

Effects of whey protein additions on the quality characteristics of surimi-like materials made from porcine *longissimus* and cardiac muscles

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Abstract

The purpose of this study was to investigate the effects of added whey protein (WP) on the quality characteristics, particularly textural properties, of two surimi-like materials (SLMs) made from porcine longissimus (LM) and cardiac muscles (CM), respectively. Proximate compositions, quality traits, and texture properties were measured in the SLMs that were made from LM (SLM-LM) and CM (SLM-CM), and prepared with or without additions of 0 to 4% WP, respectively. The SLM-LM and SLM-CM containing added WP had significantly lower water contents than those without WP. In the texture profile analysis, the SLM-CM showed increasing hardness as the WP content increased. Whereas for the SLM-LM, the highest hardness value occurred in the product containing 2% WP; however, at the 4% WP level, its hardness decreased.

Introduction

Surimi is generally made from fish, but recently, the use of other animal species for its manufacture has increased (Antonomanolaki *et al.*, 1999). Furthermore, there has been interest in manufacturing surimi-like materials (SLMs) using meat by-products such as cardiac muscle. However, it was reported that SLM made from cardiac muscle (CM) had significantly weaker gel strength as compared to that made from skeletal muscle (Kang *et al.*, 2007). Rawdkuen and Benjakul (2008) reported that the addition of whey protein (WP) improved the textural properties of various foods, especially gel strength. Therefore, the objective of this study was to investigate the effects of WP additions on the quality characteristics of SLMs made from the *longissimus* muscle (SLM-LM) and cardiac muscle (SLM-CM) of pig.

Materials and methods

The LM and CM of pigs were obtained from a selected retail butcher shop 24 h after slaughter. A total of 45 crossbred pigs were used in the study. The SLMs were made from the porcine LM and CM according to the method of Park *et al.* (1996). The WP was added to the two SLMs at concentrations of 0, 2, or 4% (w/w), respectively, and mixed thoroughly. Before cooking, the proximate compositions of the samples were measured according to AOAC (1995) methods. The SLM-LM and SLM-CM were cooked in a 80 °C water bath to an internal temperature of 75 °C, and then cooled in ice water for 30 min. Cooking loss was calculated by the differences in weight between the cooked and uncooked samples, and was expressed as a percentage of the initial weight. The color of the cooked samples was measured using a Minolta chromameter (CR-300, Minolta Camera Co., Japan). Texture profile analyses were conducted on the SLMs using a Texture Analyzer (TA-XT2, Stable Micro Systems, England). Finally, statistical analyses were performed using a computer system equipped with the SAS statistical package (SAS, 2001).

Results and discussion

Table 1 shows the proximate compositions and quality traits of the SLM-LM and SLM-CM according to the different concentrations of WP. The SLM-CM had significantly higher, fat content, redness, yellowness, and cooking loss as compared to the SLM-LM. However, the SLM-CM had significantly lower lightness and whiteness values than the SLM-LM. For both types of SLM, those containing WP had lower water contents than those without added WP.

Table 1. Quality measurements of surimi-like materials made from porcine *longissimus* (LM) and cardiac (CM) muscles, and containing different levels of whey protein concentrate

Muscle type (MT)	LM			CM			Levels of significance		
Whey protein (WP)	0%	2%	4%	0%	2%	4%	MT	WP	MTx WP
Proximate composition (%)									
Water	79.13 ^c (0.97) ¹	78.14 ^d (1.19)	77.73 ^d (1.06)	81.32 ^a (0.29)	80.42 ^b (0.34)	78.69 ^{cd} (0.72)	***	***	*
Ash	2.28 ^{bc} (0.19)	2.34 ^{bc} (0.15)	2.44 ^a (0.14)	2.20 ^c (0.12)	2.41 ^{ab} (0.22)	2.40 ^{ab} (0.14)	NS	*	NS
Fat	0.41 ^b (0.11)	0.46 ^b (0.11)	0.56 ^b (0.11)	1.44 ^a (0.14)	1.54 ^a (0.14)	1.75 ^a (0.14)	***	NS	NS
Protein	18.09 ^{ab} (0.84)	19.03 ^a (0.84)	19.31 ^a (0.84)	14.85 ^b (1.46)	15.58 ^{ab} (1.46)	16.45 ^{ab} (1.46)	*	NS	NS
Quality traits									
Lightness (L^*)	73.82 ^a (1.07)	73.49 ^a (1.25)	73.76 ^a (1.11)	52.02 ^b (0.74)	52.14 ^b (0.72)	51.51 ^c (0.69)	***	NS	NS
Redness (a^*)	-0.16 ^b (0.59)	-0.19 ^b (0.68)	0.02 ^b (0.59)	8.92 ^a (0.50)	9.41 ^a (0.89)	9.78 ^a (1.04)	***	NS	NS
Yellowness (b^*)	5.43 ^d (0.91)	6.21 ^c (0.65)	6.95 ^b (0.23)	10.94 ^a (0.27)	10.96 ^a (0.48)	11.07 ^a (0.38)	***	***	**
Whiteness(W)	73.82 ^a (0.32)	73.49 ^a (0.32)	73.76 ^a (0.32)	52.03 ^b (0.32)	52.15 ^b (0.32)	51.52 ^b (0.32)	*	NS	NS
Cooking loss (%)	5.83 ^b (0.80)	5.57 ^b (0.80)	6.63 ^b (0.80)	12.84 ^a (0.80)	12.03 ^a (0.80)	11.79 ^a (0.80)	***	NS	NS
pH	6.89 (0.97)	6.90 (0.97)	6.91 (0.97)	6.92 (0.97)	6.94 (0.97)	6.94 (0.97)	NS	NS	NS

¹ Standard error of least-square means; Levels of significance: NS = not significance; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; ^{a-d} Least-square means with different superscripts in the same row differ significantly ($P < 0.05$).

Table 2 shows the textural properties of the SLM-LM and SLM-CM prepared with additions of WP at levels of 0, 2, and 4%, respectively. There were significant differences by muscle type and WP content, as well as hardness effects by their interaction. The SLM-CM had lower hardness than the SLM-LM (2.58 vs. 5.45 N, $P < 0.001$). The SLM-LM containing 2% WP had the highest hardness value, but the SLM-LMs containing 0% WP and 4% WP had similar levels of hardness. The additions of WP (0 to 4%) to SLM-CM resulted in increases in hardness, from 2.24 to 2.93 N, and the SLM-CM containing 4% WP had the highest hardness.

Table 2. Texture profile analysis of surimi-like materials made from porcine *longissimus* (LM) and cardiac (CM) muscles and containing different levels of whey protein concentrate

Muscle type (MT)	LM			CM			Levels of significance		
Whey protein (WP)	0%	2%	4%	0%	2%	4%	MT	WP	MTx WP
Hardness (N)	5.30 ^b (0.11) ¹	5.74 ^a (0.11)	5.29 ^b (0.11)	2.24 ^e (0.08)	2.58 ^d (0.09)	2.93 ^c (0.09)	***	***	***
Cohesiveness	0.49 (0.02)	0.47 (0.02)	0.46 (0.02)	0.46 (0.02)	0.43 (0.02)	0.45 (0.02)	NS	NS	NS
Springiness	0.65 (0.09)	0.74 (0.09)	0.69 (0.09)	0.83 (0.08)	0.71 (0.10)	0.89 (0.09)	NS	NS	NS
Adhesiveness (N s)	4.33 (1.18)	5.61 (1.13)	4.90 (1.15)	4.05 (1.06)	2.75 (1.24)	3.06 (1.13)	NS	NS	NS
Gumminess	318.2 ^{ab} (12.76)	333.1 ^a (12.22)	293.0 ^b (12.48)	106.3 ^c (11.52)	113.2 ^c (13.38)	134.1 ^c (12.22)	***	NS	*
Chewiness	2.06 ^a (0.20)	2.45 ^a (0.19)	2.07 ^a (0.20)	0.85 ^b (0.18)	0.80 ^b (0.21)	1.18 ^b (0.19)	***	NS	NS

¹ Standard error of least-square means; Levels of significance: NS = not significance; * $P < 0.05$; *** $P < 0.001$;

^{a-e}Least-square means with different superscripts in the same row differ significantly ($P < 0.05$).

Conclusions

To improve gel strength, we added whey protein to surimi-like materials made from porcine *longissimus* (LM-LM) and cardiac (SLM-CM) muscles. The SLM-LM and SLM-CM containing WP showed similar patterns in terms of reduced water content. The SLM-CM prepared with added WP had significantly higher hardness, and the SLM-CM containing 4% WP showed the highest hardness value. For the SLM-LM, however, the 2% WP addition resulted in the highest hardness value, but as WP content increased, hardness decreased.

References

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