Original paper

EVALUATION OF THE THICKNESS AND THE LINEAR EXPANSION OF FISH CRACKERS PRODUCED BY SOME COTTAGE INDUSTRIES OF JEPARA DISTRICT (CENTRAL JAVA)

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ABSTRACT

Fish crackers are locally known as "kerupuk ikan". The quality of fish crackers depends on the thickness of the slice before frying, the percentage of linear expansion, and some other factors. So far, there was not any standard value of the thickness and the percentage of the linear expansion of good quality fish crackers in Indonesia yet.

The objectives of this study were to gain some data on the thickness and the percentage of linear expansion of fish crackers and to compare the data with the estimated ideal value based on the reference data.

Ten cottage industries in Jepara district chosen based on the proportional stratified randomized sampling method. The first grade fish crackers (according to the processor) were obtained as the samples from each of the cottage industries. Ten fish crackers of each sample were evaluated.

The results indicated that the fish cracker samples were circular, the thickness varied from 1.0 to 3.85 mm. The average thickness of the samples was 2.77 mm which significantly thicker (p<0.01) than the estimated ideal thickness (1.50 mm). The percentage of linear expansion of the samples varied from 54.48 to 134.58 %

INTRODUCTION

Fish crackers are foods which contain comminuted fish, which can be classified as "half products", and "intermediate products" (Lachmann, 1969).

Traditionally it is made from tapioca, comminuted fish, and water (Yu et al., 1981; Siaw et al., 1985; Julianty, et al., 1994), however, a lot of processors in Indonesia add other ingredients such as salt, garlic, monosodium glutamate, baking powder and some processors also add small amount of granulated sugar (Ibrahim, 1992). All of the ingredients are then mixed to form dough, shaped, steamed or boiled to gelatinized the starch, cut into thin slices and sun-dried. The dried slices fried in hot oil to get low density and crispy products before consumption.

Moelyanto (1992) stated that the fish crackers quality depend on some factors such as the fish content and the

linear expansion. The linear expansion of fish crackers is influenced by processing parameters such as the proportion of flour to fish, various kinds of flour, the amount of leavening agents (if added), homogeneous dough, cooking time, the thickness of slices, the moisture content of dry slices and the cooking oil temperature. In relation with the fish crackers quality, the percentage of linear expansion affects the crispness of the product (Ibrahim, 1992). Yu (1991) reported that the ideal percentage of linear expansion of fish crackers and no baking powder added was 77%. Whereas in experi-ments of Primar et al (1996) and data of samples collected from a processor indicated that the percentage of linear expansion of both fish crackers samples with baking powder added was 107.1 % and 90.4 % respectively.

In general, most of consumers in Indonesia, when they buy fish crackers they decided the thickness of the fish crackers based on their own feeling. That was due to the standard value of the thickness and the percentage of linear expansion of good quality fish crackers was not available yet (Ibrahim, 1992). Yu et al (1981) reported that the average of the fish cracker thickness sliced mechanically was 1.25 mm.

Many processors in Jepara district had produced fish crackers many years ago. They categorized the fish crackers into three grades based on the ratio of flour to fish, however, there was not any publication of the thickness and the percentage of linear expansion of the product yet.

The objectives of this study were to gain some data on the thickness and the percentage of linear expansion of fish crackers produced by some cottage industries of Jepara district and to compare the data with the estimated ideal value based on the reference data.

MATERIALS AND METHODS

Samples

The first grade fish crackers (according to the processors) were obtained as the samples from ten cottage industries of Jepara district (38 %) of the population.

Sampling Method

The sampling method used was the proportional stratified randomized sampling method (Leedy, 1980; Sudjana, 1992). The samples were only taken from one time production. Ten fish crackers of each sample were evaluated.

Fish Crackers Processing Method

The fish species used were mackerels (*Scomberomorus* sp.). The type of flour used was first grade tapioca (cassava starch). Some ingredients added were salt, garlic, baking powder, monosodium glutamate, granulated sugar, and water. The proportion of tapioca to fish (beheaded) used by the cottage industries was about equal, however, the proportion became varied among the industries after the fish meat collected and mashed. The average ratio of tapioca to mashed fish meat was 1.23 to 1. The other ingredients added were also varied as shown in **Table 3**.

The mashed fish meat was mixed with tapioca, other ingredients, and water manually to form homogeneous dough. The dough shaped into rolls. Each of the rolls wrapped with a piece of muslin and tied at both ends. The rolls were then boiled in a cooking pot for about 3 hours with a gas cooker and subsequently cooled at room temperature for two days. The wrapper opened and the rolls manually thinly-sliced with a simple wooden tool at which knife attached. The slices were circular which were then sun-dried. They

packaged with polyethylene after they were dried.

Measurement of Physical Properties

The thickness of each slice of fish crackers before frying was calculated from the average of the thickness at 4 points as result of a cross mark measured with a caliper. The percentage of linear expansion (LE) of fish cracker was calculated from the average of four directions measurement of fish cracker diameter with a caliper before and after frying at temperature of 191° C to 200° C.

Frying Method

The fish crackers fried with cooking oil in a wok heated with a gas cooker. The oil temperature was measured with a thermocouple. The percentage of linear expansion was calculated as follows:

$$\% \text{ LE} = \{(Li-Lo) / Lo\} \times 100 \%$$

Where Lo is the diameter before frying and Li is the diameter after frying (Julianti, et al., 1994).

Moisture Content

The moisture content of fish cracker samples before frying was determined by the drying method (AOAC, 1984).

Statistical Hypothesis Testing

a. Thickness of samples
  Ho : $\mu = 1.5$ mm
  (The estimated ideal thickness of a fish cracker sliced manually based on the average of reference data)
  $H_1 : \mu \geq 1.5$ mm

b. Percentage of linear expansion
  Ho : $\mu = 97.88 \%$

(The average percentage of linear expansion of fish crackers with baking powder added based on reference data)
$H_1 : \mu \neq 97.88 \%$

Statistical Test

Data were analyzed using Student's test (Leedy, 1980; Sudjana, 1992)

RESULTS AND DISCUSSION

Characteristics and Quality of The Samples

The fish cracker samples before frying were circular, hard, dry, and whitish. The range of the diameter was from 6.68 to 8.17 cm. The samples expanded after frying. They become crispy, puffy, and porous. In term of the sensory quality the samples did not meet the first grade fish crackers quality based on the Indonesian National Standard (SNI) because there were some holes on the fish cracker surfaces probably because the dough did not mix homogeneously, but the moisture and the protein contents met the standard (Ibrahim et al, 2001).

Thickness of Samples

The thickness value varied among the samples within an industry and among industries as shown in **Table 1**. The range of thickness value was from 1.0 mm to 3.85 mm and the average value was 2.77 mm, which was significantly higher (p < *0.01*) than the ideal fish cracker thickness.

Table 1. The range and the mean values of fish cracker thickness of each cottage industry

Code of Cottage industry	The range of thickness value (mm)	The mean value $\pm$ Sd (mm)

I 950	1.65 – 2.55	2.23 ± 0.40
I 291	2.05 – 3.70	2.77 ± 0.47
I 612	1.75 – 3.65	2.37 ± 0.55
I 910	1.65 – 3.10	2.58 ± 0.43
I 186	1.35 – 3.20	2.31 ± 0.62
I 438	1.00 – 3.60	2.70 ± 0.85
I 665	1.14 – 3.85	2.47 ± 0.68
I 869	2.35 – 3.80	2.32 ± 0.48
I 207	2.40 – 3.85	2.06 ± 0.48
I 345	2.13 – 3.40	2.77 ± 0.46

* Each of mean value is from 10 samples measurement

The thickness of the samples were thicker than the ideal fish cracker thickness due to some factors mainly:

(1) The blade used was not as thin and sharp as a mechanical slice.
(2) The texture of the rolls was elastic and a little bit sticky. The processors overcome such things by rubbing the blade with cooking oil. At first, the workers could manage to slice as thin as possible but the roll gradually became smooth caused the difficulty to slice thinly and constantly.
(3) Not all the workers were skilled in slicing but they must do the work. Consequently, the thickness of the samples very varied as shown in **Table 1.**

The Linear Expansion of Samples

The average diameter of samples before frying was 7.56 cm. The range of the linear expansion was from 54.48 % to 134.58 % as shown in **Table 2**. The average of linear expansion of samples was 104.33 %, which was not significantly different ($p > 0.05$) to the average of linear expansion of fish crackers based on reference data.

Table 2.   The percentage of linear expansion of fish crackers of each cottage industry

Code of cottage industry	Diameter before frying (cm)	Diameter after frying (cm)	Mean of linear expansion (%)
I 950	8.17	18.34	124.48
I 291	7.07	13.75	89.11
I 612	7.13	16.58	132.53
I 910	6.68	15.67	134.58
I 186	6.8	14	105.88
I 438	8.07	16.37	102.85
I 665	8.5	15.5	82.35
I 869	7.82	12.08	54.48
I 207	8.0	16.0	100
I 345	7.37	16.0	117.11

- The average of moisture content was 12 % ± 0.14 within the range of 11.03 % to 12.56 %
- The range of cooking oil temperature was from 191^0 C to 200^0 C
- The range of frying time was from 28" to 39"

Data on **Table 2** shows that the linear expansion of the samples varied widely. The variation seemed influenced by some factors such as:

(1) The variation of the percentage of the mashed fish meat, the tapioca, and the other ingredients used among the industries as shown in **Table 3**.

(2) The processing parameters varied among the industries such as homogeneous dough and cooking time.
(3) The variation of the samples thickness resulted in different frying time as shown in **Table 3**.

Each of the ingredients was not measured by a metric system. The processors only used kitchen utensils such as a bowl, a spoon, and a plastic bucket.

Table 3.   The percentage range of the ingredients used in fish crackers production among the cottage industries of Jepara district after calculated

Ingredients	Ranges (%)
Mashed fish meat	35.9 – 45.6
Tapioca	49.4 – 57.1
Water	0.3 – 6.3
Salt	0.3 – 2.9
Garlic	0.4 – 1.26
Baking powder	0.03 – 0.2
Monosodium glutamate	0.2 – 0.8
Granulated sugar	0.04 – 0.06

The percentage of the ingredients was calculated based on the total weight of mashed fish meat and tapioca after converted in a metric system.

Primar et al. (1996) reported that fish crackers prepared from tapioca and four different fish species in the ratio of 2.5 to 1 and baking powder added had the linear expansion 92.5 %, 94.2 %, 102,4 % and 100,7 % respectively. The thickness of the fish crackers was not reported. Yu (1981) also studied on fish crackers prepared from fish and tapioca in ratio of 1.51 to 1, no baking powder added, sliced with a mechanical slice. The results indicated that the thickness of the fish crackers was 1,25 mm and the percentage of linear expansion was 101 %.

Based on the average ratio of tapioca and fish meat used which was 1,23 to 1 it seems that the percentage of linear expansion of fish crackers samples was almost similar to the percentage of linear expansion of fish crackers prepared from tapioca 2 times more as reported by Primar et.al. (1996). Theoretically fish crackers prepared from higher proportion of tapioca than fish and baking powder added should have higher percentage of linear

expansion. That was related to the firmness of the gel formation. As mentioned by Be Miller Whistler (1996) that the firmness of the gel depends on the extent of junction zone formation. Junction zone formation is influenced by the presence of the ingredients such as fats, proteins, sugar, acids, and the amount of water present. In comparison with the percentage of linear expansion of fish- crackers reported by Yu (1981) the percentage of linear expansion of fish cracker samples did not very differ although the former more tapioca used and no baking powder added but the slices were thinner.

Those data indicated that the thickness of slices played important role on the percentage of linear expansion of fish crackers.

CONCLUSION

The average thickness of fish crackers produced by some cottage industries of Jepara district was 2.77 mm, which was thicker than the estimated ideal thickness (1.50 mm) or the fish crackers thickness sliced with a mechanical slice.

The average percentage of linear expansion of fish cracker was 104.33 %. The value did not differ from the average percentage of linear expansion of fish crackers based on reference data and it was normal.

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