Bioscientist: Jurnal Ilmiah Biologi
https://e-journal.undikma.ac.id/index.php/bioscientist

June 2025 Vol. 13, No. 2
e-ISSN: 2654-4571
pp. 929-938

Analysis of Fiber Content, Reduced Sugar and Organoleptic Quality of Nata De Avocado on The Concentration Variations of Lime Juice and Mung Bean Extract

[1]Ibnu Zulfan Fikriansyah, [2*]Titik Suryani,
[1,2]Departement of Biology Education, Faculty of Teacher and Education, Muhammadiyah University of Surakarta, Kartasura, Indonesia
**Corresponding Author e-mail: ts169@ums.ac.id*
Received: March 2025; Revised: April 2025; Accepted: May 2025; Published: June 2025

Abstract: The purpose of this study was to determine the content of fiber, reducing sugar and organoleptic quality of nata de avocado on the concentration variations of lime juice and mung bean extract. This research method was an experiment with Completely Randomized Design (CRD), two factors. The first factor was lime juice 2.4% of the medium volume (6ml/250ml)/J1 and lime juice 2.8% of the medium volume (7ml/250 ml)/J2. The second factor was mung bean extract 20% of the medium volume (50ml/250 ml)/H1 and mung bean extract, 25% of the medium volume (62.5ml/250 ml)/H2 and nata de coco as a control. Organoleptic quality testing included color, texture, aroma, and acceptability carried out 25 respondents. The results showed the best content of fiber, reducing sugar and organoleptic quality of nata de avocado were 4.45%, 13.425%, white in color, chewy texture, non-sour aroma and quite likes in J2H1 treatment (2.8% of lime juice + 20% of mung bean extract).
Keywords: Nata de avocado; fiber; reducing sugar; organoleptic quality; lime juice and mung beans

How to Cite: Fikriansyah, I., & Suryani, T. (2025). Analysis of Fiber Content, Reduced Sugar and Organoleptic Quality of Nata De Avocado on The Concentration Variations of Lime Juice and Mung Bean Extract. *Bioscientist : Jurnal Ilmiah Biologi, 13*(2), 929-938. doi:https://doi.org/10.33394/bioscientist.v13i2.15793

https://doi.org/10.33394/bioscientist.v13i2.15793

INTRODUCTION

Nata is type of functional food containing fiber, as source of probiotics and is beneficial for digestive health. The fermentation process of nata with the starter bacteria of *Acetobacter xylinum* produces lactic acid as metabolite from the breakdown of glucose (Wahyuni & Jumiati, 2019) turning into cellulose (Alfarisy & Rahmadhia, 2022). Nata de coco was using coconut water as substrate (Farida et al., 2021) and the raw materials as nata substrate include coconut water (Rodiah et al., 2021), watermelon(Muzafri & Syukron, 2022), pineapple peel (Putri et al., 2022), and leri water(Maryam, 2020). One of the raw materials as nata substrate is avocado fruit.

Avocado (*Persea americana*) fruit contains 84.3 grams of water, 85 calories of energy, 0.9 g of protein, 6.5 g of fat, 7.7 g of carbohydrates, and 0.6 g of ash, the minerals calcium (10 mg), phosphorus (20 mg), iron (0.9 mg), sodium (2 mg), potassium (278 mg), copper (0.20 mg), and zinc (0.4 mg) (Hartati et al., 2022). Avocado also contains beta-carotene (189 mcg), total carotene (180 mcg), thiamine (Vitamin B1) 0.05 mg, riboflavin (Vitamin B2) 0.08 mg, niacin 1.0 mg, and vitamin C 13 mg / 100 grams.(Hartati et al., 2022). The carbohydrate content of avocado fruit is 7.7 g which has the potential to be nata substrate. The novelty of this study was using avocado fruit as nata substrate, whereas previous studies used coconut water, watermelon peel, and pineapple peel, also cassava peel as substrates.

Lime (*Citrus aurantifolia*) contains 7-8% citric acid to be used as pH regulator for fermentation media.(Purwaningsih, 2016). Lime contains 27 mg of vitamin C, 40 mg of calcium, 22 mg of phosphorus, 12.4 g of carbohydrates, 0.04 mg of vitamin B, 0.6 mg of iron, 0.1 g of fat, 37g of calories, 0.08g of protein, 86g of water/100g (Yulianto et al., 2022). Lime is used as an acidity regulator or pH regulator for nata fermentation medium. The low pH (acid) of lime can help *Acetobacter xylinum* of the nata fermentation process.

Mung beans are source of nutrition containing 22% protein (Rumenser et al., 2021) and research results (Sari et al., 2020) Mung beans contain 323 calories, 22.9g protein, 7.5 mg iron, 1-1.2% fat/100g and Vitamin B1. The research results Ratnasari et al. (2021) the potential of mung beans as an alternative food for degenerative diseases and is useful for increasing immunity, facilitating the digestive system, reducing the risk of diabetes and as source of vegetable protein and contributing to increasing the nutritional value of nata. The results study (Hidayat, 2020) showed that 25% of mung beans produce nata fiber content of 4.08%, so mung beans were source of nutrition (protein) in nata (functional food) good for digestion.

The carbon source is needed to help the bacterial metabolism process of the nata fermentation process. Granulated sugar contains sucrose and essential components of the nata fermentation process. Sucrose acts as the main carbon source for *Acetobacter xylinum* bacteria, converting it into cellulose of the fermentation process. The research results (Yanti, 2017) mentions granulated sugar as nutrient and energy for bacteria in the nata fermentation process. The concentration of granulated sugar in the fermentation medium directly affects the quality and quantity of nata yields. According to research (Putri, 2018) said the increase of granulated sugar concentration is directly proportional to the increase in the crude fiber content of purple sweet potato nata, where the higher sugar concentration produces the higher crude fiber content of nata as well. This study was aimed to determine the fiber content, reducing sugar and organoleptic quality of nata de avocado on the concentration variations of lime juice and mung bean extract.

METHOD

This research was conducted in September 2024 – March 2025 at the Industrial Microbiology Laboratory, Faculty of Teacher Training and Education, Muhammadiyah University of Surakarta, The contents of fiber and reducing sugar tests were conducted at the Nutrition Laboratory, Faculty of Health Sciences, Muhammadiyah University of Surakarta, and organoleptic quality tests were conducted on the campus environments of Muhammadiyah University of Surakarta.

The tools used in this study were 50 ml measuring cup, 500 ml beaker, thermometer, glass stirrer, pan, pH stick, digital scales, plastic, mask, gloves, scissors, spoon, basin, cloth, sieve, blender, stove, cutting board, knife, rubber, jar, plastic box, caliper, test tube, tissue, rubber band, label paper. Materials used, avocado fruits, granulated sugar, lime, *Acetobacter xylinum* bacterial starter, mung beans, umbrella paper, mineral water, distilled water, 70% alcohol.

This research method was an experiment with Completely Randomized Design (CRD), factorial pattern with 2 factors and 3 replications. The first factor was lime juice 2.4% of the medium volume (6ml/250ml)/J1 and lime juice 2.8% of the medium volume (7ml/250 ml)/J2. The second factor was mung bean extract 20% of the medium volume (50ml/250 ml)/H1 and mung bean extract, 25% of the medium volume (62.5ml/250 ml)/H2

The equipment used in this study, including 500 ml plastic containers, chopping board, knife, measuring cup, beaker, wooden stirrer, and basin, was sterilized using an autoclave. The fermentation substrate was prepared by blending 100 grams of avocado fruit with 600 ml of water, then straining the mixture and placing the extract into a 500 ml plastic container. For nata de avocado production, 250 ml of avocado extract and 25 g of granulated sugar were used per treatment, with treatment variations as follows: J1H1 (2.4% lime juice + 20% mung bean extract), J1H2 (2.4% lime juice + 25% mung bean extract), J2H1 (2.8% lime juice + 20% mung bean extract), and J2H2 (2.8% lime juice + 25% mung bean extract). The mixtures were pasteurized at 60°C for 15 minutes, then allowed to cool until warm. Lime juice was added according to each treatment to adjust the pH to approximately 4, creating an acidic environment. The prepared media was poured into sterilized 500 ml plastic containers, followed by the addition of 30 ml of *Acetobacter xylinum* starter culture per treatment. The mixture was gently shaken to ensure homogeneity, then covered with umbrella paper secured with rubber bands, and incubated in a sterile room at room temperature on a level surface. Fermentation was conducted for 14 days, and pH measurements were taken before fermentation using pH sticks. After fermentation, washed the nata de avocado thoroughly with running water, cut into small pieces, soaked for 2 days (changed the water every 24 hours), then washed again, then boiled to remove the sour smell.

Fiber testing was carried out using the gravimetric method. Weighed 1 g of nata (A), put it in an Erlenmeyer flask, added 1.25% H2SO4, then heated with a hot plate for 1 hour. Next, 3.25% NaOH was added and reheated for 1 hour, then filtered (filter paper with a known empty weight (B). The filter paper was cleaned with 1.25% H2SO4 3 times, put in an oven at 105°C for 10 hours, cooled in a desiccator, then weighed (C). The filter paper and sediment were weighed, put in a petri dish with a known empty weight (D) and put in an oven at 600°C for 5 hours, cooled in a desiccator, and weighed after reaching room temperature (E). The fiber content was calculated using the formula (Hidayat, 2020):

$$\frac{(C-D)(E-B)}{A} X\ 100\%$$

Information:
A = Sample weight (g)
B = Weight of empty filter paper (g)
C = Weight of filter paper + sediment (g)
D = Weight of empty glass (g)
E = Weight of cup + ash (g)

Testing the reducing sugar content of nata de avocado using the Nelson-Somogyi method. 4 gram nata sample was added with 20 ml of 15% potassium iodide (KI) with a pipette then titrated with thiosulfate solution. Next, 1% starch indicator was added, make sure the indicator drops do not turn dark blue, the first titration volume (V1) was recorded. Next, a test blank was made by replacing 25 ml with distilled water (L2) and the same procedure was repeated. After that, the titration volume of the test blank obtained (V2) was recorded. Finally, the reducing sugar content was calculated before the inversion process using the following formula (Sari, 2019):

$$\frac{AT = (V2 - V1) X\ 0{,}1\% = (AT\ X\ FP)}{W\ (100\%)}$$

Information:
AT = Table Number
V1 = Titration Volume of Sample 1
V2 = Titration Volume of Sample 2
FP = Dilution Factor
W = Sample Weight

Organoleptic quality tests of nata de avocado included color, aroma, texture and acceptability by 25 panelists. Thickness test of nata de avocado done by using a vernier caliper and dividing the average as the result of the thickness of the nata de avocado. Yield test by measuring the total volume of nata de avocado media with a measuring cup (ml), measure the mass of nata de avocado divided by the volume of the media before fermentation (%):

$$\text{Result} = \frac{massa\ nata\ (gram)}{volume\ media\ (ml)} x\ 100$$

Analysis of fiber and reducing sugar content of nata de avocado used quantitative descriptive method (Kruskal-Wallistest), while organoleptic quality, thickness and yield of nata de avocado used qualitative descriptive method (Microsoft Excel).

RESULTS AND DISCUSSION

Fiber Content

The highest fiber content of nata de avocado was 4.76% in the J1H2 treatment (2.4% lime juice + 25% mung bean extract) compared to the fiber content of commercial nata/control (nata de coco) which was 3.265%, while the lowest fiber content of nata de avocado was 4.45% in the J2H1 treatment (2.8% lime juice + 20% mung bean extract). The high fiber content of nata de avocado was due to the high fiber content of green beans. According to (Insania et al., 2024) every 100 g of dried green beans contains 7.5g of dietary fiber. According to Hidayat (2020) said the provision of sufficient green bean extract (25%) produced the high levels of nata de kersen fiber, this was if the nutritional needs of the bacteria were also sufficient. The substrate factor of nata can affect the fiber produced by nata de avocado. The avocado substrate contains carbohydrates7.7 g (Hartati et al., 2022), this can affect the high and low fiber content produced.

The high addition of granulated sugar also had an effect on the high fiber content of nata. The granulated sugar contains sucrose actings as the main carbon source for the *Acetobacter xylinum* bacteria was converted into cellulose during the fermentation process. The high fiber content of nata de avocado can be influenced by the fermentation duration. Nata can be formed with the fermentation duration of 7-10 days, if the formation of nata was longer then the fiber content of nata would increase. According to research results Ummiyati et al. (2024) the fermentation duration had significant effect on the crude fiber content of nata de ocha, the fermentation duration of 14 days and 15% sugar produced crude fiber content of nata de ocha of 1.353%. In addition, the source of nitrogen in the fermentation medium also affected the formation of nata fiber, the higher the nitrogen content, the higher the nata fiber content produced (Putri, 2021).

Table 1. The Fiber content, reducing sugar, thickness, nata de avocado yield

Treatment	Fiber Content (%)	Reducing Sugar Content (%)	Thickness (cm)	Yield (%)
J1H1	4.61	14,015	0.9*	18.55
J1H2	4.76**	14,625**	1.1	18.50
J2H1	4.45*	13,425*	3.2**	16.06*
J2H2	4.54	14,250	1.1	29.63**

Information:

J1H1 : lime juice 2.4% + mung bean extract 20%

J1H2 : lime juice 2.4% + mung bean extract 25%

J2H1 : lime juice 2.8% + mung bean extract 20%
J2H2 : lime juice 2.8% + mung bean extract 25%
** Level highest fiber and reducing sugar
* Level lowest fiber and reducing sugar

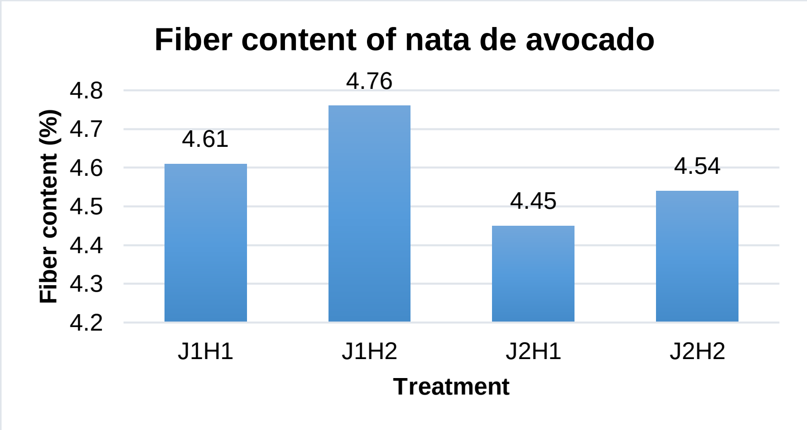

Figure 1. Fiber content of nata de avocado

The results of the Kruskal-Wallis non-parametric statistical test showed that the difference in fiber content of nata de avocado between treatments was not statistically significant (p> 0.05), (Asymp. sig) was 0.111> 0.05, so H0 was accepted, this means that the concentration of lime and green bean extract did not have significant difference in the fiber content of nata de avocado. The best fiber quality of nata de avocado was 4.45%. in treatment J2H1 (2.8% lime juice + 20% green beans). This was in accordance with the SNI standard, fiber content of 4.5% (SNI 01-4317-1996).

Reducing Sugar Content

The reducing sugar content of nata de avocado increased significantly in all treatments when compared to the reducing sugar content of commercial nata/control (nata de coco.) which was 1.845%. The highest reducing sugar content of nata de avocado was 14.625% in treatment J1H2 (2.4% lime juice + 25% mung bean extract), while the lowest reducing sugar content was nata de avocado 13.425% in the J2H1 treatment (2.8% lime juice + 20% mung bean extract). The high reducing sugar content of nata de avocado can be caused by granulated sugar containing 5.4g of water, 394 calories of energy, 94g of carbohydrates/100g(Permata & Wijaya, 2023).The increase in the reducing sugar levels of nata de avocado in all treatments showed that the enzymatic activity of microorganisms during fermentation was able to break down complex sugars into simple sugars (reducing sugars), and most of them were used as substrates by *Acetobacter xylinum* in nata yield. The study Hidayat & Yunita (2022), the substrate material of rice washing water and the addition of granulated sugar showed reducing sugar content of nata de leri of 0.01047 mg/ml and protein content of 0.1539 mg/ml. The high reducing sugar indicated the success of the hydrolysis process from complex carbohydrates to simple sugars, as the main source of nutrition for *Acetobacter xylinum*. The presence of lime juice containing citric acid as pH regulator of the media,so that the optimal conditions for the activity of *Acetobacter xylinum* bacteria in the nata fermentation process. *Acetobacter xylinum* can be active of the pH range of 3-6, but the ideal acidity level for optimal growth was at pH 4(Nining, 2019).

The levels of reducing sugar between treatments showed the clear difference descriptively, the Kruskal-Wallis non-parametric statistical test showed that the difference was not statistically significant ($p > 0.05$). The output result (Asymp. sig) 0.078 > 0.05, then H0 was accepted, meaning that the concentration of lime and green bean extract did not have significant difference in the reducing sugar levels.of nata de avocado.

Thickness of nata de avocado

The highest thickness of nata de avocado was 3.2 cm in treatment J2H1 (2.8% lime juice + 20% mung bean extract), while the lowest thickness of nata de avocado was 0.9 cm in treatment J1H1. This showed that the maximum thickness of nata de avocado was in the treatment of J2H1, this showed that the concentration of lime and green bean extract affected the thickness of nata de avocado.

The thickness of nata was influenced by the availability of nutrients, especially nitrogen sources supporting the growth of *Acetobacter xylinum* bacteria in synthesizing cellulose. The thickness of nata de avocado is 3.2 cm in the treatment of J2H1 (lime juice 2.8% + mung bean extract 20%). The concentration of 2.8% lime and 20% mung bean extract was able to produce optimal nata de avocado thickness. However, the concentration of 25% mung bean extract in the J2H2 treatment (2.8% lime juice + 25% mung bean extract) did not contribute to a significant increaseof nata de avocado thickness. This may be due to an imbalance of nutrients or less than optimal fermentation process at that concentration. According to the research results of Romadhoni (2023) the optimal starter concentration of 30% can significantly increase the thickness of nata. The other ingredients such as sugar were the main carbon sources of *Acetobacter xylinum* in producing cellulose. The sugar concentration and the nitrogen source (mung bean) can increase the thickness of nata de avocado**.** This was in line with research of Manurung et al. (2024) 7.5% sugar concentration can increase the thickness of nata 6.6 mm - 8.2 mm. The source of green bean nitrogen affected the thickness of nata de kersen. The higher the thickness of nata at the concentration of mung bean extract was getting smaller and the thickness of nata de kersen was getting lower at the addition of more mung bean extract concentration (Hidayat, 2020).

Avocado Nata Yield

The highest yield of nata de avocado was 29.63% in the J2H2 treatment (2.8% lime juice + 25% mung bean extract), while the lowest yield of nata de avocado was 16.06% in the J2H2 treatment. J2H1 (lime juice 2.8% + mung bean extract 20%). This showed that the nitrogen source of mung bean extract affected the nata yield. The combination of lime juice and mung bean extract concentrations affected the nata yield. The nata yield was influenced by the availability of nutrients (nitrogen sources) supporting the growth of *Acetobacter xylinum* bacteria of the synthesizing cellulose. The mung beans as source of essential nitrogen and contain protein for the growth and activity of bacteria and contribute to the nata yield. The synergy of optimal pH and the availability of nitrogen sources sufficiently supported the metabolism of *Acetobacter xylinum* in the formation of nata. The results of research by Hastuti et al. (2017)showed that mung bean sprout extract as a nitrogen source significantly increased the yield of nata de lerry and lime juice as pH regulator (acid) could lower the pH of the fermentation media, thus affecting the enzymatic activity of bacteria and accelerating the cellulose formation process. The research results of Iryandi et al. (2014) that supplementation of lime juice in the fermentation process could increase the nata de soya yield of 44.30%. The combination between the organic nitrogen sources and pH regulators of the fermentation media can increase the nata yield. This was in line with research by Fitri et al. (2022) that the balance of nutrients (nitrogen sources) and pH regulation greatly determined the success of the fermentation process and nata yield.

Organoleptic Quality of Nata de avocado

The organoleptic quality of nata de avocado (color, texture, aroma, and acceptability) was as follows:

Table 2. The Organoleptic quality results of nata de avocado

Treatment	Assessment aspects			
	Color	**Texture**	**Aroma**	**Acceptance**
J1H1	White	Springy	Quite Sour	Quite Like
J1H2	Cloudy White	Springy	Quite Sour	Quite Like
J2H1	White	Springy	Quite Sour	Quite Like
J2H2	White	Springy	Quite Sour	Quite Like

Information:
J1H1 : lime juice 2.4% + mung bean extract 20%
J1H2 : lime juice 2.4% + mung bean extract 25%
J2H1 : lime juice 2.8% + mung bean extract 20%
J2H2 : lime juice 2.8% + mung bean extract 25%

The color of nata de avocado was cloudy white in treatment J1H2 (2.4% lime juice + 25% mung bean extract), and the color was white in treatment J1H1 (2.4% lime juice + 20% mung bean extract), J2H1 (2.8% lime juice + 20% mung bean extract), and J2H2 (2.8% lime juice + 25% mung bean extract), while the color of commercial nata/control was transparent white, however the cloudy white color of nata de avocado in J1H2 may be caused by the higher concentration of green bean extract. The difference color of nata de avocado can be caused by the addition of green bean extract, containing the natural chlorophyll pigments, so it affects the clarity of the nata color. In line with the results study of Fitri et al. (2022) the addition of mung bean sprouts as nitrogen source of nata de coco produces cloudy white nata color. This supports that the use of plant materials such as mung beans can affect the color of the nata yields.

Texture of nata de *avocado nata* was chewy in all the treatments, this showed that the addition of green bean extract did not affect the formation of the desired gel structure. The chewy texture was the good characteristic of nata quality. The texture of nata can be caused by the fiber content of green bean nutrition, resulting in an increase of fiber levels. The results study of Fitri et al. (2022) showed that the addition of mung bean sprout extract can produce the very chewy nata texture. The chewy texture showed that the *Acetobacter xylinum* bacteria were in an optimal fermentation process, so that they can form optimal cellulose. This showed that mung bean extract as source of nutrition causing the growth of *Acetobacter xylinum* bacteria to be maximized, resulting in the chewy nata texture.

The aroma of nata de avocado wass quite sour in all the treatments, this was the typical characteristic of nata. This sour aroma was produced from bacterial activity during fermentation producing oganic acids. The addition of green bean extract did not provide significant changes to the aroma of nata de avocado, this showed that this green bean extract had no effect on the aroma of nata de avocado. According to Hidayat (2020) the sour aroma of nata can be caused by not boiling it for long enough, so that the sour aroma of nata had not completely disappeared.

Acceptability of nata de avocado was quite like in all the treatments, while the acceptability of commercial nata/control (nata de coco) was liked. The acceptability of nata de avocado in all treatments was quite like compared to the control nata, but the acceptability of nata de avocado was acceptable to the panelists.

CONCLUSION

Based on the results, it can be concluded that the fiber content, reducing sugar and organoleptic quality of the best nata de avocado were 4.45% and 13.4%, white color, chewy texture, quite sour aroma and quite liked at the J2H1 treatment (2.8% lime juice + 20% mung bean extract).

RECOMMENDATION

Further research is recommended to compare various types of nutrient sources and pH adjusters to assess their effects on the fiber content and organoleptic characteristics of nata de avocado. This study aims to determine the most effective ingredient combination for producing the best quality product.

ACKNOWLEDGMENTS

The author would like to express gratitude to all those who have provided support, guidance, and assistance in the completion of this research.

REFERENCES

Alfarisy, M., & Rahmadhia, S. N. (2022). An Analysis of the Causes of Damage to Nata de Coco in the Fermentation Process. *Journal of Agri-Food Science and Technology*, *2*(1), 96–103. https://doi.org/10.12928/jafost.v2i1.4861

Farida, A., Rahmawati, R., Asnawi, H. S., & Saputra, A. A. (2021). Pemberdayaan Pembuatan Nata Decoco Bahan Limbah Air Kelapa Pada Fatayat Nu Metro. *Jurnal Pengabdian Masyarakat Khatulistiwa*, *4*(1), 41–51. https://doi.org/10.31932/jpmk.v4i1.1082

Fitri, A. I., Annisa, A., Amini, D. S., Rahma, D., & Advinda, L. (2022). Pembuatan nata de coco dengan penambahan kecambah kacang hijau (vignaradiata) sebagai sumber nitrogen. *Prosiding SEMNAS BIO*, *C*, 243–249.

Hartati, S., Yunus, A., Yuniastuti, E., & Pujiasmanto, B. (2022). Diversifikasi Tanaman Pekarangan Dengan Tanaman Alpukat untuk Meningkatkan Gizi Keluarga. *Jurnal SEMAR*, *11*(2), 161–166.

Hastuti, M., Andriyani, M., Wiedyastanto, A., Gisyamadia, D. S., & Margono. (2017). Pemanfaatan Ekstrak Kecambah Kacang Hijau Sebagai Sumber Nitrogen Alternatif Dalam Pembuatan Nata De Lerry. *Prosiding SNST Ke-8*, *m*, 1–5.

Hidayat, U., & Yunita, N. P. (2022). Penentuan Kadar Gula Reduksi dan Kadar Protein secara Spektrofotometri, serta Uji Organoleptik Produk Nata de Leri Hasil Optimalisasi Asam Asetat Glasial. *Jurnal Penelitian Inovatif*, *2*(2), 355–362. https://doi.org/10.54082/jupin.76

Ihsan Hidayat. (2020). Uji Serat dan Organoleptik Nata Buah Kersen Dengan Variasi Konsentrasi Ekstrak Jeruk dan Ekstrak Kacang Hijau. *Skripsi thesis, Universitas Muhammadiyah Surakarta*

Insania, K., Mulyo, G. P. E., Judiono, J., Rosmana, D., & Fitria, M. (2024). Formulasi Bean Flakes Tepung Kacang Hijau Dan Tepung Kacang Kedelai Sebagai Alternatif Sarapan Tinggi Protein Tinggi Serat. *Jurnal Gizi Dan Dietetik*, *3*(1), 12–20. https://doi.org/10.34011/jgd.v3i1.2181

Iryandi, A. F., Hendrawan, Y., & Komar, N. (2014). Pengaruh Penambahan Air Jeruk Nipis (*Citrus aurantifolia*) dan Lama Fermentasi Terhadap Karakteristik Nata De Soya Effect of Lime Juice (*Citrus aurantifolia*) Addition and Fermented Duration toward the Characteristics of Nata De Soya. *Jurnal Bioproses Komoditas Tropis*, *1*(1), 8–15.

Manurung, H., Naibaho, B., & Simbolon, E. (2024). Pengaruh amonium sulfat dan gula terhadap bobot produksi, ketebalan, kekerasan dan kadar serat nata de coco. *Journal of Agricultural Sciences (AJAS)*, *1*(1), 1–10.

Maryam, A. (2020). Analisis Karakteristik Mutu Nata De Leri Dengan Variasi Konsentrasi Gula Pasir Sebagai Sumber Karbon. *Cross-Border*, *3*(2), 252–260.

Muzafri, A., & Syukron, F. (2022). Analisis mutu dan penerimaan konsumen nata de watermelon dengan beberapa variasi proporsi daging buah dan kulit buah semangka (*Citrullus lanatus*). *Syntax Literate: Jurnal Ilmiah Indonesia*, *7*(4), 4463–4471.

Nining, S. A. (2019). Pengaruh Derajat Keasaman (pH) dan Konsentrasi Bakteri *Acetobacter Xylinum* Terhadap Kualitas Nata De Pina.

Permata, T. W. I., & Wijaya, Y. A. (2023). Pengaruh Penggunaan Jenis Gula yang Berbeda terhadap Hasil Jadi Shortbread. *Jurnal Pendidikan Tambusai*, *7*(3), 24532–24539.

Purwaningsih, I. (2016). Perbandingan Perendaman Asam Sitrat dan Jeruk Nipis Terhadap Penurunan Kadar Kalsium Oksalat Pada Talas. *Jurnal Vokasi Kesehatan*, *2*(1), 89–93.

Putri, A. (2021). Karakteristik Nata De Soya Dari Limbah Cair Tahu dengan Pengaruh Penambahan Ekstrak Jeruk Nipis Dan Gula. *Indonesian Journal of Chemical Analysis*, *04*(02), 47–57. https://journal.uii.ac.id/IJCA

Putri, R. H., Fauziah, N., Aryunita Putri, I., & Fevria, R. (2022). Pembuatan Nata de Pina dari Ekstrak Buah Nanas (*Ananas comosus*). *Prosiding Seminar Nasional Biologi*, *2*(1), 61–68. https://semnas.biologi.fmipa.unp.ac.id/index.php/prosiding/article/view/369

Putri, T. A. (2018). *The Effect of Sugar Concentration on Physicochemical and Organoleptic Properties of Nata de Purple Sweet Potato*. 1–10.

Ratnasari, D., Dewi Rahmawati, Y., Fajarini, H., & Nafisyah, D. (2021). Potensi Kacang Hijau Sebagai Makanan Alternatif Penyakit Degenaratif. *JAMU : Jurnal Abdi Masyarakat UMUS*, *1*(02), 90–96. https://doi.org/10.46772/jamu.v1i02.365

Rodiah, S. A., Putra, A. W., Advinda, L., & Putri, D. H. (2021). Pembuatan Nata Menggunakan Air Kelapa. *Prosiding Seminar Nasional Biologi*, *1*, 748–755.

Romadhoni, N. R. T. (2023). Pengaruh Perbedaan Konsentrasi *Acetobacter Xylinum* Terhadap Kualitas Nata De Banana Skin. *Pasundan Food Technology Journal*, *10*(01), 14–17. https://doi.org/10.23969/pftj.v10i1.6782

Rumenser, D. C., Langi, T. M., & Koapaha, T. (2021). Karakteristik Kimia dan Organoleptik Snack Bar Berbasis Tepung Ampas Kelapa (*Cocos nucifera* L.) dan Tepung Kacang Hijau (*Vigna radiata*). *Sam Ratulangi Journal of Food Research*, *1*(1), 27–34. https://ejournal.unsrat.ac.id/index.php/srjfr/index

Sari, A. M., Melani, V., Novianti, A., Dewanti, L. P., & Sa’pang, M. (2020). Formulasi Dodol Tinggi Energi untuk Ibu Menyusui dari Puree Kacang Hijau (Vigna radiata l), Puree Kacang Kedelai (Glycine max), dan Buah Naga Merah (*Hylocereus polyrhizus*). *Jurnal Pangan Dan Gizi*, *10*(2), 49–60.

Sari, N. (2019). The Use of Glucose Syrup as Product of Selulosa Hidrolyze from the Jackfruit Rags (Artocarpus heterophylus Lamk) as Sweetner on Candies Production from the Coconut Plam (*Cocos Nucifera* L). *Journal of Pharmaceutical And Sciences*, *2*(1), 17–23. https://doi.org/10.36490/journal-jps.com.v2i1.12

Ummiyati, A., Kustyawati, E. M., & Satyajaya, W. (2024). *Kajian Nata De Ocha Sebagai Konsumsi Pangan: Efek Penambahan Gula Dan Lama Fermentasi Terhadap*

Karakteristik Nata De Ocha. *3*(1), 134–148.

Wahyuni, S., & Jumiati, J. (2019). Potensi Acetobacter Xylinum Dalam Pembuatan Nata De Syzygium. *Bio-Lectura*, *6*(2), 195–203. https://doi.org/10.31849/bl.v6i2.3575

Yanti, N. A. (2017). Pengaruh Penambahan Gula Dan Nitrogen Pada Produksi. *Biowallacea*, *4*(1), 540–545.

Yulianto, S., Jamilatun, M., & Pangesti, F. A. (2022). *Analisis Kadar Vitamin C Wedang Jeruk Nipis (Citrus Aurantifolia) Berdasarkan Variasi Suhu Menggunakan Metode Spektrofotometri UV – VIS*. *7*(2), 208–218.