

YOGHURT FORMULATION FROM RED DRAGON FRUIT AND ACTIVITY TEST AGAINST PATHOGENIC BACTERIA

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Abstract: *The dairy product known as yogurt is fermented by lactic acid bacteria. The purpose of this study is to evaluate the properties and antibacterial activity of yogurt at concentrations of 0%, 10%, 20%, and 30% against harmful bacteria, specifically Escherichia coli and Bacillus subtilis. The properties were examined for lactic acid bacteria, viscosity, pH, hedonic value, and organoleptic features. The disk diffusion method was used to test the antibacterial activity. According to the findings of evaluating the yogurt's organoleptic properties, every formula was homogenous, thick, sour-tasting, and pink. The range of the viscosity values is 412 cP to 972 cP. The lactic acid bacteria vary from 6.8×10^9 to 9.0×10^9 , and the pH levels fall between 4.26 and 4.42. In contrast, F3 was the most favored formula in the hedonic test. Following that, the average inhibition zones for the antibacterial activity of yogurt against E. coli bacteria at concentrations of 0%, 10%, 20%, and 30% were 7.5 mm, 9.9 mm, 11.2 mm, and 12.2 mm, respectively. In contrast, the inhibition zone diameters against B. subtilis bacteria were 7.4 mm, 9.8 mm, 13.1 mm, and 14.4 mm. A p-value of less than 0.05 indicated a statistically significant difference in antibacterial activity tests. Red dragon fruit yogurt shows antibacterial action against B. subtilis and E. coli, according to the diameter of the inhibition zone that was obtained.*

Keywords: *yoghurt, red dragon fruit peel, antibacterial activity, E. coli, B. Subtilis*

A. Introduction

One nation that has widely cultivated dragon fruit is Indonesia. Dragon fruit tastes sweet and offers many health benefits. (Sari and others, 2020). However, customers rarely use dragon fruit peel and typically throw it away (Hiola et al., 2024). Based on research, the skin of red dragon fruit contains active compounds such as alkaloids, terpenoids, flavonoids, theanine, niacin, pyridoxine, cobalamin, phenolics, carotene, and phytoalbumin (Sukmawati et al., 2024). Therefore, adding red dragon fruit peel to a product can increase its antibacterial potential and serve as a natural coloring agent, one example being yogurt. Yogurt is a fermented beverage formed by bacteria breaking down the sugar in milk, lactose, into lactic acid (Hidayati et al., 2021). In Indonesia, diarrhea is a common occurrence. Diarrhea is the passing of loose to watery stools with a frequency of three or more times a day. One of the risk factors for diarrhea is poor food sanitation and contamination by microorganisms (Hutasoit, 2020). One example of a microorganism that causes diarrhea is the bacteria Escherichia coli and Bacillus subtilis. Yogurt consumption is an alternate method of treating diarrhea. Escherichia coli is a type of Gram-negative bacteria; this bacteria becomes pathogenic when its numbers increase in the digestive tract or when it is outside the intestines (Hutasoit, 2020). Meanwhile, Bacillus subtilis is a Gram-positive bacterium that can cause gastroenteritis infections characterized by symptoms such as diarrhea (Faristin et al., 2023). Previous research on dragon fruit skin yogurt products has been conducted by Astridwiyanti et al. (2019). The

antibacterial activity of red dragon fruit peel (*Hylocereus polyrhizus* (F.A.C. Weber) Britton & Rose) ethanol extract has an average inhibition zone diameter of 12.5 mm against *Staphylococcus aureus* bacteria. Then, the research results by Siregar & Daniela (2023) showed that the ethyl acetate extract of red dragon fruit peel (*Hylocereus polyrhizus* (F.A.C. Weber) Britton & Rose) had an inhibition zone diameter of up to 17.23 mm against *Escherichia coli* bacteria. Based on these two studies, it can be concluded that red dragon fruit peel extract has potential as an antibacterial agent. Based on the background presented above, the author conducted research on "Testing the Antibacterial Activity of Red Dragon Fruit Skin Sari Yogurt (*Hylocereus polyrhizus* (F.A.C. Weber) Britton & Rose) Against *Escherichia coli* and *Bacillus subtilis* Bacteria."

B. Research Methods

Glassware, scales, micropipettes, hot plates, LAF, autoclaves, incubators, colony counters, Brookfield viscometers, calipers, and pH meters are among the equipment utilized. Water, UHT milk (Greenfields), red dragon fruit peel, yoghurt starter (Lactina), plain yoghurt (Biokul), NaCl, distilled water, spirit, nutrient agar (NA), MRSA (Man Ragosa and Sharpe Agar), MHA (Mueller Hinton Agar), H₂SO₄, BaCl₂, *Escherichia coli*, and *Bacillus subtilis* bacteria are among the ingredients.

The skin of a red dragon fruit (*Hylocereus polyrhizus* (F.A.C. Weber) Britton & Rose) that was purchased from Pekanbaru city's traditional fruit markets served as the sample. The entire skin of the red dragon fruit was red, indicating that it was ripe.

Peeling the red dragon fruit separates the flesh from the skin. The dragon fruit skin should next be thoroughly cleaned once the ends and scales have been taken off. 300 g should be weighed, cut into little pieces, and then added to a blender. Pour in 300 milliliters of mineral water, combine, then strain through food-grade cheesecloth to extract the red dragon fruit skin. (Hiola et al., 2024).

Prepare 50 milliliters (10 percent concentration), 100 milliliters (20 percent concentration), and 150 milliliters (30 percent concentration) of extract from dragon fruit peel. After placing each concentration in a separate glass container, mix it with the UHT milk until it is uniform. The three UHT milk and dragon fruit peel extract combinations should then be pasteurized. Pasteurize the milk at 80°C for 15 minutes. To avoid contamination, place it into containers after pasteurization and cover with aluminum foil. Allow it to cool to 43°C. Fill each container with 1.5 grams of yogurt starter and mix until well combined. It was then incubated for 24 hours at 37°C. (Hiola et al., 2024).

Table I. Formulation of Red Dragon Fruit Skin Yogurt Preparation

Composition	Formula			
	F0	F1	F2	F3
Red dragon fruit peel juice	0 mL	50 mL	100 mL	150 mL
Starter Yogurt	1,5 g	1,5 g	1,5 g	1,5 g
Milk UHT	ad 500 mL	ad 500 mL	ad 500 mL	ad 500 mL

C. Results and Discussion

Red dragon fruit peel (*Hylocereus polyrhizus* (F.A.C. Weber) Britton & Rose) yogurt's properties and antibacterial efficacy against *Bacillus subtilis* and *Escherichia coli* germs were examined in this study. Organoleptic, viscosity, pH, and total BAL assays were the characterization tests that were conducted. Using human senses to test a sample is known as

organoleptic testing. Identification of a sample's appearance, color, taste, scent, and texture is the aim of organoleptic testing (Sari et al., 2020). SNI (2981:2009) states that yogurt must have a thick, uniform thickness, a sour, distinctive flavor, and a distinct scent. Table II displays the outcomes of the organoleptic test, and Figure 1 is a yoghurt product.

Table II. Organoleptic Test of Yoghurt

Organoleptic Test	Results			
	F0	F1	F2	F3
Flavor	Typical sourness of yoghurt	Sour with a hint of dragon fruit flavor	The sourness and taste of dragon fruit is stronger	Sour and dominant dragon fruit taste
Color	White	Very pale pink	Pink	Purplish pink
Texture	Thick, Homogeneous	Thick, slightly smooth textured	Thicker, soft texture with a little fiber	The thickest, densest and most fibrous
Smell	Light sourness typical of yoghurt	Light sour with a hint of dragon fruit smell	The smell of dragon fruit blends with the smell of yogurt.	The smell of dragon fruit stands out from the smell of yogurt.

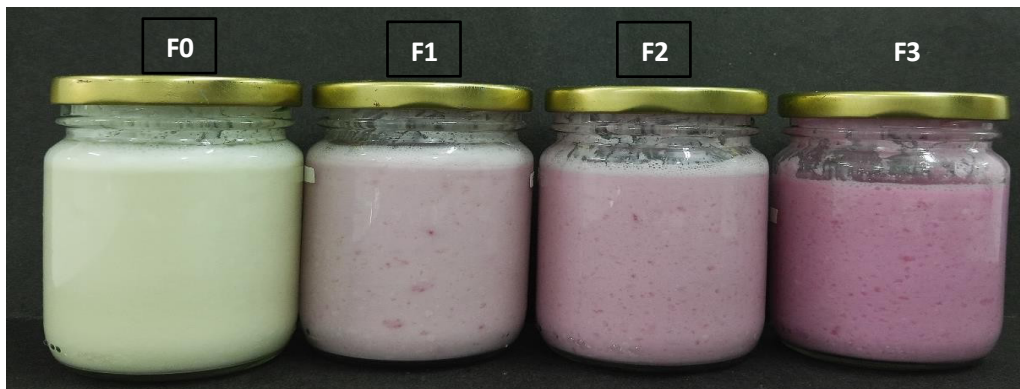


Figure 1. Yoghurt With Various Formulas

A liquid's viscosity can be used to describe its thickness. Viscosity levels have an impact on the density and thickness of yogurt, among other physical characteristics. Since LAB generates the lactase enzyme, its activity has a major impact on yogurt's viscosity (Rohman et al., 2022). A Brookfield viscometer with spindle 2 operating at 60 rpm was used to assess viscosity. Since yogurt has a somewhat high viscosity, spindle 2 was utilized. Table III displays the results of the viscosity test. For every formula, the viscosity of the yogurt decreased when extract from dragon fruit peels was added. Since the final yogurt product's viscosity value is between 400 and 900 cP, it still satisfies the requirements. (Hartono & Hamad, 2023).

Table III. Viscosity Value of Yoghurt

Formula	Results			Average ± SD
	P1	P2	P3	
F0	980,6 cP	964,0 cP	971,4 cP	972 cP±8,316
F1	983,3 cP	945,0 cP	907,0 cP	945,1 cP±38,150
F2	526,8 cP	551,3 cP	603,4 cP	560,5 cP±39,119
F3	400,5 cP	422,0 cP	414,7 cP	412,4 cP±10,932

To evaluate the quality and safety of the yogurt that will be ingested, the pH test seeks to ascertain the acidity level of the yogurt. Lactic acid bacteria viability is correlated with yogurt's pH level. The pH of the resultant yogurt decreases as the vitality of lactic acid bacteria increases. Table IV displays the results of the pH test. The yogurt used in this investigation had pH test readings between 3.80 and 4.50, which satisfied the requirements (SNI, 2009).

Table IV. pH Value of Yoghurt

Formula	Results			Average±SD
	P1	P2	P3	
F0	4,42	4,41	4,43	4,42±0,01
F1	4,31	4,31	4,30	4,30±0,005
F2	4,29	4,28	4,27	4,28±0,01
F3	4,26	4,27	4,26	4,26±0,005

Probiotic bacteria called lactic acid bacteria (LAB) are present in fermented foods and drinks, including kefir, Yakult, and yogurt, and are good for the digestive system (Novia et al., 2022). The plate count method (total plate count) was used to test for total lactic acid bacteria. The total amount of BAL that grew on agar media was calculated to determine the BAL count. MRSA (Man, Rogosa, and Sharpe Agar) was the agar medium utilized in this investigation. Table V displays the results of the complete BAL test. The product's total BAL test results satisfied the SNI (2009) standard, which is a minimum of 1×10^7 CFU/mL and serves as a benchmark for the quality of flavored fermented milk probiotic drinks.

Table V. Total Lactic Acid Bacteria Test of Yogurt

Formula	Dilution	P1	P2	Results
F0	10^{-6}	225	236	$2,3 \times 10^8$
	10^{-7}	210	217	$2,1 \times 10^9$
	10^{-8}	183	174	$1,8 \times 10^{10}$
	Average CFU/mL			$6,8 \times 10^9$
F1	10^{-6}	249	238	$2,4 \times 10^8$
	10^{-7}	230	228	$2,3 \times 10^9$
	10^{-8}	196	184	$1,9 \times 10^{10}$
	Average CFU/mL			$7,2 \times 10^9$
F2	10^{-6}	256	252	$2,5 \times 10^8$
	10^{-7}	239	248	$2,4 \times 10^9$
	10^{-8}	219	223	$2,2 \times 10^{10}$
	Average CFU/mL			$8,2 \times 10^9$
F3	10^{-6}	280	289	$2,9 \times 10^8$
	10^{-7}	250	264	$2,6 \times 10^9$
	10^{-8}	246	232	$2,4 \times 10^{10}$
	Average CFU/mL			$9,0 \times 10^9$

To ascertain the panelists' degree of acceptance of yogurt containing extract from dragon fruit peels, the hedonic test was used in this investigation. The panelists were all female Abdurrah University students, ages 21 to 23. Young age groups are thought to have strong sensitivity when evaluating food products, and they are typically potential consumers of functional processed products like yogurt, so this information was taken into consideration when choosing the panelists. The hedonic test employed four primary criteria: taste, texture, color, and scent. Figures 1-4 show the outcomes of the hedonic test. All things considered, the panelists' favorite formula was Formula F3.

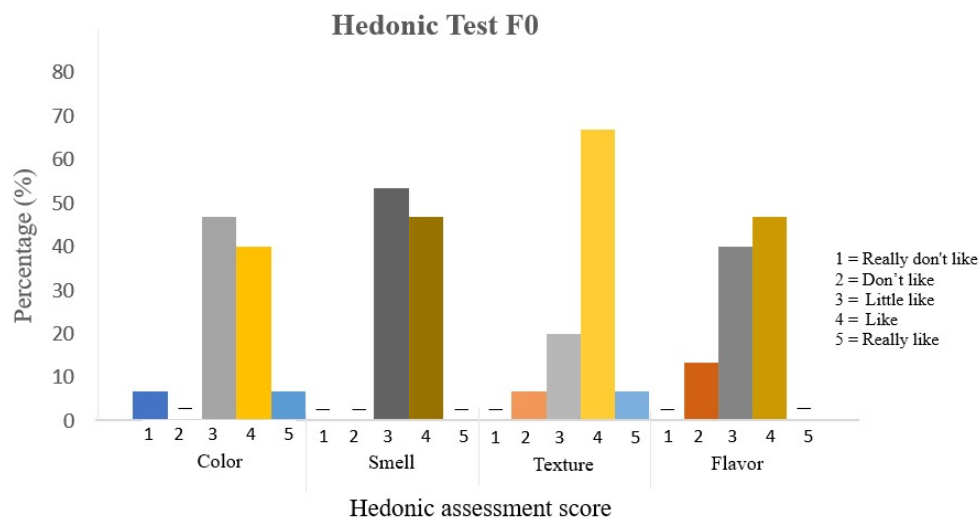


Figure 2. Hedonic Test Results on Dragon Fruit Peels Yoghurt at F0

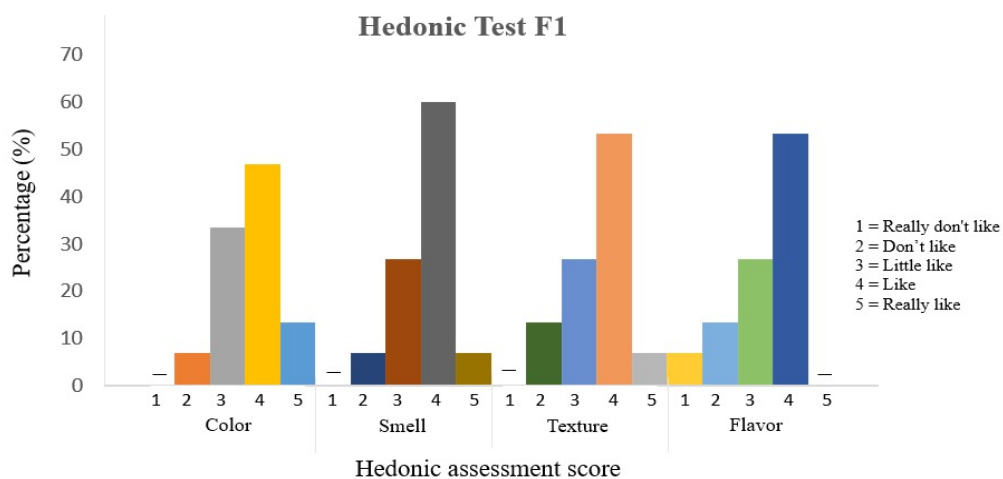


Figure 3. Hedonic Test Results on Dragon Fruit Peels Yoghurt at F1

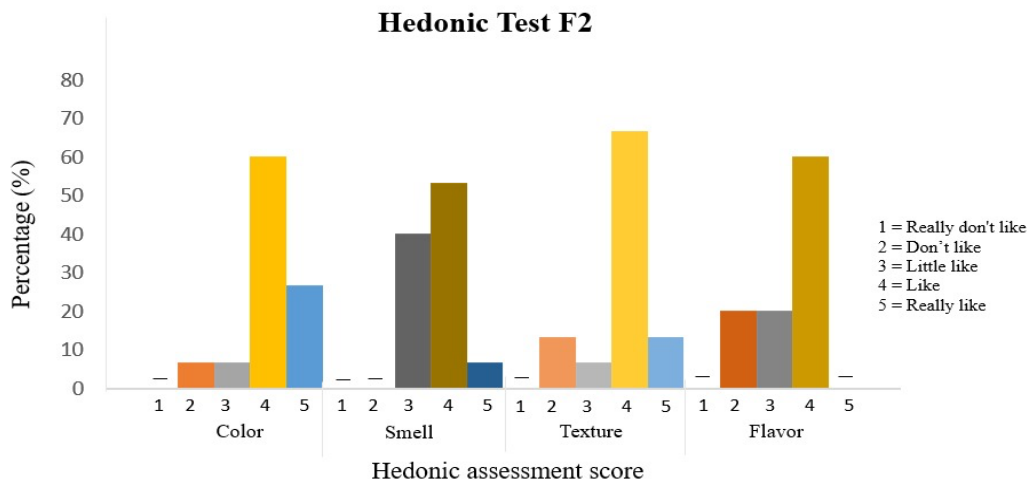


Figure 4. Hedonic Test Results on Dragon Fruit Peels Yoghurt at F2

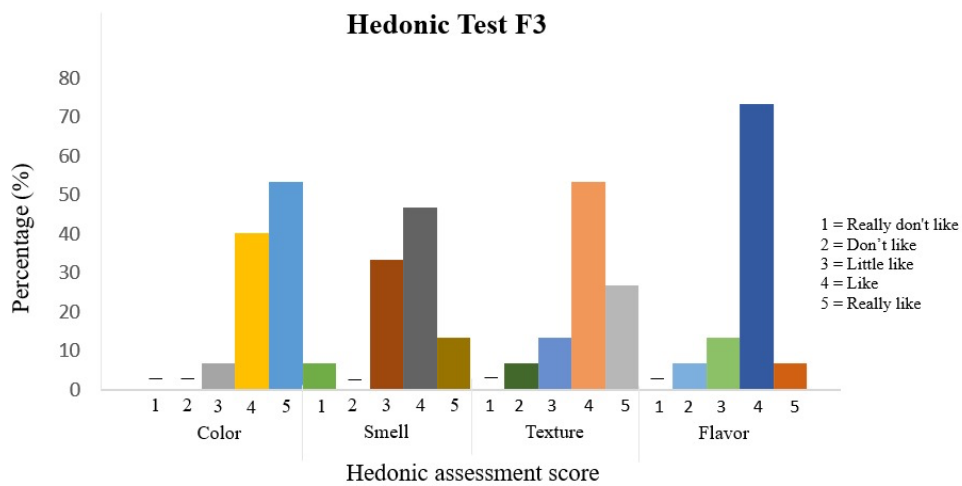


Figure 5. Hedonic Test Results on Dragon Fruit Peels Yoghurt at F3

Red dragon fruit peel yogurt's antibacterial properties against *B. subtilis* and *E. coli* bacteria were then examined. Tables VI and VII display the antimicrobial test findings. Compared to *E. coli*, the inhibition zone value against *B. subtilis* was greater. This suggests that the yogurt extract from the red dragon fruit peel is more successful than *Escherichia coli* at preventing the growth of *Bacillus subtilis* bacteria.

Table VI. Antibacterial Activity Test of Yoghurt Against *E. coli* Bacteria

Formula	Inhibition Zone Diameter (mm)			Average±SD
	P1	P2	P3	
F0	7,4	7,5	7,6	7,5±0,1
F1	9,25	11,55	8,85	9,9±1,457
F2	10,85	12,05	10,55	11,2±0,794
F3	11,1	13,25	12,35	12,2±1,08
Positive control	14,35	16,8	18,35	16,5±2,017

Table VII. Antibacterial Activity Test of Yoghurt Against *B. subtilis* Bacteria

Formula	Inhibition Zone Diameter (mm)			Average±SD
	P1	P2	P3	
F0	7,6	7,3	7,4	7,4±0,153
F1	9,9	9,2	10,15	9,8±0,492
F2	13,9	11,8	13,55	13,1±1,125
F3	14,3	13,7	15,05	14,4±0,676
Positive control	17,3	16,5	16,75	16,9±0,409

SPSS was used to conduct statistical tests based on the information on the zone of inhibition of antibacterial activity mentioned above. The data on antibacterial activity against *Escherichia coli* and *Bacillus subtilis* were already homogeneous and normally distributed, according to the SPSS test findings, which displayed a p-value >0.05. A one-way ANOVA test was then performed, and the results showed a significant value of 0.000 ($p < 0.05$). This suggests that F0, F1, F2, F3, and the positive control have varying inhibitory powers. A significant difference in inhibitory power between the groups is shown by a p-value of less than 0.05.

D. Conclusion

Research on the characterization test of red dragon fruit peel yogurt has led to the conclusion that the organoleptic characteristics, pH, viscosity, and total lactic acid bacteria have satisfied the SNI 2981:2009 quality requirements for yogurt. In contrast, the panelists' favorite formula in the hedonic test was F3. The maximum inhibitory zone diameter for yogurt against *E. coli* bacteria was 12.2 mm at a 30% concentration, but it was 14.4 mm for *B. subtilis* bacteria.

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References

- Astridwiyanti, A. A. B., Mahendra, A. N., & Dewi, N. W. S. (2019). Uji Efektivitas Ekstrak Etanol Kulit Buah Naga Merah (*Hylocereus polyrhizus*) Terhadap *Staphylococcus aureus* ATCC 25923 Secara In Vitro. *Intisari Sains Medis*, 10(3), 482–486. <https://doi.org/10.15562/ism.v10i3.425>

- Faristin, A., Natawaskita, K., & Irawati, A. D. (2023). Uji Aktivitas Antibakteri Ekstrak Etanol 96% Daun Turi (*Sesbania grandiflora* L.) Terhadap Pertumbuhan Bakteri *Bacillus subtilis* dan *Escherichia coli* secara in Vitro. *Mantra Bhakti*, 1(1), 33–40.
- Hartono, M. S. T., & Hamad, A., (2023). Aplikasi Penggunaan Tepung Porang (*Konjac Glucomannan*) Sebagai Stabilizer Yogurt yang Ditambahkan Sari Buah Nanas. *Sainteks*, 20(2), 205-218.
- Hidayati, H., Afifi, Z., Triandini, H. R., Sari, I. P., Ahda, Y., & Fevria, R. (2021). Pembuatan Yogurt Sebagai Minuman Probiotik Untuk Menjaga Kesehatan Usus. *Prosiding SEMNAS BIO*, 1265–1270.
- Hiola, F., Rasdianah, N., Puluhalawa, L. E., & Papatungan, J. U. (2024). Pembuatan Yoghurt dengan Penambahan Kulit Buah Naga Merah (*Hylocereus polyrhizus*) Sebagai Minuman Kesehatan. *Jurnal Farmasi Teknologi Sediaan Dan Kosmetika*, 1(2), 72–81. <https://doi.org/10.70075/jftsk.v1i2.27>
- Hutasoit, D. P. (2020). Pengaruh Sanitasi Makanan dan Kontaminasi Bakteri *Escherichia coli* Terhadap Penyakit Diare. *Jurnal Ilmiah Kesehatan Sandi Husada*, 12(2), 779–786. <https://doi.org/10.35816/jiskh.v12i2.399>
- Mulangsri, D. A. K., Ningrum, R. A., & Imliyah, N. (2022). Antibacterial Activity of N-hexane and Diethyl Ether Fraction of Piper betle L. Leaf Against *Staphylococcus aureus* dan *Escherichia coli* Bacteria. *Indonesian Journal of Chemical Science*, 11(1), 26–32. <https://doi.org/10.15294/ijcs.v11i1.51850>
- Novia, D., Dharmayanti, L., & Khoiriya, R. (2022). Uji Total Bakteri Asam Laktat Pada Minuman Kefir Dengan Kombinasi Sari Buah Jeruk Gerga (*Citrus* Sp). *Journal Pharmacopoeia*, 1(2), 143–154. <https://doi.org/10.33088/jp.v1i2.298>
- Rohman, Z., Hindratinigrum, N., & Zulaikhah, S. R. (2022). Keasaman, pH, Dan Viskositas Yoghurt Buah Naga Merah Dengan Penambahan Beberapa Level Sukrosa Acidity, pH and Viscosity of Red Dragon Fruit Yoghurt with The Addition of Some Levels of Sucrose. *Indonesian Journal of Food Technology*, 1(1), 1–10.
- Sari, A., Okfrianti, Y., & Darwis. (2020). Total Bakteri Asam Laktat (Bal) Dan Uji Daya Terima Organoleptik Pada Yoghurt Sari Buah Naga Merah (*Hylocereus polyrhizus*). *Jurnal Penelitian Terapan Kesehatan*, 7(1), 01– 102.
- Sari, T., Abriliant, P. S., Prasasti, E. W. W., Gunawan, H. R., & Herawati, E. (2024). Uji Organoleptik dan Hedonik Yoghurt dengan Penambahan Sari Nanas Kelud asal Kabupaten Kediri. *Seminar Nasional Sains, Kesehatan, Dan Pembelajaran 4*, 1123–1131.
- Siregar, T. W., & Daniela, C. (2023). Uji Antimikroba Ekstrak Kulit Buah Naga Merah Terhadap Bakteri *Escherichia coli*, *Staphylococcus aureus* Dan *Lactobacillus acidophilus*. *Jurnal Riset Teknologi Pangan Dan Hasil Pertanian (RETIPA)*, 3(2), 78–85.
- Standar Nasional Indonesia (SNI). (2009). SNI Yoghurt. No.01-2981-2009. Pusat Industri Standarisasi Departemen Perindustrian. Jakarta: Republik Indonesia.
- Sukmawati, I., Mulkiya Yulawati, K., & Patricia, V. M. (2024). Pengujian Aktivitas Antibakteri Ekstrak Kulit Buah Naga Merah (*Hylocereus Polyrhizus*) Terhadap *Staphylococcus Aureus*. *Bandung Conference Series: Pharmacy*, 4(1), 105–111. <https://doi.org/10.29313/bcsp.v4i1.12175>