International Journal Of Health, Engineering And Technology (IJHET) *E-ISSN 2829 - 8683*
Volume 4, Number 6, March 2026, *Page. 2262 - 2272*
Email : editorijhess@gmail.com

Analysis Of Total Polyphenol Content Of Carrot Extract (Daucus Carota L.) Using The Folin-Ciocalteu Method

Wa Ode Nurani Arma[1)*], Rahmat Hidayat[2)], Annie Rahmatillah[3)]
[1,2,3)] Bachelor of Pharmacy Study Program, Duta Bangsa University Surakarta

*Corresponding Author
Email : raniarma1205@gmail.com

Abstract

Carrots (Daucus carota L.) are known to contain bioactive compounds, particularly phenolic compounds, which act as antioxidants. Objective: This study aimed to determine the total polyphenol content in carrot ethanol extract and evaluate its potential as a natural antioxidant source. This study was a quantitative experimental laboratory study. Carrot simplicia was obtained through a process of sorting, washing, chopping, drying, and grinding, then extracted using 70% ethanol solvent. The total polyphenol content was determined using UV-Vis spectrophotometry with Folin-Ciocalteu reagent and gallic acid as a standard, and the results were expressed in mg Gallic acid equivalent per gram of extract (mg GAE/g). Results: Gallic acid solution was used to obtain a standard curve. The analysis results showed a linear regression equation of y = 0.0161x + 0.042, R2 = 0.9947, with a correlation coefficient (r) value of 0.997. The total phenol content of each sample was determined with three replications. The results showed that carrot ethanol extract had a total polyphenol content of 42,205 mg GAE/g extract. This value indicates that carrot extract contains polyphenol compounds that have the potential to be a source of natural antioxidants.

Keywords: Antioxidants, Carrot (Daucus Carota L.), Follin-Ciocalteu, Total Polyphenols, UV-Vis Spectrophotometry).

INTRODUCTION

Carrots (Daucus carota L.) contain β-carotene as the main component, which is converted in the digestive system after consumption (Lina et al., 2024). Carrots (Daucus carota L.) are known for their high β-carotene content, along with Vitamins B and E. Vitamin A in raw carrots contains 34.94% β-carotene. β-carotene has high antioxidant properties, thus inhibiting the action of free radicals that can potentially damage body cells. In addition, this compound also plays a role in boosting the immune system and maintaining eye health (Sagita et al., 2025). Polyphenols are bioactive compounds found naturally in plants. Several factors can affect the efficiency of the polyphenol extraction process (Imanda et al., 2025). The extraction method influences the polyphenol content. Factors that influence this include the particle size of the material, temperature, and the length of extraction time. Finer particle size, higher temperature, and longer extraction time can generally increase polyphenol yield (Perdana et al., 2024). In addition to the method, the right solvent also determines the final extraction result. The principle of solvent selection must comply with the principle of like dissolves like, where the solvent will dissolve compounds with the same polarity (polar with polar, non-polar with non-polar) (Samudra et al., 2022). Types of solvents frequently used in extraction analysis of polyphenol content are ethanol, methanol, and acetone. In this study, the solvent used was 70% ethanol, known to be good at extracting phenolic and flavonoid compounds, which are key components in antioxidant activity. This concentration can optimize the extraction of alcohol-soluble compounds, but may not be fully effective for compounds with higher polarity (Pramushinta et al., 2025).

Analysis of total polyphenol levels is very important because polyphenol compounds act as natural antioxidants that can ward off free radicals in the body. Several studies on various plants have shown that total polyphenol levels vary depending on the type of plant, the extraction process, and the environmental conditions of the plant. For example, research by (Rauf et al., 2023) on the ethanol extract of senggani fruit (Melastoma malabathricum L.), showed that the total polyphenol content in the ethanol extract of senggani fruit (Melastoma malabathricum L.) was 2.275 mg GAE/g extract and the IC50 value of the ethanol extract of senggani fruit (Melastoma malabathricum L.) was 13.159 ppm with a very strong antioxidant category using the ABTS method.

The UV-Vis Spectrophotometry method is used to measure the intensity of light absorption by a solution at a certain wavelength that is proportional to the concentration of the substance (Ramadhani et al., 2023). In this study, the total polyphenol content was determined using the Folin-Ciocalteu method. Folin-Ciocalteu is an organic reagent that has the ability to oxidize phenolates (alkali salts), reducing heteropoly acids to a molybdenum-tungsten (Mo-W) complex in alkaline conditions (Sari & Zulfa, 2022). The principle of the Folin-Ciocalteu method is the formation of a blue complex compound that can be measured at the maximum wavelength of gallic acid (Nofita & Rahman, 2025).

Based on the statement above, this study was conducted to determine the total polyphenol content in carrot (Daucus carota L.) extract using the Folin-Ciocalteu method with UV-Vis spectrophotometry. Through this study, it is hoped that information will be obtained regarding the level of natural antioxidant activity found in carrots as a source of bioactive compounds.

RESEARCH METHODS

Place and Time of Research

The research was conducted at the Chemistry Laboratory of the Faculty of Health Sciences, Duta Bangsa University, Surakarta, over a period of approximately three months, from November 2025 to January 2026.

Types of research

This research was conducted experimentally with the aim of determining the total polyphenol content in carrot extract (Daucus carota L.) to show the potential of carrots as a source of antioxidants.

Tools and materials

Research The equipment used in this study consisted of a UV-Vis Spectrophotometer (EMCLab®), cuvette, knife, blender (Philips®), 60 mesh sieve, 5 mL, 10 mL, 100 mL Pyrex® flask, Pyrex® measuring cylinder, Pyrex® beaker, oven (Memmert®), The materials used were carrot extract, Na2CO3, 70% ethanol, distilled water, Folin-Ciocalteu reagent, gallic acid, 2N HCl, Dragendorff, H2SO4, 3% FeCl, Mg, concentrated HCl.

Research Procedures

1. Plant Determination
   The carrot plants (Daucus carota L.) that were studied were determined.
2. Making Simple Drugs
   Fresh carrot samples were sorted, cleaned, and weighed. The samples were washed, cut into pieces, and air-dried indoors, away from direct sunlight. The dried carrots were then cut into small pieces and ground using a blender to obtain carrot leaf powder. The powder was weighed to determine its mass (Widiyantoro et al., 2023).
3. Examination of Simplex Characteristics

Powder Drying Shrinkage Test

In determining the drying shrinkage of simple substances, an oven is used, namely by inserting ±2 grams of powder into the oven and then setting the temperature to 105°C for 30 minutes, after which the tool will produce the drying shrinkage value of the sample being tested (Wijaya, 2024).

Total Ash Content Test of Powder

Determination of ash content was carried out by weighing 2 grams of carrot (Daucus carota L.) simplicia, put into a tared porcelain crucible, heated in a furnace slowly, then gradually increased to 600˚C until carbon-free, then cooled in a desiccator and weighed the ash. Ash content formula (Krismayadi et al., 2024):

Water Content Test

Using a moisture balance by inserting ±2 grams of the simplicia then drying it at a temperature of 105°C for 5 minutes after which the tool will produce a water content value for the sample being tested (Ayun et al., 2025)

Maceration

The extract was prepared using the maceration method. 300 grams of finely ground carrots were soaked in 1500 mL of 70% ethanol. The maceration process was carried out for 3 days with occasional stirring. The filtrate was then re-macerated for 2 days with occasional stirring. The resulting extract was evaporated using a rotary evaporator and recondensed using a water bath. The yield of the resulting thick extract was calculated using the formula (Purnama et al., 2021).

5. Extract Standardization

Water Content Test

Put approximately 2 grams of carrot extract (Daucus carota L.) into the moisture balance, dry it at a temperature of 105°C for 10 minutes after which the tool will produce a water content value for the sample being tested (Ayun et al., 2025).

Ethanol Free Test

The ethanol-free test in carrot (Daucus carota L.) extract was performed using the following procedure. The extract was added with H2SOH4, then CH3COOH, and heated. A negative test result was indicated if no characteristic ether odor was detected (Ardianti et al., 2024).

6. Phytochemical Test of Extracts

Alkaloid Test

A total of 0.5 grams of carrot extract was dissolved in 70% ethanol plus 1 mL of HCl and 3 mL of distilled water, heated in a water bath for 2 minutes, then cooled and filtered. Three drops of the filtrate were taken and 2 drops of Dragendorff's reagent were added. The formation of an orange color indicates a positive result for the presence of alkaloid compounds.

Saponin Test

To 1 mL of carrot extract dissolved in 70% ethanol, 10 mL of hot distilled water was added, cooled, and then shaken for 10 seconds. The formation of foam indicates the presence of saponins.

Tannin Test

Weigh 20 mg of carrot ethanol extract and add 2 drops of 5% FeCl3 solution. A positive reaction of tannin compounds is indicated by the presence of a blackish green color.

Flavonoid Test

A small amount of Mg metal powder and a few drops of concentrated HCl were added to 1 mL of carrot extract dissolved in 70% ethanol. A reddish-orange color indicates the presence of flavonoids.

Determination of Total Polyphenol Content of Carrots

Preparation of gallic acid stock solution (0.05%)

A total of 50.0 mg of gallic acid was dissolved in 0.5 ml of ethanol pa, then diluted with distilled water to a volume of 100.0 ml.

Preparation of 7.5% Na2CO3 solution

Add 7.5 g of Na2CO3 to 80 ml of distilled water, then boil until the Na2CO3 powder dissolves completely. After that, let it stand for 24 hours, filter it, and dilute it with distilled water to a volume of 100.0 ml.

Determining Operating Time (OT)

A total of 300 µl of gallic acid solution with a concentration of 30 ppm was added with 1.5 ml of Folin-Ciocalteu reagent (1:10), then shaken and left for 3 minutes. 1.2 ml of 7.5% Na2CO3 solution was added to the solution, shaken until homogeneous, and the absorbance was measured every 5 minutes at a wavelength of 765 nm.

Determination of maximum wavelength (λmax)

A total of 300 µl of gallic acid solution with a concentration of 30 ppm was added with 1.5 ml of Folin-Ciocalteu reagent (1:10), then shaken and left for 3 minutes. 1.2 ml of 7.5% Na2CO3 solution was added to the solution, shaken until homogeneous, and left at room temperature for the operating time range, then the absorbance was measured at a wavelength of 600-850 nm.

Determination of the standard curve of gallic acid

The determination of the standard curve was carried out by taking 300 µl of gallic acid solution with concentrations of 10, 20, 30, 40 and 50 ppm, each of which was put into a tube, then added 1.5 ml of Folin-Ciocalteu reagent (1:10) and shaken. After being left for 3 minutes, each solution was added with 1.2 ml of 7.5% Na2CO3 solution, shaken homogeneously, and left in the operating time range at room temperature. All solutions were measured for absorbance at the maximum absorbance wavelength, then a calibration curve was made of the relationship between gallic acid concentration (ppm) and absorbance.

Total polyphenol content testing

A total of 20.0 mg of carrot ethanol extract was dissolved to a volume of 10.0 ml with a mixture of ethanol: distilled water (1:1). The obtained extract solution was pipetted 300 µl and added 1.5 mL of Folin-Ciocalteu reagent and shaken. Let it stand for 3 minutes, added 1.2 ml of 7.5% Na2CO3 solution and let it stand again at the operating time range at room temperature. The absorbance of the extract solution was measured with a UV-Vis Speccrophotometer at the maximum absorbance wavelength. This was repeated 3 times.

Data analysis

Data analysis was first performed using the standard curve method. A linear regression equation using Microsoft Excel was used to calculate the absorbance versus the concentration of the standard solution. Then, from the obtained linear regression equation, the total polyphenol content was calculated using the formula(Wilijeng & Anggarani, 2021).

RESULTS AND DISCUSSION

Plant Determination

Determination of Carrot plants (Daucus carota L.) was carried out at the UPF Yankestrad Tawangmangu Laboratory-Dr. Sardjito General Hospital in Tawangmangu. Determination aims to determine the truth of the plants to be studied and avoid errors in collecting materials and avoiding the possibility of mixing the plants to be studied with other plants (Sandepogu & Somineni., 2024). Based on the results of the determination, it is proven that the carrot plant (Daucus carota L.) used in this study is a carrot plant (Daucus carota L.).

Sample Preparation

A total of 2 kg of fresh carrots were wet sorted, washed, chopped, and air-dried at room temperature for 15 days. The dried raw material was then blended and sieved using a 60-mesh sieve. The resulting raw material powder was 157 grams. The yield of the raw material is shown in Table 1.

Table 1. Yield of carrot (Daucus carota L.) simplicia

Initial simplex(g)	Final simple (g)	Yield of simple drug (%)
2000 grams	157 grams	7.85%

Standardization of Simple Drugs

Drying Loss

Table 2. Drying loss of carrot (Daucus carota L.) simplex

Replication	Results	Average
1	7.6%	
2	8.9%	8.0167%
3	7.55%	

In this study, the results of the drying shrinkage of carrot simplex obtained a drying shrinkage value of 8.0167%, slightly higher than the study byAyun et al (2025), in carrot leaves, namely 7.3%. This difference is caused by the difference in sample types between tubers and leaves.

Determination of Water Content

Table 3. Determination of water content of carrot (Daucus carota L.) simplex

Replication	Results	Average
1	5.63%	
2	5.79%	5.77%
3	5.89%	

The water content results obtained for carrot (Daucus carota L.) simplicia were 5.77% on average. The water content requirement is no more than 10%, so the results obtained from the water content test are in line with (Tasya et al., 2025).

Determination of Ash Content

Table 4. Results of determining the ash content of carrot samples (Daucus carota L.)

Replication	Results	Average
1	5.1%	
2	6.3%	6.117%
3	6.95%	

Extraction

Extraction was carried out using the maceration method using 70% ethanol in a 1:10 ratio. From 130 grams of powdered simplicia, 43 grams of thick extract was obtained. The extraction results produced a yield as shown in Table 5.

Table 5. Yield of carrot extract (Daucus carota L.)

Simple Powder (g)	Thick Extract (g)	Extract Yield (%)
130 grams	43 grams	33.076%

Extract Standardization

Determination of Water Content

Table 6. Results of determining the water content of carrot extract (Daucus carota L.)

Replication	Results	Average
1	5.23%	
2	5.77%	5.683%
3	6.05%	

In this study, the results of the drying shrinkage of carrot simplex obtained a drying shrinkage value of 8.0167%, slightly higher than the study byAyun et al (2025), in carrot leaves, namely 7.3%. This difference is caused by the difference in sample types between tubers and leaves.

Determination of Water Content

Table 7. Results of determining the ash content of carrot extract (Daucus carota L.)

Replication	Results	Average
1	7.7%	
2	7.85%	7.967%
3	8.35%	

The water content results obtained for carrot (Daucus carota L.) simplicia were 5.77% on average. The water content requirement is no more than 10%, so the results obtained from the water content test are in line with (Tasya et al., 2025).

Ethanol Test Free Inspection

The test results showed that the carrot extract did not have an ester odor.

Phytochemical Screening

The test tube phytochemical screening test includes the examination of alkaloids, saponins, tannins, and flavonoids. Identification of chemical compounds, or phytochemical screening, is performed to determine the chemical compounds contained in carrot extract. The results of the carrot phytochemical screening test are shown in Table 8.

Table 8. Results of phytochemical screening of carrot extract (Daucus carota L.)

Contents	Reagent	Color	Information
Alkaloid	*Drangendorff*	Orange	Positive
Saponin	Hot distilled water	There is foam	Positive
Tannin	FeCl3 5%	Blackish green color	Positive
Flavonoid	Concentrated HCl + Mg Powder	Reddish orange	Positive

Determination of Total Polyphenol Content of Carrots

Determining Operating Time (OT)

From the results obtained, the absorbance was stable at the 30th minute so it can be concluded that the Operating Time for determining the total polyphenol content of carrot extract was 30 minutes, as can be seen in table 9.

Table 9. Determination of Operating Time

Time (s)	Abs
1440.0 s	0.372
1500.0 s	0.372
1560.0 s	0.373
1620.0 s	0.373
1680.0 s	0.374
1740.0 s	0.374
1800.0 s	0.374

Determination of Maximum Wavelength (λmax)

Based on the results of the scanning that has been carried out, the maximum wavelength used for reading the standard curve of gallic acid and samples is 752 nm.

Determination of the Standard Curve of Gallic Acid

The results of the standard solution measurements were then made into a curve and the regression equation was obtained in Figure 1.

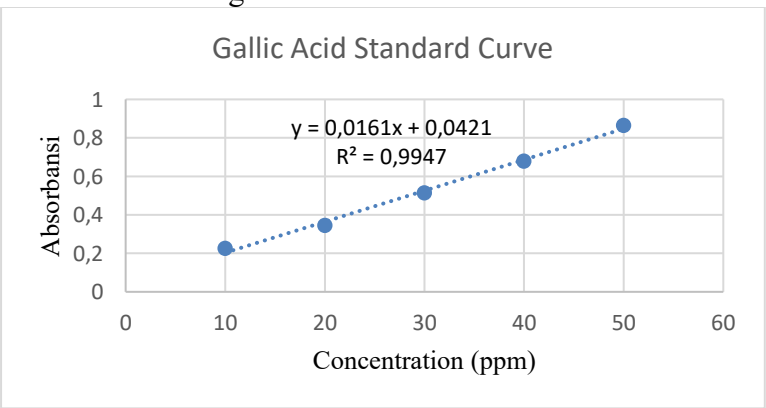

Figure 1. Gallic acid standard curve

Total Polyphenol Level Testing

Table 10. Absorbance measurement values for carrot extract samples (Daucus carota L.)

Replication	Wavelength	Absorbance	Average
1		0.178	
2	752 nm	0.177	0.178
3		0.179	

In this study, the total polyphenol content in carrot extract was 42.205 mg GAE/g, indicating that every gram of carrot ethanol extract contains phenolic compounds with activity equivalent to 42.205 mg gallic acid.

Data analysis

The results of the total polyphenol content in plants are expressed in GAE (Galic Acid Equivalent) units, namely mg of extract concentration per gram of sample (mg/g). Measurement of total polyphenol compounds in this study showed a correlation coefficient (r) value of 0.997, which is in the range of 0.996-1, thus meeting the linearity requirements of the analytical method. Thus, the regression equation of the gallic acid standard curve obtained can be used as a comparison in determining the levels of total polyphenol compounds in carrots (Daucus carota L.). These results are in accordance with research conducted by Maryam et al (2024), which also reported that the gallic acid standard curve has a correlation coefficient (r) value in the range that meets the linearity requirements, even though the samples used are different. The similarity of the linearity values indicates that the Folin-Ciocalteu method used has good accuracy in determining total polyphenol levels in various types of plant samples.

In this study, the total polyphenol content in carrot extract was 42.205 mg GAE/g, indicating that each gram of carrot ethanol extract contains phenolic compounds with activity equivalent to 42.205 mg gallic acid. These results are consistent with a study conducted by Sari & Zulfa (2022), which reported that carrot tuber extract had a total phenolic content of 43.3 mg GAE/g. The closeness of the total polyphenol content values in the two studies indicates that carrot extract is a potential source of phenolic compounds and has antioxidant activity. However, the total polyphenol content in this study was slightly lower than the study by Sari & Zulfa (2022), which is thought to be influenced by differences in solvent concentrations used, where this study used 70% ethanol while the study by Sari & Zulfa (2022), used 96% ethanol. In addition, differences in extraction conditions, particle size of the crude drug, and characteristics of the raw materials can also affect the total polyphenol content produced. Nevertheless, the results of this study indicate that carrot ethanol extract still contains significant phenolic compounds and has the potential to be a source of natural antioxidants.

CONCLUSION

Determination of total polyphenol content of carrot extract (Daucus carota L.) can be done using the Folin-Ciocalteu method, which is based on the oxidation reaction of phenolic compounds by Folin-Ciocalteu reagent in alkaline conditions to produce a blue complex that can be measured using a UV-Vis spectrophotometer. The total polyphenol content in carrot extract (Daucus carota L.) was obtained at 42.205 mg GAE/g extract. Based on the total polyphenol content value, it shows that carrot extract (Daucus carota L.) contains phenolic compounds so it has the potential as a source of natural antioxidants that can play a role in warding off free radicals.

REFERENCES

Agustin, A., Widayanti, E., Ikayanti, R., & Kesuma, S. (2022). Determination of Total Phenol Content of Ethanol Extracts of Various Bali Snake Fruit Seeds (Salacca zalanca var. ambonensis) Using the Folin Ciocalteu Method. Jurnal Nutriture, 1(3), 19–25.

Aji, AP, Issusilaningtyas, E., & Ratih, D. (2023). The Effect of Extraction Methods on the Secondary Metabolite Content of Black Mangrove Leaf Extract (Rhizopora mucronata). Sains Indonesiana: Jurnal Ilmiah Nusantara, 1(3), 173–181.

Amin, S., & Assafa, Z. (2025). The Role of Polyphenol Compounds in Antioxidant Mechanisms: A Review from a Medicinal Chemistry Aspect. Scientific Journal of Health Sciences, 3(2), 822–832. https://doi.org/10.31004/jiik.v3i2.44456

Anggraini, Y. (2020). Use of a UV-Vis Spectrophotometer for Phosphate Nutrient Analysis in Sediments in the Context of Developing a Chemical Oceanography Practical Module. Journal of Science Research, 21(3), 163–167. http://ejurnal.mipa.unsri.ac.id/index.php/jps/index

Ardianti, A., Sari, GK, & Purwanji, W. (2024). Antibacterial Activity Test of 70% Ethanol Extract Face Toner Preparation of Sweet Starfruit Leaves (Averrhoa carambola L.) Against Staphylococcus aureus Bacteria. Duta Pharma Journal, 4(2), 318–331.

Asworo, RY, & Widwiastuti, H. (2023). The Effect of Simplicia Powder Size and Maceration Time on the Antioxidant Activity of Soursop Peel Extract. Indonesian Journal of Pharmaceutical Education, 3(2), 256–263. https://doi.org/10.37311/ijpe.v3i2.19906

Ayun, RAQ, Ardiyantoro, B., & Raharjo, D. (2025). The Effect of Carrot Leaf Extract (Daucus carota L.) on Improving the Memory of White Mice (Mus musculus) Using the Radial Arm Maze Method. Journal of Integrated Health Innovation, 6(3), 19–34.

Indonesian Ministry of Health. (2008). Indonesian Herbal Pharmacopoeia, 1st Edition. Ministry of Health of the Republic of Indonesia, 1–221.

Indonesian Ministry of Health, 2000. (2000). General standard parameters for medicinal plant extracts, Jakarta: Indonesian Ministry of Health. In Edition IV.

Dongi, FE, Benu, NM, & Rumagit, GAJ (2019). Analysis of Carrot Marketing Margins in Sinisir Village, Modoinding District. Agri-Socioeconomics, 15(3), 511. https://doi.org/10.35791/agrsosek.15.3.2019.26164

Evani, S., Juniar, LEK, & Syafitri, MH (2024). Determination of Total Phenol Content in Ethanol Extract of Red and Black Betel Leaves Using Spectrophotometric Techniques. 9(1), 29–33.

Febri, RM, & Rosa, Y. (2022). Activity of secondary metabolites of ethanol extract of carrot tubers (Daucus carota L.) against Aedes aegypti mosquitoes. Jurnal Kesehatan Jurnal Ilmiah Multi Sciences, 12(1), 34–40. https://jurnal.stik-sitikhadijah.ac.id/index.php/multiscience/article/view/341

Fendri, STJ, Rahim, F., Nazarina, M., & Ferilda, S. (2023). Formulation of Chewable Tablet Preparation with the Addition of Natural Coloring Agent of Purple Sweet Potato Peel Extract (Ipomoea batatasL.). Jurnal Kesehatan Medika Saintika June 2023 |Vol, 14(1), 211–219.

Fitria, EHN (2020). Determination of Total Phenolic Content of Ethanol Extract of Leaves, Stems and Roots of Tutup Bumi by UV-VIs Spectrophotometry.

Giawa, Yunus Y., Zulfida, I., & Harahap, L. Henderlan. (2024). The Effect of NPK Fertilizer Application on the Growth and Production of Carrot Plants (Daucus carota L.). Agroplasma Journal, 11(2), 530–538. https://doi.org/p-ISSN 2303-2944 | e-ISSN 2715-033X

Herawati, N., Juniar, H., & Setiana, RW (2021). Bioethanol Production from Taro Starch (Colocasia L. Schoot) by Hydrolysis Process. Distillation, 6(1), 7–17.

Hersila, N., Chatri, M., Vauzia, & Irdawati. (2023). Secondary Metabolite Compounds (Tannins) in Plants as Antifungals. Embryo Journal, 15(1), 16–22.

Hidayatullah, M., Rakhmatullah, AN, & Perdana, D. (2023). Determination of Total Phenolic and Total Flavonoid Content of Ethanol Extract of Bajakah Tampala Stem (Spatholobus littoralis Hassk .). Journal of Pharmacopolium, 6(2), 41–52.

Husna, PAU, Kairupan, CF, & Lintong, PM (2022). Review of the Benefits of Flavonoids in Medicinal Plants as Antioxidants and Anti-Inflammatories. EBiomedik, 10(1), 76–83.

Imanda, SD, Kaseng, ES, & Mihrani. (2025). Analysis of Polyphenol Content and Antioxidant Activity of Turmeric Herbal Drink (Curcuma Longa L.) with the Addition of Ginger (Zingiber Officinale Roscoe). JIMU: Multi-Disciplinary Scientific Journal, 03(03), 821–829.

Islamy, RA, & Senas, P. (2023). Effect of Adding Carrot Flour (Daucus carota L) to the Nutritional Value and Organoleptic Snakehead Fish Nuggets (Channa striata). Journal of Science Education Research, 9(4), 1705–1712. https://doi.org/10.29303/jppipa.v9i4.3270

Jumalia, R., & Zainul, R. (2020). Sodium Carbonate: Thermodynamics and Ion Transport.

Kadarohman, A., Salima, G., Salim, AH, Safitri, A., Gustiawan, KH, Sardjono, RE, Pratiwi, A., Muftiasih, A., Surani, & Khumaisah, LL (2022). Fructone Synthesis from Ethanol and Acetic Acid. Indonesian Journal of Chemical Science, 11(229).

Khotimah, H., Anggraeni, EW, & Setianingsih, A. (2021). Characterization of Water Treatment Results using Distillation Equipment. Journal of Chemurgy, 01(2), 167–186.

Krismayadi, Halimatushadyah, E., Apriani, D., & Fitri Cahyani, M. (2024). Standardization of the Quality of Simplex and Ethanol Extract of Basil Leaves (Ocimum x africanum Lour.). Pharmacygenius, 03(02), 13630.

Kumalasari, E., Nararia, NM, & Musiam, S. (2021). Determination of Total Phenolic Content of 70% Ethanol Extract and Ethyl Acetate Fraction of Dayak Leek (Eleutherine palmifolia L.) Using UV-Vis Spectrophotometry Method. Indonesian Journal of Pharmaceutical Insan, 4(April), 74–84. https://doi.org/10.36387/jifi.v4.i1.665

Kusuma, AE (2022). The Effect of Solvent Amount on the Yield of Sauropus androgynus Leaf Extract. Journal of Pharmaceutical Science and Traditional Medicine, 1(2), 125–135.

Lara-Abia, S., Welti-Chanes, J., & Cano, P. (2022). Effect of Ultrasound-Assisted Extraction of Carotenoids from.

Lavlinesia, Monica E., & Ulyarti. (2023). Antioxidant Activity of Fresh Yam and Its Changes During Processing into Flour and Storage. Journal of Science Education Research, 9(10), 8686–8694. https://doi.org/10.29303/jppipa.v9i10.3752

Lin, TY, Wu, YT, Chang, HJ, Huang, CC, Cheng, KC, Hsu, HY, & Hsieh, CW (2023). Anti-Inflammatory and Anti-Oxidative Effects of Polysaccharides Extracted from Unripe Carica papaya L. Fruit. Antioxidants, 12(8). https://doi.org/10.3390/antiox12081506

Lina, RN, Rahmawaty, A., Setyoningsih, H., Wijaya, HM, Pratiwi, Y., Palupi, DA, Sugiarti, L., Septian, TC, & Madia, W. (2024). Training on Processing Carrots into Healthy Sticks to Control Blood Glucose Levels for PKK Mothers in Temulus Mejobo Village, Kudus. Journal of Health Service, 2(1), 8–14.

Listiana, L., Wahlanto, P., Ramadhani, SS, & Ismail, R. (2022). Determination of Tannin Content in Juiced and Boiled Mangkokan (Nothopanax scutellarium Merr) Leaves Using a UV-Vis Spectrophotometer. Pharmacy Genius, 1(1), 62–73.

Listiawati, MDA, Nastiti, K., & Audina, M. (2022). The Effect of Different Solvent Types on Phenolic Content of Soursop Leaf Extract (Annona muricata L.). Journal of Pharmaceutical Care and Sciences, 3(1), 110–120.

Luciana. (2020). The Use of Sodium Carbonate in Alkali-Discharge Printing with Dispersion Dyes on Polyester Fabrics. Journal of Science and Engineering, 2(2).

Luringunusa, E., Sanger, G., Sumilat, DA, Montolalu, RI, Damongilala, & Dotulong, V. (2023). Quantitative Phytochemical Analysis of Gracilaria Verrucosa from North Sulawesi Waters. PLATAX Scientific Journal, 11(2), 451–463.

Luviana, A., Putri, A., Reynaldi, R., Rahmawati, SP, Azzahra, RC, Sihombing, RP, & Paramitha, T. (2023). The Effect of Solvents Used on Turmeric (Curcuma Longa L.) Extraction Results. Proceedings of the Industrial Research Workshop and National Seminar, 14(1), 123–127. https://doi.org/10.35313/irwns.v14i1.5372

Maryam, F., Utami, YP, Mus, S., & Rohana, R. (2023). Comparison of Several Ethanol Extraction Methods of Sapodilla Durian (Chrysophyllum cainito L.) Leaves on Total Flavonoid Content Using UV-VIS Spectrophotometry Method. Jurnal Mandala Pharmacon Indonesia, 9(1), 132–138. https://doi.org/10.35311/jmpi.v9i1.336

Maryam, Muflihunna, A., & Salim, M. (2024). Chemical Content Analysis and Determination of Polyphenol Content of Soapberry Leaves (Sapindus rarak DC) Using UV-Vis Spectrophotometry Method. Makassar Pharmaceutical Science Journal, 2(3), 485–495. https://doi.org/10.33096/mpsj.v2i3.290

Morales, A., Medina-garc, M., Mart, P., Pascual-garc, S., & Sempere-ortells, J. M. (2024). The Antitumour Mechanisms of Carotenoids : A Comprehensive Review. 1–37.

Nofita, D., & Rahman, DF (2025). Analysis of Phenolic Compound Content in 70% Ethanol Extract of Syzygium myrtifolium Walp. Using the Folin-Ciocalteu Method. Jurnal Pharma Saintika, 8(2), 19–26.

Nofita, D., Sari, SN, & Mardiah, H. (2020). Chimica et Natura Acta Determination of Total Phenolics and Flavonoids of Stem Bark Ethanol Extract. Chimica et Natura Acta, 8(1), 36–41.

Pamungkas, P., Asrul, B., Nurlaela, L., & Gita, MM (2021). The Benefits of Adding Carrots (Daucus Carota L.) to Several Traditional Indonesian Cakes. JOURNAL OF Culinary Arts, 10(3), 511–518.

Perdana, F., Martiani, I., Rustammsyah, A., Aryanti, RS, & Khairunnisa, A. (2024). The Effect of Different Extraction Methods on Polyphenol Content of White Tea Leaves (Camellia sinensis). Journal of Food Technology and Agricultural Sciences (JIPANG), 06(02), 48–55.

Pramushinta, IAK, Ambarwati, N., & Jamlean, GS (2025). Comparison of Characteristic Test of 70% Ethanol and 96% Ethanol Solvent Extracts on Soaking Papaya Flower Extract (Carica papaya L.). 6(September), 13681–13689.

Purnama, NS, Hasan, H., & Pakaya, MS (2021). Standardization and Total Flavonoid Content of Ethyl Acetate Extract of Jackfruit (Artocapus heterophylus L) Stem Bark. Indonesian Journal of Pharmaceutical Education, 1(3), 142–151. https://doi.org/10.37311/ijpe.v1i3.11140

Qodri, UL (2023). MEASUREMENT OF β -CAROTENE IN YELLOW PUMPKIN FLESH (CUCURBITA MOSCHATA DURCH) USING ETHANOL, METHANOL, AND HEXANE SOLVENTS. Jurnal Syntax Dmiration, 4(7), 989–999.

Qomaliyah, EN, Indriani, N., Rohma, A., & Islamiyati, R. (2023). Phytochemical Screening, Total Flavonoid and Antioxidant Content of Cocor Bebek Leaves. Curr. Biochem, 10(1), 1–10.

Ramadhani SN, Aktsar RA, & Syarif Rezki AS (2023). Determination of Phenolic Content of Ethanol Extract of Cocoa Beans (Theobroma cacao L.) Using UV-Vis Spectrophotometry Method. Makassar Natural Product Journal, 1(4), 2023–2212. https://journal.farmasi.umi.ac.id/index.php/mnpj

Ratu, ZG, A'yuni, TA, Setiana, WA, Rosyidah, SA, Putrida, S., & Cahyani, VR (2024). Formulation and Physical Quality Test of Carrot (Daucus carrota L.) Ethanol Extract Cream Scrub. Mantra Bhakti, 1(25), 73–79. https://doi.org/10.47575/mb.v1i2.630

Rauf, AA, Himaniarwati, & Saranani, S. (2023). Determination of Total Polyphenols and Total Tannins From The Ethanol Extract of Senggani Fruit and Antioxidant Activity Test Using the ABTS Method. Pharmacia Mandala Waluya Journal, 2(6), 2829–6850. https://jurnal-pharmaconmw.com/jpmw/index.php/jpmwDOI:https://doi.org/10.54883/jpmw.v2i6.60

Riskianto, Windi, M., Karnelasatri, & Aruan, M. (2022). Antioxidant Activity of 96% Ethanol Extract of Japanese Papaya Leaves (Cnidoscolus aconitifolius (Mill.) IM Johnst) Using DPPH Method (1,1-diphenyl-2-picrylhydrazyl). Borneo Journal of Pharmacy, 5(4), 315–324. https://doi.org/10.33084/bjop.v5i4.3511

Rusmawati, L., Sjahid, RL, & Fatmawati, S. (2021). The Effect of Drying Method of Simple Drugs on Phenolic Content and Sunscreen Activity of 70% Ethanol Extract of Green Grass Jelly Leaves (Cyclea barbata Miers.). Indonesian Pharmaceutical Media, 16(1), 1643–1651. https://doi.org/10.53359/mfi.v16i1.171

Sagita, E., Yeni, Y., Fiona, F., Aulia, M., & Putri, A. (2025). Identification of Beta Carotene in Crude Palm Oil (CPO). Journal of Food Security and Agroindustry, 3(1), 31–36. https://doi.org/10.58184/jfsa.v3i1.597

Salim, R., Fauza, D., Selonni, F., & Taslim, T. (2021). Phenolic and Flavonoid Content of the Mentawai Purple (Graptophyllum pictum (L.) Griff). Catalyst, 6(1), 34–54.

Samudra, AG, Ramadhani, N., Fitriani, D., & Putri, D. (2022). Comparison of Maceration and Soxhletation Extraction Methods on Total Phenolic Content of Ethanol Extract of Sargassum Sp. National Seminar on Research Results and Community Service, 2(4), 500–511.

Sari, Ulfa, RN, Marpaung, MP, & Purnama. (2021). Determination of Antioxidant Activity and Total Flavonoid Content of Papasan Leaves Extract (Coccinia grandis L.) Based on Different Polar Solvents Determination of Antioxidant Activity and Total Flavonoid Contents Extract of Papasan Leaves (Coccinia grandi. KOVALEN: Jurnal Riset Kimia, 7(1), 30–41.

Sari, & Zulfa, HU (2022). Formulation of an Antioxidant Peel-Off Gel Mask Made from Carrot (Daucus carota L.) Extract. Scientific Journal of Pharmacy, 9(2), 40–53. https://doi.org/10.52161/jiphar.v9i2.416

Setyawati, I., Fitriyah, Z., Emilia, M., & Indahsari, NW (2024). Potential of Carrot (Daucus carota L.) Root Extract as a Source of Bioactive Compounds. 2(88), 16–24.

Shaban, NZ, El-Kot, SM, Awad, OM, Hafez, AM, & Fouad, GM (2021). The antioxidant and anti-inflammatory effects of Carica Papaya Linn. seeds extract on CCl4-induced liver injury in male rats. BMC Complementary Medicine and Therapies, 21(1), 1–15. https://doi.org/10.1186/s12906-021-03479-9

Tasya, EM, Cahyanta, AN, & Rejeki, DS (2025). Exploration of Carrot Extract (Daucus Carota L.) as Sunscreen in SPF (Sun Protection Factor) Analysis of Lotion Preparations (Sun Protection Factor) of the preparation. The SPF value describes the product's ability in Time and Place of Nature and Lab Research. 3(3).

Tuslinah, L., Gustaman, F., Rohimah, M., & Silviani, D. (2021). Comparison of Anthocyanin Stability of Ethanol Extract of Etlingera Elatior (Jack) RM Sm. With Tartaric Acid and Gallic Acid Copigmentation. Journal of Pharmaceutical Science and Practice, 7(3), 2579–4558. http://journal.ummgl.ac.id/index.php/pharmacy

Wahyuningsih, S., Yunita, I., Sundari, UY, Nurmalasari, E., Suryandani, H., Pagalla, DB, Kalalinggi, SY, Alpian, Ramlah, & Nasrullah, M. (2024). Natural Material Extraction Book 2024 Edition. In Researchgate (Issue March).

Wijaya, RH (2024). Formulation and Stability Test of Effervescent Granule Preparation of Moringa Leaf Extract (Moringa oleifera Lam.). Journal of Public Health, 1, 528–542.

Wilijeng, DT, & Anggarani, MA (2021). Determination of Total Phenolics, Total Flavonoids, and Antioxidant Activity of Male Onion (Allium sativum L.) Extract. UNESA Journal of Chemistry, 10(3), 295–306.

Wismayani, L., Roni, A., & Minarsih, T. (2022). Determination of Total Phenolic and Flavonoid Content of Renggak Leaf Extract (Amomum dealbatum Roxb.) from Various Solvents by UV-Vis Spectrophotometry. Indonesian Journal of Pharmacy and Natural Product, 5(2), 142–151.

Wulandari, S., Marpaung, MP, & Sari, DK (2024). Measurement of Flavonoid Content in Robusta and Arabica Coffee Bean Infusions Using UV-Vis Spectrophotometry. Scientific Journal of Pharmacy, 11(1), 83–92. https://doi.org/10.52161/jiphar.v11i1.551

Yulianis, Fitriani, E., & Saniddin, M. (2020). Determination of Polyphenol Content of Areca Nut (Areca catechu L.) Peel Extract and Fractions Using UV-Vis Spectrophotometry Method. 6(1), 170–178.

Yusika, DA, Islam, I., & Sahlan, M. (2023). Analysis of Total Polyphenol and Total Flavonoid Content of Propolis from Tanah Laut and Soppeng. Journal of Life Science and Technology, 1(1), 2–12.