

Production of Inferior Fish Hydrolyzate Sauce Under Different Concentration of Coconut Sugar and Caramel

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Abstract: Fish inferior (Bibisan (*Apogon albimaculoses*), Baji-baji (*Platycephalidae cymbacephallus*), and Lidah (*Cynoglossus lingua*)) have a low economic value. One of effort to increase the economic value of the inferior fish and production as a better quality of food products is sweet fish sauce. This research, the process of making fish sauce by enzymatic hydrolysis using protease of biduri and papain. Flavor of fish sauce not only from hydrolysis but also from the addition of sugar. The addition of *coconut* sugar and caramel contribute in characteristics of fish sauce. The purpose of this research to obtain the addition of coconut sugar and caramel concentration is proper so as to produce inferior fish sauce with characteristics that good and the panel favored. The addition of *coconut* sugar treatments consisted of concentration (20, 25, and 30%) and caramel (5 and 10 %). The results showed of viscosity of 41.41 mp, intensity of color (chroma) 15.99, dissolved solids 65.9 %, protein dissolved 7.21 mg/mls, ash content 3.03 %, levels of protein 4.6 %, organoleptik 3.66 color, the scent of 3.45, 3.45 taste, viscosity 2.90, and the whole 3.41 (reather like until like). Test the effectiveness of the highest or best treatment is A2B1 (brown sugar 25 % and caramel 5 %) by value of 0.88.

Keywords: inferior fish; hydrolysis; Coconut sugar; caramel.

Introduction

Fish is a source of animal protein it is relatively expensive and also has a high nutrient. Nevertheless fish belonging to the product quickly decompose both biokemis and microbiological (Yunuzal, 1986). Generally fish very superior kind of consumer demand. On the other hand quite a lot of fish (inferior) such as bibisan (*Apogon albimaculosus*), baji-baji (*Platycephalidae cymbacephalus*), and the lidah (*Cynoglossus lingua*) but this fish is less demand by the public so that this problem triggering the decline in the economic value of the inferior fish. above the problems, it is necessary efforts to reduce the damage to the fish and process them into a higher quality of food products.

Fish sauce is one of the product diversification of fish. Fish Sauce is a preferred flavoring ingredients and many kinds of widely used in various foods. Fish sauce have brown liquid that has a distinctive flavor and aroma. Factors that play a role in the manufacture of fish sauce is the raw material, pre-treatment, stages and advanced treatment processes ¹.

Hydrolysis process that occurs in the manufacture of soy sauce is the process of solving the substrate into compounds simpler with the help of water molecules so that it will produce a clear brown liquid hydrolyzate containing a lot of dissolved nitrogen².

Manufacture of fish sauce, flavor compounds other than obtained from the hydrolysis of proteins, can also be produced from Maillard reactions and caramelization. Maillard and caramelization reactions contribute to the formation of color, flavor, aroma and texture. Thus the amount of sugar affects the level of the Maillard

reaction. Sugar plays an important role in a sweet soy sauce. Sugar can increase the sweetness and aroma characteristics, lowering A_w , so as to extend the shelf life by inhibiting pertumbuhan mikroorganisme, as well as affect the color and flavor of fish sauce through Maillard and caramelization reactions³. In addition, the ratio of caramelized sugar to amino acids affects the color-forming reaction. The purpose of this study was to determine the effect of adding coconut sugar and caramel on physical, chemical, and sensory inferior fish sauce, and get coconut sugar and caramel concentration appropriate to produce inferior fish sauce with good properties and panelists preferred.

Experimental

The research was conducted through two phases:

- The main research aims to determine the variation of the concentration of Coconut sugar and caramel.
- Determining the best treatment using test effectiveness.

This research used Factorial Randomized Block Design (RBD) single factor and repeated three times. The treatment is selected with the addition of Coconut sugar and caramel.

A1B1 = Addition of coconut sugar: caramel (20%: 5%)
 A1B2 = Addition of coconut sugar: caramel (20%: 10%)
 A2B1 = Addition of coconut sugar: caramel (25%: 5%)
 A2B2 = Addition of coconut sugar: caramel (25%: 10%)
 A3B1 = Addition of coconut sugar: caramel (30%: 5%)
 A3B2 = Addition of coconut sugar: caramel (30%: 10%)

Data were analyzed using analysis of variance (ANOVA) to determine the difference, then the test is continued using DMRT (Duncan Multiple Range Test) with a 5% test level.

Production of Inferior Fish Sauce:

The Proses of Making the inferior fish hydrolyzate reference to Mananda⁴, while the manufacture of fish sauce refers to Prasetyo⁵ and modified. Making sweet fish sauce begins with wet hydrolyzate of inferior fish filtered and the filtrate thus obtained residue. Filtar of the fish hydrolyzate added spices is 2% ginger, galangal 1%, 1% salt, lemongrass and anise 1% 1% (concentrations(%) by weight of fish hydrolyzate was filtered) is heated at a temperature of 80-90 ° C for 15 minutes . Furthermore added coconut sugar and caramel with coconut sugar concentration variation: caramel (20%: 5%; 20%: 10%; 25%: 5%; 25%: 10%; 30%: 5%; 30%: 10%). Do boiling at a temperature of 80-90 ° C for 30 min and filtered using a filter cloth, so that would be obtained fish sauce from fish hydrolyzate inferior. Percentage of materials for the hydrolyzate based on the percentage of weight used. The amount of additional material manufacture of fish sauce added fish have the same number for all treatments.

Results

Viscosity

The viscosity of fish sauce produced inferior fish ranged 18.01 mp - 57.10 mp. The results of the analysis of the viscosity of the inferior fish sauce with a variety of treatment is shown in Figure 1.

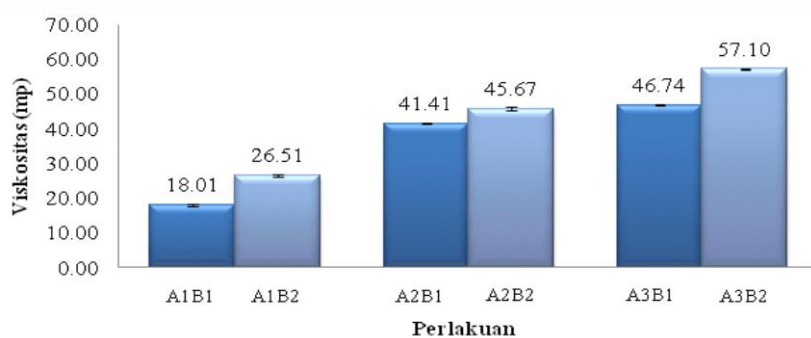


Figure 1. Histogram Viscosity Inferior Fish Sauce

Color intensity (Chroma)

The intensity of the color (Chroma) inferior fish sauce produced range 15.681-17.370. The results of the analysis of color intensity inferior fish sauce with a variety of treatment is shown in Figure 2.

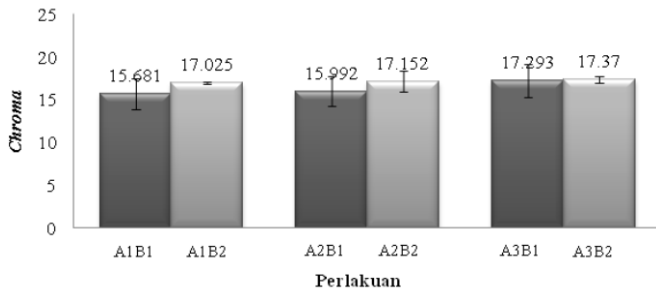


Figure 2. The intensity of the color histogram Inferior fish Sauce

Total Dissolved Solids

Total dissolved solids inferior fish sauce produced ranges from 61.00% - 71.20%. The results of the analysis of total dissolved solids inferior fish sauce with a variety of treatment is shown in Figure 3.

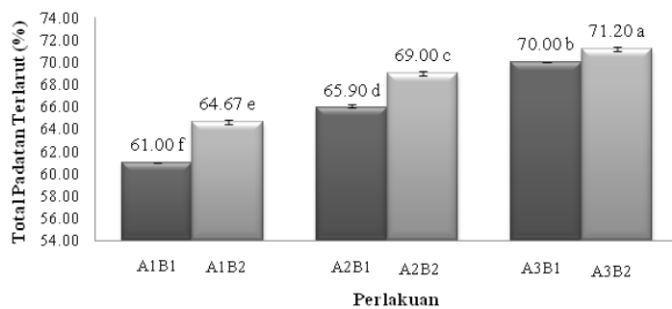


Figure 3. Histogram TSS Inferior Fish Sauce

Proximate Component

Proximate analysis of inferior fish sauce observed including protein, protein dissolved, and ash content. The observation of the chemical composition of Inferior fish sauce are presented in Table 1.

Tabel 1. Proximate composition of inferior fish sauce under different concentrations of coconut sugar and caramel .

| Sampel | Protein dissolved content (mg/ml) | Ash content (%) | Protein content (%) |
|--------|-----------------------------------|-----------------|---------------------|
| A1B1 | 8.07 | 1.21 | 5.17 |
| A1B2 | 7.83 | 2.02 | 4.67 |
| A2B1 | 7.21 | 3.03 | 4.88 |
| A2B2 | 6.75 | 3.41 | 4.44 |
| A3B1 | 6.36 | 3.64 | 4.6 |
| A3B1 | 5.76 | 4.34 | 4.37 |

Sensory quality

The ranking of the value of A color, aroma, taste, Viscosity and overall inferior fish sauce in a variety of the various treatments can be seen in Table 2.

Table 2. Ranking favorite color, aroma, taste, consistency and overall inferior fish sauce under different concentrations of coconut sugar and caramel

| Treatment | Color | Aroma | Taste | Viscosity | Overall |
|-----------|-------------|-------------|-------------|-------------|-------------|
| A1B1 | 3.52 ± 0.03 | 3.24 ± 0.04 | 3.00 ± 0.00 | 2.45 ± 0.45 | 2.86 ± 0.24 |
| A1B2 | 3.55 ± 0.04 | 2.97 ± 0.27 | 3.03 ± 0.42 | 3.48 ± 0.04 | 3.14 ± 0.20 |
| A2B1 | 3.66 ± 0.00 | 3.45 ± 0.00 | 3.45 ± 0.00 | 2.90 ± 0.17 | 3.41 ± 0.00 |
| A2B2 | 3.59 ± 0.00 | 3.31 ± 0.14 | 2.83 ± 0.17 | 3.07 ± 0.27 | 3.38 ± 0.03 |
| A3B1 | 3.59 ± 0.07 | 3.28 ± 0.03 | 3.00 ± 0.03 | 3.34 ± 0.14 | 3.34 ± 0.04 |
| A3B2 | 3.45 ± 0.07 | 2.72 ± 0.25 | 2.66 ± 0.17 | 3.52 ± 0.00 | 3.10 ± 0.04 |

Best treatment

The result of the effectiveness of inferior fish sauce under different concentrations of coconut sugar and caramel can be seen in Table 3.

Table 3. The effectiveness of inferior fish sauce under different concentrations of coconut sugar and caramel .

| Treatments | effectiveness |
|------------|---------------|
| A1B1 | 0.29 |
| A1B2 | 0.56 |
| A2B1 | 0.88 |
| A2B2 | 0.63 |
| A3B1 | 0.71 |
| A3B2 | 0.29 |

Discussion**Viscosity**

Based on the results of variance at 5% significance level indicates the addition of coconut sugar and caramel very significant effect on the viscosity of the inferior fish sauce. 18,01 lowest viscosity value mp is the A1B1 treatment (20% coconut sugar and caramel 5%). The highest viscosity was obtained at A3B2 treatment (30% coconut sugar and caramel 10%) with a value of 57.10 mp.

Fig.1 shows that the higher the addition of coconut sugar and caramel sauce, the viscosity of the resulting higher as well. It is thought the addition of sugar will cause the bound water into food, because increasing the concentration of dissolved solids in the solution, the higher a_w . A solution with a high concentration will have a higher viscosity, because the concentration of the solution denote the number of particles dissolved substance per unit volume. The more particles are dissolved, the higher the friction between the particles and the higher viscosity. This is in accordance with the statement ⁶, the greater the viscosity, the greater the viscosity of a product. According to Winarno⁷ that the increase in viscosity is affected by the addition of sugar and sugar concentrations were added.

Color intensity (Chroma)

Based on the results of variance at 5% significance level indicates the addition of coconut sugar and caramel does not significantly affect the color of inferior fish sauce. Color intensity values with the value of 15.681 is the lowest in A1B1 treatment (20% coconut sugar and caramel 5%). The highest color intensity values with the value of 17.370 is the A3B2 treatment (30% coconut sugar and caramel 10%). The color of the inferior fish sauce tends toward brownish yellow and blackish brown. It is suspected during the making of the inferior fish sauce with the addition of coconut sugar and caramel will form a non-enzymatic reaction that Maillard and Caramelization.

According Dedin⁸ carbonyl cluster of reducing sugar if met⁸ with the amine group will easily Maillard reaction which would form a brown color (melanoidin), so the more the concentration of brown sugar and caramel in the sauce, the higher the Maillard and caramelization reactions resulting in the formation of

increased brown color. Both of these reactions result in discoloration, odors, Flavour and followed by the formation of the middle product, 5-hydroxy metal fufural (HMF) and the final product is formed pigment brown/Brown pigment formation (BPF).

Total dissolved solids

Based on the results of variance at 5% significance level indicates the addition of coconut sugar and caramel very significant effect on the resulting total dissolved solids. Total dissolved solids lowest with 61.00% value is in the treatment of A1B1 (coconut sugar 20% and caramel 5%). TSS highest with 71.20% value obtained in A3B2 treatment (30% coconut sugar and caramel 10%).

Figure 3 shows that the higher the addition of coconut sugar and caramel, the value of total dissolved solids produced fish sauce also high. Total dissolved solids increased with increasing number of coconut sugar added to the sauce. This is because the coconut sugar contains sucrose composed of glucose and fructose are easily soluble in water. This is consistent with the statement proposed by Solomon and Sinuraya⁹ which states that if the sucrose dissolved in the water molecule hydrolyzed to α -D-glucose and β -D-fructose. The more components are soluble sugars, the soluble organic substances are also more and more, so that the amount of total dissolved solids becomes higher.

Proximate Components

Protein Dissolved

Based on the results of variance at 5% significance level indicates the addition of coconut sugar and caramel significant effect on soluble protein produced. Soluble protein with the lowest value of 5.76 mg / ml is the treatment of A3B2 coconut sugar (coconut sugar caramel 30% and 10%). The highest soluble protein obtained in A1B1 treatment (20% coconut sugar and caramel 5%) with a value of 8.07 mg/ ml.

Table 1. shows that the more the addition of coconut sugar and caramel in the inferior fish sauce, the lower the levels of soluble protein produced. This is presumably the higher the addition of coconut sugar and caramel will reduce the levels of soluble protein in soy sauce produced as proteins react with reducing sugars and used in the Maillard reaction. Besides decreasing levels of soluble protein due to deamination ϵ -amino groups of lysine in the Maillard reaction in inferior fish sauce that will form a brown color (melanoidin)¹⁰. Deamination of amino-carbonyl reaction is different from the deamination reaction of α -amino group of an amino acid through degradation Stecker, because it is not yet known¹¹.

Ash Content

Based on the results of variance at 5% significance level shows shows the addition of coconut sugar and caramel significant effect on ash content produced the lowest ash content with 1.21% value is the A1B1 treatment (20% coconut sugar and caramel 5%). The highest ash content was obtained on A3B2 treatment (30% coconut sugar and caramel 10%) with a value of 4.34%.

Table 1. shows that the higher the concentration the addition of coconut sugar and caramel in the inferior fish sauce, the higher the ash content in inferior fish sauce. It is thought to increase the sugar high organic matter and mineral elements in it too high. Brown sugar (coconut) contains organic acids and minerals are also higher compared with caramelized sugar warming. Moreover, the addition of increasing concentrations of coconut sugar and caramel resulting water content decreases so that more residue left in the material. The more components are soluble sugars, the soluble organic substances are also more and more. According Winarno¹² Raw foods are 96% largely composed of organic matter and water, the rest is composed of mineral elements.

Protein Content

Based on the results of variance at 5% significance level indicates the addition of coconut sugar and caramel very significant effect on the levels of protein produced the lowest protein content with 4:37% value is the A3B2 treatment (30% coconut sugar and caramel 10%). The highest protein content was obtained on A1B1 treatment (20% coconut sugar and caramel 10%) with a value of 5:17%.

Table 1. shows that the higher the concentration the addition of coconut sugar and caramel in the inferior fish sauce, the lower the levels of protein produced. Differences in protein content in each treatment is

due to the addition of sugar can increase the levels of carbohydrates, especially sugar reduction. Reducing sugar levels will increase as more sugar added. If the sugar content increases, the reduction will be many who binds to the amino acid of the protein material that will be used in the Maillard reactions and caramelization.

According Dedin ¹³ Maillard reaction proceeds to give effect to the decrease in the levels of lysine. Lysine residues of proteins at the beginning of the reaction bonded to form a reducing sugar derivatives as laktulosil deoksiketosil-lysine-lysine. In further stages of the reaction, the compound decomposes laktulosil-lysine produce pramelanoidin that can react with other amino acids on the protein side chains that affect to damage some types of essential amino acids and the formation of crosslinks between protein chains. Therefore the total protein content contained in the inferior fish sauce will decline as a result of the high concentration of coconut sugar and caramel are added.

Sensory quality

Table 2 shows that the value of A color in sweet inferior fish sauce ranged from 3.45 to 3.66 (not like to like). Based on the results of variance at the level of 5% significance test show panelist assessment of the color parameters inferior fish sauce with coconut sugar and caramel not significantly affect color preferences inferior fish sauce. Color most preferred by the panelists are A2B1 treatment and least preferred is the treatment of A3B2. In the treatment of A2B1 color is blackish brown sauce. So the color of fish sauce preferred inferior is not too dark.

A value of fish sauce flavor to the inferior fish ranged from 2.72 to 3.45 (do not like to like). Based on the results of variance at the level of 5% significance test showed that the addition of coconut sugar and caramel aroma significantly affect favorite inferior fish sauce. The flavor of the most preferred by the panelists are A2B1 treatment and least preferred is the treatment of A3B2. The addition of 25% and 5% coconut sugar and caramel has a greater role in the aroma that panelists have the right scent perception than the addition of coconut sugar 30% and 20%. The role of coconut sugar to give effect to A panelist on the addition of caramel aroma attributes. This is due to the caramel has a smooth aroma typical caramel so as to compensate for the distinctive scent of brown sugar that has the characteristics of a stronger almost like honey and give the right aroma that can be accepted by the panelists.

A sense of the value of fish sauce that was applied to the inferior fish fried rice ranging from 2.66 to 3.45 (do not like to like). Based on the results of variance at the level of 5% significance test showed that the addition of coconut sugar and caramel significant effect on A taste of sweet fish sauce inferior. The interaction between the addition of coconut sugar and caramel cause taste sweet, sour and savory. The presence of a sweet and slightly sour taste as sugar and caramel. Savory flavor itself is derived from the wet fish hydrolyzate inferior. Most panelists less like excessive sweetness and some consumers are not like ketchup. coconut sugar concentration of 25% and 5% caramel chosen as the preferred product by panelists. This is because most of the panelists do not like fish sauce with excessive sweetness.

A value of viscosity on the inferior fish sauce ranges from 2.45 to 3.48 (do not like to like). Based on the results of variance at the level of 5% significance test showed that the addition of coconut sugar and caramel a very significant effect on the viscosity of inferior fish sauce. Viscosity of the most preferred by the panelists are A3B2 treatment and least preferred is the treatment of A1B1. The addition of sugar with high concentrations in fish sauce can affect the level of viscosity. The higher the concentration of sugar is given, the higher the viscosity level. According Winarno ¹⁴ that increase in viscosity is affected by the addition of sugar and sugar concentrations were added.

A value overall in inferior fish sauce ranged from 2.86 to 3:41 (do not like to like). Based on the results of variance at the level of 5% significance test showed that the coconut sugar and caramel addition is significantly affect the overall a sweet fish inferior sauce. Overall most preferred by panelists from organoleptic color, aroma, flavor and consistency are A2B1 treatment adding 25% to 5% coconut sugar caramel and least preferred is the treatment of A1B1 treatment 20% and 5% coconut sugar caramel.

Best treatment

Table 2. shows that the best value is A2B1 treatment (25% brown sugar and caramel 5%) with a value of 0.88. Treatment A2B1 has a viscosity of 41.41 mp, the intensity of the color (Chroma) 15.99, 65.9 dissolved solids, protein dissolved 7.21 mg/ml, Ash content 3.03 %, protein content 4.88, color of organoleptic 3.66 ,

aroma 3.45, 3.45 flavor, viscosity 2.90, and a overall 3.41. Thus treatment formulations A2B1 is the addition of coconut sugar and caramel appropriate, acceptable and preferred by the panelists.

Conclusion

Based on the research can be concluded that the addition of coconut sugar and caramel concentration very significant effect on the viscosity, total dissolved solids, organoleptic taste, viscosity and overall, significantly affect the falvor organoleptic and no significant effect on the intensity of color, color organoleptic the fish sauce of hydrolyzate inferior fish. The results of the effectiveness test showed that the best value is A2B1 treatment (25% concentration of coconut sugar, caramel 5%) with a value of 0.88. Inferior fish sauce meet quality standards set SNI 01-3543-1994.

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References

1. Rahayu, W.P., et al. 1992. Fermentation Technology Products fishery. Bogor: Bogor Agricultural University.
2. Kumalaningsih, S. 1986. Fermented Soy Sauce Fish Lemuru. Malang: UB.
3. Wiratma E. 1995. "Analysis of flavor components of soy sauce" .skripsi. Bogor: IPB, Fateta.
4. Mananda, A. 2013. "Enzymatic Hydrolysis Process Modifications to the substrate Fish Inferior in Application For Indigenous Flavor". Thesis. Jember: Faculty of Agricultural Technology. University of Jember.
5. Prasetyo N, Maulana. 2012. "Making Ketchup From Fish Cork In Hydrolysis Enzymatic Using Sari pineapple". Thesis. Semarang: Faculty of Engineering, Department of Chemical Engineering, University of Diponegoro.
6. Setiyoningrum, F., and D.N. Surahman. 2009. *Influence of Apples Not Ripe Tomatoes on the Quality of Tomato Pasta in PT. Partner Assorted Food-Brass*. LIPI BSS, 235 (2), 1-6.
7. Winarno. 2002. *Food Chemistry and Gizi*. Jakarta: PT Gramedia
8. Dedin, 2006. "The decline Lysine Amino Acid Levels In The reaction Due Sweet Soy Sauce With Carbonyl compounds in Maillard Reaction". Script. Surabaya: UPN-Veteran
9. Solomon, A. H., and G. Sinuraya. 1995. *Fundamentals of Biochemistry for Agriculture Industry*. Terrain: USU-Press.
10. Dedin, 2006. "The decline Lysine Amino Acid Levels In The reaction Due Sweet Soy Sauce With Carbonyl compounds in Maillard Reaction". Script. Surabaya: UPN-Veteran.
11. Namiki, M. 1988. *Chemistry of the Maillard reaction. Recent studies on browning reaction mechanism and the development of antioxidant and mutagen*. Advances in Food Research, 32: 116-170.
12. Winarno. 2002. *Food Chemistry and Gizi*. Jakarta: PT Gramedia.
13. Dedin, 2006. "The decline Lysine Amino Acid Levels In The reaction Due Sweet Soy Sauce With Carbonyl compounds in Maillard Reaction". Script. Surabaya: UPN-Veteran.
14. Winarno. 2002. *Food Chemistry and Gizi*. Jakarta: PT Gramedia
