

## Development of Value-Added Fishery Products

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### Abstract

*Studies on the development of value-added products using arrow squid (*Loligo sp.*) and bullet tuna (*Auxis rocheii*, R.) were conducted. The recommended steps in new product development were systematically followed while establishing control to all steps in these product development studies to ensure that the requirements for quality fishery products are met.*

*New product concepts were generated, evaluated, and refined. The most plausible concepts were then advanced to the product optimization stage wherein samples were subjected to a series of sensory evaluations to come up with the standardized formulations. Three (3) squid products, namely squid nuggets, squid loaf, and squid rolls, and two (2) bullet tuna products, namely tuna loaf and dried seasoned tuna, were then subjected to either accelerated or actual shelf life testings, consumer acceptability testings, and cost analyses.*

*In collaboration with a private company, the most promising technologies generated from the preceding activities were advanced to pilot-scale production in which the HACCP-concept of quality assurance was applied, and the hazards and critical control points associated with each step in the production of the new products were established. The resulting products were finally subjected to consumer testing at the Japan Food Expo '95 which proved their acceptability to the export market as well as the products' feasibility for commercialization.*

### Introduction

A stream of new and varied food products are continuously being introduced to the consumers. Clearly, the demand for these new products is strong and growing while conventional processed products have been gradually creating an old-fashioned image among consumers. It becomes necessary, therefore, for seafood processors to direct their efforts towards

better utilization of seafood through the development of value added products.

As a rule of thumb, new product development should be approached systematically. The usual "hit or miss" process of new product development must be replaced by a system which involves a process of developing an investment opportunity (Pearson, 1983), a consumer-oriented product development scheme (Fishken, 1983; Kraft, 1981), a "step-by-step risk reduction" process and lastly, a scheme that requires the combined effort of an interdisciplinary team (Meyer, 1984).

Interestingly, the introduction of such a system for new product development decreases the financial risks while enhancing the financial rewards of the undertaking. In addition, it takes into account innovative ideas that utilize one's clear concept of the consumer consumption pattern, the market demands, and more importantly, the concept of quality management. Needless to say, a company has to implement a quality management scheme in order to improve the efficiency and profitability of its operation and to enable the production of quality products which are globally competitive.

With all these in mind, studies on the development of value-added fishery products were conducted using the recommended steps in new product development. Specifically, these aim to:

1. develop quality, convenient, and shelf-stable value-added products through the application of the advances made in fish post-harvest technology;
2. establish the storage stability and consumer acceptability of the newly formulated products through actual/accelerated shelf life testing and consumer testing respectively;
3. use the Hazard Analysis Critical Control Point (HACCP)-concept of quality assurance to enable the development of quality and globally competitive fishery products; and
4. assess the commercial feasibility of the new products through a collaborative project with a private company in the conduct of pilot scale production, consumer acceptability testing and cost analyses of the new products.

## Materials And Methods

New value-added fishery products were developed using the recommended steps in new product development.

### 1. Generation, evaluation and refinement of product concepts

A ten-man focus group was formed for the generation of new product concepts. These concepts were then evaluated based on their respective commercial feasibility. Subsequently, the concepts were refined by defining the specific attributes that the target products should possess.

### 2. Translation of product concepts into optimized prototypes

The most plausible concepts were translated into optimized bench-top product prototypes by conducting a search for possible model products, screening of ingredients and a series of sensory evaluation of quality.

## Raw Materials

Arrow squid (*Loligo* sp.), weighing about 50 to 100 g each, were purchased at the Iloilo Fishing Port Complex, Tanza, Iloilo City, Philippines, iced with ice:squid ratio of 1:1, and immediately transported to the laboratories of the UPV College of Fisheries. The squids were washed, cleaned, and the heads and internal organs were removed. The squid mantle were then skinned, splitted in half, frozen in polyethylene bags, and stored at -20°C until needed.

Bullet tuna (*Auxis rocheii*, R.), on the other hand, weighing 100 to 150 g each, were purchased at the wet market in Miagao, Iloilo, iced with the ice: fish ratio of 1:1 and immediately transported to the laboratory.

## Product Formulation

The organoleptic properties of the products were optimized through variations on the levels of high impact ingredients/spices (for flavor and odor), processes (for texture and appearance), and color additive (for appearance). The samples were prepared and subjected to sensory evaluation of semi-trained panelists.

The sensory scores were statistically analyzed as a function of treatment and the interaction factor for the analysis of odor and flavor, texture, and appearance. The data were subjected to the Analysis of Variance (ANOVA) and to the Duncan's Multiple Range Test (DMRT) whenever differences exist between samples. Treatments were considered significantly different when  $p \leq 0.05$ .

## Shelf life Testing and Package Development

Packaging materials and methods specific to each of the products were used during shelf-life testing. Accelerated shelflife testing (ASLT) of squid nuggets (SN) and squid loaf (SL) were done using the procedure of Labuza and Schmidl (1985) whereas actual shelflife testing of squid rolls (SR), tuna loaf (TL), and dried seasoned tuna (DST) were conducted.

Samples were analyzed using : (1) the Thiobarbituric Acid (TBA) Test (Lemon, 1975), to determine the extent of lipid oxidation in the samples; (2) moisture content (MC) determination (AOAC, 1975), to characterize the moisture changes during storage; and sensory evaluation of quality.

For products subjected to ASLT, their respective  $Q_{10}$  values were obtained to enable the prediction of shelf life of these products at different storage temperatures.

## Consumer Testing

Four consumer testings were conducted in an attempt to determine the acceptability of the products to local consumers. The frequency distribution of the responses were analyzed accordingly.

### 3. Collaboration with a private company

At this point, collaboration with Josephine Marine Trading Corporation (JMTC), a privately owned exporting company with its plant located at the Iloilo Fishing Port Complex, Tanza, Iloilo City, was made possible through a Memorandum of Agreement between the University, JMTC and the Department of Science and Technology. Included in the agreement were the pre-feasibility studies for the products.

### 4. Cost analyses

Cost analyses were conducted in an attempt to establish the pricing scheme for the new products.

The prevailing retail prices of the ingredients were used in the computations as well as the average price at source of the raw material.

#### 5. HACCP-concept in product development

The Hazard Analysis Critical Control Point (HACCP)-concept of quality assurance was applied in these new product development activities. The hazards and preventive measures in the production of each of the newly-formulated products were established, together with the degree of control necessary for each of the hazards identified.

#### 6. Consumer testing of value-added products

To determine the commercial feasibility and the effect of the application of the HACCP-system, the new value-added products manufactured in pilot scale were subjected to consumer testing at the Japan Food Expo '95.

### Results And Discussion

#### 1. New product concepts

Table 1 lists the concepts generated by the focus group. It can be noted that most of these concepts are influenced by the current market trends,

and the consumption patterns as affected by the consumers' food habits and attitudes. These concepts were evaluated based on marketability or market potential, product competitiveness, product advantages, feasibility as a business proposition and the technical requirements in concretizing these concepts. Based on these evaluations, the most feasible concepts were refined, as shown in Table 2, through the definition of the specific attributes of each of these concepts, or simply the specific characteristics the target products should possess. These concepts were then advanced to the next steps.

#### 2. Product formulation and optimization

In this stage, the optimum levels and combinations of high impact ingredients/spices that significantly affect odor and flavor, and the most appropriate textural properties of the products were obtained. At least three (3) levels of each of the ingredients were methodically and systematically tested. Processes which affect the texture of the products were likewise varied to come up with texturized products. Through a series of sensory evaluations and appropriate statistical analyses of results, the optimized formulations were achieved. Table 3 shows an example of a standardized formulation of one of the newly-formulated fishery products.

Table 1. List of new product concepts.

Raw material	Product concepts	
Squid ( <i>Loligo</i> sp.)	Squid Noodles	
	Squid Rings	
	Squid Sticks	
	Squid Nuggets	
	Squid Franks	
	Squid Patties	
	Squid Jerky	
	Squid Loaf	
	Squid Longganisa	
	Squid Rolls	
	Bullet Tuna ( <i>Auxis rocheii</i> , R.)	Seasoned Tuna Jerky
		Tuna Ham
		Tuna Loaf
Dried Seasoned Tuna		
Canned Tuna Flakes with Vegetables		
	Canned Pet Foods	

Table 2. Specific attributes of the new fishery products.

New fishery products	Specific attributes
1. Squid Nuggets	Pre-fried; frozen; crunchy; spicy; convenient ovenable/microwaveable; ideal for snacks and meals
2. Squid Loaf	"Cold-cuts"; ready to eat; spicy; texturized; ideal for sandwiches and meals
3. Squid Rolls	Frozen; ready to cook; convenient; ideal for snacks and meals; economical and healthy alternative to pork rolls
4. Tuna Loaf	"Cold-cuts"; texturized; spicy; ideal for sandwiches and meals; economical and healthful alternative to meat loaves
5. Dried Seasoned Tuna	Spicy; ready to cook (fried or broiled); ideal for meals; sprinkled with sesame seeds for added appeal

Table 3. Standardized formulation of Tuna Loaf.

Ingredient	Percent (%) weight ( % weight of minced fish)
Flour	10.00
Pork Fat	10.00
Water	5.00
	( % weight of minced fish + flour, pork fat, water )
Sugar	7.50
Salt	3.00
Black Pepper	1.25
Onion Powder	1.00
Garlic Powder	1.00
Annato Powder	0.80
Monosodium Glutamate	0.50
Praque Powder	0.40

### 3. Shelf-life testing

The optimized products, packed as specified in Table 4, were subjected to shelf life testing wherein the changes in some quality factors were determined. These changes were monitored using different physico-chemical tests and sensory evaluation of quality. Correlation of values obtained from these evaluations enabled the determination of

their respective shelf-life at different temperatures, as shown in Table 5.

The  $Q_{10}$  values of SL and SN are reported in Table 6. These data clearly indicate that SL is relatively more temperature sensitive than SN; thus implying that any drastic change in storage temperature of SL results to a significant increase or decrease in its shelf-life.

Table 4. Packaging materials/methods for the different value added fishery products.

Product	# of pcs/pack; Weight/pack	Packaging material and method used
Squid Nuggets	10 pcs (150 g) / pack	Pre-fried, frozen nuggets vacuum packed in polyethylene (PE) bags; bags packed in laminated cartons
Squid Loaf	6 pcs (110 g) / pack	Stored as "cold-cuts" slices; lined in styrofoam trays (12"x5"); vacuum packed in PE bags
Squid Rolls	10 pcs (100 g) / pack	Frozen rolls layered in PE bags (2 layers); heat sealed
Tuna Loaf	6 pcs (110 g) / pack	Stored as "cold-cut" slices; lined in styrofoam trays; vacuum sealed in PE bags
Dried Seasoned Tuna	1 pc (35-100 g) / pack	Cut as butterfly fillets; head off; sprinkled with sesame seeds; vacuum packed in PE bags

Table 5. Shelf life (days) of value-added fishery products at different temperatures.

Product	-14°C	0°C	35°C
Squid Nuggets	56	19	2
Squid Loaf		48	2
Squid Rolls	59		
Tuna Loaf		49	
Dried Seasoned Tuna		15	6

Table 6.  $Q_{10}$  values of value-added fishery products.

Product	$Q_{10}$ values
Squid Nuggets	1.35
Squid Loaf	1.66

#### 4. Consumer Testing of value-added fishery products

The squid products were subjected to a series of consumer testing. The average frequency distribution of the responses in these testing are reported in Table 7.

It can be noted that of the three products tested, SN obtained the highest "like very much" mark of 70.14%; thus suggesting that this product is more preferred by the respondents, relative to the other two (2) products. One may also say that this could also mean that SN has the most potential for

commercialization because of the respondents' preference to it. On the other hand, SL and SR received fairly good rating of 51.30% and 39.71% "like very much" score, respectively.

Clearly, the consumer testing proved the acceptability of the products to the local consumers. This preference is in the following order: SN, SL, and SR. Interestingly, such observation was further backed up by the comments on the potential for commercialization of SN, SL, and SR, as perceived by the panelists, which received the ratings of 67.89%, 50.53%, and 39.47%, respectively.

Table 7. Frequency distribution (%) of the responses of the local consumers to the products (n=345).

Preference scale	Squid nuggets	Squid loaf	Squid rolls
Like very much	70.14	51.30	39.71
Like	23.77	32.17	40.58
Slightly like	4.93	10.72	11.30
Neither like nor dislike	-	2.03	3.48
Slightly dislike	0.29	2.03	2.80
Dislike	0.58	-	0.58
Dislike very much	-	-	-
No Answer	0.29	1.74	1.45

#### 5. Cost analyses

The suggested retail prices of the products are presented in Table 8. These prices were based on the average price of P58.00/kg squid (USD 2.21/kg)

and P30.00/kg bullet tuna (USD 1.14/kg), and on the retail prices of the ingredients. Labor cost was included in the computation of prices of squid products, which was done together with the private counterpart of the project.

Table 8. Prices of value added fishery products.

Product	Quantity	Value (PHP)	Value (USD)*
Squid nuggets	250 g	38.18	1.45
Squid loaf	110 g	23.39	0.89
Squid rolls	100 g	16.45	0.63
Tuna loaf	110 g	13.39	0.51
Dried seasoned tuna	150 g	9.40	0.35

\* FOREX : 1.00 USD = PHP 26.25

## 6. HACCP-concept in product development

An important element of a quality system, as specified in the ISO 9000 standards is the requirement which is necessary for any product development activity (Huss, 1994). This specifies that plan should be established to control and verify all phases of any product development activity in order to ensure that the specific requirements for a particular product are met. As such, it becomes necessary to apply in this study the recommended system for new product development which, in effect, not only increases the financial reward of the undertaking but also ensures that quality products are produced.

Likewise, the application of HACCP-concept of quality assurance in this study is very important. As a result, the hazards and preventive measures in the production of each of the new products were established; these are reported in Tables 9 and 10.

## 7. Consumer testing at the Japan Food Expo '95

Samples of SN, SL and SR were prepared in pilot scale, with the application of the HACCP-concept. These were brought by the JMTC and were subjected to product exposition and consumer testing at the Japan Food Expo '95, which was held in Tokyo, Japan in March 1995.

According to JMTC, the products were exhibited side-by-side with other food products brought to the said fair by the Philippine Food Mission. Based on the consumer testing conducted on site, the products have the potential for commercialization and can, therefore, be potentially marketed to Japan and other countries. However, general comments included the following: too spicy for the Japanese taste, the SN has too much bread crumbs, SL should have less fat. With these comments at hand, the products were reformulated accordingly.

This consumer testing proved the efficiency

of the HACCP-system applied to the products. It clearly showed that using such system, the quality of the products are ensured, and in order to come up with globally competitive products, such system must be used.

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### Discussion

Ms Santos-Yap explained that the products were subjected to various temperatures in order to obtain the  $Q_{10}$  value. As for shelf life testing, various storage temperatures were used. The products stored under these temperatures were then tested for physico-chemical changes, microbiological indices and evaluated for their sensory attributes.

Table 9. General safety hazards and preventive measures during processing and distribution of value-added squid products.

Product flow	Hazard	Preventive measure	Degree of control
Live squid	Contamination	Monitoring of environment	CCP 2
Catching			
Chilling	Growth of bacteria	(Txt) control	CCP 1
Transport	Growth of bacteria	(Txt) control	CCP 1
Receipt at plant	Growth of bacteria	(Txt) control	CCP 1
<u>Processing steps :</u>			
Washing/Cleaning	Growth of bacteria Contamination	(Txt) control Water quality	CCP 1 CCP 1
Skinning/Beheading			
Mincing	Contamination Growth of bacteria	Hygiene/Sanitation (Txt) control	CCP 2 CCP 1
Prep. of ingredients			
Mixing of meat and ingredients			
For SN / SL :			
Molding	Growth of bacteria	(Txt) control	
Steaming			
Slicing	Growth of bacteria Contamination	(Txt) control Hygiene/Sanitation	CCP 1 CCP 2
Breading/Battering			
For SR :			
Wrapping of paste	Growth of bacteria Contamination	(Txt) control Hygiene/Sanitation	CCP 1 CCP 2
Packaging	Growth of bacteria	Packaging material Hygiene/Sanitation	CCP 1
Chilling (for SL)	Spoilage (oxidation) Growth of bacteria	(Txt) control (Txt) control	CCP 1 CCP 2
Freezing (for SN, SR)	Spoilage	(Txt) control	CCP 1
Distribution	Growth of bacteria	(Txt) control	CCP 1



Table 10. General safety hazards and preventive measures during processing and distribution of value-added bullet tuna products.

Product flow	Hazard	Preventive measure	Degree of control
Live bullet tuna	Contamination	Monitoring of environment	CCP 2
Catching			
Chilling	Growth of bacteria Histamine formation	(Txt) control (Txt) control	CCP 1 CCP 2
Transport	Growth of bacteria	(Txt) control	CCP 1
Receipt at plant	Growth of bacteria	(Txt) control	CCP 1
Processing steps : Washing/Cleaning	Growth of bacteria Contamination	(Txt) control Water quality	CCP 1 CCP 1
For TL :			
Skinning/Loining	Contamination Growth of bacteria	Hygiene/Sanitation (Txt) control	CCP 2 CCP 1
Mincing	Contamination Growth of bacteria	Hygiene/Sanitation (Txt) control	CCP 2 CCP 1
Mixing of meat and ingredients	Growth of bacteria	Hygiene/Sanitation	CCP 2
Molding			
Steaming	Growth of bacteria	(Txt) control	CCP 1
Slicing	Contamination Growth of bacteria	Hygiene/Sanitation (Txt) control	CCP 2 CCP 1
For DST:			
Splitting/Eviscerating	Growth of bacteria Contamination	(Txt) control Water quality	CCP 2 CCP 2
Marinating			
Drying	Growth of bacteria Contamination	(Txt) control Hygiene/Sanitation	CCP 1 CCP 2
Packaging	Growth of bacteria	Packaging material Hygiene/Sanitation	CCP 1 CCP 2
Chilling	Spoilage (oxidation) Growth of bacteria	(Txt) control (Txt) control	CCP 1 CCP 1
Distribution	Growth of bacteria	(Txt) control	CCP 1