PROCESSING OF FISH FLOUR FROM CROAKER (*Pseudociena amoyensis*)

by

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ABSTRACT

The experiment aimed at studying fish flour processing, particularly to determine the best method to produce fish flour that meets the requirements for a food product. Four methods were tried, (1) without steaming, spray drying; (2) without steaming, drum drying; (3) steaming, spray drying and (4) steaming, drum drying.

The results indicated that the best quality was obtained by the third method which consisted of the following steps: dressing - mincing - washing three times - dewatering - steaming- pressing - blending - spray drying. The proximate composition of fish flour produced was 4.66% moisture, 92.48% (d.b.) protein, 1.62% (d.b.) fat) and 2.77% (d.b.) ash. The fish flour was also physically good with a whiteness value of 85.55% and microbiologically free from *E. coli* and *Salmonella.*

INTRODUCTION

Although several countries have developed fish flour or fish protein concentrate (FPC) commercially and used the products to supplement or fortify foods like bread and noodles, limited attempts have been made in Indonesia. Some studies have been conducted to produce FPC from shark (Astawan, 1990), FPC from the by-products of the tuna industry (Sulistiani, 1994), fish flour from shark (Juwono, 1989) and fish flour from sardine (Nurhayati, 1994).

This research studied the effect of processing method on the quality of fish flour from croaker, *Pseudociena amoyensis*, a demersal fish, often found in North Java waters. This fish contains relatively low fat, approximately 2%, and is commonly marketed fresh, cooked or dry-salted at relatively low prices. It is hoped that the results will provide more information and alternative products to support the fish product diversification programme.

MATERIALS AND METHOD

Croaker or 'gulamah' (*Pseudociena amoyensis*) was used as raw material. The fish was obtained from Indramayu, West Java with the physical size and proximate composition as presented in Table 1.

Fish flour processing was done using the method of Juwono (1989), slightly modified as described in Figure 1. Firstly, the fish was washed, eviscerated and filleted. The fillet was then minced using a meat-bone separator and washed 3 times with cold water (5 - 10°C). After de-watering by centrifuge, the minced fish was steamed for 30 minutes followed by pressing, blending and drying. Drying was either by a spray dryer at 180°C or a drum dryer at 100-110°C and pressure of 4.5-5.0 Bar.

Table 1. Physical size and proximate composition of croaker (*P. amoyensis*).

Parameter	
Physical size	
- Total length (cm)	28.5 ± 2.66
- Width (cm)	7.52 ± 0.83
- Thickness (cm)	3.67 ± 0.43
- Weight (g/fish)	292.75 ± 91.83
Chemical composition	
- Moisture (%)	79.40
- Ash (%)	1.32
- Protein (%)	16.64
- Fat (%)	0.52

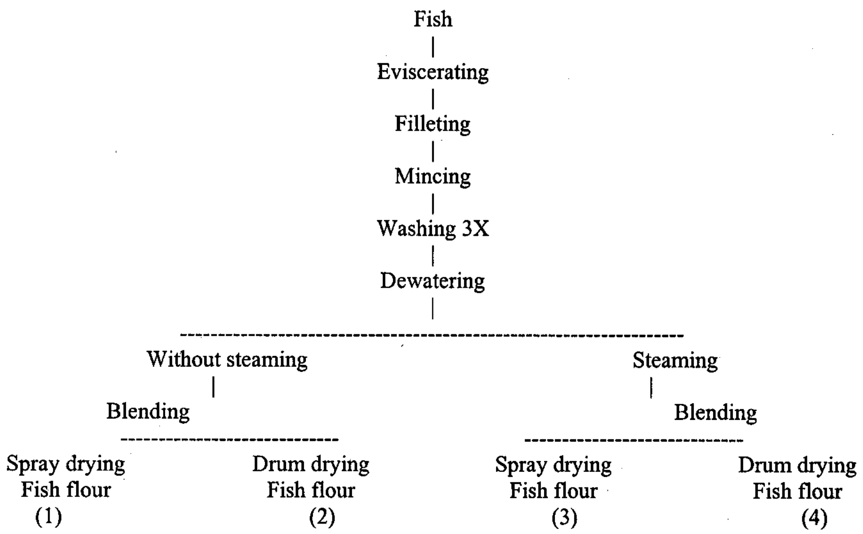

Fig. 1. Schematic diagram of fish flour processing.

Quality of fish flour was assessed by chemical, physical, microbiological and organoleptic analysis. Moisture, crude protein, crude fat and ash contents were determined according to AOAC (1984). Non protein nitrogen (NPN) was determined according to Apriyantono (1989) using the Kjeldahl method. Water solubility was determined using Lembono's method (1989), while water absorption was determined according to Beuchat (1977). Whiteness was measured using a whiteness meter with a green filter and sodium carbonate as standard (with a score of 100). Microbiological analysis was for TPC (Fardiaz, 1987), *E. coli* (Miwa, 1992) and *Salmonella* (Miwa, 1992). Organoleptic assessment was carried out by a descriptive scoring method and data were statistically analyzed using a Complete Randomized Design.

RESULTS AND DISCUSSION

Yields

Processing of fish into fish flour caused a large reduction of the material weight due to losses during preparation (dressing up to washing/after mincing) and moisture losses during pressing and drying. The average processing yields obtained from the four methods (1-4) were 4.44%, 8.54%, 5.15% and 4.67% respectively. The yields were significantly affected by the processing method (p>0.01). Spray drying produced a lower yield of fish flour than drum drying because the preparation for spray drying requires blending finely. Consequently, losses from spray drying were more than for drum drying.

Physical Properties

The effect of processing method on the physical properties of fish flour is shown in Table 2. The results revealed that the processing method significantly affected whiteness and water solubility of fish flour, but no significant effect was shown in water absorption. Spray drying resulted in a whiter fish flour compared to drum drying (method 1 and 3 vs method 2 and 4) probably due to the HTST (high temperature short time) in spray drying reducing oxidative browning. Drum drying in open air accelerated oxidation.

Table 2. Physical properties of fish flour from croaker.

Parameter	Processing method			
	1	2	3	4
Whiteness (%)	84.25[a]	82.00[b]	85.50[a]	79.75[c]
Water absorption (%)	248.26[a]	171.71[a]	204.76[a]	179.71[a]
Water solubility (%)	15.96[a]	21.51[b]	38.27[c]	15.01[a]

Note : The same letter at the same row indicates not significant (p>0.01).

Water absorption is one of the important characteristics of protein. Interaction of protein and water affects hydration, swelling, viscosity and gelation (Hutton and Campbell, 1981). Table 2 shows that the water absorption of fish flour from croaker was in the range of 171.71 - 248.26%, indicating that water absorption was insignificantly affected by processing method. Astawan (1990) found that water absorption of FPC from shark produced by extraction using cold ethanol reached 482%. The lower water absorption of croaker flour might be due to the heating/steaming and drying process causing denaturation and aggregation of protein molecules thus reducing water absorption.

Processing method significantly affected water solubility with the highest water solubility (38.27%) obtained from the third method (combination of steaming and spray drying).

Chemical Composition

Table 3 shows that processing method has a significant effect on the chemical composition, particularly moisture and fat content. Fish flour produced from method 1 and 3 contained lower moisture than those from method 2 and 4. This means that spray drying resulted in a lower moisture than drum drying. According to Kulikov (1971) moisture content of fish flour and FPC type B should be not more than 10%. Therefore, all of the processing methods except method 2, met the requirement.

Fat content for methods 1 and 2 was not significantly different from those from method 3 and 4, meaning that steaming had no significant effect on the fat content. On the contrary, drying method greatly influenced the fat content, indicated by significant difference in fat contents between methods (1 and 3) and methods (2 and 4). The fat contents of fish flour from drum drying were lower than spray drying. It is suspected that some of the fat in the drum drying process separated from the solid material because of the heating.

Table 3. Chemical composition of fish flour from croaker.

Parameter	Processing method			
	1	2	3	4
Moisture (%)	4.51^{a}	13.01^{b}	4.66^{a}	8.08^{c}
Ash (% db)	3.50^{a}	3.13^{a}	2.77^{a}	2.12^{a}
Protein (% db)	92.13^{a}	93.25^{a}	92.48^{a}	91.36^{a}
Fat (% db)	2.15^{a}	1.10^{b}	1.62^{c}	1.04^{b}
NPN(% db)	0.15^{a}	0.20^{a}	0.21^{a}	027^{a}

Note : The same letter at the same row indicates not significant (p>0.01).

Compared to the standard for fish flour as stated either by Kulikov (1971) or FPC type B (FAO, 1964), the fish flour from croaker met the requirements for fat and protein contents. The requirement of FAO (1964) for FPC type B was 65% protein (minimum) and 3% fat content (maximum), while Kulikov (1971) lists a protein content of more than 70% and a fat content less than 3% for fish flour.

Microbiological quality

Microbial load of fish flour was in the range of 1.5×10^2 - 3.3×10^4 as described in Table 4. The load of TPC was not significantly affected by the process method. *E. coli* which is often associated with faecal contamination was not found in the fish flour. *Salmonella* was also absent, implying that products were safe as foodstuffs or for fortification.

Table 4. Microbiological quality of fish flour from croaker.

Parameter	Processing method			
	1	2	3	4
TPC (cfu/g)	1×10^{4a}	$2.1\ 10^{3a}$	3.3×10^{4a}	1.5×10^{2a}
E. coli	negative	negative	negative	negative
Salmonella	negative	negative	negative	negative

Note : The same letter at the same row indicates not significant (p>0.01).

Organoleptic quality

Organoleptic quality of the fish flour is presented in Table 5. Processing method significantly affected appearance, colour and acceptance of the fish flour, but no significant effect was shown on both odour and texture. Spray drying resulted in improved organoleptic quality compared to drum drying. The highest score of organoleptic parameters was obtained from the third method (steaming and spray drying) with description of the fish flour as follows: good appearance, fine and homogenous particle, no contamination (dust, insect, etc.), white-creamy, specific odour and dry.

Table 5. Organoleptic score of fish flour from croaker.

Method	Appearance	Colour	Odour	Texture	Acceptance
1	4.55^{ac}	4.35^{a}	4.45^{a}	4.70^{a}	4.50^{ac}
2	3.90^{b}	3.85^{bc}	4.40^{a}	4.30^{a}	3.70^{b}
3	4.80^{c}	4.60^{a}	4.65^{a}	4.75^{a}	4.70^{a}
4	4.15^{ab}	3.45^{b}	4.60^{a}	4.55^{a}	4.05^{bc}

Note : The same letter at the same column indicates not significant (p>0.01).

CONCLUSION AND SUGGESTION

Of the four processing methods, the best was: dressing - filleting - mincing - washing three times - dewatering - steaming- pressing - blending - spray drying.

Even though the method provided good quality fish flour, the processing yield was relatively low (5.15%) making it economically difficult to produce commercially. Therefore, it is necessary to make efforts to develop alternative methods that are able to give higher yields.

Experiments on the stability of the fish flour during storage should be carried out to determine the storage life of the product.

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Organoleptic Score Sheet for Fish Flour

Date : Panellist : Fish :

Please, give the score for the sample of fish flour at the appropriate scale line !

Example :

A C B
D
1 2 3 4 5

PARAMETERS	DESCRIPTION	SCORE				
		1	2	3	4 5	
APPEARANCE	Very dirty					Very clean
	Many contaminants					No contaminants
	unhomogenous particle size					Homogenous particle size
	Very dull					Very shine
COLOUR	Brown					White
ODOUR	Specific odour /fish flour					Neutral
	Strong rancid odour					No rancid odour
	Strong musty odour					No musty odour
	Strong burnt odour					No burnt odour
	Strong acid odour					No acid odour
	Strong putrid odour					No putrid odour
TEXTURE	Clumpy					Not clumpy
	Wet					Dry
	Coarse					Fine
ACCEPTANCE	Do not like					Like