The effect of sucrose addition on the sensory quality of “terasi” an Indonesian shrimp paste

L Rianingsih¹, Sumardianto¹, Romadhon¹, M B Rusdi¹, and P H Riyadi¹

¹Departement of Fisheries Product Technology, Diponegoro University, Semarang, Central Java, Indonesia.

Email: laras_rianingsih@yahoo.com

Abstract. Terasi is a fermented product made from shrimp or fish with or without salt. In general shrimp paste producers only add high salt concentration to preserve the raw materials and to ensure successfully fermentation process. However there are shrimp paste producers in the Pati, Central Java, Indonesia that use sucrose sugar as a source of carbohydrate in the shrimp paste production. Sugar will affect the reactions that occur during the shrimp paste production process and will ultimately affect the characteristics of the product. This study aims was to determine whether there is an effect of adding sucrose sugar to the flavor and sensory characteristics of the shrimp paste. The Result showed that the addition of sugar did not affect the aw and TPC BAL value, but it decreased the TVBN value, soften the texture value and in addition the sensory was more prefered by the panelist. The characteristic of shrimp paste with sugar addition was low aw value 0.631 ± 0.631, TPC BAL was not detected, TVBN value 115.641 ± 9.940 mgN/(100 gr) and sensory 7.872 < µ < 8.328. The use of sucrose can be recommended to be added during shrimp paste production to increase consumer preference.

1. Introduction
Terasi or shrimp paste is a solid food flavoring, have distictive smell and a result of fermenting shrimp, fish or a mixture both shrimp and fish with 20-25% salt or other ingredients [1], [2]. Terasi has a slightly cheese-like flavor and an appetizing aroma and made through natural fermentation with addition salt at room temperature. Besides the delicious taste, shrimp paste also cheap and contain protein [3], [4].

Some processors in Indonesia also add sugar in addition to salt when making shrimp paste. According to the processor, the sugar is intended to balance the salty taste. The addition of sugar will give a different and better character of shrimp paste. Shrimp paste which fermented by enzyme and lactic acid bacteria whose growth is influenced by oxygen and nutrients in raw materials and other materials. Lactic acid bacteria will convert organic components such as protein into simpler forms [5], [6]. Research shows that amino acids can interact with other substances such sugar in the Maillard reaction and form Maillard reaction products [7]. The metabolism of microorganism and chemical reaction like Maillard reaction will produce compounds including those that affect the flavor. Most shrimp paste processor only use salt as additive to control the fermentation process. In some area there a few differences. In west java there is a producer that use brown sugar and in Juwana, Central Java
a few shrimp paste producers used sugar cane during make the product. Juwana is one of central of terasi producer in Java. Sugar which have glucose and fructose as a monomer certainly will effected several aspect in the shrimp paste.

Sugar will also have effect in microorganism aspect. Sugar is the most easily metabolized C source so that could support the growth of microorganism. However a certain concentration it is also possible to suppress the growth of microorganism. through hypertonic osmotic pressure mechanism. Chemically, sugar will be able to react with various components in the shrimp paste. One of the reaction that may occur is the mail lard reaction and resulting MRPs. MRPs are known to have various effects, for example in the colour, flavour, increasing antioxidant and protection nutrition. Our research conducted to find out the effect of sugar addition that may contribute to the mail lard reaction, to changes in the chemical characteristic including the antioxidant activity, nutritional protection and the one part of that study that today will be presented is effect on sensory. The aim of this study was to determine whether there is an effect of adding sucrose sugar to the flavour and sensory characteristics of the shrimp paste.

2. Materials and methods

2.1. Production of shrimp paste
The shrimp were cleaned and dried for 8 hours. The dried rebon shrimps were added with 15% solar salt w/w and divided into 2 part. One part was added with 10% sucrose and the other part was not added with sucrose. The sample are then pounded traditionally using mortar until evenly mixed. The mixture was transferred into a plastic basin for initial fermentation overnight. The shrimp paste dough then formed into a round slab and dried in the sun until dry, dense and tough. The dough was then melded into blocks and packaged using teak leaves. The shrimps paste was then analyzed for chemical and microbiological measurement on days 0 and 30.

2.2. Texture analyses
Samples were cut in size 3x3x3 cm$^3$. The sample is pressed with a probe with diameter 6 mm. The probe speed is set to 5 mm/s and the sample is compressed to 30% of its initial height. The results will be obtained from the macro program of the TXT 32 texture analyzer software [8].

2.3. Active water analyses
Measurement of water activity was carried out using an aw meter. The prepared sample was put into a container, then the tool was closed and left for 3 minutes. The scale on the aw meter is then read and recorded.

2.4. TPC lactic acid bacteria
Enumeration of lactic acid bacteria using MRSA with pour plate method [9].

2.5. TVBN
TVBN value of the shrimp paste were measured with the Conway microdiffusion method.

2.6. Sensory
Sensory testing refers to [10] First, the sample is placed in a container and given a sample code. Panelists were given a sensory paste scoresheet with a 30 panelists. The sensory assessment scale is 5-9. Tests on shrimp paste include:
1. Appearance, panelists assess the overall shape and specifications of the shrimp paste.
2. Odor, panelists assessed by means of the sense of smell on the shrimp paste.
3. Taste, panelists judge by tasting the shrimp paste using the sense of taste.
4. Texture, panelists judge by feeling the shrimp paste using their fingers.
2.7. **Statistical analysis**
All data were subjected to Analysis of Variance (ANOVA) and the differences between means were evaluated by Honestly Significant Difference Test [11].

3. **Result and discussion**

3.1. **Texture**
Texture analysis is shown in Table 1. The hardness value in shrimp paste is lower with the sucrose addition and this phenomenon does not change with the increasing storage time (p < 0.05). The hardness value range from 1274.633 to 1765.056.

| Sucrose concentration | Storage time   |   |
|-----------------------|---------------|---|
|                       | Days 0        | Days 30       |
| 0%                    | 1626.232 ± 245.168 a | 1765.056 ± 26.343 a |
| 10%                   | 1533.585 ± 152.771 b | 1274.633 ± 243.984 b |

Means ± SD from triplicate determinations
Different superscripts in the same column indicate the significant difference (p < 0.05).

3.2. **Active water**
Active water (aw) of shrimp paste are shown in Table 2. Data showed that aw was not significantly different in shrimp paste with or without sugar (p < 0.05). The aw range from 0.631 to 0.646. This value consider low aw and did not support bacterial growth. This may be caused by the addition of salt and sugar during the making process of the shrimp paste [12].

| Sucrose concentration | Storage time   |   |
|-----------------------|---------------|---|
|                       | Days 0        | Days 30       |
| 0%                    | 0.642 ± 0.011 a | 0.646 ± 0.015 a |
| 10%                   | 0.632 ± 0.014 a | 0.631 ± 0.631 a |

Means ± SD from triplicate determinations
Different superscripts in the same column indicate the significant difference (p < 0.05).

[13] reported that the range aw of Klongkone shrimp paste was range 0.7 to 0.74. This aw value did not support the growth of pathogens and spoilage bacteria. For food microbiological safety, aw should not exceed 0.7. Korean shrimp has aw 0.682, and Bruneian shrimp paste aw was 0.728. While Filipino shrimp paste have aw approximately 0.67 [12]. Activity water can be affected by salt and sugar.

3.3. **TPC lactic acid bacteria**
Table 3. shows the TPC LAB. The TPC lactic acid bacteria was not detected in all samples when measured. This phenomenon maybe due to the very low aw value on the samples. Each microorganism have an optimum aw for its growth. Usually, halophilic grows at aw 0.8-0.85 although some are able to grow at 0.75. While at aw 0.65 or 0.6 the microorganism that were able to grow were xerophilic groups, fungi and osmophilic yeast [12].
### Table 3. TPC lactic acid bacteria (log cfu/g)

| Sucrose concentration | Storage time | 
|-----------------------|--------------|
|                       | Days 0       | Days 30      |
| 0%                    | Not detected | Not detected |
| 10%                   | Not detected | Not detected |

Means ± SD from triplicate determinations

### 3.4. TVBN

The summarises of TVBN are presented in Table 4. The TVBN of the samples range from 77.767 to 151.256 mg/100 g. The highest level of TVBN for salted fish product is 200 mg per 100 grams for some countries. Certain spoilage bacteria will produce TVBN and TMA. Fisheries product with higher TVBN value indicating have lower quality [14]. Data in the table 4. Showed that addition of sucrose will reduce the TVBN value (p < 0.05). And the increase in storage time will result in an increase in TVBN value (p < 0.05).

### Table 4. TVBN (mg/100 g) of shrimp paste

| Sucrose concentration | Storage time | 
|-----------------------|--------------|
|                       | Days 0       | Days 30      |
| 0%                    | 82,037 ± 9,455 a A | 151,256 ± 20,871 a B |
| 10%                   | 77,767 ± 4,605 b A | 115,641 ± 9,940 b B |

Means ± SD from triplicate determinations

Different small superscripts in the same coloum indicate significant difference of sugar addition (p < 0.05)
Different kapital superscripts in the same row indicate significant difference of fermentation time (p < 0.05)

### 3.5. Sensory

Sensory data can be seen in table 5. Based on the panellist’s observations, the appearance and texture did not show a significant difference between treatment (p < 0.05). While in terms of aroma and taste, the addition of sugar treatment and the longer storage time resulted in higher panellist acceptance (p < 0.05).

### Table 5. Sensory of shrimp paste

| Parameter          | treatment | appearance | odor     | Taste               | texture               | Interval                     |
|--------------------|-----------|------------|----------|---------------------|-----------------------|-----------------------------|
|                    | 0% 0 days | 7.533 ± 0.900a | 7.400 ± 1.102a | 7.333 ± 1.061a | 7.533 ± 1.042a | 7.242< µ< 7.658 |
|                    | 0% 30 days| 7.733 ± 0.980a | 8.000 ± 1.017bc | 7.933 ± 1.015bc | 7.800 ± 0.997a | 7.641< µ< 8.093 |
|                    | 10% 0 days| 7.667 ± 0.959a | 7.533 ± 0.900abc | 7.533 ± 1.042abc | 7.333 ± 1.184a | 7.517< µ< 7.698 |
|                    | 10% 30 days| 7.867 ± 1.008a | 8.467 ± 0.900c | 8.400 ± 0.932c | 7.667 ± 1.322a | 7.872< µ< 8.328 |

Means ± SD from triplicate determinations

Different superscripts in the same column indicate the significant difference (p < 0.05)

### 4. Conclusion

The addition of sugar did not affect the active water and TPC BAL value, but it decreased the TVBN value, soften the texture value and in addition the sensory was more preferred by the panellist. The characteristic of shrimp paste with sugar addition was low aw value 0.631 ± 0.631, TPC BAL was not detected, TVBN value 115.641 ± 9.940 mgN/(100 gr) and sensory 7.872 < µ < 8.328. The use of sugar can be recommended to be added during shrimp paste production to increase consumer preference.
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