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Nata De Coco Quality Development Model from Different Inoculum Sources

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ABSTRACT: The results of the study "Nata De Coco Quality Development Model from Different Inoculum Sources", aim (1) to utilize wasted coconut water from the coconut industry and home industry, (2) to obtain a Nata de Coco quality development model from different inoculum sources (inoculum from pineapple flesh and inoculum that are already available on the market. The methodology used is quantitative (laboratory experiments) with Complete Randomized Design (RAL). This research includes stages, as follows, namely: Phase I, using coconut water media sources with the maturity level of ripe coconuts, with Treatment A = basic ingredients of fresh Coconut Water (0 storage), B = basic ingredients of Coconut Water with storage for 1 week, C = basic ingredients of coconut water with storage for 2 weeks, and treatment D = basic ingredients of coconut water with storage for
3 weeks. Phase II, fermenting coconut water which becomes a substrate as a fermentation medium using inoculum sources, namely: liquid inoculum sources from natural ingredients of pineapple flesh and liquid inoculum sources available on the market in producing cellulose pellicle.
The results of the study can be concluded as follows: (1) Coconut water waste wasted from the coconut industry and coconut home industry in the North Minahasa Regency area of North Sulawesi from ripe coconuts can be utilized by Acetobacter xylinum bacteria in producing Nata de Coco pellicle, (2) IN treatment (Natural Acetobacter xylinum liquid inoculum from pineapple fruit) provides the best treatment results from several quality parameters of Nata de Coco produced such as: parameters of Layer Thickness, Water Content, Fiber Content, and Color, than IP treatment (liquid inoculum Acetobacter xylinum on the market).

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KEYWORDS: Nata De Coco, Inoculum Sources

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1. INTRODUCTION

In North Minahasa Regency, North Sulawesi Province, coconut water is one component that still has the potential to be used as raw material in making vinegar, alcohol, soft drinks, and also Nata de Coco. Nata de Coco products can also be used as substitutes for canned fruit or can be consumed for other fruits as food fresheners or desserts (food deserts) which can be classified as *dietary* (Rindengan, et al., (2017). Nata de Coco is a food made from coconut juice, shaped like jelly, white to clear and has a chewy texture. This food is favored by many people and has high economic value, (Yamin, M., Khairuddin, L. Japa., I. Putu Artayasa , 2022).

The technology of the Nata De Coco manufacturing process requires the basic ingredients of coconut water, especially water from ripe coconuts, which is one type of waste from making copra, coconut oil, VCO and coconut flour. Coconut water which is part of the coconut fruit that has not been widely used so that it becomes waste, which often causes problems because it can pollute the environment. Especially in the coconut area of North Minahasa Regency, North Sulawesi Province, the waste can be utilized optimally to increase the income of the community (coconut farmers), because there are many profitable processing alternatives that can be done by the community according to their potential . This will encourage the growth of new *home industries* and the growth of agribusiness businesses from coconut communities in this region. To overcome the problem of environmental pollution due to coconut water and at the same time To increase the economic value of coconut water, this coconut water can be utilized by processing it into various products, one of which is food products that contain high fiber (dietary fiber) *in* the form of Nata De Coco, (Mandey., et al ., 2020, 2021) and Langi., et al (2022). However, it is necessary to pay attention to the right source of coconut water media to

produce cellulose pellicles from the role of microbes *Acetobacter xylinum*, with different coconut water storage times. Furthermore, to ferment coconut water which will become a substrate as a fermentation medium by using different inoculum sources, namely: liquid inoculum sources from natural pineapple fruit and liquid inoculum sources available on the market in producing cellulose pellicle as a source of fiber that is faster harvest time.

2. MATERIALS AND METHODS

2.1. Materials

The ingredients used are old coconut water aged 10-11 months, glazial acetic acid 99%, liquid inoculum *Acetobacter xylinum* (from natural ingredients pineapple fruit) and liquid inoculum that is already on the market., sucrose, alcohol 95 %, H_2SO_4, NaOH, K_2SO_4 10%, distilled water . The tools used are analytical scales, pH meters, measuring cups, funnels, erlenmeyer , filter paper, ovens, pipettes, stoves, plastic trays, stainless steel pans, rulers, desiccators, paper, cotton, ose needles, spirit lamps, petri dishes, and test tubes, presses and tools c utter.

2.2. Inoculum sources

Inoculum sources, Phase I : utilizing resources coconut water media with the maturity level of ripe coconuts, with Treatment A = basic ingredients of fresh Coconut Water (0 storage), B = basic ingredients of Coconut Water with storage for 1 week, C = coconut water base with storage for 2 weeks, and treatment D = coconut water base with storage for 3 weeks . Phase II, fermenting coconut water which becomes a substrate as a fermentation medium by using inoculum sources, namely: Liquid inoculum sources from natural meat ingredients Pineapple fruit and liquid inoculun sources are available in the market.
Phase I research was conducted as follows:
Treatment A = Fresh Coconut Water (0 storage), B = Coconut Water with storage for 1 week,
C = coconut water with storage for 2 weeks, D = coconut water with storage for 3 weeks.

Phase II, Utilization of Liquid Inoculum Sources , namely by Fermenting coconut water using inoculum sources, namely: Inoculum sources liquid from natural ingredients of pineapple fruit (IC) and sources of liquid inoculum available on the market (IP) in producing cellulose pellicle .

2.3. Variable Data

The data obtained includes the o bserved Nata de Coco Quality Parameters : the Pelicle Weight (Wijandy and Fardiaz , 1985), the Layer Thickness (Wijandy and Fardiaz , 1985), the Moisture Content using the Oven, Sudarmadji , et al, 1997), the Fiber Content AOAC Method, (2005) and the Color (MCDA Method, 2021).

2.4. Data analysis

This study used laboratory experimental methods, with Random Design Complete (RAL), The data obtained were analyzed statistically using analysis of Variance at a 95% confidence levels.

3. RESULTS AND DISCUSSION

Phase I : In the results of p hase I research, using coconut water to make Nata de Coco by adding additional ingredients in the form of *food grade* nitrogen sources, carbon sources from sucrose, acetic acid and mineral sources from nutrients contained in coconut water. This is in accordance with the opinion of Tari, et al. (2010), that nata processing with raw materials from coconut water requires several additional ingredients, such as 0.3% nitrogen sources and other additions such as 10% carbon sources, 2.5% acetic acid and 0.03% mineral sources. The function of N in nata processing is to provide proteins for the formation and proliferation of bacterial cells that will affect the cellulose formed, (Riyani, 2020). According to Mandey (2016) the characteristics of coconut water are that it has a suitable nutritional content as a substrate for the manufacture of Nata de Coco products, where coconut water has sufficient nutritional content in the form of vitamins and minerals. The characteristics of coconut water contain carbohydrates, vitamin C, vitamin B complex, and minerals are quite good, while the caloric value ranges from 17.4 calories per 100 ml and the level of acidity (pH) ranges from 6.1.
The results of the study obtained Nata de Coco products with different qualities according to the treatment given.

1. Utilization of Coconut Water with Different Storage Times

a. Layer Thickness

The results of testing the thickness of the Nata de Coco product layer using the main substrate source in making Nata de Coco, namely coconut water with different storage time treatments such as storage treatment of 0 weeks (A), storage time treatment for 1 week (B), storage time treatment for 2 weeks (C) and treatment with storage time for 3 weeks (D), can be seen in Figure 1.

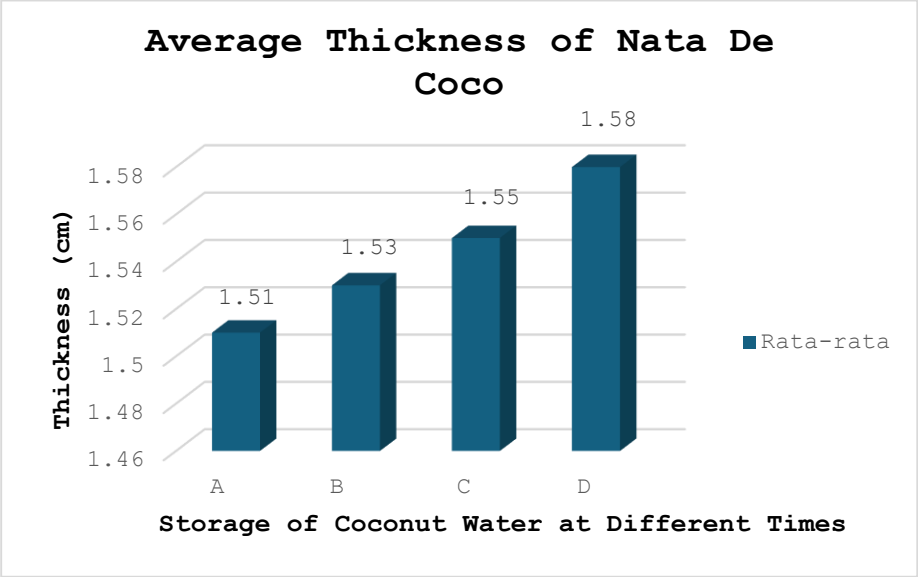

Figure 1. Graph of Nata de Coco Layer Thickness Testing Chart using Coconut Water Substrate with Different Storage Time

In Figure 1 it can be seen that the results of testing the thickness of the Nata de Coco layer, gives almost the same thickness of the Nata de Coco layer. The highest treatment in samples with coconut water storage time for 3 weeks is with sample code D of 1.58 cm, while the smallest treatment with layer thickness is treatment with a storage time of 0 days. The thickness of the Nata de Coco layer is produced due to the activities carried out by the work of *Acetobacter xylinum* microbes during the fermentation process of coconut water substrate with other nutrients, sources of nitrogen (food grade), carbon sources such as granulated sugar (sucrose). The longer the coconut water undergoes storage for 3 weeks, it can affect the thickening of Nata de Coco. The thickening of the cellulose layer on the resulting Nata de Coco products proves that the work of *Acetobacter xylinum* microbes can be effective / can work well in forming Nata de coco pellicles. This is in line with the results of research by Mandey, et al (2018) which states that coconut water from coconuts with maturity levels accelerates *Acetobacter xylinum* microbes synthesize coconut water substrates with materials such as carbon sources and N sources and acetic acid can produce cellulose pellicles in the form of chewy Nata de Coco sheets. This is also, in accordance with the results of Santoso, et al.'s research, 2021 on the use of organic nitrogen sources in making Nata de Coco, providing a maximum thickness of 2.83 cm.

Acetobacter xylinum plays a role in the fermentation process into Nata de Coco. These microbes convert the glucose in coconut water into cellulose plates. The plate, turns into a solid clear white, called nata, (Kandou., et al., 2014., and Alfarisy, et al., 2021).

b. Water Content

The results of testing the moisture content of Nata de Coco products using coconut water substrate sources on some treatments the storage time can be seen in Figure 2.

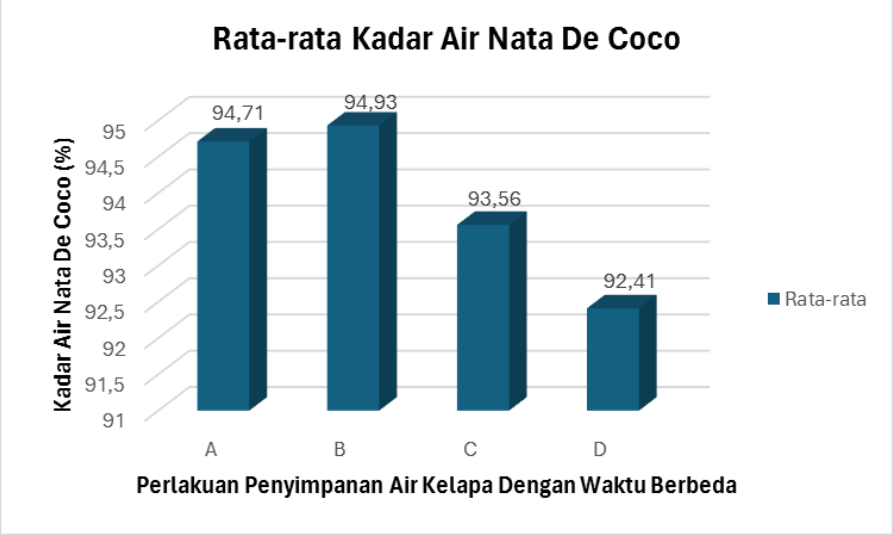

Figure 2. Graph of Nata de Coco Water Content Test Results Using Coconut Water Substrate with Different Storage Time

In Figure 2. it can be seen that, the results of the moisture content test of Nata de Coco products produced at various different storage time treatments, give almost the same moisture content process results. However, in treatment B with coconut water storage for 1 week, the percentage of water content was 94.93%., followed by treatment A, treatment C and treatment D with each percentage of water content of 94.71%., 93.56% and 92.41%) . The high percentage of water content in Nata de Coco, allegedly when coconut water is stored for 1 week, *Acetobacter xylinum* microbes synthesize coconut water substrates with the presence of other supporting materials such as nitrogen sources, carbon sources in producing Nata de Coco sheets, which is 94.93%. The high water content in this Nata de Coco product, according to Ramdani's research (2008), is 98.47%. The moisture content parameters of Nata de Coco can affect the quality of Nata de Coco by affecting the texture of the Nata de Coco.

c. Fiber Content

Fiber is one of the important food sources for our body's metabolism that is needed every day for health. The fiber in Nata de Coco is needed in physiological processes and can help diabetes and facilitate absorption of food in the body. Therefore, this product is used as a source of low calorie food for dietary purposes. Nata de Coco is considered a functional food because it has content and food that is very good for health (Mandey, et al., 2018). According to Anam (2019), Nata is extracellular cellulose resulting from the activity of *Acetobacter bacteria xylinum* is in the process of fermentation, and is one of the health foods rich in Fiber. Nata de Coco fiber content data on each water storage time treatment Different coconuts, in this study, can be seen in Figure 3.

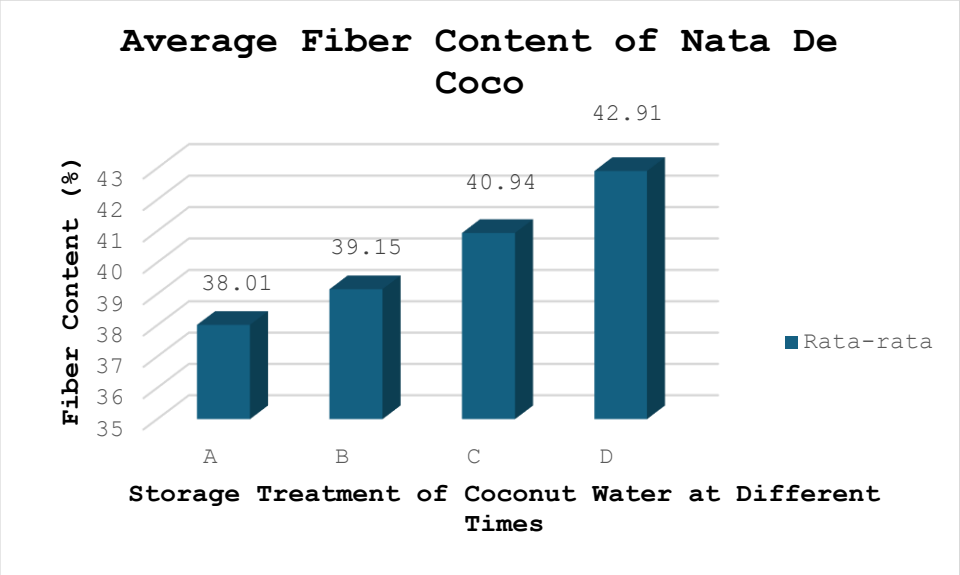

Figure 3. Graph of Nata de Coco Fiber Content Test Results using Water Substrate Coconut with different Storage Time

In Figure 3 it can be seen that the highest percentage of fiber content is 42.91% in treatment D (coconut water storage treatment for 3 weeks). The longer the coconut water undergoes storage for 3 weeks, naturally the coconut water is good for the microbial life of *Acetobacter xylinum* in forming the pellicle Nata de coco. This can be seen with the results of fiber content with the highest percentage at the storage time of coconut water for 3 weeks. The longer the storage time of coconut water, the nutritional content in coconut water changes with the natural fermentation of coconut water and is thought to facilitate *Acetobacter xylinum* bacteria in synthesizing the nutritional content contained in coconut water.

d. Colour

Nata de Coco color parameters produced at each storage time treatment The different coconut waters, can be seen in Table 1.

Table 1. Color Testing Results of Nata de Coco Products Using Coconut Water Substrate With Different Storage Times

Sample Code	Milky White Yellowish White
A	v
B	v
C	v
D	v

In Table 1 it can be seen that, Nata de Coco products are milky white, yellowish white and white color. In treatment C and treatment D, the resulting color of Nata de Coco is white, while treatment A is milky white, and treatment B is yellowish white.

The color of the resulting Nata de Coco products is mostly white. The color of Nata can be improved by speeding up the fermentation time, because the longer the fermentation time the color of nata becomes more yellowish.

Phase II Research Results

1. **Utilization of Liquid Inoculum Source:**

a. Layer Thickness

The results of testing the thickness of the Nata de Coco product layer using the Liquid Inoculum source in the form of natural inoculum from pineapple fruit (IN) and liquid inoculum on the market (IP) in the manufacture of Nata de Coco can be seen in Figure 4 .

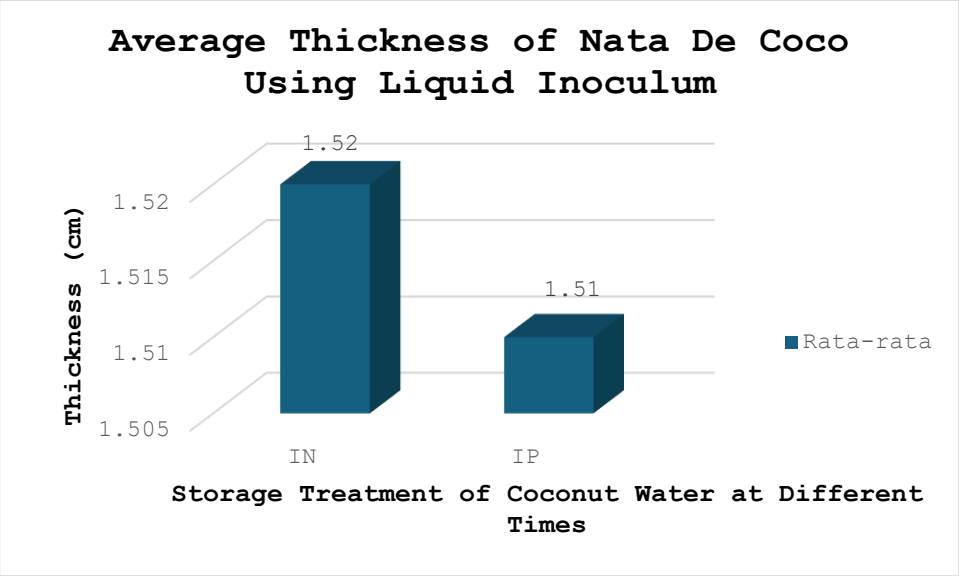

Figure 4. Graph of Nata de Coco Product Layer Thickness Test Results using Source of Liquid Inoculum

Figure 4, you can see the results of testing the thickness of the nata de coco layer, gives almost the same thickness of the Nata de Coco layer. The highest treatment on the Liquid Inoculum sample from Pineapple fruit with a sample code (IN) of 1.52 cm, while the smallest treatment with a layer thickness is IP treatment with a liquid inoculum source from the market. The thickness of the Nata de Coco layer of the natural inoculum of ripe pineapple fruit shows the effectiveness *of Azetobacter xylinum* in synthesizing nutrients in the coconut water substrate and additional ingredients in the form of other nutrients such as granulated sugar (sucrose) as a carbon source. The thickening of the cellulose layer on the resulting Nata de Coco products proves that the work of *Acetobacter xylinum* microbes can be effective and work well in forming Nata de Coco pellicles.

Acetobacter xylinum *bacteria* which are very effective in synthesizing coconut water into Nata de Coco pellicle , have high economic value, because it can be used in several productions, including vinegar products, namely by converting ethanol in wine into acetic acid. According to the classification of Bergeys, bacteria from the genus *Acetobacter* have characteristics including: ellipsoid to rod-shaped, straight or slightly bent, measuring 0.6 – 0.8 um x 1.0 -0.4 um, optimum growth temperature 25 – 30 ^{o}C, optimum growth pH 5.4 – 6.3, true aerobes and chemoorganotrophs (Madigan, 2005).

A. Xylinum belongs to acetic acid bacteria, these bacteria can oxidize acetic acid into CO_2 and H2O, does not use ammonium salts as the only source of nitrogen . *A. xylinum* can produce capsules excessively so that it is used in the manufacture of cellulose nata. Nata is an extracellular cellulose produced from the activity of *Acetobacter xylinum* bacteria in the fermentation process, and is one of the health foods/functional food products rich in fiber, (Anam, 2019., Putri, et al., 2021, and Mandey, 2018).

b. Water Content

The results of testing the moisture content of Nata de Coco products using sources liquid inoculum from natural ingredients of pineapple fruit and inoculum sources on the market, can be seen in Figure 5 .

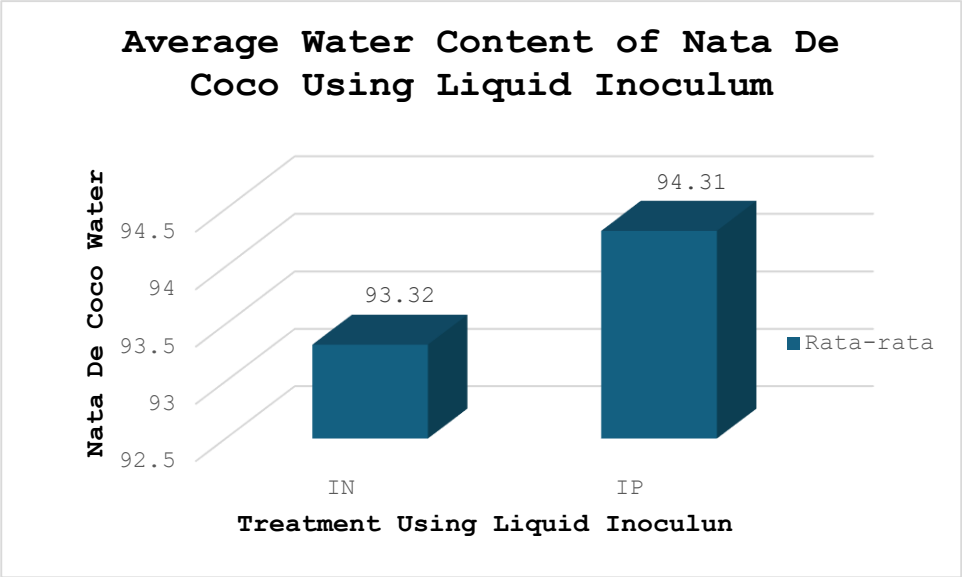

Figure 5 . Graph of Moisture Content Test Results of Nata de Coco Products with using Liquid Inoculum Source

In Figure 5, It can be seen that the results of the moisture content test of Nata de Coco products produced at various different inoculum time treatments, give almost the same percentage of water content results. However, the IP treatment (liquid inoculum treatment on the market) shows a higher water content than other treatments such as treatment with the IN code (treatment with the addition of inoculum obtained from pineapple fruit. The high water content of Nata de Coco products produced in accordance with the results of Ramdani's research (2008) amounted to 98.47%. The moisture content parameters of Nata de Coco can affect the quality of Nata de Coco by affecting the texture of the Nata de Coco product.

c. Fiber Content

Data on Nata de Coco fiber content in each liquid inoculum source treatment in this study, can be seen in Figure 6 .

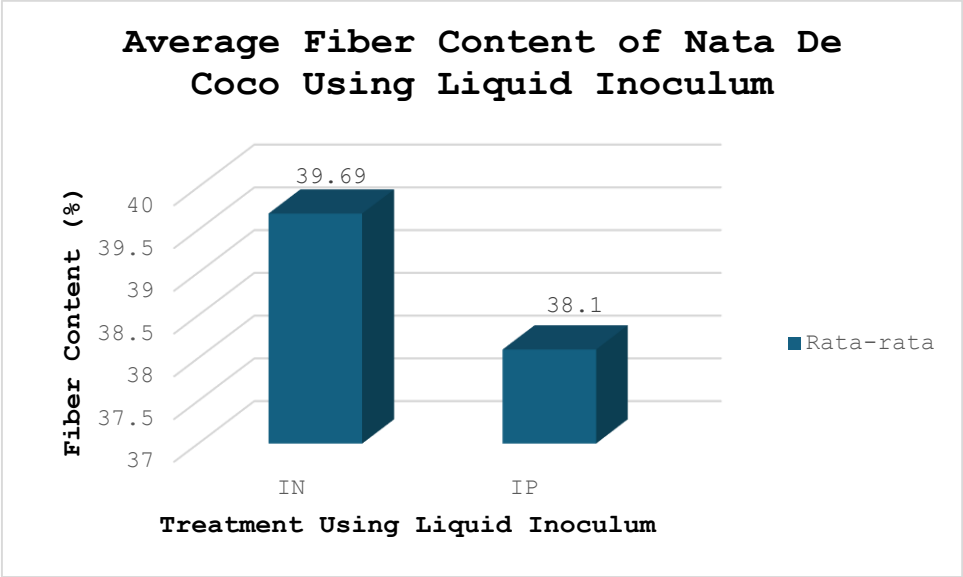

Figure 6. Graph of Fiber Content Test Results of Nata de Coco Products using Source of Liquid Inoculum

Figure 6, shows the highest percentage of fiber content of 39.69% in the IN treatment (treatment of liquid inoculum source from pineapple fruit). While the treatment of liquid inoculum sources on the market is 38.10%. This natural inoculum source of pineapple fruit shows the level of effectiveness of Acetobacter xylinum in *synthesizing organic compounds that become substrates for the microbial life* of Acetobacter xylinum *to form pellicle nata in the form of fiber faster process.*

e. Colour

Nata de Coco color parameters produced at each treatment using liquid inoculum, can be seen in Table 2.

Table 2 . Color Testing Results of Nata de Coco Products using liquid inoculum

Sample Code	Milky White Yellowish White
IN	v
IP	v

In Table 2 , it can be seen that, Nata de Coco products are milky white and white Yellowish. The milky white color is obtained by Nata de Coco products which are partially producedLarge white in color. Nata colors can be improved by speeding up time fermentation, because the fermentation time is getting longer, the color of nata becomes more
Yellowish.

4. CONCLUSION AND ADVICE

Conclusion

The results of research on the development model of Nata de Coco product quality as a source of dietary fiber and its business opportunities can be concluded as follows:

(1) Coconut water waste wasted from the coconut industry and *home industry* in the North Minahasa Regency area of North Sulawesi from ripe coconuts, can be utilized by *Acetobacter xylinum* bacteria in producing Nata de Coco pellicles.

(2) IN treatment (Natural *liquid inoculum of Acetobacter xylinum* from fruit pineapple) gives the best treatment results from several parameters the quality of Nata de Coco produced such as: Thickness parameter Layer, Water Content, Fiber Content, and Color, rather than IP treatment (Inoculum liquid *Acetobacter xylinum* on the market).

2. Advice

Coconut water waste that is wasted in coconut areas widely in the North Sulawesi Province, it is recommended that it can be used as raw material for the manufacture of Nata de Coco products. Likewise, the source of liquid inoculum *Acetobacter xylinum* from natural ingredients of ripe pineapple fruit can be used as a starter to form the best Nata de Coco pellicle.

Conflict of Interest:

The author states there is no conflict of interest

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