSION

SDS-PAGE electrophoresis results showed polymer formation by all the four binders. There was clear polymer in SDS-PAGE of four binders when they were incubated at 37℃ for one hour. This band of polymer in SDS-PAGE was clearly present with the % of pig plasma. Ikura reported that transglutaminase exists in pig plasma and can form a cross linkage (acyl-transfer reaction) of ε-(γ-glutamyl)lysine between proteins[7].

Storage modulus (G') and Tangent delta (δ) were estimated for dynamic viscoelasty in this study. When the heating temperature was above 75℃, the storage modulus of the four binders increased as the temperature increased (from 0 to 2.5 10^2N/m^2) . Conversely, storage modulus values decreased as the % of whey protein concentrate and egg white increased in the binders (Fig 1).

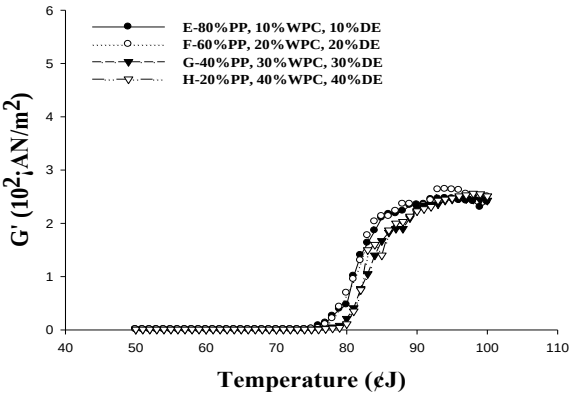

Figure 1 Changes in storage modulus (G') of four binders (different % of PP, WPC and DE) heated from 50 to 100℃ by 1 ℃/min.

Tangent delta is an index indicating elasticity of the samples, with tanδ=0° meaning that the sample shows elasticity texture while tanδ=90° means the sample is viscosity.

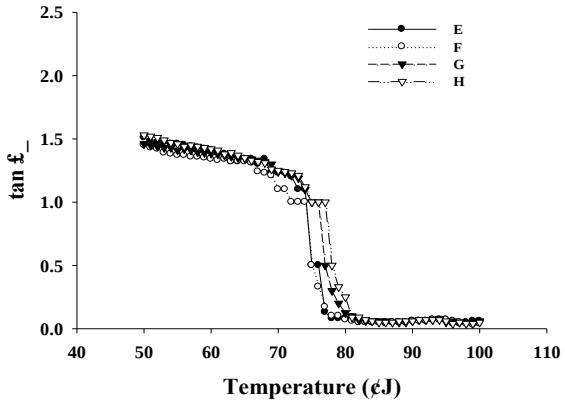

Figure 2 Changes in tangent delta (δ) of four binders (different % of PP, WPC and DE) heated from 50 to 100℃ by 1 ℃/min.

In this research, we also found the binders showed gel formation and had significant elasticity texture when heating temperature was increased from 50℃ to 82 ℃and the biggest elasticity (tanδ=0°) of the four binders (E, F, G and H) was evident at 82℃. When the heating temperature increased from 75 to 82℃, the tanδ of the four binders declined quickly but the binders with higher % of whey protein concentrate and egg white needed higher heating temperatures to reach the same tanδ.

The crude protein values (%) of pork chops with binders were significantly higher than that of control (P<0.05). Moisture(%), crude fat(%), ash and pH were not significantly different among treatments (Table 1).

Table 1. Proximate compositions and pH of restructured pork chop with different binders

	C	E	F	G	H
Moisture	73.80[a]	73.20[a]	73.10[a]	72.80[a]	73.20[a]
C Fat	4.21[a]	3.95[a]	4.00[a]	3.72[a]	4.01[a]
C Protein	17.60[b]	20.10[a]	19.80[a]	19.60[a]	19.70[a]
Ash	1.67[a]	1.76[a]	1.68[a]	1.67[a]	1.73[a]
pH	6.20[a]	6.40[a]	6.50[a]	6.30[a]	6.40[a]

C = no additive, E= 80% PP, 10% WPC, 10% DE; F= 60% PP, 20% WPC, 20% DE;G= 40% PP, 30% WPC, 30% DE; H= 20% PP, 40% WPC, 40% DE

Cooking loss values of the restructured pork chop with different binders were significantly lower than those of the control in this study. However, shrinkage of the restructured pork chops with different binders were better than the control but the values were not significant difference (Table 2).

Table 2. Analysis of cooking loss and shrinkage of restructured pork chop with four different binders

Binders	Cooking loss %	Shrinkage%
C	30.20±0.84[b]	8.80±2.39[a]
E	27.00±0.22[a]	7.80±1.30[a]
F	26.80±0.64[a]	8.60±2.61[a]
G	26.80±0.71[a]	8.80±2.17[a]
H	27.40±0.14[a]	7.20±2.35[a]

C = no additive, E= 80% PP, 10% WPC, 10% DE; F= 60% PP, 20% WPC, 20% DE;G= 40% PP, 30% WPC, 30% DE; H= 20% PP, 40% WPC, 40% DE.

In the cutting test results (Table 3), the shear strength of restructured pork chops with different binders was higher than that of the control, meaning that all restructured pork chop with binders were tougher than the control. Restructured pork chop with binders containing high % (30 or 40%) of WPC and DE had significantly higher shear values ($P<0.05$). This result also can be evidenced in the texture item of sensory panel.

Table 3. Analysis of cutting test of restructured pork chop with four different binders

Binders	Shear strength (g/mm^2)	Shear energy (KJ/m^2)
C	1330.00±107.00[b]	42.83±1.29[b]
E	1627.00±239.00[ab]	55.73±5.95[a]
F	1697.00±218.00[ab]	56.26±5.89[a]
G	1941.00±213.00[a]	57.06±6.5[a]
H	1825.00±293.00[a]	56.66±4.62[a]

Footnote is the same as table 1.

In the sensory panel results (Table4), the binding and juiciness scores of the restructured pork chops with binder G and H significantly presented higher scores when compared to those of E, F and control. However, no differences were found in the appearance, flavor and texture of all restructured pork chops. In overall acceptance, all restructured pork chops can be accepted by the panelists in this study.

Table 4. Analysis of sensory panel of restructured pork chop with four different binders

	Control	E	F	G	H
Appearance	4.8[a]	4.7[a]	4.8[a]	4.7[a]	4.9[a]
Binding	4.6[b]	4.7[b]	4.6[b]	5.0[a]	5.1[a]
Flavor	4.5[a]	4.6[a]	4.8[a]	4.7[a]	4.7[a]
Juiciness	4.3[a]	4.7[a]	4.5[a]	4.7[b]	4.7[b]
Texture	4.4[a]	4.3[a]	4.4[a]	4.3[a]	4.4[a]
Overall acceptance	4.6[a]	4.6[a]	4.5[a]	4.6[a]	4.7[a]

Footnote is the same as table 1.

IV. CONCLUSION

In conclusion, in this study, the better quality and binding of low salt restructured pork could be prepared using binder G and H, which consisted of 40% PP, 30% WPC, 30% DE and 20% PP, 40% WPC, 40% DE, respectively.

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