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EFFECT OF WASHING TEMPERATURE AND PH ON THE QUALITY OF SURIMI FROM MECHANICALLY DEBONED CHICKEN MEAT

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Background:

Mechanically deboned poultry meat has been used in the production of emulsion type products, salami, turkey rolls, and soup mixes. However, several constraints have limited the use of mechanically deboned poultry meat(MDPM), because of high content heme pigments, bone marrow, fat, and connective tissue. For example, (1) it has a dark color, (2) the particle size is generally small, which results in poor textural properties, (3) the storage life is short, (4) the high levels of unsaturated fatty acids in poultry fat resulted in a greater chance of rancidity development compared with red meats(Knight, 1992). Therefore, aqueous washing and sieving have been used to remove fat, heme pigments, connective tissue and other water soluble components from mechanically deboned chicken meat(MDCM). The resulting preparation is a wet concentration of chicken myofibrillar proteins, which may be described as chicken surimi(Smyth and O'neill, 1997). The heat-induced gelation characteristics of chicken surimi could be exploited to produce wide fabricated meat products. One of the important factors affecting quality of surimi by using of MDCM might be the washing temperature and the use of pH with low ionic sodium chloride solution in the washing procedure.

Objectives:

Our objective is to investigate the effect of washing temperature and pH on the quality of surimi from mechanically deboned chicken meat. The properties of thermally induced gelation from surimi were also investigated.

Methods:

Preparation of surimi. Mechanically deboned chicken meat(MDCM) from backs, necks, ribs, and frames was obtained from a local poultry processing company. The MDCM was ground with silent cutter for 2 min, and mixed with 5 volumes of 0.5% NaCl solution for 8 min. The suspension was stood for 8 min, strained out connective tissues with 2 mm mesh, and centrifuged at 3,000rpm for 25 min. The precipitate was remixed and continued to repeat procedure by using different sieve mesh size for three times. The pH of washing solution was divided with pH 5, 6, 7, and 8, respectively. The washing temperatures were 4 and 20℃, respectively.

Cooking procedures. Surimi mixed with 2% salt, blended at 8,000rpm for 2 min, and stuffed into cellulose casing. Samples were cooked in a water bath for 30 min after the internal temperature reached 70℃. Cooked samples cooled slowly and were stored at 5℃.

Analytical procedures. Water holding capacity was determined by the method of Jauregui et al.(1981). Salt soluble protein was determined following the method of Saffle and Galbreath(1964). Textual properties of cooked surimi were measured by Texture analyser(TA-XT2i, Stable micro system Ltd. UK). Texture profile was measured by texture analyser software(version 1.12). Cutting strength was measured by a food analyser equipped with a guilotin blade(HDP/BS). Compressive strength and tensile strength were used by a food analyser equipped with cylinder probe(P/35, length 15cm, diameter 20cm) and tensile grips(A/TG), respectively. Color values were measured by a Color difference meter(Minolta CR-310, Japan) using lightness(L^*), redness(a^*), yellowness(b^*) values. The whiteness(W) was calculated by a method of Reppond and Babbit(1997); $W=100-\{(100-L^*)^2+a^{*2}+b^{*2}\}^{1/2}$. The saturation(C) value and hue-angle(h^0) value were calculated as $C=(a^{*2}\pm b^{*2})^{1/2}$, and $h^0=\tan^{-1}(b^*/a^*)$, respectively.

Results and discussions:

Surimi after thermal gelation had higher lightness(L^*) and whiteness(W) values, lower redness(a^*) value than uncooked surimi(Table 1). Surimi washed with 20℃ solution had lower a^* value than that with 4℃. Although hardness of surimi washed with 20℃ solution was slightly higher than that with 4℃, no difference in most textural and functional properties between products prepared with 4℃ or 20 ℃ washing. In case of myofibrillar protein extraction from MDCM, extracting at 13.0℃ recovered only slightly more protein than at 3.5℃ but such temperatures are not of practical importance(Young, 1975). The pH had the largest effect on the quality of the surimi from MDCM. The L^* and W of uncooked surimi increased, but the a^* decreased in low pH of washing solution(Table 2). The washing of MDCM with 0.5% NaCl solution at pH 5.0 was the most effective solution to reduce redness and increase lightness. This result was somewhat different from Hernandez et al.(1986), who reported that washing mechanically deboned turkey meat(MDTM) with 8.0 phosphate buffer was the most effective solution in reducing redness

and increasing lightness in MDTM among phosphate buffer solutions(pH 6.4, 6.8, 7.2, 8.0). Textural properties such as hardness, cutting strength, tensile strength and compressive strength was greatest in pH 5, pH 5, pH 7 and pH 6, respectively. The moisture content, water holding capacity, collagen content and salt soluble protein increased as pH solution increased in th range of pH 5~8(Table 2).

Conclusions:

Surimi made from mechanically deboned chicken meat(MDCM) was prepared in 0.5% NaCl solution with different washing temperature and pH. This study was carried out on the effects of washing temperature(4 and 20℃) and the use of pH(5, 6, 7, 8) on the textural properties after thermal gelation of surimi, color, and functional properties of chicken surimi. Surimi after thermal gelation had higher lightness(L^*) and whiteness(W) values, lower redness(a^*) value than uncooked surimi($P<0.05$). Surimi washed with 20℃ solution had lower a^* value than that with 4℃. There were not any differences in most textural and functional properties except hardness between products prepared with 4℃ or 20 ℃ washing. The pH had the largest effect on the quality of the surimi from MDCM. The L^* and W of uncooked surimi increased, but a^* decreased at low pH of washing solution. The washing procedure of MDCM with pH 5.0 was the most effective solution in reducing redness and increasing lightness in MDCM. Textural properties such as hardness, cutting strength, tensile strength and compressive strength was greatest in pH 5, 5, 7 and 6, respectively. The moisture content, water holding capacity, collagen content and salt soluble protein increased as pH of solution increased in the range of pH 5~8.

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Table 1. Effect of washing temperature on the color values of chicken surimi from MDCM

Temp. (℃)	Processing Steps	CIE Color value[1]					
		L^*	a^*	b^*	W	C	h^0
4℃	Surimi	55.9 ± 0.3^{ab}	14.0 ± 0.2^{b}	14.2 ± 0.1^{c}	51.6 ± 0.3^{c}	19.9 ± 0.2^{b}	45.5 ± 0.1^{d}
	2% salt added	53.2 ± 0.9^{b}	14.9 ± 0.2^{a}	15.2 ± 0.2^{a}	48.5 ± 0.8^{d}	21.3 ± 0.3^{a}	45.5 ± 0.2^{d}
	Cooked surimi	63.0 ± 0.4^{a}	5.1 ± 0.1^{e}	12.6 ± 0.2^{e}	60.6 ± 0.4^{a}	13.6 ± 0.2^{d}	68.0 ± 0.4^{b}
20℃	Surim	55.7 ± 0.9^{ab}	12.5 ± 0.1^{d}	13.9 ± 0.2^{d}	51.9 ± 0.7^{c}	18.7 ± 0.2^{c}	48.0 ± 0.3^{c}
	2% salt added	53.2 ± 0.8^{ab}	13.4 ± 0.3^{c}	14.7 ± 0.3^{b}	49.1 ± 0.6^{d}	19.9 ± 0.4^{b}	47.8 ± 0.2^{c}
	Cooked surimi	61.6 ± 0.6^{a}	4.5 ± 0.2^{f}	11.9 ± 0.3^{f}	$59.5\pm0.5b$	12.8 ± 0.3^{e}	69.6 ± 0.8^{a}

$P<0.05$. [1]L^*=lightness, a^*=redness, b^*=yellowness, W=whiteness, C=saturation value, h^0=hue-angle.

Table 2. Effect of pH on the color and physicochemical properties of chicken surimi from MDCM

Parameter	pH			
	5	6	7	8
Lightness(L^*)	61.5 ± 0.3^{a}	57.8 ± 0.3^{b}	56.4 ± 08^{b}	57.2 ± 1.1^{b}
Redness(a^*)	8.5 ± 0.1^{c}	12.5 ± 0.5^{a}	12.1 ± 0.2^{a}	10.3 ± 0.5^{b}
Whitness(W)	58.4 ± 0.5^{a}	53.6 ± 0.2^{b}	52.5 ± 0.7^{b}	53.4 ± 0.8^{b}
Hardness(g)[1]	290 ± 35^{a}	277 ± 42^{a}	103 ± 22^{b}	32 ± 7^{c}
Cutting strength(g)[1]	473 ± 20^{b}	214 ± 68^{b}	145 ± 31^{c}	35 ± 2^{d}
Tensile strength(g*s)[1]	-108 ± 18^{bc}	-171 ± 11^{ab}	-238 ± 51^{a}	-36 ± 8^{c}
Compressive strength(g*s)[1]	633 ± 5^{c}	1056 ± 84^{a}	781 ± 4^{b}	156 ± 13^{d}
Moisture(%)	84.9 ± 0.2^{d}	85.4 ± 0.1^{c}	88.2 ± 0.1^{b}	92.0 ± 0.1^{a}
Water holding capacity(%, D.B.)	192 ± 19^{d}	238 ± 10^{c}	318 ± 7^{b}	698 ± 21^{a}
Collagen(%, D.B.)	5.4 ± 0.2^{c}	6.8 ± 0.4^{b}	7.3 ± 0.2^{b}	10.8 ± 0.3^{a}
Salt soluble protein(%, D.B.)	6.9 ± 0.01^{d}	8.3 ± 0.01^{c}	10.62 ± 0.1^{b}	14.4 ± 0.1^{a}

$P<0.05$. [1]Cooked surimi.