Indonesian Journal of Pharmaceutics
IdJP
ISSN : 2597-8748

Vol 5, Issue 1, 2023 (347-356)
http://journal.unpad.ac.id/idjp

Applcation of Red Dragon Fruit Extract (*Hylocereus polyrhizus)* as an Antioxidant in Lip Cream Preparation

Ine Suharyani[1,2*], Rindiyani[1], Rima Yulia Senja[1], Lusy Nurdianti[3], Yuniarti Falya[1]
[1]Sekolah Tinggi Farmasi Muhammadiyah Cirebon
Cideng Indah, Kertawinangun, Kedawung, Cirebon, Jawa Barat 45133
[2]Departmen Farmasetika dan Teknologi Farmasi, Fakultas Farmasi, Universitas Padjadjaran, Jln. Raya Bandung-*Sumedang* Km. 21 Jatinangor, Kab. *Sumedang* 45363
[3]Prodi S1, Universitas Bakti Tunas Husada, Jl. Cilolohan 36 Tasikmalaya, Jawa Barat 46115

Submitted : 04/07/2022, Revised : 14/08/2022,, Accepted : 24/08/ 2022, Published : 12/09/2022

Abstract

Many lip creams contains both synthetic or natural dye. One of the fruit that can be used as natural dyes in a lip cream preparation is dragon fruit (Hylocereus polyrhizus) which has an attractive color. In addition, red dragon fruit contains anthocyanins, a group of flavonoid, that has efficacy as an antioxidants. This study aim to develope lip cream as cosmetic preparation containing of red dragon fruit for antioxidant. The extraction was done by Microwave Assisted Extraction (MAE) using ethanol 95%:aquadest (4:1). Lip cream preparations were made in 3 formulas with varying concentrations of extract, 5% (LCE5), 10% (LCE10) and 15% (LCE 15). The extraction uasing MAE method was yielded the rendemen of 44,12%. *Evaluation of the preparations carried out included organoleptic, pH, homogeneity, and spreadability, while antioxidant activity were carried out using spectrophotometry UV-Vis with the DPPH (2,2-diphenyl-1-picrylhidrazyl) method. The results showed that all lip cream formulas fulfill the requirement i.e organoleptic, pH, homogeneity, and spreadability. The antioxidant activity of LCE5, LCE10 and LCE15 were 195.26 ± 0.40, 174.94 ± 0,63, and 168.27 ± 0.60, respectively. All the preparation has medium antioxidant activity but LCE15 has a stronger antioxidant activity due to the smallest IC_{50} compared to LCE5 and LCE10. This result underlying the application of red dragon fruit extract as an antioxidant agent in lip cream preparation.*

Keywords: *Antioxidant, Lip cream, Red dragon fruit, IC_{50}*

*Corresponding author,
e-mail : inesuharyani25@gmail.com (I. Suharyani)

https://doi.org/10.24198/idjp.v5i1.44548

1. Introduction

Nowadays, there are various forms of cosmetics on the market, especially cosmetics for lips, one of which is lip cream. Lip cream is a cosmetic preparation that has a semi-solid texture and is used as a lip color (1). In the process of making cosmetics required additional materials such as dyes (2). Synthetic dyes are more widely used in beauty products because they are cheap, easy to obtain, and have sharper colors. However, excessive and continuous use of synthetic dyes can result in negative health effects such as irritation and cancer (3).

The efforts to replace the use of synthetic dyes with natural dyes from plants was elevated, one of which is the red dragon fruit plant (*Hylocereus polyrhizus*). red dragon fruit flesh (*Hylocereus polyrhizus*) contains high concentration of anthocyanin so it can be used for food, as well as cosmetics both as a coloring agent and as an antioxidant.

Antioxidants are substances that can withstand or prevent damage to cells in the body caused by free radicals. Previous research stated that the antioxidant activity in red dragon fruit flesh was higher than in white dragon fruit flesh (4). To determine the antioxidant activity of a plant, you can use the DPPH (2,2 diphenyl-1-picrylhidrazyl) method. The DPPH method is used because it has a simple procedure to find out if a compound has antioxidant activity (5).

2. Method

Materials

Red dragon fruit obtained in Cirebon City and determined in IAIN Syekh Nurjati Cirebon. Carnauba wax (PT. Pratama Sains Global), microcrystalline wax (PT. Pratama Sains Global), setil alkohol (PT. Pratama Sains Global), castor oil (PT. Pratama Sains Global), propilen glikol (PT. Pratama Sains Global), titanium dioksida (PT. Pratama Sains Global), metil paraben (PT. Pratama Sains Global), oleum rosae (PT. Pratama Sains Global), tween 80 (PT. Pratama Sains Global), span 80 (PT. Pratama Sains Global), Vitamin C (PT. Pratama Sains Global). DPPH from HiMedia Laboratories, vitamin C from Sigma Aldrich, while ethanol 96%, and aquadestillata obtained from Bratachem. All the materials were used without further purification.

Method

Extraction of red dragon fruit

This study used red dragon fruit (*Hylocereus polyrhizus*) with an even red outer skin color found in Plered, Weru, Cirebon. The red dragon fruit plant (*Hylocereus polyrhizus*) was determined at the Biology Study Program Laboratory of IAIN Syekh Nur Jati Cirebon to confirm and confirm the plant samples to be used.

Red dragon fruit extract was prepared using the microwave-assisted extraction (MAE) method. 3 kg of red dragon fruit flesh, cut into thin slices, then put in the oven at 40 oC for 1 day. After the dragon fruit is dry, it is then soaked in 95% ethanol and distilled water in a ratio of 4:1 for 1 night. The simplicia soaked was put into the microwave and extracted for 4 minutes, then filtered to obtain the filtrate using filter paper and put into the rotary evaporator at 50^{o}C with a speed of 100 rpm (6). Next, the concentration of the extract was carried out using a water bath. The yield obtained is calculated by the following equation (7):

$$\% \, yield \, extract = \frac{extract \, weight}{the \, simplified \, weights \, used} 100 \, \% \, ... \quad (1)$$

Phytochemical screening

Alkaloid

Small amount of sample was diluted with 2 mL distilled water. Two mililiters solution of 2% HCl was added, heated for 5 minutes and filtered. The filtrate is reacted with 3 drops of Mayer reagent. Positive alkoloid with white precipitate or yellow precipitate formed (8).

Flavonoid

The sample was diluted with 5 ml of distilled water, then five drops of magnesium powder and concentrated HCl were added, respectively. The formation of red or orange

color indicates the presence of flavonoids (Lanisthi dan Febrina, 2015).

Saponin
2 ml of the extract was diluted with 5 ml of aquadest, then 10 drops of KOH were added and heated for 5 minutes, shaken for 15 minutes. Positive saponins formed with the high of 1 ml and stable for 15 minutes (9,10).

Steroid dan Triterpenoid
A piece of extract reacted with 1 ml of Liberman-Burchard reagent. The appearance of green indicates steroids, and the red or purple color indicates the presence of triterpenoids (8).

Tanin
A piece of extract reacted with 2 ml of $FeCl_3$. The presence of tannins and polyphenolic compounds indicated with a blackish green or dark blue (8).

Anthocyanin
A piece of extract was diluted with 2 ml of water. 2M HCl was added. The prescence of anthocyanin indicated with the red color (11).

Lip Cream Preparation
Lip cream preparations are made by heating the fat phase and the water phase in different containers. The oil phase, namely castor oil, carnauba wax, microcrystalline wax, and cetyl alcohol, was heated at 80^{o}C until completely melted. The water phase, namely distilled water, propylene glycol, tween 80, and methyl paraben, was heated at 60 oC. Enter the oil phase into magnetic stirrer, add the water phase, and stir until it forms a homogeneous cream. Add the titanium dioxide and oleum rosae, then add the red dragon fruit extract, and continue to stir until homogeneous (12).

Table 1. Formulation of Lip *Cream* containing Extract (LCE)

Formulation	Extract (g)	Castor oil (mL)	Carnauba wax (g)	*Microcrystalline wax* (g)	Setil alkohol (g)	Span 80 (mL)	Propilenglikol (g)	Tween 80 (mL)	Metil paraben (g)	Ol. Rosae (mL)	Distilled Water (mL)
LC	-	12	6	7	5	1,5	10	1,5	0,15	0,05	56,8
LCE 5	5	12	6	7	5	1,5	10	1,5	0,15	0,05	51,8
LCE 10	10	12	6	7	5	1,5	10	1,5	0,15	0,05	46,8
LCE 15	15	12	6	7	5	1,5	10	1,5	0,15	0,05	41,8

Evaluation
Organoleptic observations were carried out using the five senses to observe the shape, color and smell of the lip cream preparations (12).
To measure the pH, weigh 1 gram of lip cream and then dissolve it in a beaker glass with 10 mL of distilled water. Then dip the electrode in the lip cream until it shows a constant pH value. Lip pH 4.5–6.5 (13). Homogeneity test, take enough lip cream then place it between the object glass and observe whether there are any granules or not (1).
Spreadability test Take 1 gram of lip cream and place it in the middle of two flat

glasses. Add a load weighing 125 g, let it sit for 1 minute, and note how many diameters of lip cream are spread. Good spreadability is 5-7 cm (1).
Stickiness test: place 0.25 gram of lip cream between the slides, and then add a load weighing 1 kg on top of the slide for 5 minutes. After that, the weight was taken, then the two slides were pulled using an 80-gram load, and the time was recorded until the slide was released. It is said to have good adhesion when the object glass is removed within 2-300 seconds (14).

Antioxidant Activity
Antioxidant activity of DrF-POMG was determined by uv-vis spectrophotometer UV-Vis (Shimadzu UV Mini-1240) using DPPH method and vitamin C as a standard.

Determination of maximum wavelength (λ_{maks}) DPPH
The initial preparation is making a DPPH solution, which is weighed at 10 mg and then dissolved with 95% ethanol in 100 ml. Pipette 4 ml of the solution, then add 2 ml of 95% ethanol, and then determine the maximum wavelength at 400–700 nm (15).

Determination of operating time
The solution was prepared by adding 2 mL of DPPH and adding 4 mL of 95% ethanol, then shaking until homogeneous. Then the absorption is measured at the maximum wavelength at 0, 10, 20, 30, 40, 50 and 60 minutes (15).

Preparation of standard vitamin C solution
Vitamin C mains solution is prepared by weighing 10 mg of vitamin C and then dissolving it in 95% ethanol to 100 ml. Dilute the solution so that 3 concentrations are obtained, namely 2, 4, and 6 ppm.

Preparation of sample
The LCE5, LCE10 and LCE15 samples were weighed as much as 10 mg and dissolved in 95% ethanol up to 100 ml. Each solution was diluted to obtain concentrations of 40, 50 and 60 ppm.

Antioksidan measurement
Each 4 mL of vitamin C solution 2, 4, 6 ppm, added 2 mL of DPPH solution, shaken until homogeneous, incubated 10 minutes in a dark place. Measure the absorbance using a UV-Vis spectrophotometer at λ_{max}. Each sample of LCE 5, LCE10 and LCE15 which had been diluted at a concentration of 40, 50, 60 ppm was pipetted as much as 4 mL then added 2 mL of DPPH solution, shaken until homogeneous, and incubated for 10 minutes in a dark place. Measure the absorbance using a UV-Vis spectrophotometer at λ_{maks}.

Data Analysis
This study uses data analysis techniques with the Statview program version 5.0 with Scheffe's testing. The data analyzed were the results of the evaluation of the preparations in the form of measurements of pH, spreadability, adhesion and antioxidant activity which were then calculated on the average ± SD, and the differences were compared statistically. The results for the evaluation of the preparation were compared with LC, while the antioxidant activity test was compared with vitamin C.

3. Result

Extraction of Red Dragon Fruit
Red dragon fruit was extracted using the MAE (Microwave Assisted Extraction) method with 95% ethanol and distilled water (4:1) as the solvent to increase the polarity of the sovent. Before MAE, the simplisia was macerated by the solvent for a night to wetting the simplisia. After extraction was finished, the extract was filtered with filter paper to obtain the filtrate, then evaporation was carried out with a rotary evaporator at 100 rpm to evaporate the extraction solvent with a temperature of 50ºC, to avoid damage to the heat-resistant compounds.

*Corresponding author,
e-mail : inesuharyani25@gmail.com (I. Suharyani)
https://doi.org/10.24198/idjp.v5i1.44548

Furthermore, the extract was concentrated using a water bath to obtain a thick extract. The extract obtained is brown in color, this is because dragon fruit contains anthocyanins which are a group of flavonoids that have color stability that is affected by light, temperature and also pH (16). This method give the yield extract about 44.12%. This results meets the requirement because the yield extract should be more than 10% (17).

A phytochemical screening were examined to determine the secondary metabolite contained in extracts. These compounds identified by reagents that provide the characteristics of each secondary metabolite (18). The tests included alkaloids, flavonoids, saponins, steroids, triterpenoids and tannins. The results of identifying secondary metabolites of DrF extract can be seen in Table 2. DrF extract contains alkaloid, flavonoid, triterpenoids, saponin, and antochyanins, but didn't contained tannins and steroid (18).

Table 2: Phytochemical screening of DrF Extract

Secondary metabolites	Results
Alkaloids	+
Flavonoids	+
Tannins	-
Triterpenoids	+
Steroids	-
Saponin	+
Antochyanins	+

Note: (+) = indicates present, (-) = indicates absent/not detected

Lip cream preparation for LC is white, LCE5 is light brown, LCE10 is brown and LCE15 is dark brown.

Figure 1. Organoleptis appearance of LCE5, LCE10 dan LCE15

Organoleptic observation to see whether the preparation were good or not, that is seen from the shape, color and also the smell is evenly distributed (12). Organoleptically, the LC, LCE5, LCE10 and LCE15 preparations are semi-solid (creamy) with a distinctive smell of roses. LC which did not contain extract was white, LCE5 was light brown, LCE10 and LCE15 were dark brown.

The pH measurement is carried out to determine the acidity level of the preparation so that it does not irritate when applied to the lips. pH LC was 5.64±0.10, LCE5 was 5.06±0.01, LCE10 was 5.05±0.03 and LCE15 was 5.04 ± 0.04. This shows that the higher the concentration of the extract will cause a decrease in pH so that it becomes more acidic. pH of LC preparations, LCE5. LCE10 and LCE15 are in accordance with

the requirements for lip pH, namely 4.5-6.5(13). The results of this pH measurement show that all lip cream formulas are safe to use.

Homogeneity test was carried out to determine whether there were coarse grains in the preparation or not. Based on the tests that have been carried out, all lip cream preparations show that there are no coarse grains in all formulas when placed between glass objects. This result indicates that the preparation is homogeneous and safe to use.

The spreadability test was carried out to see how fast the lip cream can spread on the lips when used so that it is easier to apply. The scatter power results obtained for LC = 5.14 ± 0.02 cm, LCE5 = 5.25 ± 0.02 cm, LCE10 = 5.33 ± 0.03 cm and LCE15 = 5.34 ± 0.17 cm, so that the higher the concentration of the extract used, the more liquid the consistency and the easier it is to apply. This spreadability test states that all lipcream results meet the requirements, namely 5-7 cm (12).

Antioxidant Activity

The DPPH method is used because the method is simple, easy, only requires a few samples, fast and sensitive. The principle of this test is to measure the damping power of an extract or sample against DPPH free radicals. For comparison, use vitamin C, because vitamin C is a natural antioxidant that has the function of capturing free radicals. At the beginning of the test, a search for λmax was carried out using a blank solution, namely DPPH solution in 95% ethanol (2:4) and scanning at λ = 400-700 nm using a UV-Vis spectrophotometer (19).

The highest absorbance was obtained at λmax = 519 nm of 0.988. This λmax still meets the requirements for the maximum DPPH wavelength of 515-530 nm (19). Operating time determination starts from 0 minutes to 60 minutes. 0 to 10 minutes is the most stable time because it produces the same absorbance value of 0.973 and will be used for the sample and vitamin C incubation time, which is 10 minutes.

After determining the operating time, proceed with measuring the absorbance of vitamin C at concentrations of 2, 4 and 6 ppm. For lip cream preparations consisting of LCE5, LCE10 and LCE15 each was made with 3 concentrations namely 40, 50 and 60 ppm. Sample solution of vitamin C and lip cream each concentration added with DPPH solution and also 95% ethanol which was then incubated for 10 minutes beforehand. If the sample solution contains a compound that has a function as an antioxidant, when it is reacted with DPPH, the initially dark purple color will fade to bright purple or yellow (5). After carrying out the incubation process, the sample is inserted into the UV-Vis spectrophotometer at a maximum wavelength of 519 nm to determine the absorbance value.

Table 3. Antioxidant activity

Sample	Concentration	% inhibisi (Y)			IC50			Mean ± SD
		Replication 1	Replication 2	Replication 3	Replication 1	Replication 2	Replication 3	
Vitamin C	0 ppm	0	0	0	3.51	3.51	3.51	3.51 ± 0
	2 ppm	37.65	37.65	37.65				
	4 ppm	58.5	58.5	58.5				
	6 ppm	77.73	77.73	77.73				
LCE5	0 ppm	0	0	0	195.03	195.03	195.74	195.26 ± 0.40†
	40 ppm	14.06	14.06	14.06				
	50 ppm	14.06	14.06	14.06				
	60 ppm	13.86	13.86	13.76				
LCE10	0 ppm	0	0	0	174.93	175.01	174.37	174.77 ± 0.34†
	40 ppm	14.37	14.27	14.37				
	50 ppm	15.38	15.38	15.38				
	60 ppm	15.78	15.78	15.89				
LCE15	0 ppm	0	0	0	167.57	168.62	168.62	168.27 ± 0.60†
	40 ppm	15.78	15.78	15.78				
	50 ppm	16.09	16.09	16.09				
	60 ppm	16.29	16.09	16.09				

% inhibition was calculated by using the equation Y = bx + a, with x is concentration of each sample and Y is % inhibition so that the IC_{50} value were described in table 2. The IC_{50} for vitamin C, LCE 5, LCE 10 and LCE 15 were 3.51± 0; 195.26 ± 0.40; 174.77 ± 0.34; and 168.27 ± 060, respectively. The higher the concentration of the extract in LCE15 with an extract concentration of 15%, resulting the smaller IC_{50}, which means the antioxidant acvitity was more active to fight the free radical of DPPH. Vitamin C has a very strong antioxidant activity because the IC_{50} is less than 50 ppm, while the preparation has an IC_{50} value of more than 150 ppm which means it has moderate antioxidant strength. In evaluation of the antioxidant activity, temperature, light and pH of the sample greatly affected the results, and this can also be caused because when the sample was made, the antioxidant activity test is not immediately carried out so that it affects the results of the antioxidant activity. Based on the research results obtained, it shows that red dragon fruit extract can be used as a natural dye in lip cream preparations by producing colors from light brown to dark brown and has antioxidant activity that can be used to reduce free radicals.

4. Discussion

Red dragon fruit is extracted using the MAE (Microwave Assisted Extraction) method, because it only requires a short extraction time, uses a small amount of solvent and is easy. 95% ethanol is used as a solvent because red dragon fruit contains flavonoids which have a polarity close to that of 95% ethanol and distilled water is added to increase the polarity (20).

Organoleptic observation to see whether the preparation that has been made can be stated as good or not, that is seen from the shape, color and also the smell is evenly distributed (12). The results for LC, LCE5, LCE10 and LCE15 preparations were obtained in semi-solid (creamy) form with a distinctive smell of roses. LC which did not contain extract was white, LCE5 was light brown, LCE10 and LCE15 were dark brown. so it can be concluded that this lip cream preparation is good or meets the requirements.

a. pH measurements were carried out to determine the acidity level of the preparation so as not to irritate it when applied to the lips. The result of the pH of LC, LCE5, LCE10 and LCE15 preparations were 5.64±0.10; 5.06±0.01; 5.05±0.03; and 5.04±0.04, respectively. This result indicates that the higher the

concentration of the extract will produce a more acidic pH value and this can also be caused because this red dragon fruit extract has an acidic pH of 5. The results of this pH measurement are in accordance with the requirements for lip pH, namely 4.5-6.5 (13). The results of this pH measurement show that all lip cream formulas are safe to use.

b. Homogeneity test is carried out to find out whether there are coarse grains in the preparation or not. Based on the tests that have been carried out, all lip cream preparations show that there are no coarse grains in all formulas when placed between glass objects. This result indicates that the preparation is homogeneous and safe to use.

c. c. The spreadability test was carried out to see how fast the lip cream can spread on the lips when used so that it is easier to apply. The spreadability results obtained for LC, LCE5, LCE10 and LCE15 preparations were 5.14±0.02 cm; 5.25±0.02 cm; 5.33±0.03 cm; and 5.34± 0.17 cm, respectively. The higher the concentration of the extract used, the more liquid the consistency and the easier it is to apply. This spreadability test stated that all the results of the formula met the requirements, namely 5-7 cm (12).

The DPPH method is used because the method is simple, easy, requires only a few samples, is fast and sensitive. The principle of this test is to measure the damping power of an extract or sample against DPPH free radicals. For comparison, use vitamin C, because vitamin C is a natural antioxidant that has the function of capturing free radicals.

The higher concentration of the extract used as in LCE15 with an extract concentration of 15%, the smaller the IC_{50} value obtained, which means the more active the power of antioxidant compounds that can be used to fight DPPH as free radicals. Vitamin C has very strong antioxidant activity because the IC_{50} is less than 50 ppm, while the three formulations have an IC_{50} value of more than 150 ppm which means they have moderate antioxidant strength. In testing the antioxidant activity, temperature, light and pH of the sample greatly affect the results of the antioxidant activity test.

5. Conclusion

Based on the results of the research that has been described, it can be concluded that red dragon fruit extract can be used as a natural coloring agent in lip cream preparations by producing colors from light brown to dark brown. The antioxidant activities for LCE5, LCE10, and LCE15 were expressed in IC_{50} values, respectively, 195.26 ± 0.40 (moderate), 174.77 ± 0.34 (moderate), 168.27 ± 0.60 (currently). LCE15 is the best formula because it has a smaller IC_{50} value compared to LCE5 and LCE10, which means that the lower the IC_{50} value, the higher the antioxidant activity. Based on the research results obtained, it shows that red dragon fruit extract can be used as a natural dye in lip cream preparations by producing colors from light brown to dark brown and has antioxidant activity that can be used to reduce free radicals..

6. Acknowledgements

We would like to thank Sekolah Tinggi Farmasi Muhammadiyah Cirebon for supporting this study.

References

1. Jessica, Rijai L, Arifian H. Optimalisasi Basis Untuk Formulasi Sediaan Lip Cream. Proceeding Mulawarman Pharm Conf. 2018 Dec;8:260–6.
2. Kartika Sitorus A dan VED. Formulasi Sediaan Lipstik Ekstrak Etanol Buah Naga Merah (*Hylocereus polyrhizus*). J Pharm world. 2017;2(1):1–8.
3. Yulyuswarni Y. Formulasi Ekstrak Kulit Buah Naga Merah (*Hylocereus*

polyrhizus) Sebagai Pewarna Alami Dalam Sediaan Lipstik. J Anal Kesehat. 2018;7(1):673.
4. Widianingsih M. Antioxidant Activity Extract Methanol of Red Dragon Fruit and Evaporation by Dry Air. 2016;146–50.
5. Helda RN. Aktivitas Antioksidan Ekstrak Etanol Kulit Buah Naga Merah Daerah Pelaihari , Kalimantan Selatan. 2016;03(02):36–42.
6. Suharyani I, Falya Y, Rindiyani, Nurmaya N, Afidah Y. Pengaruh Pelarut Polar terhadap Aktivitas Antioksidan Daging Buah Naga Merah (*Hylocereus Polyrhizus*) yang diekstraksi dengan Metode Microwave Assisted Extraction (MAE). 2022;5(2):237–48. Available from: https://e-journal.unper.ac.id/index.php/PHARMACOSCRIPT/article/view/1007
7. Yasa Q, Shiddiqi A, Apriyani RF, Kusuma D, Karisma AD. Anthocyanin Extraction from The Pericarp of Red Pitaya (*Hylocereus polyrhizus*) Using Microwave Assisted Hydrodistillation (MAHD) Method. 2021;05(200):30–7.
8. Dida Fitri Lanisthi, Lizma Febrina MAM. Analisis Senyawa Metabolit Sekunder Ekstrak Etanol dan Ekstrak Air Kulit Buah Naga Merah (*Hylocereus polyrhizus*). 2015;1–5.
9. Ningsih DR, Zusfahair, Mantari D. Ekstrak Daun Mangga (*Mangifera indica* L.) sebagai Antijamur terhadap Jamur Candida albicans dan Identifikassi Golongan Senyawanya. J Kim Ris. 2017;2(1).
10. Khalid S, Shahzad A, Basharat N, Abubakar M, Anwar P. Phytochemical Screening and Analysis of Selected Medicinal Plants in Gujrat. J Phytochem Biochem. 2018;2(1):2–4.
11. Meidayanti Putri N, Gunawan I, Suarsa I. Aktivitas Antioksidan Antosianin Dalam Ekstrak Etanol Kulit Buah Naga Super Merah (*Hylocereus Costaricensis*) Dan Analisis Kadar Totalnya. J Kim. 2015;9(2):243–51.
12. Mufidah KA, Mahmudah F, Rijai L. Formulasi Sediaan Lipcream Dengan Pewarna Alami Ekstrak Buah Senggani (*Melastoma Malabhatricum*). 2021;(April 2021):106–10.
13. Falya Y, Rizikiyan Y, Suharyani I, Amelia R, Yulia Senja R. Formulation and Evaluation of Lipstick with Braziline Pigment of *Caesalpinia sappan* L. J Farm Etam. 2022;1(2019):92–107.
14. Ambari Y, Hapsari FND, Ningsih AW, Nurrosyidah IH, Sinaga B. Studi Formulasi Sediaan Lip Balm Ekstrak Kayu Secang (*Caesalpinia sappan* L.) dengan Variasi Beeswax. J Islam Pharm. 2020;5(2):36–45.
15. Ahmed R, Tanvir EM, Hossen MS, Afroz R, Ahmmed I, Rumpa NEN, et al. Antioxidant properties and cardioprotective mechanism of Malaysian propolis in rats. Evidence-based Complement Altern Med. 2017;2017.
16. Hidayah T. Uji Stabilitas Pigmen dan Antioksidan Hasil Ekstraksi Zat Warna Alami dari Kulit Buah Naga (*Hylocereus undatus*). Fak Mat Dan Ilmu Pengetah Alam Univ Negeri Semarang. 2013;29(18):2616–27.
17. Wardaningrum R, Susilo J. Perbandingan Aktivitas Antioksidan Ekstrak Etanol Terpurifikasi Ubi Jalar Ungu (*Ipomoea batatas* L) Dengan Vitamin E. [Internet]. 2019. Available from: http://repository2.unw.ac.id/696/
18. Nova C. Skrining Fitokimia Dan Uji Aktivitas Antioksidan Ekstrak Metanol Daun Sirih Lengkung (*Piper aduncum* L.). Universitas Sanata Dharma Yogyakarta; 2016.
19. Herdiani N, Putri EBP. Efek Antioksdian Ekstrak Buah Naga Merah (*Hylocereus polyrhizus*)

Terhadap Makrofag Alveolar Tikus yang Dipapar Asap Rokok. Univ Widyagama Malang. 2018;(September):391–400.
20. Noviyanty A, Salingkat CA, Syamsiar S. Pengaruh Jenis Pelarut terhadap Ekstraksi dari Kulit Buah Naga Merah (*Hylocereus polyrhizus*). KOVALEN J Ris Kim. 2019;5(3):271–9.