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Processing of Liquid Waste in the Tofu Industry to Become High Quality Fibrous Food

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ABSTRACT: *This study aimed to process liquid waste from the tofu industry into edible food that is high in fiber in the form of nata de soya. Soya waste which is used as a medium in the manufacture of nata de soya is added with Acetobacter xylinum with respective concentrations of 10%, 20%, 30%, 40% from 400 ml of media solution. The results of the study showed that the thickness of the nata de soya skin with each treatment variation was 0.76cm, 2.07cm, 2.76cm, 2.37cm, the yield was 22.6%, 42.3%, 51.4%, 46 .4%, fiber content 50.05%, 52.74%, 54.02%, 51.60% and water content of 87.6%, 86.6% 85.8% 86.2%. The organoleptic test that was preferred by panelists with high scores in each test was at a concentration of 30% with color, taste and elasticity tests. The results of the study can be concluded that the liquid waste in the tofu industry can be made into food that has high fiber and testing with the addition of Acetobacter xylinum as much as 30% is the treatment with optimum results in testing the thickness, yield, fiber content, water content, and nata de soya organoleptic test.*

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I. INTRODUCTION

Industrial liquid waste is a liquid produced from industrial processes. Industrial wastewater contains various types of chemicals that are harmful to the environment if disposed of carelessly. The tofu industry is a business place for the production of tofu with its basic ingredients from soybeans. The tofu industry is an industrial area that produces large amounts of liquid waste. The waste liquid produced in this industry comes from several stages of work including washing, soaking, boiling to pressing. Liquid waste from tofu industry production on average per one kilogram of soybeans can produce as much as 9 liters of liquid waste [1].

The tofu industry besides being able to increase the economy also has a negative impact on the environment, namely if it is not handled properly, the waste produced can pollute the environment [2], thus it is necessary to take correct handling steps so that the environment around the tofu industry is not polluted. The XYZ tofu industry is one of the tofu-making businesses in West Aceh district that has not yet carried out wastewater treatment before it is discharged into the environment. Tofu liquid waste still contains protein, carbohydrates and fat, so if further processing is carried out it will be able to add economic value. Environmental pollution from tofu waste can be done by processing the liquid waste into various products that are beneficial to society. One of them is a simple biotechnology process using Acetobacter Xylinum bacteria capable of processing liquid from tofu waste into food that contains high fiber, namely ata de soya.

Nata is produced by the bacterium Acetobacter Xylinum by polymerizing glucose into a layer of cellulose [3]. Acetobacter Xylinum is able to grow and develop in a medium containing water, carbohydrates, proteins, fats and minerals. Acetobacter Xylinum bacteria produce nata by breaking down the sugar contained in the media [4]. It is hoped that in the future this research will be able to provide knowledge about the utilization of liquid waste from the tofu industry into a high-fiber food, namely nata de soya, which can increase economic value for those who want to do it.

II. RESEARCH METHODS

The treatment was carried out by preparing 3 liters of liquid waste from the tofu industry. Then filtered and heated until boiling. In this waste liquid, you need to add granulated sugar. This mixture of waste and granulated sugar will become the medium for the formation of nata. Nata media was measured for its pH until it reached 4-4.5 by adding acetic acid and urea. After the cold media solution was put into 4 containers measuring 8x8x10 cm to carry out 4 stages of treatment. Then stored for 24 hours by covering the container with newspaper. Then each container was added Acetobacter Xylinum as a starter to each of 10%, 20%, 30% and 40% of the total media. Then stored at room temperature and stored for fermentation for 14 days.

Observations made in the form of thickness, yield, water content and organoleptic. Thickness testing was carried out by measuring the nata layers that had been formed from each treatment container. Determination of the yield is done by taking the formed nata and weighing it, determining the yield using the following equation:

$$\text{Yield (\%)} = \frac{\text{the resulting nata}}{Medium\ weight}\ x\ 100\%$$

Measurement of fiber content was carried out by taking a sample of 3 grams each, put in 500 ml and added 25% H_2SO_4 as much as 50 ml. Then heated to boiling for 30 minutes. After chilling filtered using filter paper, washed with hot water, H_2SO_2 and ethanol. Then it is dried and the fiber content is measured using gravimetry using the following equation:

$$Fiber\ content\ = \frac{\text{fiber weight}}{Sampel\ Weight}\ \text{x } 10\%$$

Measurement of water content can be done by baking 5 grams of formed nata for 6 hours at 100-110 0C. Then put in a desiccator and use the graphimetric method. Calculation of water content using the following equation:

$$Water\ Content\ = \frac{\text{Initial weight awal}-\text{final weight}}{Sampel\ Weight\ (g)}\ \text{x } 100\%$$

Organoleptic measurements observed were: color, taste and elasticity of each treatment. The colors to note are the color, white, cream color and slightly brownish color. The taste tests were sweet, less sweet and not sweet, while the elasticity test was chewy, less chewy and not chewy. The values obtained in the organoleptic test were carried out by 10 respondents, each respondent did the test 2 times with repetition for each sample.

III. RESULTS AND DISCUSSION

The test results for each sample that has been carried out can be seen in table 1.

Table 1. Effect of starter thickness, yield, fiber content and water content on nata de soya.

Starter (%)	Thickness (cm)	Yield (%)	Fiber content (%)	Water content (%)
10	0,76	22,6	50,05	87,6
20	2,07	42,3	52,74	86,6
30	2,76	51,4	54,02	85,8
40	2,37	46,4	51,60	86,2

Based on the table above, an observation graph can be made of the influence of the concentration of Acetobacter Xylinum bacteria on the thickness, yield, fiber content and water content of nata de soya. In each test there was a change in the results obtained so that thus there was an influence on the addition of acetobacter xylinum bacteria to the test for thickness, yield, fiber content, water content of nata de soya. For more details, see the figure 1.

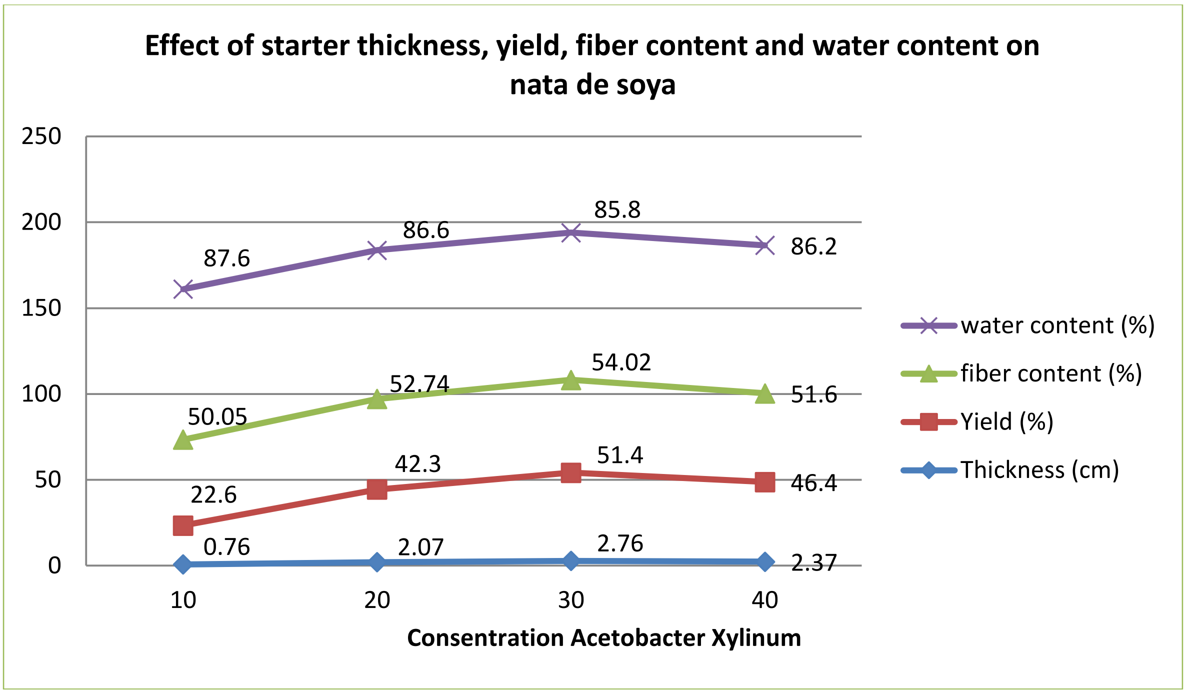

Figure 1. Effect of starter thickness, yield, fiber content and water content on nata de soya

1. Thickness Test

Observation of the thickness of the nata showed that the addition of the Acetobacter Xylinum bacterial starter was able to affect the thickness of the resulting nata, when the starter was added 0.76 cm, the thickness obtained was 0.76 cm, the addition of 20% resulted in a thickness of 2.07 cm, the addition of 30% starter produced nata. with a thickness of 2.76 cm and the addition of 40% starter produces nata with a thickness of 2.37. The highest thickness of nata was obtained with an addition of 30% which was 2.76 cm while the lowest thickness was obtained with an addition of 10%. This shows that different starter concentrations indicate the ability of bacteria to convert sugar into cellulose layers that form nata solids with a certain thickness. The addition of Acetobacter Xylinum as much as 30% is the optimal amount for bacteria to be able to increase their energy in converting sugars contained in soy medium, as research [5] shows, with the addition of Acetobacter Xylinum as much as 30%, the nata media achieves the highest energy to form nata thickness. The thickness of the nata also affects the weight, when the resulting nata gets thicker as well as the weight of the nata will increase [6].

2. Yield test

The yield test showed that the addition of starter was able to affect the amount of yield produced, the more starter added, the higher the yield value obtained. At the addition of 10% starter the yield produced was 22.6%, the addition of 20% starter became 42.3%, the addition of 30% became 51.4%, but at the addition of 40% it decreased to 46.4%. The ability of Acetobacter Xylinum to form cellulose and the composition of medical materials and environmental conditions can affect the amount of yield formed [7].

3. Fiber Content Test

In assessing the amount of fiber produced by nata de soya, the amount was different in each treatment, thus indicating that the increase in the number of starters had a different capacity to form fibers in the nata produced. The addition of 10% starter has a fiber content of 50.05% while the addition of 20% starter has a fiber content of 52.74%, the addition of 30% becomes 54.02 and the addition of 40% has a fiber content of 51.60. This shows that the more cellulose formed, the more fiber contained in the nata. The fiber formed is produced from the breakdown of sugar in soy media with the help of Acetobacter Xylinum bacteria, according to [8], said that crude fiber is obtained from the breakdown of sugar by Acetobacter Xylinum bacteria in fermentation media. In research [9] showed that the activity of the Acetobacter Xylinum bacteria was able to convert sugar to form cellulose in the form of a gel on the surface of the fermented liquid.

4. Water Content Test

The water content in the nata obtained indicates the amount of water contained in the network of nata layers formed. At the addition of 10% starter produces a water content of 87.1%, at an addition of 20% it becomes 86.5, at an addition of 30% it is 85.9% and a 40% addition of starter becomes 86.0%. This shows that there is a decrease with increasing water content. The more starter added the less water content because the thick and tight nata layers have space for a little capacity, while the thin nata layers have a larger cellulose layer that can accommodate more water. The water content that binds the least water is found in the addition of 30% starter, this is due to the correct amount of sugar contained in the media which increases the formation of cellulose.

5. Organoleptic Test

The results of organoleptic test observations can be seen in the table 2.

Table 2. Effect of starter on organoleptic test result.

Starter(%)	Organoleptic Test								
	Color			Flavor			Elasticity		
	P	C	SB	S	LS	NS	C	LC	NC
10	3	7	-	7	3	-	-	8	2
20	8	2	-	9	1	-	7	3	-
30	10	-	-	10	-	-	9	1	-
40	9	1	-	8	2	-	8	2	-

Where,
W : White
C : Cream
SB : Slightly Brown
S : Sweet
LS : Less Sweet
NS : Not Sweet
C : Kenyal
LC : Less Chewy
NC : Not Chewy

Based on the table above shows that the results of the assessment on each test sample are not the same value. The organoleptic assessments carried out were the color, taste and firmness of the nata de soya. Organoleptic testing on nata de soya was carried out to see the condition of nata which was assessed directly by the panelists. The effect of adding a different starter shows different assessment results from each panelist. Assessment of color, with the addition of 10% starter, 3 panelists rated white and 7 panelists rated cream. At 20% increments 8 chose white and 2 chose cream. At the addition of 30% all panelists rated white while at 40% there were 9 panelists rated white and 2 rated cream. This shows that each sample has a different color, white being the dominant color so that at the addition of 30% starter it has a whiter color than the other colors. This is because the basic color of the cellulose that is formed is indeed white in color supported again by the soya waste media which has a more dominant white color, so that the addition of Acetobacter Xylinum which processes sugar into energy can increase the white cellulose layer.

In the taste assessment, 10% starter there were 7 panelists who were sweet and 3 not sweet enough, 20% starter there were 9 panelists who chose sweet and 1 chose less sweet and 30% starter all panelists chose sweet while in starter 40% 8 chose sweet and 2 chose less sweet, this shows that in the media there is sugar which is used as energy by the acetobacter xylinum battery in forming nata, in the 30% sample the sugar obtained from the media is very optimal so that the sweet taste is more dominant in nata.

The elasticity test obtained different values for each sample on a 10% starter there were 8 panelists who chose less springy and 2 chose not springy, on 20% starter there were 7 panelists who chose springy and 3 chose less springy. At the addition of 30% there were 9 panelists who chose chewy and one chose less chewy. At the addition of 40% there were 8 panelists who chose chewy and 2 chose less chewy. This shows that the elasticity of each layer has a different value, this is due to the cellulose layer that is formed in the form of a slime layer produced by the activity of Acetobacter Xylinum. The layers that are composed the more and more they become denser and more elastic, in salpel with an addition of 30% it produces a higher elasticity than the others. This is influenced by the thickness of the cellulose layers formed which makes the nata's elasticity higher.

IV. CONCLUSION

Based on the results of the tests and discussions that have been carried out, the conclusion that can be obtained is to obtain nata de soya which is best seen in thickness, yield, fiber content and water content and organoleptic testing has a higher value in the addition of Acetobacter Xylinum as much as 30%, so acetobacter xylinum concentration of 30% is the optimum addition in the manufacture of nata de soya.

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