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Original article

Removing fish scale by using tuna protease

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Introduction

Fish fillet and whole fish with skin on, but without scales, are important in the market of fish processing industries. Descaling by hand is a very labour-intensive operation and although descaling machines are available, they have not proven to be satisfactory. In many cases, the machine-descaling process must be repeated, but even then remaining scale requires manual removal. Therefore, much of the flesh and skin are lost, and the process appears to be uneconomical. Mechanical descaling of some fish species such as canned sardine is a difficult task due to high liability of soft muscle damage. An enzymatic process has been developed to remove the scales in a very gentle manner in order to yield a product of superior quality compared to the corresponding mechanically descaled product. The objective of this research was to remove fish scale by using tuna protease. This protease would be a future processing aid in fish processing industries.

Materials and methods

Materials
Tuna viscera was obtained from Thai Union Group PCL, Samutsakorn, Thailand. The frozen tuna viscera was contained in low temperature-controlled container and transported to laboratory of Department of Fishery Products, Faculty of Fisheries, Bangkok within 2 h then kept in -20ºC until use.

Protease extraction
The protease was extracted from tuna viscera by stirring with 0.2 M acetic acid at 4ºC for 3 h, then centrifuge at 6,000 ×g for 30 min. Protein concentration was determined by the method of Lowry [1] and Peterson [2] using bovine serum albumin as protein standard. Protease activity was determined by the modified method of Nalinanon [3] using haemoglobin as enzyme substrate.

Effect of pH and temperature on tuna protease
pH and temperature stability: tuna protease was incubated in various pH (2-7) or temperature (10-60°C) for 30 min before the residue protease activity were determined by the modified method of Nalinanon [3]. pH and temperature optimum: tuna protease activity were determined by the modified method of Nalinanon [3] in various conditions of pH (2-7) or temperature (10-60°C).

Removing fish scale
Crude extraction was applied to fish skin and fish then incubated at 4 and 25ºC for 24 h. Weight loss of each treatment was estimated. Fish from the best condition of enzyme treatment and conventional method (removed manually by knife) were deep fried and sensory evaluated for acceptance by an untrained 30 panelists, of age ranging from 19 to 35 years. Panelists were asked to give acceptance scores for overall acceptance using the 9-point hedonic scale.

Results and discussion

The protease specific activity was 0.84 U/mg protein. Temperature optimum and stability of protease were 50ºC and 0-10ºC, respectively, whereas pH optimum and stability of protease were 2.0 as shown in Fig. 1. The results were similarly to pepsin from the stomach of albacore tuna [3].

Removing fish scale
Fish skins were incubated in tuna protease for 6 h to remove fish scale at 4°C as shown in Table 1. When increase temperature to room temperature (25°C) incubation time was reduced to 2 h as shown in Table 2. All of the scales can be removed using tuna protease without damage any fish skin in suitable time.

Fish were incubated in tuna protease at 4 °C for 3 h and room temperature (25 °C) for 2 h that were the best condition for removing fish scale at appropriate temperature as shown in Table 3 and Fig. 2. All of the

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scales could be removed using tuna protease even though in difficult area without damage any fish skin and fresh in suitable time. Fish flesh from both of enzyme treatment were firmer than conventional method.

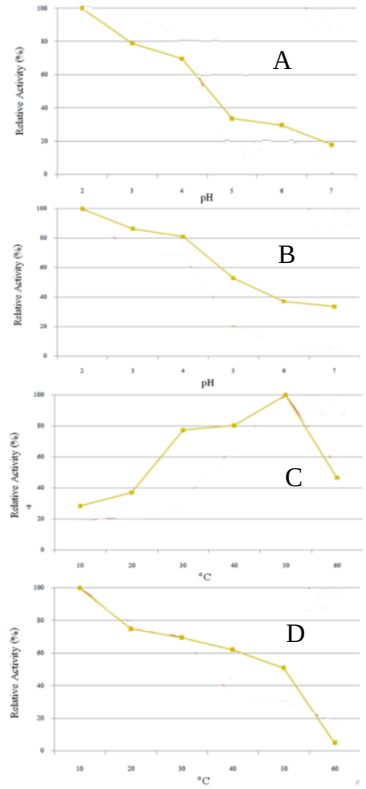

Fig. 1. Effect of pH and temperature on tuna protease; (A) pH optimum; (B) pH stability; (C) optimum temperature; (D) temperature stability.

Table 1. Percentage weight loss of fish skin after incubating skin in tuna protease at 4°C

	Incubation time (h)			
	0	6	12	24
% weight loss	0[c]	15.60±3.36[b]	15.88±1.01[b]	19.63±0.91[a]

[a-b] mean with different letter in the same row indicated significant difference.

Table 2. Percentage weight loss of fish skin after incubating skin in tuna protease at room temperature (25°C)

	Incubation time (h)					
	0	1	1.5	2	2.5	3
% weight loss	19.68 ±2.37[d]	24.51 ±3.25[d]	33.94 ±2.27[c]	32.09 ±3.94[bc]	31.46 ±2.44[b]	39.02 ±2.07[a]

[a-d] mean with different letter in the same row indicated significant difference.

Deep fried fish from both of enzyme treatment and conventional method were accepted by panelists. Moreover texture of enzyme treatment fish more firm freshness than conventional method. Tuna protease had no effect in fish products taste.

Table 3. Percentage weight loss of whole fish after removing fish scale

	Incubation time (h)		
	Conventional method	Protease 4°C	Protease RT
% weight loss	11.44±0.07[a]	10.01± 0.34[b]	10.31±0.30[b]

[a-b] mean with different letter in the same row indicated significant difference.

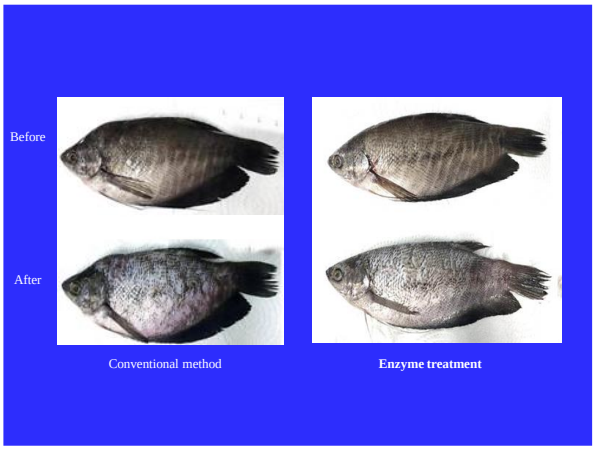

Fig. 2. Appearance of fish before and after descaling by conventional method and enzyme treatment.

Conclusions

Descaling by tuna protease at 25ºC faster than 4ºC. The result shown in satisfactory with no remaining scale for 2 h crude extract treatment at 25ºC and the fish flesh was accepted by panelists.

References

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2. Peterson GL (1977) Anal Biochem 83: 346–356
3. Nalinanon S et al. (2010) Food Chem 121: 49–55