JURNAL BIOMEDIKA
Volume 15 No. 02 September 2022
P-ISSN: 1979 - 035X (printed) & E-ISSN: 2302 – 1306 (online)
DOI: https://doi.org/10.31001/biomedika.v15i2.1454

The potency of Temu Mango Rhizome Extract (*Curcuma mangga* Valeton & Zijp) at Variation of Solvent Concentration as Sunscreen

Dwi Susiloningrum* & Dessy Erliani Mugitasari

Pharmacy Study Program, Sekolah Tinggi Kesehatan Cendekia Utama Kudus
Jl. Lingkar Timur No.5 Km 5, Jepang, Kec Mejobo, Central Java, Indonesia

INFORMASI ARTIKEL

Article History:
Received: July, 2021
Revise: July, 2022
Accepted: Agustus, 2022

Keywords:
SPF, *Curcuma mangga* Valeton & Zijp, spectrophotometry

ABSTRACT

Human skin has a natural protection system against the harmful effects of sunlight by thickening the stratum, corneum, and skin pigmentation. Some plants are known to have benefits that can be used as natural ingredients to protect the skin from the adverse effects of sunlight. Plants that have secondary metabolites as sunscreen activity are temu mango rhizome (*Curcuma mangga* Valeton & Zijp). Secondary metabolite compounds contained in the mango meeting include flavonoid compounds, phenolics, tannins, essential oils which are known to function as sunscreens. This study aims to determine the SPF value of temu mango rhizome (*Curcuma mangga* Valeton & Zijp) using various solvents, namely ethanol 50%, 70%, and 96%. Calculation of the SPF value using the Mansur method. The results showed that the SPF value produced by the 50% ethanol extract of temu mango rhizome (*Curcuma mangga* Valeton & Zijp) with concentrations of 1250 ppm, 2500 ppm, 3750 ppm, 5000 ppm were 9.0613; 12,4133; 10.6027; 17,1233 with an SPF value of 12,3001 including the category of maximum protection. The SPF value produced by the 70% ethanol extract of temu mango (*Curcuma mangga* Valeton & Zijp) with the same concentration was 14.1767, respectively; 13.4787; 17,699; 17.4507 with an SPF value of 15.7013 including the ultra protection category. The SPF values produced by the 96% ethanol extract of temu mango rhizome (*Curcuma mangga* Valeton & Zijp) with the same concentration were 14,892, respectively; 17.3617; 16.9197; 16,972 with an SPF value of 16,5363 including ultra protection category.
.

*Koresponden author
Dwi Susiloningrum
Pharmacy Study Program Sekolah Tinggi Kesehatan Cendekia Utama Kudus
Email: dsusiloningrum@gmail.com

"Jurnal Biomedika" *is an open access article under the CC BY-SA license*
Homepage: www.biomedika.setiabudi.ac.id

INTRODUCTION

Human skin has a natural protection system against the harmful effects of sunlight by thickening the stratum, corneum, and skin pigmentation. However, it is not effective to withstand exposure to excessive sunlight. To overcome this, additional protection is needed, such as using sunscreen preparations (Agustin, Oktadefitri & Lucida, 2013).

Sunscreen is a preparation that is used to prevent or reduce the occurrence of skin disorders due to sun exposure. The ability of a sunscreen to protect the skin by delaying erythema is expressed by SPF (Sun Protection Factor). The SPF value shows how many times a person's skin protection is doubled so that it is safe in the sun without experiencing erythema, the higher the SPF value of a sunscreen, the better its protective activity (Adawiyah, 2019).

Indonesia is a country that has natural wealth with various types of plants. In plants there are secondary metabolites as a potential source of sunscreen because they are photoprotective, including flavonoids and phenolics(Prasiddha *et al.*, 2016). Plants that have these secondary metabolites as sunscreen activity are from the Zingiberaceae group including temulawak (Curcuma xanthorriza), turmeric (Curcuma domestica), temu Mangga (*Curcuma mangga* Valeton & Zijp), temu Putih (*Curcuma zedoaria*), temu giving (*Curcuma heyneana*) and temu Hitam (*Curcuma aeruginoza*) (Yurleni, 2018). In this study, the use of temu mango (Curcuma mango Valeton & Zijp) for chemotaxonomic reasons. Chemotaxonomy is the science which states that with the similarity of anatomical signs, histology, and substances contained in plants in one family usually have the same activity (Hafid *et al.*, 2017)

Determination of the effectiveness of sunscreen is done by determining the SPF value in vitro with spectrophotometry. This study aims to determine the SPF value of ethanol extracts 50%, 70%, and 96% of temu mango rhizome in the form of extracts with extract concentrations of 1250 ppm, 2500 ppm, 3750 ppm, and 5000 ppm.

MATERIAL AND METHODE

Time and Place

This research was conducted at the Pharmacy Phytochemical and Instrumentasi Laboratory of STIKES Cendekia Utama Kudus. The study was conducted from August to September 2021

Material and Equipment

The materials used for the extraction include temu mango rhizome, aquadest, ethanol 50%, 70%, and 96%. The materials used for phytochemical screening were 50%, 70%, and 96% ethanol extract of mango Intersection, aquadest, magnesium powder, 1 N HCl, 10% NaOH, 1% FeCl3, and Sudan III solution. The materials used for testing the SPF value were 50%, 70%, and 96% ethanol extracts of temu mango rhizome, pro-analytical ethanol, 50%, 70%, and 96% ethanol.

The equipment UAE (Ultrasound Assisted Extraction) (Jinyuanbao brand), analytical balance (Ohaus), spatula, porcelain cup, blender (Getra), oven (Memmert), 44 mesh sieve, water bath, aluminum foil, stirring rod, measuring cup (Herma), and filter paper. The tools used for phytochemical screening are test tubes (pyrex), tube racks, dropper pipettes, test tube clamps, and water baths. Thisools used for testing the SPF value are analytical balance (Ohaus), UV-Vis spectrophotometer (Biobest), cuvette, glass bottle, glass beaker (Herma), volumetric flask (Herma), volume pipette, test tube (pyrex), tube rack, micropipette.

1. Plant of determination

   Plant determination was carried out at the Ecology and Biosystems Laboratory, Department of Biology, Diponegoro University, Semarang
2. Poweder making of temu mango rhizome (*Curcuma mangga* Valeton & Zijp)

   Temu mango rhizomes (*Curcuma mangga* Valeton & Zijp) which have been cleaned and then cut into small pieces to facilitate the drying process. Temu mango rhizome (*Curcuma mangga* Valeton & Zijp) which has been cut and then weighed as much as 10,000 grams, then dried in the oven. The dried simplicia was then made into powder by

means of a blender and sieved using a 40 mesh sieve then weighed 200 grams for each solvent.

3. Moisture Analysis
   The sample is weighed as much as 1 gram and put into the moisture balance tool until it is evenly distributed into the cup. Close the moisture balance and wait for about 3-5 minutes until the screen shows the results of the moisture content.
4. Temu Manggo rhizome of extraction (*Curcuma mangga* Valeton & Zijp)
   The powder of temu mango rhizome (*Curcuma mangga* Valeton & Zijp) was extracted using the UAE (Ultrasound Assisted Extraction) method, namely 200 grams of powder added with each solvent, namely 50%, 70%, and 96% ethanol which was then sonicated for 2 minutes and repeated three times. The results obtained were then carried out using a funnel to obtain dregs and filtrate I. The samples obtained were re-extracted to a clear solution, three times with the same number of findings and treatments. The filtrates I, II, and III were combined into one and then evaporated using a water bath. The viscous extract obtained was weighed and the yield weight calculated

$$\% \text{ Rendement } = \frac{extraction\ weight\ (g)}{sample\ weight\ (g)} x\ 100\%$$

5. Phytochemical screening
   a.Identification of Flavonoid Compounds
   A total of 100 mg of the extract was dissolved in 5 mL of ethanol, then divided into 3 test tubes according to each concentration and the test was carried out :
   1. Wilstater Test
      1 mL of the extract was put into a test tube, then added with magnesium powder and 2-4 drops of concentrated HCl then shaken. If there is an orange color change, it indicates the presence of flavonoids from the flavanone group.
   2. Bate-Smith Test
      1 mL of the extract was put into a test tube, then added with a few drops of concentrated HCl. Then heated for 15 minutes on a bath. If there is a dark red to purple color change, it indicates the presence of anthocyanin flavonoids.
   3. NaOH 10% Test
      1 mL of the extract was put into a test tube, then added with a few drops of 10% NaOH solution. If there is a color change, it indicates the presence of flavonoids from the phenol group

   b. Idenntification of Phenolic Compounds
   1 mL of the extract was put into a test tube and added with a few drops of 1% FeCl3 solution. If a green, red, purple, blue or black color is formed, it is positive for phenolic content.

   c. Identification of essential oil
   Extract as much as 1 mL then added 3 drops of Sudan III reagent. Positive results of essential oils are indicated by the appearance of a red color.

   d. Identification if saponins
   1 mL of extract is then added with 10 mL of hot water, cooled and shaken vigorously for 10 seconds, a stable foam will be formed for not less than 10 minutes as high as 1-10 cm. then added 2N HCl, if the foam does not disappear then it indicates the presence of saponins.
6. Determination of the value of the Sun Protection Factor (SPF) of temu mango rhizome extract (*Curcuma mangga* Valeton & Zijp). The rhizome extract of temu mango (*Curcuma mangga* Valeton & Zijp) was weighed as much as 0.0125 grams; 0.025 grams; 0.0375 grams; and 0.05 grams, then diluted with ethanol 50%, 70%, and 96%. And replicated 3 times for each test. The absorption value was measured in the wavelength region of 290-320 nm with 5 nm intervals using a UV-Vis spectrophotometer to obtain the SPF value..

7. Data analysis

Test the SPF value using the Mansur formula

$$SPF_{Spectrophotoometric} = CF \sum_{290}^{320} \text{EE } (\lambda) \text{x I } (\lambda) \text{x Abs } (\lambda)$$

Keterangan :

EE : Erythema spectrum of effect
I : Light intensity spectrum
Abs : Sunscreen sample absorbance
CF : Correction factor (=10)

RESUTS AND DISCUSIONS

The Results From Plant Determination

Plant determination is carried out as a first step before conducting a study. The rhizome of temu mango (*Curcuma mangga* Valeton & Zijp.) obtained from Kandangmas village, Dawe sub-district, Kudus district was determined at the Ecology and Biosystemic Laboratory of the Department of Biology, Diponegoro University, Semarang. The results obtained can ensure that the plant used as research material is the rhizome of temu mango (*Curcuma mangga* valeton & Zijp).

Key of determination :

1b - 2b - 3b - 4b - 12b - 13b - 14b - 17b - 18b - 19b - 20b - 21b - 22b - 23b -24b - 25b - 26b - 27a - 28b - 29b - 30b - 31a - 32a - 33b - 34b - 333a - 334b - 335a - 336a - 337b - 338a - 339b - 340a - Fam 207. Zingiberaceae - 1a - 2b - 6a - Genus Curcuma - 1a - 2a - Spesies : *Curcuma mangga*

The Results of Making Temu Mango Rhizome Powder

A total of 10,000 grams of rhizome temu mango (*Curcuma mangga* Valeton & Zijp.) were washed and then dried in an oven until 815 grams (Table 1) of dried simplicia were obtained. The simplification obtained is powdered until smooth, and drying shrinkage is calculated. The UAE (Ultrasound Assisted Extraction) method is a prospective extraction method because it produces higher yields and shorter processing times (Widyasanti, Nurlaily, & Wulandari, 2018). The UAE (Ultrasound Assisted Extraction) method was carried out by extracting the simplicia rhizome of Intersection mango powder (*Curcuma mangga* Valeton & Zijp.) with various solvents, namely 50% ethanol, 70% ethanol, and 96% ethanol. The solvent used in the extraction process is that it can dissolve the desired extract, has a large solubility, is harmless or non-toxic, and does not cause chemical changes to the extract components. The factors considered in the selection of solvents include being selective or the solvent can dissolve all compounds quickly, being inert or the solvent does not react with the oil component, easy to obtain, and inexpensive (Arsa & Achmad, 2020).

In this study, the rendements of 50% ethanol extract was higher than that of 70% ethanol extract and 96% ethanol. This shows that 50% ethanol solvent is able to extract compounds better than 70% ethanol and 96% ethanol solvents. Sun Protection Factor (SPF) is a universal indicator that explains the effectiveness of a product or substance that is UV protector, the higher the SPF value of a sunscreen product or active substance, the more effective it is to protect the skin from the adverse effects of UV rays (Dutra et al. , 2004). The Sun Protection Factor (SPF) assessment refers to the provisions of the Food and Drug Administration (FDA) which classifies the effectiveness of sunscreen preparations based on SPF.Pengkuran rata-rata nilai SPF pada ekstrak etanol 50 % pada konsentrasi 1250 ppm, 2500 ppm, 3750 ppm, 5000 ppm yaitu 12,3001 so that in this case it is included in the category of maximum protection with an SPF value range (8-15). The measurement of the average SPF value on 70% ethanol extract concentration of 1250 ppm, 2500 ppm, 3750 ppm, 5000 ppm is 15.7013, so that the SPF value of 70% ethanol extract is included in the ultra protection category with an SPF value range (≥15). The measurement of the average SPF value in the ethanol extract 96% concentration of 1250 ppm, 2500 ppm, 3750 ppm, 5000 ppm is 16.5363, so the SPF value of 96% ethanol extract is included in the ultra protection category with an SPF value range (≥15).

Figure.1. Temu Mango Rhizome

Table 1. drying shrink

Wet simplicia (gram)	Dry simplicia (gram)	Drying shrink (%)	Colour
10000	815	85,18	Kuning Kecoklatan

The Results of Moisture Analysis

Determination of the moisture content of the rhizome powder of Temu Mango (*Curcuma mangga* Valeton & Zijp.) using moisture balance (Table 2).

Tabel 2. Moisture Analysis

Replication	Moisture Analysis (%)	Average (%)
1	3.64	
2	3.29	3.44±0.18
3	3.38	

The Results of Extraction

Extraction was carried out using the UAE (Ultrasound Assisted Extraction) method in which 200 grams of simplicia powder from the Temu mango rhizome was extracted with 50% ethanol, 70% ethanol, and 96% ethanol respectively, which were then sonicated for 2 minutes and repeated three times (Table 3).

Table 3. Result of thick extract and rendement

Extract	Poweder (gram)	Thick extract (gram)	Rendement (%)
Ethanol 50%	200	64,55	32,27
Ethanol 70%	200	53,29	26,65
Ethanol 96%	200	58,42	29,21

The Results of Phytochemical Screening

The results of phytochemical screening of extracts of ethanol 50%, ethanol 70%, and ethanol 96% rhizome of Temu Mango (Curcuma mango Valeton & Zijp.) showed that they contained flavonoids, phenolics, and essential oils.

Table 4. Results of Phytochemical Screening

Extract	Identification	Results
Ethanol 50%	1. Flavonoid	
	Wilstater Test	+
	Bate-Smith Test	+
	NaOH 10% Test	+
	2. Phenolic	+
	3. Essensial Oil	+
	4. Saponin	–
Ehtanol 70%	1. Flavonoid	
	Wilstater Test	+
	Bate-Smith Test	+
	NaOH 10% Test	+
	2. Phenolic	+
	3. Essensial Oil	+
	4. Saponin	–
Ehtanol 96%	1. Flavonoid	
	Wilstater Test	+
	Bate-Smith Test	+
	NaOH 10% Test	+
	2. Phenolic	+
	3. Essensial Oil	+
	4. Saponin	–

The Result of Sun Protection Factor (SPF) Value of Temu Mango Rhizome Extract

Result of Sun Protection Factor (SPF) value of Temu Mango extract with 50% ethanol solvent with concentrations of 1250 ppm, 2500 ppm, 3750 ppm, and 5000 ppm

Table 5. SPF value of temu mango rhizome extract with 50% ethanol solvent

No	Concentration(ppm)	Replication			Average	Average of Value SPF	SD	Sun Protection
		I	II	III				
1	1250	9,145	9,014	9,025	9,0613	12,3001	3,49	Maximum Protection
2	2500	12,518	12,4	12,322	12,4133			
3	3750	10,775	10,548	10,485	10,6027			
4	5000	16,999	17,386	16,985	17,1233			

Result of Sun Protection Factor (SPF) value of Temu Mango extract with 70% ethanol solvent with concentrations of 1250 ppm, 2500 ppm, 3750 ppm, and 5000 ppm

Table 6. SPF value of temu mango rhizome extract with 70% ethanol solvent

No	Concentration (ppm)	Replication			Average	Average of Value SPF	SD	Sun Protection
		I	II	III				
1	1250	14,127	14,133	14,27	14,1767	15,7013	2,18	Ultra Protection
2	2500	13,504	13,496	13,436	13,4787			
3	3750	16,891	17,999	18,207	17,699			
4	5000	17,746	17,165	17,441	17,4507			

Result of Sun Protection Factor (SPF) value of Temu Mango extract with 96% ethanol solvent with concentrations of 1250 ppm, 2500 ppm, 3750 ppm, and 5000 ppm

Table 7. SPF value of temu mango rhizome extract with 96% ethanol solvent

No	Concentration (ppm)	Replication			Average	Average value of SPF	SD	Sun Protection
		I	II	III				
1	1250	15,091	14,981	14,604	14,892	16,5363	1,11	Ultra Protection
2	2500	17,323	17,483	17,279	17,3617			
3	3750	16,757	16,962	16,223	16,9197			
4	5000	17,053	16,881	16,982	16,972			

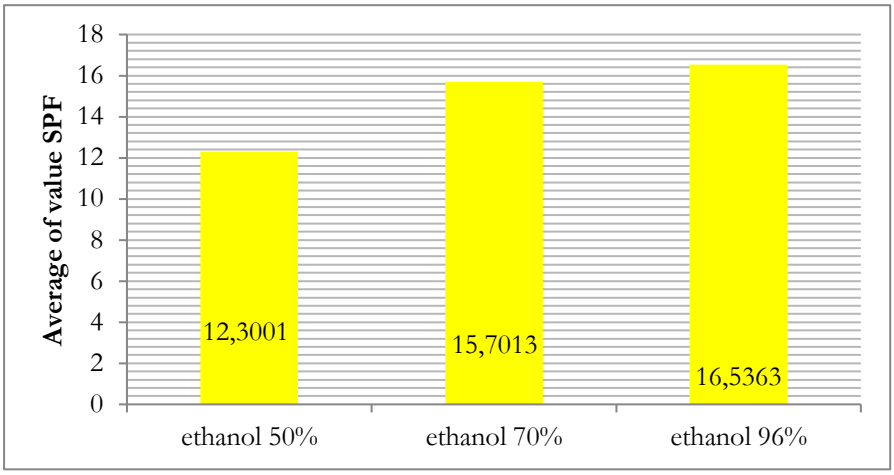

Figure 2. Comparison of SPF Values 50%,70% and 96% Ethanol Extracts of Mango Rhizome (*Curcuma mangga* Valeton & Zijp.).

The results of the SPF value above indicate that the concentration of ethanol extract 96% the SPF value is greater than the SPF value of 50% ethanol extract and 70% ethanol extract, this is indicated by the category of 50% ethanol extract value 8-15 (maximum protection), ethanol extract value 70%≥15 (ultra protection), and the value of the ethanol extract 96%≥15 (ultra protection).

This sunscreen activity is due to the content of secondary metabolites contained in the rhizome of Intersection mango (Curcuma mango Valeton & Zijp), namely the flavonoid, phenolic, and essential oil groups. Phenolic compounds have potential as sunscreens because they have conjugated bonds in the benzene core, where when exposed to UV there will be resonance by means of electron transfer which is able to absorb UV A / B rays, thereby reducing the intensity on the skin (Marpaung, Luliana & Susanti, 2015).

Normally human skin can defend itself from the effects of erythema and pigmentation for approximately 25 minutes, so after using sunscreen preparations with an SPF value of 3.3 (Minimum Protection) and 5.0 (Medium Protection), it means that the skin will last for 3 ,3 times and 5.0 times the normal time for the skin to defend itself. As the concentration of the extract increases, the protection function against UV rays also increases as indicated by the greater SPF value (Ajwad, 2016).

CONCLUSION

Based on the results of the research that has been done, it can be concluded that :

1. Extracts of ethanol 50%, ethanol 70%, and ethanol 96% rhizome of temu mango (*Curcuma mangga* Valeton & Zijp) contain secondary metabolites such as flavonoids, phenolics and essential oils
2. The SPF values of 50% ethanol extract, 70% ethanol, and 96% ethanol rhizome of temu mango (*Curcuma mangga* Valeton & Zijp) were 12.3001 (maximum category), 15.7013 (ultra protection category), and 16.5363 (ultra protection category).

KNOWLEDGMENTS

This research was funded by the Ministry of Education and Culture Research (Research Lecturer Beginners)

CONFLICT OF INTEREST

We have no conflict of interest related to this work

REFERENCES

Adawiyah, R. (2019) 'Penentuan Nilai Sun Protection Factor secara In Vitro pada Ekstrak Etanol Akar Kalakai (Stenochlaena palustris Bedd) dengan Metode Spektrofotometer UV-Vis', *Jurnal Surya Medika*, 4(2), pp. 26–31. doi: 10.33084/jsm.v4i2.604.

Alhabsyi.,D.F.,Suryanto.E.,Wewengkang.D.S. 2014. Aktivitas antioksidan dan tabir Surya Pada Ekstrak Kulit Buah Pisang Goroho (*Musa acuminate*.L). Jurnal Ilmiah Farmasi.Vol.3.No.2.

Agustin, R. Oktadefitri, Y. & Lucida, H. (2013). 'Formulasi Krim Tabir Surya Dari Kombinasi Etil P - Metoksisinamat Dengan Katekin, Jurnal Prosiding Seminar Nasional Perkembangan Terkini Sains Farmasi dan Klinik III.

Ajwad, M. M. (2016) Uji Potensi Tabir Surya Dan Nilai Sun Protection Factor (SPF) Ekstrak Etanol Daun Pedang-Pedang (Sansevieria trifasciata Prain) Secara In Vitro.

Arsa, A. K. & Achmad, Z. (2020) 'Ekstraksi Minyak Atsiri Dari Rimpang Temu Ireng (Curcuma aeruginosa Roxb) Dengan Pelarut Etanol Dan N-heksana', *Jurnal Teknologi Techonoscientia*, 13(1), pp. 83–94.

Balakrishnan.K.P.,Narayanaswamy.2011. Bothanicals as Suncreen : Their Role The Prevention of Photoaging and Skin Cancer. Internasional Journal of Research In Cosmetic Science.Vol.1(1).1-12

Dutra, E. A., Oliveira, D. A, Hackman, E. R., & Santoro, M. I. (2004). 'Determination of sun protection factor (SPF) of sunscreens by ultraviolet spectrophotometry', Revista Brasileira de Ciencias Farmaceuticas/Brazilian Journal of Pharmaceutical Sciences, 40(3).

Hafid, A.F., Pulinasari,N., Lestari, N.S., Tumewu, L, L., Rahman, A, Widyawaruyanti, A. (2016). Skrining Aktivitas Antimalaria beberapa Tanaman Indonesia Hasil Eksplorasi dari Hutan Raya Cangar Batu Malang Jawa Timur. Jurnal Farmasi dan Ilmu Kefarmasian .Vol.3 (1).Ma'arif, B., Mahardiani.A, M. F., Mirza,D. (2021). *Fitokimia dan aplikasinya*. Surabaya: Sintesa Books

Marpaung, M.E., Luliana, S., & Susanti, R. (2015) 'Uji Aktivitas Krim Ekstrak Metanol Bunga Rosella (Hibiscus sabdariffa) Sebagai Tabir Surya', *Jurnal Mahasiswa Farmasi Fakultas Kedokteran UNTAN*, 3(1), pp. 3–8.

Oktaviasari.,L.,Zulkarnain.,A.K.2017. Formulasi dan Uji Stabilitas Fisik Sediaan Lotio O/W Pati Kentang (*Solanum toberosum*.L) Serta Aktivitasnya Sebagai tabir Surya. Majalah Farmaseutik. Vol.3.No.1.9-27.

Prasiddha, I. J., Laeliocattleya, R. A., Estiasih, T., & Maligan, J. M. (2016) 'The Potency of Bioactive Compounds from Corn Silk (Zea mays L.) for the Use as a Natural Sunscreen : A Review', *Jurnal Pangan dan Agroindustri*, 4(1), pp. 40–45.

Rini Agustin, Yulida Oktadefitri, H. L. (2013) 'Formulasi Krim Tabir Surya Dari Kombinasi Etil P – Metoksisinamat Dengan Katekin', pp. 184–198.

Susiloningrum, D. and Indrawati, D. (2020) 'Penapisan Fitokimia Dan Analisis Kadar Flavonoid Total Rimpang Temu Mangga (*Curcuma mangga* Valeton & Kata Kunci : Rimpang temu mangga (*Curcuma mangga* Valeton & Zijp .), Kadar Flavonoid Total , etanol , etil asetat Tanaman obat adalah tanaman yang salah', pp. 126–136.

Widyasanti, A., Nurlaily, N. and Wulandari, E. (2018) 'Karakteristik Fisikokimia Antosianin Ekstrak Kulit Buah Naga Merah Menggunakan Metode UAE', *Jurnal Ilmiah Rekayasa Pertanian dan Biosistem*, 6(1), pp. 27–38.

Yurleni (2018) 'Penggunaan Beberapa Metode Ekstraksi Pada Rimpang Curcuma Untuk Memperoleh Komponen Aktif Secara Kualitatif', 11(1), pp. 48–56.