JUATIKA
JURNAL AGRONOMI TANAMAN TROPIKA
VOL. 7 NO. 2 May 2025

DOI :https://doi.org/10.36378/juatika.v7i2.4305
eissn 2656-1727
pissn 2684-785X
pages : 490 – 494

RESEARCH ARTICLE Open Access

Morphological Identification and Evaluation of Phytochemical Content and Antioxidant Activity of Gembili Tuber (*Dioscorea esculenta* L.) in Malaysia

Mohammad Raiehan Prayoga[1], Asritanarni Munar[1,*], Razali Bin Mirad[2]

Abstract

Gembili tuber (*Dioscorea esculenta* L.) is a tuberous plant known for its high nutritional value and richness in bioactive compounds. These bioactive compounds, including diosgenin, β-sitosterol, and saponins, offer various health benefits, such as antimicrobial, anticancer, and antioxidant properties, crucial in preventing degenerative diseases. This study aims to investigate the differences in phytochemical and antioxidant content of Gembili tubers from different locations. The research was conducted at the Phytochemical Laboratory, MARDI, in Selangor, Malaysia, where the total phenolic content (TPC) was analyzed using the Folin-Ciocalteu method, and the antioxidant capacity was assessed through the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay using a UV spectrophotometer (Eon Biotek) at 517 nm. The results indicated that the total phenolic content and antioxidant values of yam bean tubers from the Serdang location in Selangor were higher than those from the Port Dickson location in Negeri Sembilan, measuring 1.6940 mg GAE/100g and 0.366 mg/ml in the DPPH test, respectively. Consequently, yam tubers cultivated in Serdang, Selangor, demonstrate greater potential as a source of natural antioxidants beneficial for health than those grown in Port Dickson.

Keywords: Antioxidants, Bioactive Compounds, Free Radicals, Gembili Tubers, Phytochemicals

1. Introduction

Tubers are plants with twisted stems that thrive in tropical regions and possess significant utility for food and nutrition within communities, as they are rich in vitamins, minerals, carbohydrates, and fiber (Komarayanti, 2017). *Dioscorea esculenta* L., commonly known as Gembili, is a type of tuber from the Dioscoreaceae family, believed to have originated in Thailand and Indochina (Vietnam). This plant is known for its high carbohydrate content and its ability to grow in tropical environments, including under forest canopies (Ode et al., 2020). In Malaysia, Gembili is often referred to as rice tubers, which are considered local tubers. In Indonesia, Gembili tubers are known by various names, including Kombili and Sido (Javanese); Kaburan and Kamburan (Madura); and Huwi Butul, Huwi Jahe, Kuwi Kawayang, and Huwi Cheker (Sundanese). Gembili tubers have the potential to serve as functional food ingredients and may also offer health benefits.

Gembili can be cultivated in lowland areas at altitudes of up to 900 meters above sea level and within a temperature range of 27.5 - 35ºC. This 3-5-meter-tall plant is commonly found in forests and can grow in tropical and subtropical areas (Herlina et al., 2015). The production of Gembili tubers can reach 60-70 tons/ha/year, compared to rice which produces around 5-10 tons/ha/planting season, so that for two to three plantings in a year, around 15-30 tons/ha can be obtained, indicating the abundance of Gembili tubers that can be used as raw materials for making food products. (Sabda et al., 2019). Embili tubers can be an option as a staple food for communities whose areas are not rice or rice producers (Paino, 2022). In Indonesia, Gembili tubers are widely used as snacks or light meals, and they are steamed and consumed. Septriana et al. (2022) stated that in 100 g of yam bean tubers, you get a total energy of 353 – 383 kcal.

Tubers have relatively good nutritional content,

*Correspondence: asritanarnimunar@umsu.ac.id
1) Universitas Muhammadiyah Sumatera Utara - Jl. Kapt. Mukhtar Basri No. 3 Medan, Sumatera Utara 20238, Indonesia
2) Malaysian Agricultural Research and Development Institute (MARDI) - UPM, Mardi, 43400 Serdang, Selangor, Malaysia

especially having a low-calorie value, high in fiber (Ervietasari & Larasati, 2021), a carbohydrate nutritional content of 27-30%, which is composed of 14.2% amylose and 85.8% amylopectin, and has several bioactive compounds such as dioscorin and iosgenin, which are beneficial for body health (Fera & Masrikhiyah, 2019). Lack of Utilization of Gembili Potential, which is rich in carbohydrates and bioactive compounds, as an alternative food ingredient or raw material for the herbal medicine industry. Gembili tubers not only have nutritional content but also contain bioactive compounds such as diosgenin, β-sistosterol, saponin, stigmasterol, and diosgenin, which are helpful as natural antimicrobials, anticancer, and antioxidants, so that Gembili tubers are efficacious as a drug.

Antioxidants have significant benefits for humans. Various natural antioxidants are found in fruits, vegetables, and tubers. Increasing the consumption of natural antioxidants found in fruits, vegetables, flowers, and other plants can prevent degenerative diseases arising from decreased organ or tissue function. Antioxidants are also helpful as free radical scavengers that cause degenerative diseases such as coronary heart disease, hepatitis, and trigger tumors and cancer. Several factors, such as climate and environment, influence the content of bioactive compounds in Gembili tubers.

Differences in location significantly impact the life cycle of plants, and different soil conditions and locations result in different morphological and anatomical influences (Hujjatusnaini et al.,2024). Air and soil temperature are the main factors influencing various physiological processes in plants, including photosynthesis, respiration, and nutrient absorption (Dayana et al., 2025). Climate change affects precipitation and thus plant architecture, flowering, fruiting, phytochemical composition, and competition with other species. Therefore, there is a need to understand the impact of higher temperatures, varying levels of precipitation, and different soil moisture and fertility, by planting them under these climates and determining how variations in temperature, moisture, and edaphic factors can affect plant phenology, nutrition, antioxidants, and secondary metabolite levels (Kumar et al., 2017). The results of a study by Lestari et al. (2021) found that the height of the growing place affected the phytochemical and antioxidant content. Phytochemical compounds at <400 masl obtained the highest detection results compared to an altitude of <800 masl. Therefore, research on the phytochemical and antioxidant content of Gembili tubers at different locations must be carried out, as the direct use of bioactive compounds to develop functional food products or natural pharmaceuticals.

2. Material and Methods

2.1. Place and Time

This research was conducted at the Phytochemical Laboratory, Center for Agrobiodiversity and Environmental Research, MARDI Headquarters, Serdang, Selangor, with specimens stored in the Herbarium, My Genebank Complex, Center for Agrobiodiversity and Environmental Research, MARDI, Serdang, Malaysia, with coordinates 2°58'52.3"N 101°41'55.0"E, at an altitude of 1,400 meters. Research was conducted in September 2024.

2.2. Tools and Materials

The equipment used in this research is a knife, scales, cutting board, oven, baking pan, blender/smoothie, sieve, plastic clip, patry cup, Erlenmeyer flask, centrifuge (centrifuge) separates the supernatant (liquid) and pellet (sediment), Micropipettes (automatic pipettes) are used to transfer samples, UV spectrophotometer (Eon Biotek), tissue culture plates, aluminum foil, mixers/stirrers , sample bottles and measuring cups. The materials used in this study were raw materials consisting of Gembili tubers obtained from farmers in Serdang S elangor Malaysia and Port Dickson Negeri Sembilan Malaysia, 70% methanol, phenolpholine reagent, sodium carbonate (Na_2CO_3) and 2,2 - diphenyl - 1 - picryl -hydrazyl methanol solution.

2.3. Research Design

This study used a replication experiment (n=3) of Gembili tuber extract with the total phenolic content calculated using a calibration curve using gallic acid (0-10 μg/ml) as a reference. 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) test standard and analysis using a UV spectrophotometer (Eon Biotek) at 517 nm. The results are expressed as inhibitory concentration values (IC50) representing the concentration at which DPPH radicals are cleared up to 50%.

2.4. Sample Collection and Preparation

As many as 2 types of Gembili tubers are obtained from different regions in Malaysia. (Serdang, Selangor and Port Dickson, Negeri Sembilan). Botanists from the Center for Agrobiodiversity and Environmental Research, MARDI, confirmed the characteristics and morphology of the tubers. 1618.86 g of tubers were weighed, and the skin was peeled. The tubers are cleaned of dirt with running water. The tubers were cut into cubes and dried in an industrial ketuhar at 50°C for 3 days, and dry results were obtained. The dried tubers were ground into a fine powder using an industrial mixer and sieved. Then, each sample is inserted into a special plastic vacuum before further analysis.

2.5. Total Phenolic Content Test (KFT)

Phenolic analysis using the Folin-Ciocalteu method with nanospectro (SPECTROstar Nano BMG LABTECH). Absorbance will be measured using a wavelength of 765 nm. The results will be presented as milligrams of gallic acid equivalents (GAE) per gram of dry weight (Heriansyah et al., 2025). A 2 g sample of tuber powder was weighed and extracted with 20 µl of 70% methanol. The extract was added with 100 µl of phenol folin reagent and left for 3 minutes. A 120 µl of sodium carbonate (Na_2CO_3) was added and left in the dark for 30 minutes to avoid oxidation. Using gallic acid (0-10 µg/ml) as a standard reference, KFT was calculated from the collaboration curve.

2.6. Free Radical Scavenging Test (2,2-diphenyl-1-picryl-hydrazyl-hydrate, DPPH)

All powder samples were subjected to extraction and assessed for free radical scavenging ability, following the procedure described previously with minor modifications. The assay used a 96-well plate with 2 g of dry powder extracted in 20 µl of 70% methanol. The stock solution was diluted to the required concentration. The final volume obtained (7 µl) was mixed with 280 µl of 2,2-diphenyl-1-picryl-hydrazyl (DPPH) methanolic solution. The plate was covered with an aluminum mesh to prevent exposure to sunlight and kept in the dark for 30 min. Analysis was performed using a UV spectrophotometer (Eon Biotek) at 517 nm. The results were expressed as inhibitory concentration (1C50) values representing the concentration at which DPPH radicals were scavenged up to 50%.

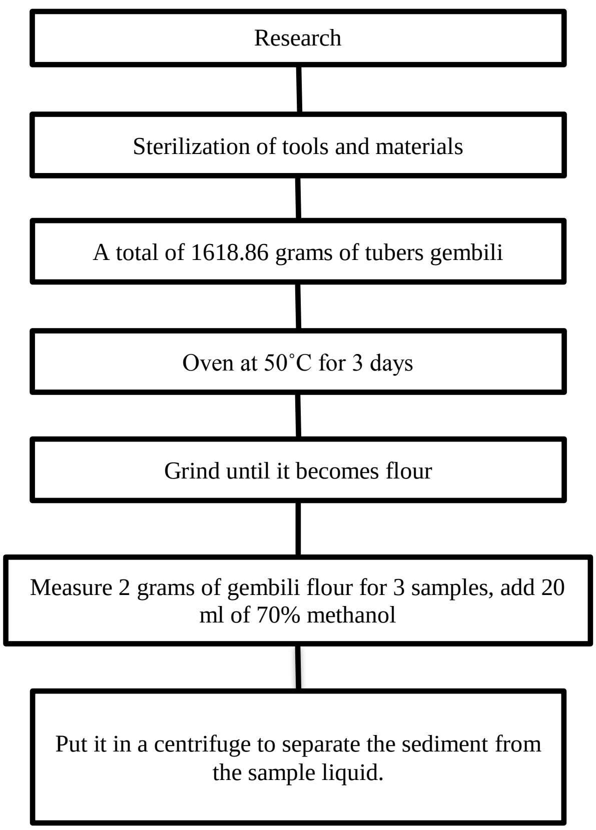

Figure 1. Research flow diagram

3. Results and Discussion

3.1. Soil Analysis Results After Application of Several Doses of Fly Ash

Phytochemical and antioxidant testing on yam bean extract was carried out to determine the compound content in yam bean tubers from different locations, so that the results obtained can be a basis for estimating other valuable compounds.

(a) **(b)**

Figure 2. (a) Umbi Gembili Serdang, Selangor, (b) Umbi Gembili Port Dickson Negeri Sembilan

3.2. Total Phenolic Content (KFT)

Table 1. Total phenolic content (KFT) of sweet potato samples

Location of Gembili tubers	mg GAE /100g
Serdang, Selangor	1.6940 ± 0.02909
Port Dickson, Negeri Sembilan	0.8331 ± 0.07362
Standard	0.00755 ± (-0.0013)

Based on Table 1, the results of the KFT test indicate that yam bean tuber samples from Serdang, Selangor, exhibit a higher KFT value of 1.6940 mg GAE per 100g compared to those from Port Dickson, Negeri Sembilan. The elevated KFT in yam bean tubers is believed to be influenced by temperature and rainfall. Serdang, Selangor, has an average temperature of approximately 25°C and receives about 2,960 mm of yearly rain. In comparison, Port Dickson experiences a higher average temperature of 29°C and receives around 2,476 mm of rainfall annually. Kumar et al. (2017) noted that variations in location and climatic conditions significantly impact the life cycle, distribution, and phytochemical composition of plants worldwide, including medicinal and aromatic species. Temperature changes associated with climate change affect precipitation patterns, which in turn influence plant architecture, flowering, fruiting, and phytochemical composition. Additionally, Fukui et al. (2017) emphasized that differences in environmental conditions can enhance the production of secondary metabolites in plants, surpassing that of primary metabolism.

Phenolic compounds contribute to antioxidant activity. The potential of phenolic compounds is due to hydroxyl groups that function as contributors of hydrogen atoms when reacting with radical compounds. Widyawati (2016) stated that phenolic compounds can release hydrogen atoms and are involved in redox reactions with Folin-Ciocalteu reagents. The greater the number of hydroxyl groups and conjugated double bonds in phenolic compounds, the greater the potential for these compounds to be involved in redox reactions.

The difference in KFT values of yam bean tubers can also be caused by sample extraction. Dry Extraction is made from plants produced by drying and concentrating liquid extracts to the required concentration using techniques that comply with the rules. Adding additional inert components often determines the settings based on the active ingredient content. The harvest age of the sample plants can also influence differences in total phenolic values. According to Nainggolan et al. (2018), the factors that affect the KFT contained in a plant are the harvest age and the method of harvesting the plants. The harvest age greatly determines the active composition contained in the raw materials; for example, old fruit has a different composition than young fruit.

The phenolic compounds produced may potentially have benefits for human health. Research Results of Hikmah et al. (2020) also stated that phenolic compounds containing flavonoids also function as antibacterial, anti-inflammatory, antiplasmodial, and anticancer, which are beneficial for human health if consumed. Phenolic compounds also function as antioxidants. Additionally, the review (Panche et al. 2016) states that flavonoids are a broad group of phenolics with antioxidants, anti-inflammatory, anticancer, and cardiovascular protective properties.

3.3. Free Radical Scattering Test (DPPH)

Table 2. Free Radical Scattering Test (DPPH) of sweet potato samples.

Gembil Tuber Location	IC50 (mg/ml)
Serdang, Selangor	0.366 ± 0.017
Port Dickson, Negeri Sembilan	14,593 ± 0,866
IC50 Standard	0.06 ± 0.01

The difference in sample locations showed very different results, significantly based on the IC50 standard. The IC50 value is the concentration of the extract required from the total DPPH, so the IC50 value is substituted as a standard (y) for the resulting value (x). Based on the free radical appearance test (2,2 -diphenyl-1-picryl-hydrazyl-hydrate, DPPH) in Table 2, the measurement results of the Gembili tuber samples located in Serdang, Selanggor at an altitude of 1824 meters above sea level show that the Gembili tuber extract has high antioxidant activity in counteracting free radicals, so that the appearance of free radicals (DPPH) is low, namely 0.366 mg/ml and in the Gembili tuber samples located in Port Dickson, Negeri Sembilan with an altitude of 103 meters above sea level has low antioxidant activity in counteracting free radicals. Hence, the free radical appearance test is high, 14.593 mg/ml. According to the IC50 standard, antioxidant activity in Gembili tuber samples located in Serdang, Selangor, is powerful in counteracting free radicals. Akter et al. (2019) stated that the lower the DPPH test value compared to the IC50 value, the higher the antioxidant activity and the stronger it is. This is also reinforced by Mar'atirrosyidah & Estiasih (2015), who conducted antioxidant activity tests of bioactive tuber substances, stating that although tubers showed low antioxidant activity, they were perfect for consumption, this was because only a few antioxidants contained were able to ward off free radicals for consumers. Yulia (2016) stated that antioxidants can capture free radicals to prevent disease. Aminurita et al. (2024) stated that differences in environmental conditions in the highlands can encourage the formation of higher secondary metabolites through light intensity, which can affect the photosynthesis process in plants.

Although the antioxidant activity of yam bean tubers from Serdang, Selangor, was higher than that from Port Dickson, the antioxidant activity at both locations was low, as indicated by the free radical scavenging test (DPPH), which yielded values higher than the IC50 standard. The low antioxidant activity in both samples is believed to be due to the prolonged contact time of the extract with the active substances. Tristantini et al. (2016) noted that high antioxidant activity values exceeding the IC50 standard can result from the degradation of antioxidants in extracts, which is influenced by the duration of contact between the active substances and the solvent and the temperature, which increases with extended heating. Previous research has indicated that the decrease in antioxidant activity, attributed to the degradation of active compounds during prolonged heating, leads to an increase in the IC50 value of the sample, resulting in thermal degradation (Jara et al., 2012).

4. Conclusion

The research discovered that yams originating from Serdang, Selangor, have a total phenol content (KTF) of 1.6940 mg GAE/100g and exhibit more potent antioxidant activity with a free radical scavenging test (DPPH) of 0.366 mg/ml compared to Gembili tubers from Port Dickson. Variations in environmental conditions, soil types, and climate substantially impact the phytochemical and antioxidant content of Gembili tubers.

Acknowledgment

We thank the Muhammadiyah University of North Sumatra and the Mardi Malaysia Headquarters Agro Biodiversity & Environment Research Center for their collaboration.

References

Akter, J., Hossain, A., Takara, K., & Islam, Z. (2019). Antioxidant activity of different species and varieties of turmeric (*Curcuma* spp.): Isolation of active compounds. *Comparative Biochemistry and Physiology Part C*, *215*(September 2018), 2018–2020.

Aminurita, A., Samodra, G., & Fitriana, A. S. (2024). Pengaruh ketinggian tempat tumbuh terhadap kadar flavonoid total dan uji aktivitas antioksidan ekstrak daun mahoni (*Swietenia mahagoni* L.). *Jurnal XYZ*, *3*(2), 108–115.

Dayana, M. E., Ruyani, A., Handini, M. N., & Pohan, H. Y. (2025). Conservation of *Murraya paniculata*: Creating an ideal environment at the Biodiversity Conservation Center. *Jurnal Agronomi Tanaman Tropika (JUATIKA)*, *7*(2), 393–397. https://doi.org/10.36378/juatika.v7i2.4216

Ervietasari, N., & Larasati, F. A. (2021). Cookies berbahan umbi gembili sebagai inovasi pangan. *Jurnal XYZ*, *1*, 15–22.

Februyani, N., & Zuhriyah, A. (2022). Perbandingan kadar senyawa antioksidan pada umbi porang (*Amorphophallus muelleri*), umbi talas (*Colocasia esculenta*), dan gembili (*Dioscorea esculenta*) dengan menggunakan metode DPPH. *Jurnal XYZ*, *17*, 451–456.

Fera, M., & Masrikhiyah, R. (2019). Ekstraksi inulin dari umbi gembili (*Dioscorea esculenta* L.) dengan pelarut etanol. *Jurnal XYZ*, *9*(2), 156–161.

Fukui, S., Ishigooka, Y., Kuwagata, T., Konndo, M., & Hasegawa, T. (2017). Taking account of water temperature effects on phenology improves the estimation of rice heading dates: Evidence from 758 field observations across Japan. https://doi.org/10.2480/agrmet.D-16-00018

Heriansyah, P., Aziz, S. A., Sukma, D., & Nurcholis, W. (2025). Enhancing total phenolic, flavonoid, and antioxidant capacity in black orchid (*Coelogyne pandurata* Lindl.) with paclobutrazol application. *BIO Web of Conferences*, *171*, 01007.

Herlina, Darmawan, I., & Rusdianto, A. S. (2015). Penggunaan tepung glukomanan umbi gembili (*Dioscorea esculenta* L.) sebagai… *Jurnal Agroteknologi*, *9*(2).

Hikmah, N., Arung, E. T., & Sukemi. (2020). Senyawa fenolik dan flavonoid, dan aktivitas antioksidan ekstrak metanol kulit buah ihau (*Dimocarpus longan* Lour. var. *malesianus* Leenh.). *Jurnal XYZ*, *3*(2), 39–42.

Hujjatusnaini, N., Iswahyudi, I., & Nur-Indahsari, L. I. (2024). Morphological characteristics and content of secondary metabolite compounds of medicinal plants for postpartum infection therapy. *Jurnal Agronomi Tanaman Tropika (JUATIKA)*, *6*(1), 80–92. https://doi.org/10.36378/juatika.v6i2.3481

Hurria, Yuhara, N. A., Tahar, N., Gultom, O. R., Amir, N. I., Andrifianie, F., Nafisah, A., Adjeng, T., & Supardan, A. D. (2023). *Fitokimia* (M. Arba & B. Hardianti, Eds.; 1st ed., p. 214). Eureka Media Aksara.

Jara, P. J., Lluís, T. J., & Eduardo, A. (2012). Effects of temperature and time on polyphenolic content and antioxidant activity in the pressurized hot water extraction of deodorized thyme (*Thymus vulgaris*).

Komarayanti, S. (2017). *Ensiklopedia Buah-Buahan Lokal Berbasis Encyclopedia of Local Fruits Based on Natural*, *2*, 61–75.

Kumar, S., Yadav, A., Yadav, M., & Yadav, J. P. (2017). Effect of climate change on phytochemical diversity, total phenolic content and in vitro antioxidant activity of *Aloe*. *BMC Research Notes*, 1–12. https://doi.org/10.1186/s13104-017-2385-3

Kurniawati, I. T., & Estiasih, T. (2015). Efek antihipertensi senyawa bioaktif dioscorin pada umbi-umbian keluarga *Dioscorea*: Kajian pustaka. *Jurnal XYZ*, *3*(2), 402–406.

Lestari, S., Aryani, R. D., & Palupi, D. (2021). Pengaruh ketinggian tempat tumbuh terhadap kandungan fitokimia dan antioksidan ekstrak akar sawi langit (*Vernonia cinerea* L.). *Jurnal XYZ*, *5*(2).

Mar'atirrosyidah, R., & Estiasih, T. (2015). Aktivitas antioksidan senyawa bioaktif umbi-umbian lokal inferior: Kajian pustaka. *Jurnal XYZ*, *3*(2), 594–601.

Masrikhiyah, R. (2020). Substitusi umbi gembili (*Dioscorea esculenta* L.) terhadap nilai gizi dan sifat organoleptik kue. *Jurnal XYZ*, *12*(2), 65–71.

Nainggolan, L., Indriyani, & Yernisa. (2018). Pengaruh tingkat kematangan buah terhadap kandungan fitokimia dan aktivitas antioksidan ekstrak n-heksan kernel biji teh. *Jurnal XYZ*, 354–367.

Nintowati, P. D. (2025). *Analisis fitokimia dan aktivitas antioksidan daun kopi robusta (Coffea canephora Pierre ex Froehner) di Kabupaten Ngawi berdasarkan perbedaan ketinggian tempat tumbuh* (Doctoral dissertation, Universitas Sebelas Maret).

Ode, W., Ariani, R., & Geo, L. (2020). Di Kabupaten Muna Provinsi Sulawesi Tenggara. *Jurnal XYZ*.

Paino, C. (2022). Gembili, pangan alternatif Indonesia di masa depan. *Mongabay*. https://www.mongabay.co.id/2022/02/28/Gembili-pangan-alternatif-indonesia-di-masa-depan/

Panche, A. N., Diwan, A. D., & Chandra, S. R. (2016). Flavonoids: An overview. *Journal of Nutritional Science*, *5*, e47.

Sabda, M., Wulanningtyas, H. S., Ondikeleuw, M., & Baliadi, Y. (2019). Karakterisasi potensi gembili (*Dioscorea esculenta* L.) lokal asal Papua sebagai alternatif bahan pangan pokok. *Jurnal XYZ*, *25*(1), 25–32.

Septriana, M., Adiyanti, M., Hamsidi, R., Indah, D., Puja, G., & Priskila, O. (2022). Manfaat pemberian stik gembili untuk menambah berat badan anak. *Jurnal XYZ*, *10*(3), 187–192.

Tristantini, D., Ismawati, A., Pradana, B. T., & Gabriel, J. (2016). Pengujian aktivitas antioksidan menggunakan metode DPPH pada daun tanjung (*Mimusops elengi* L.). *Jurnal XYZ*, 1-7.

Wahyuni, S., & Indradewi, F. (2015). Nilai gizi, fitokimia dan kadar total fenol dari beberapa umbi lokal Sulawesi Tenggara. *Jurnal XYZ*, *8*(2), 34–40.

Widyawati, P. S. (2016). Determination of antioxidant capacity in *Pluchea indica* Less leaves extract and its fractions. *Jurnal XYZ*, *8*(9).

Yulia, R. (2016). *Antioksidan hayati: Solusi dampak destruktif toksisitas oksigen* (1st ed.). Staina Press.