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PHYSICAL STABILITY EVALUATION OF CASSAVA LEAF AQUEOUS EXTRACT EMULGEL (*Manihot esculenta*)

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Abstract: Cassava leaves contain various secondary metabolites such as flavonoids and saponins that can be used as anti-inflammatory and antibacterial. This study aims to determine the physical stability of cassava leaf extract emulgel (*Manihot esculenta*), which can be used as an anti-inflammatory. Emulgel was made in 3 formulas with variations in the concentration of cassava leaf extract, namely 2.5%, 5%, and 7.5%. Emulgel stability tests include organoleptic tests, homogeneity, viscosity, dispersibility, adhesion, and pH. Stability testing using the cycling test method for 12 days of storage at temperatures 4^{o}C and 40^{o}C. This study showed cassava leaf extract can be formulated as emulgel and has good stability after storage at extreme temperatures for 12 days. Emulgel formulations from cassava leaf extract have good stability and can be anti-inflammatory.

Keywords: *Cassava leaves, emulgel, stability*

Abstrak: Daun singkong mengandung berbagai senyawa metabolit sekunder seperti flavonoid dan saponin yang dapat dimanfaatkan sebagai antiinflamasi dan antibakteri. Penelitian ini bertujuan untuk mengetahui stabilitas fisik sediaan emulgel ekstrak daun singkong (*Manihot esculenta*) yang dapat dimanfaatkan sebagai antiinflamasi. Emulgel dibuat sebanyak 3 formula dengan variasi konsentrasi ekstrak daun singkong yaitu 2,5%, 5% dan 7,5%. Pengujian stabilitas emulgel meliputi uji organoleptik, homogenitas, viskositas, daya sebar, daya lekat, pH. Pengujian stabilitas menggunakan metode cycling test selama 12 hari penyimpanan pada suhu 4^{o}C dan 40^{o}C. Penelitian ini diperoleh hasil yang menunjukkan bahwa ekstrak daun singkong dapat diformulasikan dalam bentuk sediaan emulgel serta memiliki kestabilan yang cukup baik setelah dilakukan penyimpanan pada suhu ekstrim selama 12 hari. Formulasi sediaan emulgel dari ekstrak daun singkong memiliki kestabilan yang cukup baik yang dapat digunakan sebagai antiinflamasi.

Kata kunci: *Daun singkong, emulgel, stabilitas*

INTRODUCTION

Cassava leaves have various antioxidants, such as alpha-carotene, and contain vitamin C, vitamin A, flavonoids, saponins, steroids, and glycosides (Bahekar and Kale, 2012). Cassava leaves contain flavonoid and saponin compounds that act as analgesics (Bokanisereme et al., 2013). Based on research (Tao et al., 2019). The average content of flavonoids in cassava leaf extract was 4.987 grams/100 grams, where the levels were calculated as normal flavonoid levels found in cassava leaves.

Research conducted by (S. E. Bahekar & Kale, 2015) mentioned that cassava leaf extract has an antidiarrheal effect which is indicated by a decrease in the volume of edema in the soles of rats. Baheker and Kale (2012) stated the presence of antibacterial and anti-inflammatory activity in cassava leaves. In line with the results of research by Himawan (2020), cassava leaf extract has an anti-inflammatory effect comparable to diclofenac sodium. Apart from being an anti-inflammatory, research results by Mustarichie et al. (2020) showed that cassava leaf extract had an excellent antibacterial effect. Cassava leaf extract is also effective in wound healing, made in the form of gel preparations (Megawati et al., 2020). In addition, cassava leaves also have antibacterial activity because they contain saponin compounds. When interacting with bacterial cells, saponins will increase the permeability of the bacterial cell membrane so that bacterial cell hemolysis occurs. Research conducted by Sahreni et al. (2020) showed that cassava leaf extract had inhibition against Staphylococcus aureus and Escherichia coli bacteria.

Emulgel is an emulsion preparation made in a gel with the addition of *gelling agent*. The advantage of the emulgel form is that it contains emulsion, which has better penetration ability (Shokri et al., 2012; Riski et al., 2016). Emulgel preparations have the advantages of emulsions and gels. The water phase can help increase penetration by hydrating the skin, and the oil phase can prevent evaporation of the skin so that the hydration process becomes more optimal (Siddhant Yadav, 2017).

Many studies have been reported on cassava leaf extract and emulgel stability tests, but specifically for emulgel stability tests of cassava leaf aqueous extract have not been carried out. A stability test is one of the mandatory requirements before obtaining a distribution permit and reaching the market. The stability test aims to

guarantee the effectiveness of the treatment because it is related to the effectiveness and safety of the active compound in the preparation.

Therefore, the researcher wanted to conduct a research entitled "Stability Test of Emulgel Formulation of Cassava Leaf Extract Water (*Manihot esculenta*).

METHOD

Preparation of Extract and Formulation

The sample was determined and identified in ANDA Herbarium, Andalas University. **E**xtraction using water solvent and freeze-drying method. The formulation of cassava leaf emulgel (*Manihot esculenta*) is based on Tirmiara (2018) research with several modifications to obtain the formulas in Tables 1 and 2.

Table 1. *Gel base formulation*

Gel Base Ingredients	Total % (w/v)
Carbopol 940	1.5
Triethanolamine	0.6
Aquadest ad	100

Table 2. *Emulgel formulation of cassava leaf water extract (Manihot esculenta)*

Emulgel Ingredients	Total % (w/v)			
	F0	F1	F2	F3
Cassava Leaf Extract	-	2.5%	5%	7.5%
Olive oil	5	5	5	5
Sorbitol	12	12	12	12
Tween 80	15	15	15	15
Methyl Paraben	0.3	0.3	0.3	0.3
Propyl Paraben	0.06	0.06	0.06	0.06
Gel Base	10	10	10	10
Aquadest ad	100	100	100	100

Evaluation

Organoleptic test

The examination was conducted on various organoleptic changes, including color, odor, and dosage form (Kasliwal et al., 2008).

Homogeneity test

We weighed as much as 0.5 grams of emulgel, smeared it on the slide, and clamped it with another slide (Kalayi et al., 2022).

pH test

This pH test is to determine the pH value during storage measured using a calibrated pH meter (Nurdianti & Aji, 2018).

Spreadability

The dispersion test was carried out by weighing 0.5 grams of gel, placing it on a glass, and adding 50 grams, 100 grams, and 150 grams on top. The test was carried out for 1 minute (Putranti et al., 2018).

Adhesion test

We weighed 0.5 g of emulgel and placed it in the middle of the object glass, and covered it with another object glass. The object glass is mounted on a test instrument with a load of 80 grams. Calculate the time it takes two glasses of objects to be released (Swastika et al., 2013).

Viscosity test

Viscosity test using Viscometer Brookfield NDJ-5S (Siddhant Yadav, 2017).

Cycling test

Emulgel preparations were stored at 4ºC for 24 hours, then transferred to an oven at 40ºC for 24 hours (one cycle). The test was carried out for six cycles (Melani Hariyadi et al., 2022).

Data analysis

The results of the data were analyzed using a descriptive method with the presentation of the data in the form of a table of results.

RESULT AND DISCUSSION

Plant Determination

Based on the results of the determination of the sample carried out at the Andalas University Herbarium, Padang, with the number 255/K-ID/ANDA/VI/2020, it shows that the sample used in this study is true cassava leaves (*Manihot esculenta).*

Evaluation of cassava (Manihot esculenta) leaf aqueous extract emulgel preparations

The Table 3 shows that the organoleptic emulgel preparation did not change for the four formulas in terms of color, odor, and shape after the cycling test. This indicates that all formulas have good stability.

Homogeneity test

The test results obtained before and after the cycling test showed that the whole formula has good homogeneity with no visible granules and that all parts of the emulgel material are evenly mixed.

Viscosity test

Viscosity testing aims to determine the level of viscosity of a preparation. According to SNI, a good viscosity value for semi-solid preparations is 2000-50,000. The results obtained after stability testing using a *cycling test*, all formulas have a viscosity that meets the requirements of a good viscosity value (Table 4).

Table 3. The results of the organoleptic test of the emulgel water extract of cassava leaves (*Manihot esculenta*)

Formula	*Cycling Test*	Organoleptic		
		color	**Smell**	**Form**
F0	Before	White	Fragrant	Slightly Thick
	After	White	Fragrant	Slightly Thick
F1	Before	Light green	The distinctive smell of cassava leaves	Slightly Thick
	After	Light green	The distinctive smell of cassava leaves	Slightly Thick
F2	Before	Light green	The distinctive smell of cassava leaves	Slightly Thick
	After	Light green	The distinctive smell of cassava leaves	Slightly Thick
F3	Before	Light green	The distinctive smell of cassava leaves	Slightly Thick
	After	Light green	The distinctive smell of cassava leaves	Slightly Thick

Table 4. Result of viscosity test of cassava leaf water extract emulgel (*Manihot esculenta*)

Formula	Cycling test	Viscosity	Note
F0	Before	14,500	MS
	After	13,432	MS
F1	Before	15,627	MS
	After	14,120	MS
F2	Before	16,047	MS
	After	13,532	MS
F3	Before	15.761	MS
	After	14.006	MS

Information:

TMS : Not eligible

MS :Qualified (viscosity 2,000-50,000 Cp)

Spreadability test

The dispersion test aims to determine the dispersion value for emulgel preparations that are made to be easily applied to the skin. Emulgel that can be used and applied well to the skin has a dispersion value of 3-5 cm (Ali Khan et al., 2020).

The results indicate that all cassava leaf emulgel formulas have dispersion values that meet the requirements before and after the *cycling test* (table 5). This indicates that the preparation has good stability.

Table 5. The results of the dispersion test of the emulgel aqueous extract of cassava leaves (*Manihot esculenta*)

Formula	Cycling test	Spreadability	Note
F0	Before	4.7	MS
	After	4.9	MS
F1	Before	4.3	MS
	After	4.6	MS
F2	Before	3.5	MS
	After	4.6	MS
F3	Before	4.3	MS
	After	4.8	MS

Information:

TMS : Not eligible

MS :Eligible (3-5 cm spreadability)(Daud & Suyanti, 2017).

Adhesion test

An Adhesion test was carried out to determine the ability of the emulgel to adhere to the skin. If the stickiness of the emulgel preparation is high, it is expected that more active substances can be absorbed due to the time the preparation is in contact with the skin (Shaik et al., 2019). The requirement for a good adhesion value is more than one second (Karande & Mitragotri, 2009).

The results obtained for the test of adhesion showed that all formulas experienced a decrease in the value of adhesion after the test was carried out *cycling test*. This possibility can occur due to the influence of temperature during storage and a decrease in the viscosity value of the emulgel preparation, which can affect the decrease in the stickiness of the emulgel.

Table 6. The results of the adhesion test of cassava leaf water extract emulgel (*Manihot esculenta*)

Formula	Cycling test	Adhesion	Note
F0	Before	1.18	MS
	After	0.99	TMS
F1	Before	1.2	MS
	After	0.97	TMS
F2	Before	1.1	MS
	After	0.65	TMS
F3	Before	1.1	MS
	After	0.87	TMS

Information:
TMS : Not eligible
MS :Qualified (more than 1 second)(Nurdianti & Aji, 2018).

pH test

The pH test aims to determine whether the emulgel preparation has the same pH as the skin because emulgel is a topical preparation that will be applied to the skin. Standard human skin pH value ranges from 4,5-6,5 (Proksch, 2018). Preparations that have a low pH value or are too acidic will irritate the skin and give a stinging sensation, while preparations that are too alkaline or have a high pH can cause the skin to become dry and itchy (Ali & Ali, 2019).

Table 7. Results of pH test emulgel water extract of cassava leaves (*Manihot esculenta*)

Formula	Cycling test	pH	Note
F0	Before	6	MS
	After	6.2	MS
F1	Before	5.7	MS
	After	6.4	MS
F2	Before	5.8	MS
	After	5.6	MS
F3	Before	5.9	MS
	After	5.9	MS

Information:
TMS : Not eligible
MS :Qualified (pH 4.5-6.4) (Daud and Suyanti, 2017).

The pH value obtained shows that all formulas fall into the normal pH range of

human skin. The pH value of the emulgel changed after it was done *cycling test* but was still within the required normal range.

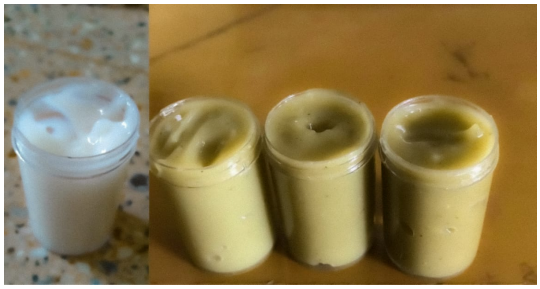

Figure 1. Emulgel results of water extract of cassava leaves (*Manihot esculenta*)

CONCLUSION

Based on the results obtained, it can be concluded that the water extract of cassava leaves (*Manihot esculenta*) can be formulated into emulgel form with various concentrations of 2.5%, 5%, and 7.5% and has good emulgel stability after a 12-day cycling test. The study showed that emulgel preparations had good physical stability and were ready to be used as anti-inflammatory drugs. This study shows that the stability of the preparation is needed to ensure the effectiveness of a drug.

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