UTILIZATION OF PROTEINS FROM FISHBALL PROCESSING WASHWATER IN FISH CRACKERS ('KEROPOK')

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ABSTRACT

Proteins recovered from the washwater of fishball processing were used in fish crackers. Up to 10% of washwater proteins was acceptable to taste panelists. Although appearance, color and crispiness were not affected, flavor scores declined significantly when 20% and above washwater proteins were used. This was also reflected in the scores for overall acceptability. Fish crackers with 10% washwater proteins contain more protein and less fat.

INTRODUCTION

In processing surimi, approximately 30–40% of the protein is lost in washing operations (Pedersen *et al.* 1990). Washing not only removes fat, suspended solids and other water-soluble substances (sarcoplasmic proteins), but more importantly, concentrates the gel-forming myofibrillar proteins (Lee 1984).

Watanabe *et al.* (1982) have estimated that soluble proteins from the first and second stages of the surimi process can be economically recovered. Some methods for recovery of washwater proteins include pH adjustment (Nishioka and Shimizu 1983), heat, complexing agents, electro-coagulation (Hasegawa *et al.* 1982), membrane filtration (Green *et al.* 1984) and air flotation (Beck *et al.* 1974).

In practice however, washwater proteins are normally not recovered for further use and are discharged as wastewater. This is of concern, since the water contains about 3.4 g of protein per liter (Lee 1984), about 80% of which is water soluble. The total protein lost accounts for approximately 30% of the

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deboned meat weight (Watanabe *et al.* 1982) and varies from plant to plant, depending upon the amount of water used and the number of washing cycles employed. If this protein could be recovered, product utilization would improve, and in addition, the environmental impact would be reduced.

In Malaysia, there are numerous small factories producing fish jelly products, such as fishballs and fishcakes, using traditional methods. The processing is similar to surimi processing and involves deboning, leaching, mixing, forming and cooking. The major loss of water-soluble proteins occurs after washing in dilute saline, when the excess water is removed by centrifugation. Dehydrators are not used, as these are expensive.

The objective of this research project was, therefore, to recover proteins currently lost in the washwater during fishball processing and to test the acceptability of these proteins by incorporation into fish crackers ('keropok').

MATERIAL AND METHODS

Recovery of Washwater Proteins

Threadfin bream *(Nemipterus tolu)* was purchased fresh from the wholesale market and transported in ice to the laboratory for immediate processing. Proteins from the washwater were recovered from three washing cycles (Fig. 1) by centrifugation at 20,000 × g for 20 min at 5C (Kubota 7800, Kubota Corporation, Tokyo, Japan).

Processing and Evaluation of 'Keropok'

'Keropok' was processed according to Siaw *et al.* (1985). The formulation used was 1:1 fish to flour, 2% salt, 1% sugar and 25–30% water. The mixture was mixed in a bowl mlxer (ADE SL18, ADE, Hamburg, Germany) until homogeneous and then stuffed into cellulose casings (35mm diameter, Teepak Shirred TWP, Wienie-Pak Cellulose Casings, Teepak Incorporation, Westchester, lllinois, USA), using a sausage stuffer (Dick, Hamburg, Germany). The stuffed rolls were cooked at 90–95C for 90 min and allowed to cool overnight at 5C. After slicing to a thickness of 2.5–3.0 mm, the samples were dried until a final moisture content of 8–10% was reached. Washwater proteins recovered by centrifugation at 20,000 × g, were used at 0, 5, 10, 20, 30 and 40% as a partial substitute of the fish component. The proportions of the other ingredients used remained unaltered. Linear expansion was measured as in Yu *et al.* (1981)

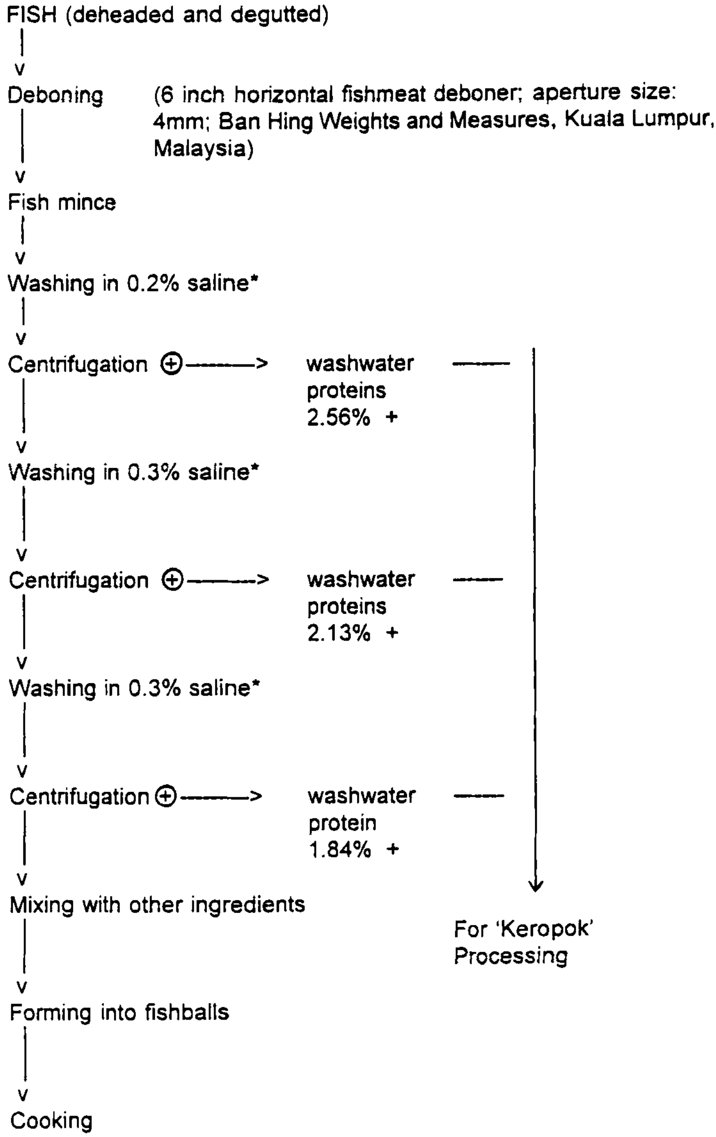

FIG. 1. RECOVERY OF WASHWATER PROTEINS FROM FISHBALL PROCESSING
*5C, 1 fish: 4 saline; + As a percentage of the proteins in the fish mince;
⊕ 20,000 × gravitational force.

after frying in oil at 180C–200C for 30 s. Organoleptic evaluation was done using a taste panel of 20 experienced personnel who were familiar with the product. The panelists evaluated the six samples as shown in Table 1 once. One piece of 'keropok' of each formulation were presented simultaneously to each panelist. The serving order for the six samples was randomized for each panelist. Samples were cooled to room temperature (30C) after frying and evaluated for appearance, color, flavor, crispiness and overall acceptability using a hedonic scale of 9 for excellent and 1 for poor. The acceptance criteria for each attribute was a score of 6 and above (Yu, unpublished observations). Results were analyzed using the analysis of variance (O'Mahony 1986).

TABLE 1.
EFFECT OF WASHWATER PROTEINS ON THE ORGANOLEPTIC PROPERTIES AND LINEAR EXPANSION OF 'KEROPOK'

	% Washwater Proteins					
Parameter	0	5	10	20	30	40
Appearance	6.25^{a}	6.10^{a}	6.40^{a}	6.00^{a}	6.20^{a}	6.05^{a}
Color	6.90^{a}	6.60^{a}	7.00^{a}	6.75^{a}	6.70^{a}	6.95^{a}
Flavor	7.10^{a}	6.95^{a}	7.20^{a}	5.65^{b}	5.10^{c}	3.65^{d}
Crispiness	7.10^{a}	7.15^{a}	7.10^{a}	7.20^{a}	7.05^{a}	7.20^{a}
Overall* acceptability	6.85^{a}	6.70^{a}	6.80^{a}	5.85^{b}	5.70^{b}	4.70^{c}
% Linear Expansion	90.9	98.4	103.3	101.7	100.0	97.9

1. Means within a column followed by the same letter are not significantly different ($p<0.05$)

2. *Acceptance for each attribute was a score 6 and above

Chemical Analyses

Analyses for moisture, fat, crude protein and ash were carried out according to Pearson (1970).

RESULTS AND DISCUSSION

Recovery of Proteins from the Washwater

The recovery of proteins from the 3 washing cycles totaled 6.53% of the protein in the first mince (Fig. 1). The recovery rates were lower than those for surimi processing (Watanabe *et al.* 1982; Pedersen *et al.* 1990) as only suspended solids were recovered from the washing processes.

Sensory Evaluation

Results (Table 1) showed that fish crackers containing up to 10% washwater protein were acceptable to taste panelists. Appearance, color and crispiness were unaffected up to 40% protein substitution. Linear expansion for all samples was above the minimum acceptable level of 77% (Siaw *et al.* 1985).

TABLE 2.
PROXIMATE COMPOSITION OF 'KEROPOK' CONTAINING WASHWATER PROTEIN (BEFORE AND AFTER FRYING)

	% Washwater Protein					
Parameter	0	5	10	20	30	40
Moisture	3.3[a] (8.9)	3.4[a] (9.6)	3.2[a] (9.2)	4.4[b] (10.1)	4.0[b] (10.2)	4.2[b] (10.0)
Crude protein	13.5[a] (15.7)	14.2[a] (16.5)	16.2[b] (18.7)	16.8[b] (19.5)	18.3[c] (21.2)	19.5[c] (22.6)
Fat	30.3[a] (1.10)	29.4[a] (1.06)	27.1[a] (0.74)	21.2[b] (0.65)	20.6[b] (0.53)	21.0[b] (0.35)
Ash	3.43[a] (4.27)	3.42[a] (4.27)	3.21[a] (4.09)	3.31[a] (4.21)	3.31[a] (4.20)	3.21[a] (3.93)

1. Means within a row followed by the same letter are not significantly different ($p<0.05$)

2. Figures in brackets are for samples before frying

TABLE 3.
PROXIMATE COMPOSITION OF *NEMIPTERUS TOLU*

Parameter	%
Moisture	78.7
Protein	18.8
Fat	0.9
Ash	1.7

However, flavor was adversely affected. It was observed that samples with higher washwater protein contents tended to absorb less fat upon frying (Table 2). A significant decrease in fat content in samples containing 20% washwater protein after frying (Table 2) coincided with simultaneous significant drops in flavor and overall acceptability scores (Table 1). 'Keropok' is consummed as a fried product and a certain threshold value of fat may be necessary for the correct mouthfeel. This will form the subject of further studies.

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