



Determination of Total Flavonoid Content in Local Sakura Leaf Extract or Small Bungur (*Lagerstroemia indica* L.)

***Nur S. Damayanti, Sri H. V. Pulukadang, Sitti Aminah, Baharuddin Hamzah & Reny**

Chemistry Education Study Program/ Faculty of Teacher Training and Education – Tadulako University, Palu – Indonesia 94119

Received 11 June 2025, Revised 15 July 2025, Accepted 29 July 2025

[doi: 10.22487/j24775185.2025.v14.i3.pp151-156](https://doi.org/10.22487/j24775185.2025.v14.i3.pp151-156)

Abstract

The small bungur plant (*Lagerstroemia indica* L.) is one of the plants with potential as a medicinal plant. Almost all parts of this plant can be used, namely the leaves, stems, fruit and roots. Bungur leaves can be used for skin diseases, leaf powder for malaria, and decoction of old leaves for diabetes. Bungur leaves contain chemical compounds, one of which is flavonoids. This study aims to determine the total flavonoid content of extracts from young and old leaves of local cherry blossoms (small bungur), using UV-Vis spectrophotometry. The extraction method used was multistage maceration using three different solvents: hexane (nonpolar), ethyl acetate (semipolar), and methanol (polar). The results showed that the average total flavonoid content of young leaf extracts and old leaves of small bungur, measured by UV-Vis spectrophotometry at a maximum wavelength of 410 nm, was 8.810 mg/100g and 7.301 mg/100g, respectively. Among the three solvents used, extracts of young and old leaves of small bungur using hexane and ethyl acetate do not contain flavonoids, whereas extracts of young and old leaves of small bungur using methanol do.

Keywords: Flavonoids; multistage maceration; small bungur leaves; UV-Vis spectrophotometry

Introduction

Plants used as medicine contain various important compounds that determine their activity; one of these is flavonoids, which are generally found in plant tissues (Amin et al., 2013). Small crape myrtle (*Lagerstroemia indica* L.) is one of the plants with potential medicinal uses. Almost all parts of this plant can be used for medicinal purposes, including the leaves, stems, fruit, and roots (Dalimartha, 2003). According to Rahmah et al. (2021), the crape myrtle plant is mainly used as an ornamental plant because it has attractive flowers, a lush canopy, and is easy to grow. In addition, parts of the plant, including the leaves, can be used to treat skin diseases; leaf powder can be used as a malaria remedy; and a decoction of old leaves can be used as a diabetes remedy. Bungur leaves can help treat stroke by boiling 7 dried leaves in water until boiling, then drinking the decoction (Rahmah et al., 2021). Bungur leaves are also among the plants used as ingredients in traditional herbal remedies and have been widely used for many years as a traditional treatment for diabetes mellitus in Southeast Asia (Yue et al., 2024).

Bungur leaves contain chemical compounds, namely saponins, flavonoids, and tannins (Dalimartha, 2003). Flavonoids are polyphenolic

compounds consisting of 15 carbon atoms arranged in a C6-C3-C6 structure, where the carbon skeleton comprises two C6 groups (substituted benzene rings) connected by a three-carbon aliphatic chain. Flavonoids are found in nearly all parts of plants, including fruits, roots, leaves, and bark. These flavonoids are polar compounds that dissolve well in solvents such as ethanol, methanol, butanol, acetone, dimethylformamide and others (Arifin & Ibrahim, 2018). The isolation or separation of flavonoid compounds is typically carried out using extraction methods.

Extraction is a method of separating a substance based on differences in solubility in two immiscible liquids (Zhang et al., 2023). The extraction method used in this research is multistage maceration. Graded maceration is a method in which the entire compound is extracted from a material, carried out in stages based on the solvent's polarity (Hasan et al., 2023). According to Nisa et al. (2019), the total flavonoid content in young leaves is higher than in old leaves. Flavonoid compounds contained in the leaves will decrease as the leaves age (Wahyuningtias et al., 2024). The flavonoid content was determined using a UV-Vis spectrophotometer at the maximum wavelength; the absorbance peak was measured, and the compound content in the extract was analysed.

*Correspondence:

Nur S. Damayanti

e-mail: sapnadamayanti56@gmail.com

© 2025 the Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Ultraviolet and visible absorption spectra are the most useful single method for identifying flavonoid structures. Flavonoids contain a conjugated aromatic system and can exhibit strong absorption bands in the UV-Vis region (Makuasa & Ningsih, 2020).

Based on the above description, further research is needed on the flavonoid content in young leaves (DM) and old leaves (DT) of local sakura or small bungur (*Lagerstroemia indica* L.) growing in Central Sulawesi using an ultraviolet visible spectrophotometer (UV-Vis). Thus, the author can determine the total flavonoid content in young and old leaves of local sakura or small bungur using a stepwise maceration extraction method and solvents with different polarities, namely hexane, ethyl acetate, and methanol.

Methods

Research design

This study is a laboratory experimental study conducted using young leaves (DM) and old leaves (DT) of local sakura or small bungur (*Lagerstroemia indica* L.) to analyse the total flavonoid content.

Research sample

The samples used in this study were DM and DT of local sakura or small bungur (*Lagerstroemia indica* L.) collected directly from the Untad Lecturer Housing block C1/2, Tondo, Palu, Central Sulawesi.

Place and time of research

The research was conducted from July to September 2024 at the Chemistry Laboratory of the Faculty of Teacher Training and Education, Tadulako University, Palu.

Tools and materials

The tools used were stirring rod, Erlenmeyer glass (Duran), test tube (Iwaki), test tube rack, funnel (Iwaki), blender (Miyako), cuvette, spatula, measuring cup (Iwaki), measuring flask (Iwaki), dropper pipette, measuring pipette (Iwaki), rotary evaporator (Eyela), UV-Vis spectrophotometer (Nanbei), and digital balance (Sonic).

The materials used were young leaves (DM) and old leaves (DT) of local sakura or small bungur (*Lagerstroemia indica* L.), quercetin standard solution, Aluminum Chloride (AlCl₃) 10%, aluminium foil, hexane, ethyl acetate, methanol, distilled water, filter paper, potassium acetate (CH₃COOK) 1 M, magnesium (Mg) metal, concentrated hydrochloric acid (HCl), tissue.

Sample preparation

Samples of local sakura leaves or small bungur collected are then separated into DM and DT, washed with running water until clean, and aerated in a place not exposed to sunlight for 3-4 days. After the sample is dry, it is mashed in a blender until not too smooth, then the sample is ready for extraction (Makuasa & Ningsih, 2020).

Sample extraction

DM and DT samples of mashed small bungur are weighed up to 10 grams, then placed into each 250 mL Erlenmeyer glass. The first maceration of each sample powder was soaked in 100 mL of hexane for 24 hours, then stirred. The sample was then filtered through filter paper, and the filtrate was collected. The residue was macerated again with 100 mL of ethyl acetate solvent for 24 hours, then stirred and filtered, yielding the filtrate and residue. The resulting residue was then macerated again with 100 mL of methanol for 24 hours, stirred, and filtered through filter paper to produce filtrate and residue. The resulting methanol filtrate was then concentrated using a rotary evaporator at 50°C (Istiqomah et al., 2021).

Qualitative analysis (flavonoid test)

All the resulting filtrates were collected to a maximum of 2 ml and then placed into each test tube. After that, magnesium metal and 3 drops of concentrated HCl were added. Positive tests produce orange, pink, or red colored solutions (Fajriah & Megawati, 2015).

Preparation of quercetin solution

A total of 5 mg of quercetin (comparator) was weighed and put into a 50 mL volumetric flask, then a methanol solution was added until the limit mark (100 ppm mother liquor).

Dilution of quercetin solution

Quercetin was diluted from a 100 ppm mother solution to 20 ppm. After that, the solution at 20 ppm was diluted to 2, 4, 6, 8, and 10 ppm.

Quantitative analysis

Determination of the maximum wavelength (λ maks) of quercetin

The maximum wavelength was determined by adding 1 mL of a 6 ppm quercetin solution to 1.5 mL of methanol, then adding 0.1 mL of 10% AlCl₃, 0.1 mL of 1 M Potassium Acetate, and 2.8 mL of distilled water, and allowing it to stand for 30 minutes. After that, readings were taken in the wavelength range of 400-450 nm.

Preparation of the standard curve

A total of 1 mL of each standard solution (quercetin) was pipetted into a test tube, then 1.5 mL of methanol, 0.1 mL of AlCl₃ 10%, 0.1 mL of potassium acetate 1 M, and 2.8 mL of distilled water were added. Then the mixture was shaken and allowed to stand for 30 minutes. The absorbance was measured using a UV-Vis spectrophotometer at the maximum wavelength. A calibration curve was then generated, and the linear equation was obtained.

Determination of flavonoid content

Taking filtrate from each sample using methanol maceration, up to 1 mL, and put into each test tube, and repeating 3 times. Next, 1.5 mL of methanol, 0.1 mL of AlCl₃ 10%, 0.1 mL of

potassium acetate 1 M, and 2.8 mL of distilled water were added to each test tube. After that, the solution mixture was shaken and then allowed to stand for 30 minutes. Then add the solution to each cuvette and measure the absorbance at the previously determined maximum wavelength using a UV-Vis spectrophotometer (Makuasa & Ningsih, 2020).

Data analysis

The data obtained are the absorbance values of the quercetin solution (comparator). A calibration curve is generated, and a linear regression equation is obtained. The total flavonoid content of the sample can be calculated using the equation $F = \frac{c \times V}{m} \times 100$, and the results are expressed in mg.

Description:

F = Total flavonoid content
V = Volume (L)
m = Sample weight (g)
c = Concentration of quercetin (mg/L)
(Chang et al., 2002).

Results and Discussion

Sample preparation

The sample preparation stages for DM and DT small bungur conducted in this study were washing, drying, and grinding. The sample was washed to remove dirt and dust. The drying process lasted 3-4 days until the leaf samples were completely dry, by airing them in a place not exposed to direct sunlight due to the heat sensitivity of flavonoids. Then, the sample grinding process was carried out to reduce particle size, thereby increasing the sample surface area and allowing more particles to be extracted by the solvent (Nugroho, 2017).

Sample extraction

The concentrated extract obtained from the multistage maceration extraction process was calculated for its % yield, as shown in **Table 1**.

Table 1. Yield of Small Bungur Leaf

Sample	Sample Weight (g)	Concentrated Extract (g)	% Yield
DM	10	6.72	67.2%
DT	10	6.79	67.9%

Extraction is the process of separating a soluble substance from its mixture, so that the substance is separated from the insoluble material. The extraction method used in this study was stepwise maceration. Stepwise maceration is a method in which compounds are extracted from a material in stages, based on the solvent's polarity. The multi-stage maceration method was chosen in this case because it produces a purer extract than total maceration, resulting in a higher yield but requiring more solvent (Hasan et al., 2023).

Extraction using multistage maceration involves gradually soaking the simplisia powder in a series of solvents, starting with nonpolar, semipolar, and polar solvents. The solvents used in this study

were hexane, ethyl acetate, and methanol. Through multistage maceration, nonpolar and semipolar compounds are removed with hexane and ethyl acetate, leaving polar compounds, which are then extracted again with a polar solvent, namely methanol (Permadi et al., 2015). According to Dias et al. (2021), flavonoids are generally polar compounds because they have OH groups that form hydrogen bonds. However, some free flavonoids, such as isoflavones, flavones, flavanones, aurones, chalcones, anthocyanins, and methoxylated flavonols, are less polar and can be extracted with hexane or ethyl acetate.

The concentrated extracts of DM and DT from small bungur obtained during the extraction process were weighed to calculate the % yield. After that, the yields for DM and DT are 67.2% and 67.9%, respectively. According to the research results, the % yield of DT is greater than that of DM. The % yield value refers to the active compounds in the sample; the higher the % yield, the more active compounds are present (Roy et al., 2021).

Flavonoid qualitative test

A qualitative flavonoid test was conducted to determine the presence of flavonoids in DM and DT extracts of small bungur using different solvents. The results of the flavonoid qualitative test are presented in **Table 2**.

Table 2. Flavonoid Qualitative Test Results

Sample	Solvent	Reagents	Color
DM	Hexane	Metal Mg + concentrated HCl	No colour change (Green) (-)
			No colour change (Dark Green) (-)
			No colour change (Deep red) (+)
	Ethyl Acetate		No colour change (Dark Green) (-)
			No colour change (Dark Green) (-)
			No colour change (Dark Green) (-)
DT	Hexane		No colour change (Green) (-)
			No colour change (Dark Green) (-)
			No colour change (Dark Green) (-)
	Ethyl Acetate		No colour change (Dark Green) (-)
			No colour change (Dark Green) (-)
			No colour change (Dark Green) (-)
	Methanol		Brownish red (+)

Description: + = Positive for flavonoids

- = Does not contain flavonoids

The flavonoid content is determined by the colour change observed in the sample upon reaction with Mg metal and concentrated HCl. The addition of concentrated HCl and Mg metal aims to reduce the benzopyrone core of the flavonoid

structure, producing red or orange flavilium salts. **Table 2** shows that DM and DT extracts prepared with hexane and ethyl acetate, respectively, each yield negative results or no flavonoid content. Whereas DM and DT extracts using methanol solvents showed positive results, producing a red colour in DM extracts and a brownish-red colour in DT extracts. The colour change is caused by the reaction of flavonoid hydroxyl groups with magnesium powder, forming a complex (QE) (Ramadhani et al., 2020).

Flavonoid quantitative test

Absorbance measurement of quercetin standard solution

The absorbance measurement results of quercetin standard solution as a comparison solution with concentrations of 2 ppm, 4 ppm, 6 ppm, 8 ppm, and 10 ppm using a UV-Vis spectrophotometer at a wavelength of 410 nm are shown in **Table 3**.

Table 3. Measurement Results of Absorbance of Standard Solution at 410 nm Wavelength

No	Concentration (ppm)	Absorbance
1	2	0.028
2	4	0.042
3	6	0.060
4	8	0.078
5	10	0.094

Preparation of a standard curve for the quercetin standard solution

The standard curve was obtained by correlating the absorbance of the quercetin standard solution (y) with its concentration (x), yielding the linear regression equation $y = 0.0084x + 0.01$. Data from the standard curve of the quercetin standard solution are shown in **Figure 1**.

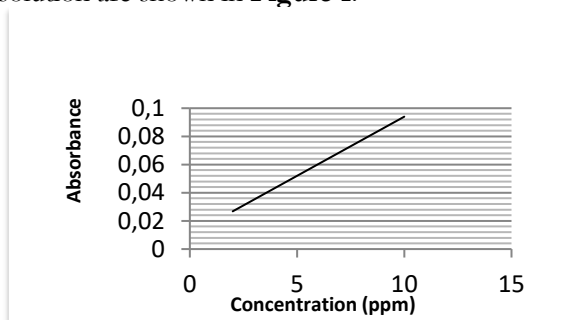


Figure 1. Quercetin Standard Solution Standard Curve

Flavonoids were calculated using a linear regression equation generated from the previously measured quercetin calibration curve. The calibration curve was generated using the Lambert-Beer law, namely the linear equation $y = ax + b$, where y is the absorbance, a is a constant, x is the sample concentration, and b is the slope of the line. According to the measurements in **Figure 1**, a straight-line equation was obtained: $y = 0.0084x + 0.01$, with $R^2 = 0.9983$.

Because the correlation coefficient (R^2) is close to 1, the relationship between the two variables is directly proportional, and the r value obtained satisfies the Lambert-Beer law (Gandjar & Rohman, 2018).

The comparison solution used was quercetin. Quercetin is one of the flavonoids from the flavanol group found in many types of plants (Jatmiko & Mursiti, 2021). Quercetin is used as a comparison compound because it is a flavonol with a keto group at the C-4 atom and hydroxyl groups at the adjacent C-3 and C-5 atoms (Azizah et al., 2014). According to Islamiyati et al. (2024), quercetin is a flavonoid compound that can react with $AlCl_3$ to form a complex.

Determination of total flavonoid content using $AlCl_3$ reagent, where the principle of this reagent is to form complex compounds. The addition of potassium acetate aims to maintain the wavelength in the visible region and detect the presence of the seven hydroxyl groups (Firlia & Hastuti, 2020). The solution was then allowed to stand for 30 minutes to complete the reaction and maximise the colour intensity. After standing, the solution will turn yellow.

Determination of flavonoid content

The results of the determination of the total flavonoid content of small bungur leaf extract are shown in **Table 4**.

Table 4. Results of flavonoid content analysis of small bungur leaf extracts

Sample	Treatment	Flavonoid Content (mg/100g)	Average Flavonoid Content (mg/100g)
DM Extract	1	8.929	8.810
	2	8.214	
	3	9.286	
DT Extract	1	8.214	7.301
	2	5.833	
	3	7.857	

The results of the determination of the total flavonoid content of small bungur leaf extract are shown in **Table 4**. The treatment was carried out 3 times for each sample of DM and DT of small bungur, and the average total flavonoid levels were 8.810 mg/100g for DM and 7.301 mg/100g for DT.

The results of this study are consistent with the findings of Rohiqi et al. (2021) on tenggulun matcha herbal tea leaves, which showed that young leaves have higher flavonoid content than older leaves. According to Farhoosh et al. (2007), the total flavonoid content in leaves is influenced by morphological factors and leaf age, which also affect the secondary metabolites and bioactive compounds produced. Dufresne & Farnworth (2000) added that differences in flavonoid content in leaves can also be caused by differences in leaf developmental age across different leaf locations.

Conclusions

Based on the results of research that has been conducted on the sample of small bungur leaves or local sakura (*Lagerstroemia indica* L.), the results of % yield on concentrated extracts of small bungur leaves with multistage maceration extraction are on DM obtained % yield of 67.2% and on DT obtained % yield of 67.9%. The average total flavonoid content of DM and DT of small bungur, measured using a UV-Vis spectrophotometer at a maximum wavelength of 410 nm, was 8.810 mg/100g and 7.301 mg/100g, respectively.

Acknowledgment

The author would like to thank the supervisor and the head of the chemistry laboratory at FKIP, Tadulako University, for their assistance in ensuring this research ran smoothly.

References

- Amin, M. H. F., Pidada, I. B. R., & Utami, C. S. B. (2013). Imunotoksitas pewarna makanan terhadap histopatologi peyer's patch goblet mencit (the immunotoxicity of food additive on histopathology of mice Peyer's patch goblet). *Jurnal Bioslogos*, 3(1), 10–16. <https://doi.org/10.35799/jbl.3.1.2013.14504>
- Arifin, B., & Ibrahim, S. (2018). Struktur, bioaktivitas dan antioksidan flavonoid. *Jurnal Zarah*, 6(1), 21–29. <https://doi.org/10.31629/zarah.v6i1.313>
- Azizah, D. N., Kumolowati, E., & Faramayuda, F. (2014). Penetapan kadar flavonoid metode $AlCl_3$ pada ekstrak metanol kulit buah kakao (*Theobroma cacao* L.). *Kartika Jurnal Ilmiah Farmasi*, 2(2), 45–49. <https://doi.org/10.26874/kjif.v2i2.14>
- Chang, C. C., Yang, M. H., Wen, H. M., & Chern, J. C. (2002). Estimation of total flavonoid content in propolis by two complementary colorimetric methods. *Journal of Food and Drug Analysis*, 10(3), 178–182. <https://doi.org/10.38212/2224-6614.2748>
- Dalimartha, S. (2003). *Atlas tumbuhan obat indonesia (Jilid II)*. Jakarta: Trubus Agrowodya.
- Dias, M. C., Pinto, D. C. G. A., & Silva, A. M. S. (2021). Plant flavonoids: Chemical characteristics and biological activity. *Molecules*, 26(17), 1–16. <https://doi.org/10.3390/molecules26175377>
- Dufresne, C., & Farnworth, E. (2000). Tea, kombucha, and health: A review. *Journal of Food Research International*, 33(6), 409–421. [https://doi.org/10.1016/S0963-9969\(00\)00067-3](https://doi.org/10.1016/S0963-9969(00)00067-3)
- Fajriah, S., & Megawati. (2015). Penapisan fitokimia dan uji toksisitas dari daun myristica fatua houtt. *Chimica et Natura Acta*, 3(3), 116–119. <https://doi.org/10.24198/cna.v3.n3.9219>
- Farhoosh, R., Golmovahhed, G. A., & Khodaparast, M. H. H. (2007). Antioxidant activity of various extracts of old tea leaves and black tea wastes (*camellia sinensis* L.). *Food Chemistry*, 100(1), 231–236. <https://doi.org/10.1016/j.foodchem.2005.09.046>
- Firlia, & Hastuti, S. (2020). Determination of total flavonoid levels on alpukat fruit skin (*persea americana* mill.). *Media Eksakta*, 2(2), 128–133. <https://doi.org/10.22487/me.v16i2.744>
- Gandjar, I. G., & Rohman, A. (2018). *Kimia farmasi analisis (Issue X)*. Yogyakarta: Universitas Gadjah Mada Press.
- Hasan, H., Suryadi, A. M. T. A., Bahri, S., & Widiastuti, N. L. (2023). Penentuan kadar flavonoid daun rumput knop (*hyptis capitata* jacq.) menggunakan spektrofotometri UV-Vis. *Journal Syifa Sciences and Clinical Research*, 5(2), 200–211. <https://doi.org/10.37311/jsscr.v5i2.19371>
- Islamiyati, R., Jayanto, I., Riyanto, B., & Firmansyah, G. (2024). Skrinning fitokimia dan penentuan kadar flavonoid total ekstrak etil asetat daun matoa secara spektrofotometri UV-Vis. *PHARMACON*, 13(3), 715–723. <https://doi.org/10.35799/pha.13.2024.55953>
- Istiqomah., Yahdi., & Dewi, Y. K. (2021). Uji aktivitas antioksidan dari ekstrak kulit batang kesambi [*schleichera oleosa*(lour) oken] menggunakan metode ekstraksi bertingkat. *Spin Jurnal Kimia & Pendidikan Kimia*, 3(1), 22–31. <https://doi.org/10.20414/spin.v3i1.3020>
- Jatmiko, M. P., & Mursiti, S. (2021). Isolation, identification, and activity test of flavonoid compounds in jambang leaves (*syzygium cumini* L.) skeel as antioxidants. *Indonesia Journal of Chemical Science*, 10(2), 129–138. <https://doi.org/10.15294/ijcs.v10i2.47037>
- Makuasa, D. A. A., & Ningsih, P. (2020). The analysis of total flavonoid levels in young leaves and old soursop leaves (*Annona muricata* L.) using uv-vis sepectrofotometry methods. *Journal of Applied Science, Engineering, Technology, and Education*, 2(1), 11–17. <https://doi.org/10.35877/454RI.asci2133>
- Nisa, F. Z., Astuti, M., Haryana, S. M., & Murdiati, A. (2019). Antioxidant activity and total flavonoid of *Carica papaya* L. leaves with different varieties, maturity and solvent. *Agritech*, 39(1), 54–59. <http://doi.org/10.22146/agritech.29737>
- Nugroho, A. (2017). *Teknologi bahan alam*. Banjarmasin: Lambung Mangkurat University Press.
- Permadi, A., Sutanto., Wardatun, S. (2015). Perbandingan metode ekstraksi bertingkat dan tidak bertingkat terhadap flavonoid total herba ciplukan (*physalis angulata* L.) secara kolorimetri. *Jurnal Online Mahasiswa (JOM) Bidang Farmasi*, 1(1), 1–10. <https://doi.org/10.37311/jsscr.v5i2.19371>

- Rahmah, S. M., Dharmono., & Putra, A. P. (2021). Kajian etnobotani tumbuhan bungur (*lagerstroemia speciosa*) di kawasan hutan bukit tamiang kabupaten tanah laut sebagai buku ilmiah populer. *BIODIK: Jurnal Ilmiah Pendidikan Biologi*, 7(1), 1–12. <https://doi.org/10.22437/bio.v7i01.12048>
- Ramadhani, N., Samudra, A. G., & Pratiwi, L. W. I. (2020). Analisis penetapan kadar flavonoid sari jeruk kalamansi (*citrofortunella microcarpa*) dengan metode spektrofotometri UV-VIS. *Jurnal Mandala Pharmacon Indonesia*, 6(1), 53–58. <https://doi.org/10.35311/jmpi.v6i01.57>
- Rohiqi, H., Yusasrini, N. L. A., & Puspawati, G. A. K. D. (2021). Pengaruh tingkat ketuaan daun terhadap karakteristik teh herbal matcha tenggulun (*protium javanicum burm.f.*). *Jurnal Ilmu Dan Teknologi Pangan*, 10(3), 345–356. <https://doi.org/10.24843/itepa.2021.v10.i03.p03>
- Roy, U. K., Nielsen, B. V., & Milledge, J. J. (2021). Antioxidant production in *dunaliella*. *Applied Sciences (Switzerland)*, 11(9), 1–24. <https://doi.org/10.3390/app11093959>
- Wahyuningtias, D., & Agustini, N. P. (2024). Pengaruh penambahan bubuk daun alpukat (*persea americana mill*) terhadap karakteristik puding. *Jurnal Gizi dan Pangan Soedirman*, 8(2), 161–173. <https://doi.org/10.20884/1.jgipas.2024.8.2.13330>
- Yue, Z., Xu, Y., Cai, M., Fan, X., Pan, H., Zhang, D., & Zhang, Q. (2024). Floral elegance meets medicinal marvels: Traditional uses, phytochemistry, and pharmacology of the genus *lagerstroemia* l. *Plants*, 13(21), 1–33. <https://doi.org/10.3390/plants13213016>
- Zhang, M., Zhao, J., Dai, X., & Li, X. (2023). Extraction and analysis of chemical compositions of natural products and plants. *Separations*, 10(12), 1–39. <https://doi.org/10.3390/separations10120598>