

# Improved Smoking Process of Squid (*Sepioteuthis lessoniana*)

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**Abstract:** The process of smoking squid (*Sepioteuthis lessoniana*) locally known as “Bakag” was enhanced. Chilling and marinating of squid mantle before smoking was introduced to improve taste and texture. The acceptable product was determined through sensory evaluation using a 5 -point hedonic scale rating. Chemical and microbial properties were determined using the standard method of analysis. Smoked squid which was chilled before smoking and those flavoured with Sprite soda was the most acceptable. The microbiological test revealed levels within acceptable limits.

**Keywords:** food processing, value adding, tenderized through chilling, bakag, value-added squid

## 1. Introduction

Squid are marine cephalopods of the Order Teuthoidea, Sepioida, Vampyromorpha, and Octopoda, with sub-order Myopsida, Cirrata and Incirrata (Jereb, and Roper, 2010) which comprises around 300 species. They roam all the oceans of the world in a wide range of distribution of various sizes ranging from 1” to 80 feet, but most common size for consumption is less than 12”. It has an edible portion of 71.27% consisting of mantle (39.26%) tentacles (20.22%) and fins (11.79%) (Kreuzer, 1984).

According to Hernando and Flores (1981), the Philippines has one of the most extensive coastlines and territorial waters in which several species of cephalopod, especially squids are available. They identified 11 major fishing areas for squids and their average annual production. It was noted that Samar Sea and the Bohol Sea had shown an increase in squid catches.

Trawling and jigging remain the most productive gear for squid catches. Landings reported to FAO, the cephalopod catch for 2002 was 3, 173.272 tonnes, of this 2,189 tonnes or 75.8% was the squid.

The proximate composition of squid meat is 75-84% water, 13-22% crude protein, 0.1-2.7% lipids, 0.9-1.9% minerals and 60 to 80% are edible (Sikorski and Kolodziejaska, 1986). For every 100g of mixed species of squid contains about 153-420 mg of phosphorus (P), 246-313 g of potassium (K), 176 mg of sodium (Na), 10-109 mg of calcium (Ca), 20 mg of magnesium (Mg), traces of iron (Fe) 0.5-18.8g, 0.8-8.4 mg of zink (Zn), 0.2-1.6 mg of copper (Cu), 0.01-0.5 g of cadmium (Cd), 20-80 µg of manganese (Mn), 1-30 µg mercury (Hg), iodine (I) and 0.7-16 µg lead (Pb) (Gajewska & Nabrzyski, 1979; Sidwell et al., 1977, 1978a).

Nutrients per 100g of the meat of mixed species of squid contain 4900 µg of

Ascorbic acid, 8-201 µg of Thiamin, 50-836 µg of Riboflavin, 1.2-5.6 µg of Niacin, 70-1300 µg of Pyridoxine, 12.5 µg of Folic acid, 1.3-13 µg of Vitamin B<sub>12</sub> and 680 µg of Pantothenic acid. The rough estimate of squid's nutrient content suggests that consuming the right proportion of its meat will be beneficial to health.

Squid as food is often marketed using the Italian word "calamari." The body can be stuffed whole, cut into flat pieces or sliced into rings. It can also be grilled added to various cooking preparations and served with a choice of dips including lemon, ketchup, mayonnaise, olive oil and soy sauce.

Street food has become synonymous with cheap, accessible, quick, yet delicious snacks that are ever popular with the "masa" (masses). These include the ubiquitous minced seafood products like fish balls, squid balls, kikiam, patties, tempura, and nuggets. Fish and squids balls are the most popular of these items in the Philippines. Popular because they are ready to eat, cheap snack foods that are suitable for both young and adult consumers (Jumdain, 2007).

Handling and stowage of squid is a concern as it is more susceptible to damage than other white fish if not handled carefully (FAO, nd). Squid are preferred to be whole in many markets, particularly overseas. When handling and stowage are bad, the value of squid goes down. Ungutted squid in ice keep in first class condition for up to 8 days only, after this the flesh begins to redden, musty odors develop, and the squid becomes inedible in 13-14 days (ibid). Immediate post-processing of squid is therefore necessary. In many parts of the world, if squid cannot be consumed fresh or frozen, it is preserved through drying and smoking or bottling.

## 2. Objective

2.1 The paper presented an improved process of smoking squid considering products acceptability in terms of;

- a. texture
- b. flavor
- c. color

2.2 Determine the chemical and microbial profile of the most acceptable product

## 3. Methodology

### 3.1 Research Design

The development of the most acceptable smoked squid uses several experimental procedures and treatments. The smoked squid that is most acceptable was submitted for proximate and microbial analysis.



Figure 1. Squid, *Sepioteuthis lessoniana*

### 3.1 Materials Used

This study used the *Sepioteuthis lessoniana* M. Norman species of squid shown in Figure 1. For the experimentation, samples weighing 350 grams to 700 grams were procured in the local market.

Table 1. Sensory evaluation scorecard for texture, flavor and general acceptability of the smoked squid using Hedonic scale of evaluation

Score Range	Texture	Flavour	General Acceptability
4.51 – 5.00	Very tender	Very much desirable	Very much desirable
3.51 – 4.50	Tender	Much desirable	Much desirable
2.51 – 3.50	Slightly Tender	Moderately desirable	Moderately desirable
1.51 – 2.50	Slightly Tough	Slightly undesirable	Slightly undesirable
1.00 – 1.50	Tough	Not desirable	Not desirable
CODE	491 (Beer)	354(Vinegar)	726 (Sprite)

In improving flavor, beer, vinegar, and Sprite soda. Other ingredients were sourced locally, and the proportion was developed until the most preferred formulation with the three flavors were made.

### 3.3 Product Testing

Samples produced from the different process and formulation were subjected to sensory evaluation. Table 1 shows the Hedonic scale.

Samples were also submitted to Department of Science and Technology for proximate and microbial analyses. The testing method used is in accordance with the Food and Drug Administration (FDA, 2004), Guidelines for the Assessment of Microbiological Policy of Processed Food. Hence, the smoked squid is safe for human consumption.

### 3.4 Statistical Analysis

Data obtained from various tests were presented in terms of frequency counts and relative frequency. Graphical presentation using bar graphs and tables were also used.

## 4. Results and Discussion

### 4.1 The Smoking Process

#### 4.1.1 Traditional Method of Smoking

The traditional way of smoking squid was performed to obtain a product for sensory evaluation. The steps include cleaning, washing, and slicing, then followed by brining that is soaking squid in the salt solution for 1 hour. After brining the squid was steamed for ten minutes then it is arranged in drying racks for partial drying for about 30 minutes or until it becomes dry to touch. Finally, the squid was smoked for 20 minutes or until golden brown.



Figure 2. Traditional Smoking of Squid

#### 4.1.2 Improved Smoking Squid

The new procedure was aimed at improving texture and flavor. Series of dry runs on the processing of the product was

done to meet the desired texture and acceptability level. Activities include the following:

- a. Effect of chilling on the texture of smoked squid
- b. Effect of marinades on the flavor of smoked squid.

The process used in the production of smoked squid is shown in Figure 2. The raw material was cleaned and washed. The skin was removed, and the meat thoroughly washed. The meat was cut into 1" x 2" pieces using a sharp knife in preparation for steaming. The squid was steamed for 10 minutes only. After steaming, the samples immediately soaked in cold water at a temperature of 0°- 4°C for 10 minutes. The lot was subdivided into three sub-lots, and the prepared marinades were added to each of the sub-lots. Each of the mixtures was soaked in marinades for 1 hour.

Table 2 shows the different ingredients used in preparing three marinades formulation. Squid samples were soaked in the solutions For 1 hour. After which samples were drained, sun-dried until dry to the touch. Finally, the squid was smoked separately in a smoke house for 20 minutes.

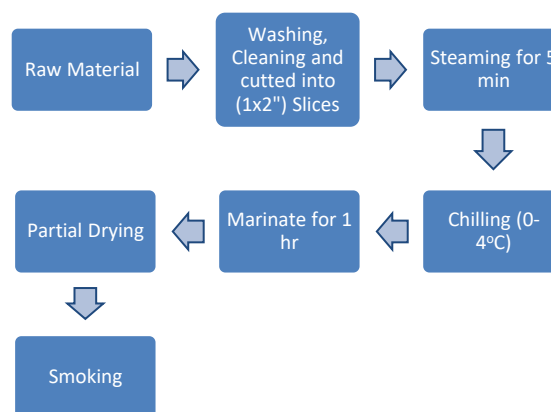


Figure 2. Improved Smoking of Squid

## 4.2 Sensory Evaluation

### 4.2.1 Traditional versus New Smoking Procedure

The smoked squid was described as having a tender to slightly tender texture. It has the right springiness and relatively juicy with succulent and desirable texture. The skin which is the collagenous fiber of the squid mantle was removed before smoking since it causes toughness of the texture. According to Otwell and Hamman (1996), the squid mantle is covered with a thin translucent skin, when heated, it swells, and the effect is that the mantle tends to be tough

Table 2. Treatment Formulations/Ingredients

Treatment 1	Treatment 2	Treatment 3
1 cup beer	35 ml vinegar	1 cup sprite
2 tbsp sugar	35 ml kalamansi	2 tbsp sugar
1 tbsp soy sauce	5 g garlic	1 tbsp soy sauce
½ tsp black pepper	2 g black pepper	½ tsp black pepper
One tsp salt	50 ml soy sauce	1 tsp salt
5 g garlic	200 ml brine solution 1:7	5 g garlic
10 ml kalamansi	2 g bay leaves	10 ml kalamansi

when cooked. There are two additional steps added to the conventional way of the smoking process. These include skinning and chilling steps, both of these contributed to the tender and succulent texture of smoked squid. The smoked squid was also soaked in various marinades, and each resulted in an acceptable product.

Table 3 shows the results of evaluation of the texture, color, flavor, and general acceptability of smoked squid comparing the traditional and improved method. The traditional method has a slightly tough texture (1.7) moderately desirable flavor (3.5), and the general acceptability is much desirable (3.6) while the improved method has a very tender texture(4.6), very much desirable both in flavor and general acceptability(5.0). Regarding color both method obtain a much desirable product (3.6).

Table3. Sensory Evaluation Scores for Smoked Squid

Product Attributes	Traditional Method of Smoking	Improved Method of smoking
Texture	1.7	4.6
Flavor	3.5	5.0
Color	3.6	3.6
General acceptability	4.5	5.0
Average	3.78 (much desirable)	4.55 (very much desirable)

Figure 3 shows the responses of the panelists as to the effect of chilling on the texture of squid mantle. Chilling squid before marinating in beer got a mean score of 2.5 which means slightly tender and 3.0-4.0 which indicate a tender texture. In Figure 3, the chilled squid was soaked in marinade added with vinegar.

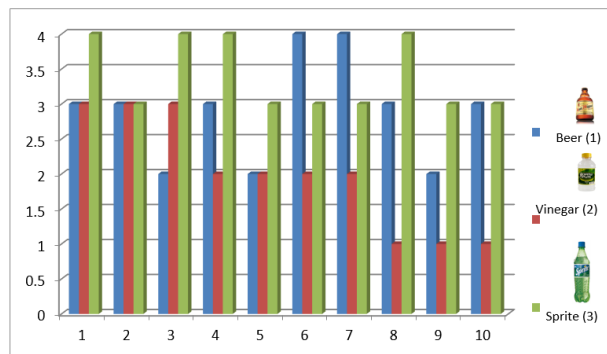


Figure 3. Panelist Score of Squids Chilled First Before Marinating with Beer, Vinegar, and Soda (Sprite)

The mean score ranges from 1.0-3.0, and the descriptive numerical rating indicates that the texture was slightly tender to tough. While in Figure 4, the chilled squid was soaked in the marinade with sprite added. The mean scores were 3.0 which indicate a tender texture and 4.0 which signify a very tender texture.



Figure 4. Samples of Smoked Squid

In the study of Lesaca (1974), it was noted that pre-treatments such as soaking of squid in beer, sodium carbonate, and lime before steaming and processing yields a product with the tender texture. In this study, it was observed that chilling of squid before soaking in marinades results to a more tender texture of squid mantle.

ANOVA test shows that the F value of 10.22 and p-value of 0.0005 suggests the panelist rated the three marinade significantly different as shown in table 3. Of the three flavors, the use of Sprite soda received the better score followed by beer and least liked is vinegar.

Table4. Post Hoc Analyses (Chilling before marinating)

Marinade	Turkey HSD p-value	
	Vinegar	Sprite
Beer	*0.0209	0.2661
Vinegar		**0.0010

\* Significant @ 0.05 \*\* Significant @ 0.01

General acceptability of marinated smoked squid soaked in beer mixture had a mean score value of 2.8 and the squid soaked in vinegar mixture had a mean score value of 2.5 both samples were described as moderately desirable. While the smoked squid soaked in marinade added with sprite having a rated mean score of 4.3 which is described as very much desirable. The panelists unanimously agreed that adding sprite to marinades results to a very flavorful smoked squid. This mixture of marinades blends well with the flavor of squid and also contributes to the tenderness of smoked squid mantle.

For the general acceptability, samples did not show significant differences with F value of 12.255 and p-value of

0.0002. Panelists find the samples marinated in Sprite soda to be the acceptable formulation. Sown on Table 5 is the Post Hoc Analyses for general acceptability.

Table5. Post Hoc Analyses (Chilling before marinating)

Marinade	Turkey HSD p-value	
	Vinegar	Sprite
Beer	0.7243	**0.0018
Vinegar		**0.0002

\* Significant @ 0.05 \*\* Significant @ 0.01

### 4.3 Chemical and Microbial Analyses

Table 6 shows the chemical and microbial results of the smoked squid processed using the improved procedure. Proximate analyses of smoked squid were determined for moisture content (69.6%); crude protein (23.3%) ash content (1.39%) and total fat (0.72%). The microbial test for *E. coli* is < 3.0 MPN/g and APC was  $3 \times 10^3$ /g. These values are within acceptable levels of the microorganism (m 11 MPN/g and  $5 \times 10^5$  /g, for APC and *E.coli* respectively). Hence the product is safe for human consumption

Table 6. Chemical and Microbial Tests of the Preferred Smoked Squid

Chemical	Percentage (%)
Moisture content	69.9 %
Crude protein	23.3%
Ash content	1.39%
Total fat	0.72%
Microbial	Values
Aerobic Plate Count (APC)	$3.0 \times 10^3$ /g
<i>E. Coli</i>	<3.0MPN/g

The above information is for unheated samples. Smoking may have caused the loss of some key nutrients or chemicals. During cooking or heating, some of the chemical content may be removed or reduced depending on the manner of cooking. The cooking loss in squid is up to about 40%, juiciness of the squid mantle can be controlled by the cooking time and by pre-treatment in some solutions like polyphosphate (Sikorski and Kolodziejska, 1985).

### 5. Conclusion and Recommendation

A better way of smoking squid with improved acceptability was developed. This process includes chilling before smoking which has improved tenderness of squid mantle. Marinating squid enhanced its flavor with Sprite soda receiving the highest acceptability score which is significantly above those treated with beer and vinegar. The developed product is 69.6% moisture, 23.3% protein, and microbial test are within acceptable limits which means the smoked squid is safe for human consumption.

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