The effect of sauerkraut liquid with sugarcane water and fermentation time on the quality of instant bekasam of mujair fish

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Abstract. The purpose of the study was to determine the effect of the addition of sauerkraut liquid with sugarcane water and fermentation time on the quality of instant bekasam of mujair fish. The research was using a factorial randomized design with addition of sauerkraut liquid with sugarcane water (P1=60%:40%, P2=70%:30%, P3=80%:20%, P4=90%:10%) and fermentation time (L1=12 hours, L2=24 hours, L3=36 hours). The addition of sauerkraut liquid with sugarcane water had a highly significant effect on moisture content, protein content, pH content, hedonic values of flavour and taste. Fermentation time had a highly significant effect on protein content, pH values, hedonic values of aroma and taste. The addition of sauerkraut liquid with sugarcane water of 80%:20% and fermentation time of 36 hours had the best quality of instant bekasam of mujair fish.

1. Introduction

Freshwater fish such as mujair fish are easily available and cultivated by the community. The protein content in mujair fish is high enough so it is good if consumed by the body. However, mujair fish have high water content and can be a medium for growing bacteria because the pH content of mujair fish is neutral. To reduce the damage to mujair fish, mujair fish are processed into bekasam. Bekasam is a fermented product that is only consumed in certain areas. Bekasam has a strong sour taste and aroma because it undergoes a fermentation process that produces lactic acid, acetic acid, propionic acid, and ethyl alcohol. These compounds are formed through the breakdown of carbohydrates by lactic acid bacteria [1].

The making of bekasam is traditionally done using ingredients such as fish, rice and salt. Rice and salt can be replaced with sugarcane water and sauerkraut liquid. The use of rice and salt (10% - 30%) slows down the growth of lactic acid bacteria thereby affecting the levels of lactic acid bacteria in bekasam [2]. The reason for changing rice to sugarcane water because sugarcane water can be obtained at an affordable price and sugarcane water contains sugar which can be a source of carbohydrates for bacterial growth like rice. Fish fermentation is carried out by anaerobic means without air. Microbes in the anaerobic state will produce decomposition such as water, CO₂, energy, and organic acids. The dominant organic acid produced is lactic acid which comes from lactic acid bacteria, so that the sour aroma will be easily smelled from the fermentation product. Apart from the aroma, taste and texture will change to become more distinctive during the fermentation process [3].
The resulting bekasam has high water content and can be easily damaged so it has a short shelf life. Therefore, the traces are processed into instant bekasam which will have a lower water content than the used and have a longer shelf life. Besides, the processing of marks into instant traces uses additional ingredients, such as coconut milk, red chilies, shallots, garlic, galangal, lemongrass, lime leaves, turmeric, salt, and sugar which can enrich the aroma and taste of the instant bekasam. By doing the processing of the used to be instant, it can make it easier for consumers to consume the instant used without having to be reprocessed.

2. Materials and methods

2.1. Research materials and tools
The ingredients used are black mujair fish (harvesting age at 4 months), sauerkraut liquid (made using white cabbage with a harvest age of 4 months), PS 864 sugarcane juice, and additional ingredients (coconut milk, red chilies, shallots, garlic, galangal, lemongrass, lime leaves, turmeric, salt, and sugar). The tools used are oven, desiccator, analytical scales, Kjedhal’s flask, burette, pH meter, and glassware.

2.2. Research methods
The research used factorial completely randomized design method with 2 factors, that is: Factor I: Comparison of sauerkraut liquid with sugarcane juice (P); (P1 = 60%: 40%, P2 = 70%: 30%, P3 = 80%: 20%, P4 = 90%: 10%). Factor II: Fermentation time (L); (L1 = 12 hours, L2 = 24 hours, L3 = 36 hours). Each treatment was made with three replications.

2.3. Research stages
In the process of making instant bekasam of mujair fish, the following stages are carried out:

2.3.1. Sauerkraut making. Cabbage is sorted and cleaned, then washed using a 1% salt solution of 1 litre of water. The cabbage is weighed as much as 200 g then the cabbage is mixed with 2.25% salt solution and stirred until blended. Then the cabbage with the salt solution is put in a glass jar that has been sterilized and compacted by putting a glass cup into a glass jar. Then the glass jar is covered with a filter cloth and a cloth napkin on top to prevent air from entering and is then closed. Fermented for 3 days in a glass jar.

2.3.2 Raw material preparation. The preparation of raw materials is done by weeding the fish on the head, stomach contents, scales, fins and gills. Then cut the fish into fillets, namely 2 parts. Then the fillets are washed with clean water until the mucus on the fish meat is gone and drained for 15 minutes.

2.3.3. Tools preparation. Boiling glass jars and glass cup for 30 minutes and cooled down. Next, blanced filter cloth to cover the glass jar.

2.3.4. Fermentation process. Fish fillets are put into glass jars with a weight of 200 g each and added sauerkraut liquid with sugarcane water according to the treatments (60%:40%, 70%:30%, 80%:20%, 90%:10%) from 500 g of water, then covered with a blanced filter cloth, then fermented according to treatment (12 hours, 24 hours, and 36 hours).

2.3.5. Instant bekasam making. Fermented fish, washed with 1% salt solution and drained for 15 minutes. Then the fish is steamed for 20 minutes and separated from the spines. Then add ingredients such as shallot, red chilli, garlic, galangal, lemongrass, lime leaves, turmeric, sugar, salt. The percentage of each ingredients is 11.6% shallot, 10% red chili, 6.6% garlic, 6% galangal, 5% lemongrass, 1.3% lime leaves, 1.6% turmeric, 8.3% sugar, and 1.3% salt which has been mashed and added 200 g of coconut milk. Then all the ingredients are mixed and heated at 80 °C for 45 minutes using a Teflon skillet until brown. Furthermore, instant bekasam of mujair fish products are packaged in polyethylene plastic.
2.4. Parameter measurement

2.4.1. Moisture content. Five grams of instant bekasam are put into aluminium cup that have been dried in an oven before and weighed. Furthermore, the instant bekasam was dried in an oven at 50°C for 24 hours and cooled in a desiccator for 15 minutes then weighed. Then heated in an oven at 105°C for 1 hour, then cooled it in desiccators for 15 minutes and weighed. The treatment was repeated until a constant sample weight was obtained.

2.4.2. Protein content. 0.1 g of the instant bekasam put into a cup and 2 g of catalyst is added (CuSO₄: K₂SO₄ = 1: 1). Then the instant former was put into a 30 ml Kjeldahl flask along with the catalyst, then 2.5 ml of concentrated H₂SO₄ was added to it. Kjedahl's flask was placed on the stove and tightly closed with the tip of the Kjeldahl flask. Next, for 1 to 1.5 hours, give the Kjedhal flask a clear colour. Then cooled the Kjedhal flask and add 10 ml of distilled water, then pour the contents of the Kjeldahl flask into the Erlenmeyer. Then Erlenmeyer was transferred to the top of the distillation device and added with 15 ml of 40% NaOH solution into it. Furthermore, Erlenmeyer contains 25 ml of 0.02 N H₂SO₄ added 2-4 drops of hinged indicator and placed under the condenser. Distillation is carried out up to 125 ml of distillate in an Erlenmeyer flask. Furthermore, the titration is carried out using 0.02 N NaOH until the colour changes from purple to green.

2.4.3 Total acid content. Five grams of instant bekasam was weighed and put into a beaker glass, then 50 ml of distilled water was added and stirred well. Furthermore, the instant marks are filtered with filter paper and infused up to 100 ml. A total of 10 ml of filtrate was taken and applied up to 100 ml. Furthermore, 10 ml of filtrate is taken and put into Erlenmeyer, then 2-3 drops of PP (phenolphthalein) indicator are added, 2-3 drops and titrated with 0.01 N NaOH.

2.4.4. pH content. The determination of the pH value is carried out using a pH meter that has been calibrated with a buffer solution at pH 4 and 7. The pH meter is turned on and left for 15-30 minutes. Furthermore, the electrode on the pH meter was rinsed with distilled water and dried with tissue paper. Then the electrode is immersed in the sample solution and set in a pH measuring device. Then the electrode is allowed to immerse in the solution for a few moments until a stable reading is obtained and the pH value of the sample is recorded.

2.4.5. Determination of the hedonic value of aroma and taste. The organoleptic aroma test was carried out using the hedonic test. Instant records were given to 30 panellists with a random code. The parameters observed were the instant scent produced on a hedonic scale.

3. Results and discussion

The research result showed that the effect of sauerkraut liquid with sugarcane water and fermentation time have an effect on moisture content, protein content, total acid content, pH content, hedonic value of aroma and taste that showed in Table 1 and Table 2.

3.1. Water content

The ratio of sauerkraut liquid to sugarcane water produced the lowest water content in the P₄ treatment (90%: 10%) is 8.979%. The fermentation time for 36 hours resulted in the lowest water content is 9.5313%. The decrease in water content occurs because the sauerkraut liquid contains 2.25% salt. The salt contained in the sauerkraut liquid will attract and reduce the water content in the used fish meat [4].

3.2. Protein content

The ratio of sauerkraut liquid to sugarcane water produced the highest protein content in treatment P₄ (90%: 10%) is 7.519%. The 36 hour fermentation time resulted in the highest protein content is 7.134%. Increasing the amount of sauerkraut liquid used will increase the protein content in the scars because
the constituent components of lactic acid bacteria are proteins [5]. The breakdown of complex proteins into free amino acids so that the longer the fermentation takes place, the dissolved protein content will increase [6].

Table 1. The effect of sauerkraut liquid with sugarcane water on the parameters of instant bekasam of mujair fish

| Quality parameters          | Comparison of sauerkraut liquid with sugarcane water |
|----------------------------|------------------------------------------------------|
|                            | P₁          | P₂          | P₃          | P₄          |
|                            | (60% : 40%) | (70%:30%)  | (80%:20%)  | (90%:10%)  |
| Moisture content (%)       | 10.468aA   | 10.083bB   | 9.554cC    | 8.979dD    |
| Protein content (%)        | 5.674cC    | 6.517bBC   | 6.698bAB   | 7.519aA    |
| Total acid content (%)     | 0.312dD    | 0.463cC    | 0.633bB    | 0.733aA    |
| pH content                 | 5.677aA    | 5.538bB    | 5.405cC    | 5.318dD    |
| Hedonic value of aroma     | 3.485dC    | 3.552eC    | 3.674bB    | 3.785aA    |
| Hedonic value of taste     | 3.981cC    | 4.015eC    | 4.063bB    | 4.133aA    |

Note: The numbers obtained in the table are the average of 3 replications. The letter notation shows significantly different effect at 5% (small letter) level and very significantly different effect at 1% level (big letter).

Table 2. The effect of fermentation time on the parameters of instant bekasam of mujair fish

| Quality parameters          | Fermentation time |
|----------------------------|-------------------|
|                            | L₁ | L₂ | L₃ |
|                            | (12 hours) | (24 hours) | (36 hours) |
| Moisture content (%)       | 10.0917a | 9.6903b | 9.5313c |
| Protein content (%)        | 0.4841bB | 0.4740aAB | 0.4694aA |
| Total acid content (%)     | 0.462bB | 0.544abAB | 0.600aA |
| pH content                 | 5.566aA | 5.471bB | 5.417bB |
| Hedonic value of aroma     | 3.564bB | 3.633aAB | 3.675aA |
| Hedonic value of taste     | 4.006bB | 4.047abAB | 4.092aA |

Note: The numbers obtained in the table are the average of 3 replications. The letter notation shows significantly different effect at 5% (small letter) level and very significantly different effect at 1% level (big letter).

3.3. Total acid content
The comparison of sauerkraut liquid with sugarcane water produced the highest total acid content in treatment P₄ (90%: 10%) is 0.733%. The 36 hour fermentation time resulted in the highest protein content is 0.600%. The bacteria found in sauerkraut liquid produce lactic acid which gives a sour taste to scars. During fermentation, carbohydrates are decomposed into simple sugars and converted into acids [7].

3.4. pH content
A comparison of sauerkraut liquid with sugarcane water resulted in the lowest pH level in treatment P₄ (90%: 10%), namely 5.318. The 36 hour fermentation time resulted in the lowest pH level is 5.417. A decrease in the level of acidity can occur if the salt concentration increases in each treatment and it can be proven that the marks have acidic properties produced by the activity of bacteria that grow during fermentation [2].

3.5. Hedonic value of aroma (numeric)
The comparison of sauerkraut liquid with sugarcane water produced the highest aroma hedonic value in treatment P₄(90%: 10%) is 3.785. The 36 hour fermentation time resulted in the highest aroma hedonic
value is 3.675. During fermentation, there is a process of breaking down protein into simpler components and producing a distinctive sour aroma of fermentation. The longer the fermentation, the stronger the aroma is produced [2].

3.6. Hedonic value of taste (numeric)
A comparison of sauerkraut liquid with sugarcane water resulted in the highest taste hedonic value in treatment P4 (90%: 10%) is 4.133. The 36 hour fermentation time resulted in the highest taste hedonic value is 4.092. The sauerkraut liquid gives a sour and salty taste to the scars and the sour taste will be more dominant during the fermentation process, the longer the fermentation is carried out, the more distinctive sour taste will be felt by the senses [8].

![Figure 1. Product of instant bekasam of mujair fish](image)

4. Conclusions
To produce instant bekasam of mujair fish with the best quality, the ratio of sauerkraut liquid to sugarcane water is 80%: 20% and the fermentation time is 36 hours.

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