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EFFECT OF DIFFERENT CONCENTRATIONS OF LIQUID PALM SUGAR ON THE QUALITY CHARACTERISTICS AND GLUTAMIC ACID CONTAINMENT OF SQUID RUSIP (*Loligo chinensis*)

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ABSTRACT

Squid has amino acids that are good for eating and are processed into rusip. Rusip is a Bangka Belitung chilli sauce made from anchovies. This study aims to determine the effect of different concentrations of liquid palm sugar on the quality and glutamic acid content. The research used experimental laboratories with Completely Randomized Design. Parametric tests were analyzed using ANOVA and BNJ, non-parametric tests using Kruskal Wallis and Mann Whitney with a test level of 5%. In the Rusip study, liquid palm sugar concentrations of 10%, 12.5% and 15% were used, with 3 replications. Glutamic acid, pH, protein and hedonic parameters showed significant differences (P<5%). The parameters of total LAB, total sugar and water content had no significant difference (P>5%). The values of protein content were 17.25%-19.66%, moisture content 33.94%-38.39%, total sugar 5.16%-7.71%, glutamic acid 2.25%-3.30%, pH 5.87-5.90 and total LAB 1.1x104-5.3 x 104 cfu/g. Hedonic parameters for appearance were 3.24-3.76, flavour 3.41-4.00, aroma 3.14-4.00, texture 3.31-4.10. The best treatment was 15% liquid palm sugar with characteristics of brown colour, chewiness, fermentation smell and savour.

Keywords: Glutamic acid, Liquid palm sugar concentration, Quality characteristics, Rusip, Squid

INTRODUCTION

Rusip is a fermented food made from small fish such as anchovies. Rusip tends to have a sour taste due to the lack of amino acids in the raw materials used. Alternative raw materials such as squid, which contains a lot of amino acids including glutamic acid, can play a role in adding a savoury taste to rusip. Squid is also not widely used by the public as a raw material for fermented products. Squid is a healthy choice as it provides the body with protein, amino acids and vitamins. The glutamic acid content of squid is 2.12g/100g. Therefore, the production of Rusip using squid as a raw material has a glutamic acid content which plays a role in giving the Rusip a savoury or umami taste. Essential amino acids such as leucine, lysine and phenylalanine. Glutamic acid and aspartic acid are the most common forms of amino acids that can be produced by the body (Wulandari, 2018). Squid is often used as the main ingredient because of its benefits; squid meat is easier to digest and contains amino acids. The dominant amino acid content in squid is mainly glutamic acid, so the production of RUSIP using squid ingredients is an innovation from existing RUSIP products (Jumiati *et al*., 2019). The sucrose content of palm sugar is synthesized by lactic acid bacteria into glucose and fructose. The sucrose content of palm sugar reaches 84%, compared to 20% and 17% for cane and beet sugar, respectively. The high sucrose content provides nutrients in large quantities. The concentration of the added liquid palm sugar is a treatment in the production of rusip that is believed to affect the quality characteristics of the product. Adding too high a concentration of sugar will inhibit the growth of lactic acid bacteria. However, the growth of

lactic acid bacteria is also affected by low sugar concentration, as lactic acid bacteria cannot meet their nutrient and carbohydrate requirements (Lingawan *et al*., 2019). Carbon sources added in small amounts cause metabolic disorders of lactic acid bacteria (Jamjami & Novitasari, 2014). People usually make rusip with sliced palm sugar, while some studies have used liquid palm sugar with concentrations of 5%, 10% and 15%.

This research aims to identify the optimal concentration of liquid palm sugar to produce rusip with the desired quality characteristics by analyzing the effect of different concentrations of liquid palm sugar on quality characteristics and glutamic acid content.

METHODOLOGY

Materials

The main ingredient was fresh squid obtained from Rejomulyo market Semarang, and the additional ingredients were palm sugar (Nira sari) and salt (Kapal) obtained from supermarkets.

Tools

The tools used were digital scales (Camry), jar bottle (175 ml), basin (Ruby), cutting board (Maspion), knife (Lion star), spoon (Dinemate) and petri dish (Herma). Deconstruction tube (Pyrex), distillation flask (Pyrex), burette (Pyrex), oven (Memmert), porcelain cup (Pyrex), erlenmeyer (Pyrex), volumetric flask (Pyrex), measuring pipette (Pyrex), pH meter (Extech), spectrophotometer (Thermoscientific), hedonic rating sheet (HVS).

Research Design

The research design used a one-factor completely randomised design (CRD). The factor used was different concentrations of liquid palm sugar, namely 10%, 12.5% and 15%. Each treatment was replicated 3 times. The data from the parametric analysis were processed using SPSS by testing for normality, homogeneity, ANOVA, BNJ, while the data from the non-parametric analysis were processed using the *Mann-Whitney* test and continued with the *Dunn multiple* comparison test at a significant level α 0.05.

Research Stages

Squid Rusip Making

The method of making rusip according to Koesoemawardani *et a*l. (2015) with modifications starts with squid purchased from the market and then washed to remove dirt. The squid was cut into small rectangular pieces of 3 x 2 cm and drained. Salt was added at a concentration of 25% and then stirred well. Liquid palm sugar was added at 10%, 12.5% and 15% and then stirred evenly. Liquid palm sugar was prepared according to the previously determined concentrations. The palm sugar weighed at 10%, 12.5% and 15% treatments is 7.50 g, 9.38 g and 11.25 g respectively, with a ratio of 3:1. Water heated to 100°C was added to each sugar concentration, the addition of water for each treatment was 2.5 ml, 3.125 ml and 3.75 ml. The octopus was placed in a glass bottle and covered with plastic foil. The squid was stored at room temperature for 7 days.

Method

This study aimed to compare the quality characteristics and glutamic acid content of octopus (*Loligo chinensis*) at three different concentrations of liquid palm sugar (10%, 12.5% and 15%). A completely randomised design (CRD) with three replicates was used for the experiment. Protein content (AOAC, 2005), moisture content (AOAC, 2005), total sugar content (BSN, 1992), glutamic acid content (Apriyantono *et al*., 1989), acidity (pH) (AOAC, 2005), total LAB (Fardiaz, 1992) and hedonics (Suena *et al*., 2020) were measured to determine product quality.

Analysis Procedure

1. Analysis of Protein Content

The micro-Kjeldahl method, which involves decomposition, distillation and titration, is used to determine the protein concentration by crushing a sample weighing 0.2 g and placing it in a decomposition tube. A solution of 250 g Na_2SO_4 + 5 g CuSO4 + 0.7 g Se/TiO_2, 0.7 g N catalyst, is brought to the boil and 4 mL of concentrated H_2SO_4 is added to the deconstruction tube. When the colour changes to bright green, transfer to a fume cupboard, allow to cool and mix with 10 ml of distilled water. After adding 20 ml of NaOH TiO (40% NaOH + 5% $Na_2S_2O_3$), distil and collect the distillate with 4% H_3BO_4 treated with mrbcg indicator. The distillation is continued until the volume of the distillate reaches 60 ml and the colour of the distillate turns blue. Stop the process when the volume reaches 60 ml and titrate with 0.02 N HCl standard solution until the colour turns pink. In this case, record the volume used in the titration and use the following formula to determine it.

Calculation :

$$\text{Protein Content (\%)} = \text{Kadar Nitrogen x factor konversi (6.25)}$$

$$\text{Nitrogen Content (\%)} = \frac{Vol.Tritrasi\ x\ N\ HCC\ (0{,}02N) X\ \ Nitrogen\ Atom\ Weight\ (14{,}008)}{Sample\ weight\ (Mg)} x100\%$$

2. Moisture Content Analysis

The moisture content is determined by the oven method: the cup was baked for 30 minutes at 102 °C to 105 °C, cooled in a desiccator and weighed. After homogenization, a 1 g sample is taken. Bake the beaker containing the sample at 100 to 102 °C for one hour. Use the formula to determine the moisture content:

$$\text{Moisture Content} = \frac{B-C}{B-A}\ x\ 100\%$$

3. Total Sugar Analysis *Luff Schrool* Method

The Luff-Schoorl method test and blank were used. A 40 ml solution of 3% HCl was added to 1 g of sample in a 250 ml conical flask, brought to a boil, allowed to stand for 1 hour and then cooled. The sample was cooled in a 100 ml volumetric flask, neutralized with 30% NaOH solution and filtered. Then 10 ml of the solution was pipetted into a 250 ml conical flask, to which 25 ml of Luff Schoorl solution containing zeolite and 15 ml of distilled water were added. After heating for 10 minutes, rinse with cold running water to stop the boiling process. Carefully mix 15 ml of 30% KI solution with 25 ml of 25% H_2SO_4 solution, titrate with 0.1N Na2S2O3 solution and repeat until the solution turns pale yellow.

4. Analysis of Total Lactic Acid Bacteria

Testing for total lactic acid bacteria by counting the number of cups. Preparation of dilution solution by dissolving 8.5 g of NaCl in distilled water until the volume becomes 1000 ml. Samples were prepared in test tubes by infusing 1 g of sample with 9 ml of 0.85% normal saline. A dilution of 10-1 can be achieved by homogenizing the solution using a spin. 1 ml of the solution was taken with a pipette to make a 10-7 dilution, put 9 ml of 0.85% saline into the test tube with the solution. For the fertilization process, 1 ml of the suspension at each dilution level was collected and placed in a sterile petri dish. About 20 ml of MRS agar medium was added to the petri dish. The sample and media were shaken rapidly to form a figure 8 on the table. After that, incubate for 48 hours in an incubator at 35 °C in an inverted position. The number of colonies on each dish ranged from 25 to 250 and was used to calculate the number of microorganisms and samples.

Colonies counted with the equation below:

$$N = \frac{\sum C}{[(1xn1)+(0{,}1xn2)]xd}$$

Note :
N : the number of product colonies, expressed in colonies per ml or colonies per g
∑C : number of colonies formed from all dilutions
n1 : number of petri dishes at the first dilution counted
n2 : number of petri dishes at the second dilution counted
d : lowest colony dilution value

5. Analysis of Degree of Acidity (pH)

The acidity analysis was carried out with the pH meter neutralized for 15-30 minutes and then read. Buffer solutions at pH 7 and pH 4 are used to calibrate the pH meter. The electrode of the pH meter should be cleaned with distilled water and wiped with a cloth. The pH meter is immersed in the sample until the reading remains constant. When the reading is complete, rinse the pH meter in distilled water and dry it with a towel.

6. Glutamic Acid Analysis

Glutamic acid testing was performed using the Ninhydrin Spectrophotometric method. The sample was mashed to homogeneity as part of the glutamate testing procedure. The sample was dissolved 1 g in distilled water to a volume of 100 ml. The solution was filtered by centrifugation used to purify the resulting liquid. The solution was transferred 1 ml to a test tube. After that, the sample solution at 50 °C was boiled for 30 minutes and added 2 ml of ninhydrin. The sample is diluted with 96% ethanol to a final volume of 10 ml and vortexed to ensure colour consistency. The absorbance of the sample solution should then be measured at 520 nm..
Calculation :

$$\% \text{ Amino Acid Content } = \frac{X \; x \; Dillution \; factor}{Sample \; weight \; (Mg)} \; x \; 100\%$$

$$X = \frac{y-a}{b}$$

7. Hedonic Analysis

The hedonic test is a preference evaluation procedure where a numerical scale is used as a benchmark. Squid rusip was evaluated based on colour, smell, taste and texture. There were a total of 30 people in the team, all of whom were students of Diponegoro University's Fishery Product Technology programme in 2019. Each criterion on the provided rating sheet was ranked between 1-5 by the panelists. The appearance parameter with a scale of 1-5 has a description of 1 = very unattractive, 2 = unattractive, 3 = somewhat attractive, 4 = attractive, and 5 = very attractive. The flavour parameter is assessed on a scale of 1-5 and has a description of 1 = very bad, 2 = bad, 3 = rather good, 4 = good, and 5 = very good. The aroma parameter is assessed on a scale of 1-5 and has a description of 1 = very not typical of fermentation, 2 = not typical of fermentation, 3 = somewhat typical of fermentation, 4 = typical of fermentation, and 5 = very typical of fermentation. Texture parameters were assessed on a scale of 1-5, with a description of 1 = very not soft, 2 = not soft, 3 = somewhat soft, 4 = soft, and 5 = very soft (Harmiatun *et al*., 2022).

RESULTS AND DISCUSSION

1. Squid Rusip Chemical Test Results

Tabel 1. Squid Rusip Chemical Test

Treatment of Aren Sugar Concentration	Parameter				
	Protein Content (%)	Moisture Content (%)	Total Sugar (%)	Glutamic Acid (%)	Acidity Degree(pH)
10%	17.25 ± 0.17^{a}	36.15 ± 0.65^{a}	5.16 ± 1.48^{a}	3.30 ± 0.12^{b}	5.87 ± 0.06^{ab}
12.5%	19.66 ± 0.86^{b}	38.39 ± 2.18^{a}	6.61 ± 0.57^{a}	2.67 ± 0.24^{ab}	5.70 ± 0.10^{a}
15%	19.17 ± 1.14^{ab}	33.94 ± 3.61^{a}	7.71 ± 0.88^{a}	2.25 ± 0.37^{a}	5.90 ± 0.00^{b}

The amount of liquid palm sugar added caused a dramatic change in protein content. There was a significant difference (P<5%). The protein content was highest at 12.5% liquid palm sugar concentration, decreased at 15% concentration and was lowest at 10% concentration. Factors affecting the protein content of a product are raw materials and lactic acid bacteria. A soluble protein released from the cells by the osmosis process increases the total N content (Yuliana, 2007). The addition of sugar tends to increase the protein content, but the treatment with 15% liquid palm sugar concentration decreased the protein content. Lactic acid bacteria have difficulty getting enough food because sugar is directly used as an energy and nutrient source (Abdillah *et al*., 2014). These results show that the value of the protein content tends to decrease as more sugar is added. This can be caused by the occurrence of non-enzymatic browning or the Maillard reaction. The Maillard reaction occurs between amine groups (amino acids) and reducing sugars (ketone or aldehyde groups). At the end of the reaction, the brown pigment melanoidin is formed, which has a high molecular weight. The reaction starts with the reaction between the aldehyde or ketone group on the sugar with amino acids in this protein to form glucosylamine (Pursudarsono *et al*., 2015). Red anchovy fermented for 7 days has a protein content of 14.33% (Kurniawan and Susilowati, 2021).

There was no significant difference (P>5%) between the concentration of liquid palm sugar added and the moisture content. The addition of liquid palm sugar increased the moisture content to a maximum of 12.5% and then decreased it to 15%. Palm sugar and the raw materials used are two factors that influence the moisture content of the product. Sugar is hygroscopic, i.e. it binds water to a material. Palm sugar undergoes structural changes to become simpler, namely from sucrose to glucose and fructose when heated. Fructose is a hygroscopic sugar. This means that fructose can easily bind and absorb water. The use of fructose will affect the water content of foods due to its hygroscopic nature, where the higher the concentration of sugar, the more water will be bound, leading to an increase in the water content of the product (Anggraeni *et al*., 2017). This leads to a decrease in the moisture content of food ingredients (Marsigit *et al*., 2018). The decrease in the results obtained was because, during the fermentation process, the water from the liquid palm sugar did not fully enter the squid cells. Sugar and salt added to trash fish rusip in the amount of water content produced is 40.56%-62.25% (Koesoemawardani *et al*., 2020). The water in a food ingredient added with sugar is absorbed by the sugar, resulting in a decrease in water content (Arsyad, 2018). Therefore, sugar added at a concentration of 15% has the lowest water content value because sugar has the property of absorbing water which causes a decrease in water content (Asmawati *et al.,* 2018).

The total sugar content was not significantly different (P>5%) with different concentrations of liquid palm sugar. The different concentrations resulted in an increase in the total sugar content of squid rusip with each treatment. The liquid palm sugar concentration of 15% had the highest total sugar content. The increasing concentration affects the total sugar value produced. The increase in total sugar content is due to the amount of sugar added. The results showed that the higher the concentration of added sugar, the higher the total sugar produced. This is because the existing sugar solution is a multi-component sugar, so adding sugar increases the total sugar content (Breemer *et al*., 2021). Tempoyak with 6% sugar and 5 days ripening where the total sugar produced is 6.502% (Erfisa *et al*., 2022).

The glutamic acid values obtained showed significant differences between the samples (P < 5%). The addition of 10% liquid palm sugar concentration had the highest glutamic acid content and decreased to 15% concentration. Factors influencing the decrease in glutamic acid content are salt concentration, protein, raw materials, amount of LAB and low pH. Glutamic acid decreased with the addition of liquid palm sugar. This is because the sugar used has a low content of amino acids in the form of glutamic acid, resulting in a decrease in glutamic acid. The flavour of rusip comes from the main components, namely the amino acids and peptides contained in the raw materials, as well as the components of the additional ingredients used (Ramandhani *et al*., 2022). Brown sugar contains 74.68% sucrose, 1.9% fructose and 3.34% glucose, while the free amino acids are lysine, tryptophan, glutamic acid,

aspartic acid, alanine and glycine (Nuraini *et al*., 2014). The ratio of different amino acids varies between species. The physiological processes of each organism vary in terms of cellular organization and other biological compounds. Age, season of capture and developmental stage of the organism can also affect the abundance of these amino acids. Glutamate levels decrease in an acidic environment. The glutamic acid content in RUSIP with the addition of a starter is 32.83%, while the glutamic acid content in RUSIP without a starter is 39.24% (Batubara *et al*., 2019).

The addition of liquid palm sugar caused a drastic change in pH value. There was a significant difference (P<5%). The addition of 15% concentration resulted in the highest pH value, while the addition of 12.5% concentration resulted in the lowest pH value. It can be seen that with the treatment of increasing palm sugar addition, there will be an increase in pH value even though it is relatively very little. There was a decrease in pH from 5.8 to pH 5.7, reflecting the action of lactic acid bacteria that break down carbohydrates into simpler components, one of which is lactic acid. Lactic acid bacteria utilize sugar as a source of growth energy and produce metabolites in the form of lactic acid during fermentation. The more sugar added, the more substrate available for microbes so that their activity increases. The relatively small increase is probably because the higher concentration of liquid palm sugar added will increase the osmotic pressure in the fermentation medium so that lactic acid bacteria will be disturbed by growth and experience a decrease in their work activity. Too high a concentration of sugar can cause osmotic imbalances inside and outside the cell, triggering lysis in bacteria (Zulaikhah *et al*., 2021).

Ingredients and lactic acid bacteria are two variables that affect the total amount of protein in the finished product. The metabolism of lactic acid bacteria leads to a decrease in pH due to the decomposition of nutrients. The increase in acidity of the product is due to the decomposition of important compounds and preservatives. The pH of food can change during storage due to the presence of proteins, which are broken down into carboxylic acids, sulphide acids, ammonia and other types of acids by proteolytic enzymes and bacterial assistance (Bawinto *et al*., 2015). Each microorganism has a pH range in the optimal pH range or grows at a pH of around 4-8 (Kiwak *et al*., 2018). The added sugar is used by lactic acid bacteria, which then break it down into lactic acid. This can reduce the acidity of the product. Rusip has a low pH starting at 4.5, making it a low-acid food. The pH of anchovy rusip is between 5 and 6 due to the high protein content of the fish (Rinto *et al*., 2019). The pH of squid rusip is still in the same range as previous rusip studies using fish. The optimal pH range for bacteria of the genus Streptococcus is 6.5, Lactobacillus is 5.8-6 and Lactococcus is 6.3-6.9 (Rimadhini *et al*., 2020).

2. Microbiological Test Results of Squid Rusip

Total lactic acid bacteria test results on squid rusip.

Tabel 2. Total Lactic Acid Bacteria

Treatment	BAL Total Value (log cfu/gram)
10%	3.85 ± 1.05^{a}
12.5%	4.18 ± 0.24^{a}
15%	3.50 ± 1.04^{a}

The value of total BAL produced by the treatment of different concentrations of liquid palm sugar was not significantly different at the test level (P>5%). The addition of 12.5% liquid palm sugar concentration produced the highest total BAL and the lowest at 15% concentration. Factors affecting the total BAL value are bacterial growth rate, raw material composition, type and concentration of sugar used, sugar composition, fermentation duration, temperature and container. The total BAL content in squid rusip with liquid palm sugar concentration treatment ranged from 1.1x104 - 5.3x104 cfu/gram. The amount of sugar added will make the environment hypertonic. Hypertonic condition is when a solution has a higher solute concentration or less water than another solution. Lactic acid bacteria will experience

plasmolysis due to these environmental conditions (Devi *et al*., 2022). The total LAB value was low from the total LAB value studied by (Koesoemawardani & Yuliana, 2009), the total lactic acid bacteria spontaneously fermented was about 1.6x10¹⁰ cfu/g. The number of lactic acid bacteria of Bangka rusip was between 4.2x107 - 1.7x1010 log cfu/g. Microorganisms have different microflora due to differences in age, environment and distribution process (Pal *et al*., 2016). An increased or decreased number of lactic acid bacteria is very important in fermentation. The most important property of lactic acid bacteria is their ability to break down complex compounds into simple compounds to produce lactic acid. This property is important in the manufacture of fermented products. Pathogenic bacteria such as Salmonella and Staphylococcus aureus that are present in an ingredient will be inhibited from growing if lactic acid bacteria are present in the ingredient. Lactic Acid Bacteria play a role in the process of fermentation and food preservation. Some active metabolites produced by lactic acid bacteria are lactic acid, ethanol, hydroperoxides and bacteriocins. Metabolites produced by these bacteria are agents that can be used in killing bacteria. One that is used as an antimicrobial is bacteriocin which is a peptide compound. Bacteriocins play the most important role in overcoming infections caused by microorganisms. In addition, lactic acid produced by BAL can reduce the pH of the environment. A low pH can inhibit contamination of spoilage microbes and also kill pathogenic microbes, especially those in the body (Ibrahim *et al*., 2015).

3. Hedonic Test Result of Squid Rusip

The hedonic test results of squid rusip include appearance, flavour, aroma and texture parameters.

Tabel 3. Hedonic Test of Squid Rusip

Treatment	Appearance	Flavour	Aroma	Texture	Mean	SD
10%	3.24 ± 0.78^{a}	3.41 ± 0.68^{a}	3.14 ± 0.64^{a}	3.31 ± 0.47^{a}	3.17	0.35
12.5%	3.69 ± 0.71^{b}	3.97 ± 0.56^{b}	3.62 ± 0.62^{b}	3.76 ± 0.58^{b}	3.63	0.37
15%	3.76 ± 0.74^{b}	4.00 ± 0.65^{b}	4.00 ± 0.71^{c}	4.10 ± 0.62^{c}	3.83	0.43

The hedonic test results obtained from each parameter are generated with a value scale of 1, 2, 3, 4, and 5 on the scoring sheet. Furthermore, the calculation of the confidence interval will be carried out. The test results from the 15% concentration treatment get a confidence interval value of 3.68 <μ<3.98, then the 12.5% liquid palm sugar concentration is 3.49 <μ<3.77 and the 10% liquid palm sugar concentration is 3.04 <μ<3.3.

Appearance

The squid rusip is brown due to the addition of liquid palm sugar. The more sugar that is added, the browner the rusip will be. If a large amount of palm sugar is added, the colour of the rusip will turn brown. This is due to the Maillard process in palm sugar. Because sugar turns yellow or brown in an acidic atmosphere, this process is called the Maillard reaction. The Maillard reaction, or non-enzymatic browning, is caused by the reaction between reducing sugars and free amine groups of amino acids or proteins. The Maillard reaction produces a brown colour in heated materials, the reaction between carbohydrates, especially reducing sugars, with primary amine groups produces brown materials called melanoidin (Nelwida et al., 2019). The natural colour of palm sugar is dark brown, so increasing the amount of palm sugar in the recipe will cause the finished product to lose its brightness (Triachdiani & Murtini, 2021).

Flavour

The amino acids in the fat and protein in the food combine to give squid its savoury taste. The breakdown of protein increases the amino acids that affect the flavour of the food. Changes in flavour are caused by the breakdown of proteins, fats and carbohydrates by enzymes, so the taste is more delicious and savoury and has a distinctive taste (Aulia *et al*., 2018). The treatment of adding liquid palm sugar concentration results in a slightly sweet taste

due to an increase in the content of liquid palm sugar, namely fructose and glucose converted from sucrose. The resulting taste comes from the raw materials used or food additives during processing, so the original taste of the product will decrease or increase depending on the compound content (Yurnalis *et al*., 2023).

Smell

The resulting squid rusip had a slightly fermented smell and was tasty and not fishy. The typical seafood smell was reduced after the addition of liquid palm sugar. The sweet flavour of palm sugar was preferred by the panelists, so the results were not very different. It is the organic acid content of palm sugar that gives it its distinctive flavour. Brown sugar has a distinctive aroma because it contains volatile benzyl alcohol. The caramel aroma of brown sugar is caused by the cooking process (Sutrisno and Susanto, 2014).

Texture

The result is a squid that is soft and easy to bite into. The use of high levels of salt will extract water from the body of the fish. The degradation of protein by lactic acid bacteria affects the texture of the product, making it easier to bite into. The texture of the product is related to the moisture content. The final texture of the product is affected by the amount of moisture it absorbs. Squid rusip became denser and chewier as the concentration of palm sugar increased. The addition of liquid palm sugar concentration as a nutrient source will make the environment acidic. The acidic atmosphere will affect the cohesiveness of the texture. The higher the concentration of palm sugar used, the denser the texture of rusip (Iryandi *et al*., 2014).

CONCLUSION

The quality of the squid rusip produced had an attractive appearance and brown colour. The flavour was salty and slightly fermented, and the texture was soft and easy to bite into. The glutamic acid content ranged from 2.26% to 3.30%. These results are low compared to the glutamic acid content of anchovies without starter, which is 39.24%. The best treatment of the test results in the treatment with 15% liquid palm sugar concentration with a high confidence interval value of $3.68 < \mu < 3.98$.

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