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Formulation and Antioxidant Activity Test of Emulgel Extract of Guava (*Psidium Guajava Linn.*) Using DPPH (*2,2-Diphenyl-1- Picrylhydrazyl*) Methods

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ABSTRAK

Tanaman yang berpotensi mengandung antioksidan adalah daun jambu biji (Psidium guajava Linn.) yang memiliki salah satu kandungan senyawa yaitu flavonoid yang memiliki aktivitas antioksidan yang dapat meredam radikal bebas. Emulgel memiliki keunggulan seperti bersifat thixotropic, mudah menyebar, mudah dibersihkan, tidak meninggalkan noda, tahan lama dan dapat menjadi sistem penghantaran zat hidrofobik dan hidrofilik. Penelitian ini bertujuan untuk memformulasikan emulgel ekstrak daun jambu biji dan menentukan aktivitas antioksidan dengan metode DPPH. Penelitian ini diawali dengan ekstraksi daun jambu biji dan optimasi basis dengan variasi konsentrasi asam stearat sebagai bahan pengemulsi yang terdiri dari F1 8%, F2 10% dan F3 12%. Basis yang memenuhi syarat stabilitas fisik yang baik adalah F2. Basis F2 dibuat menjadi sediaan emulgel dengan 3 variasi konsentrasi ekstrak daun jambu biji, yaitu F2a 1%, F2b 2% dan F2b 3%. Ketiga formula tersebut diuji stabilitas fisiknya meliputi uji organoleptis, tipe emulsi, uji pH, daya sebar, daya lekat, uji viskositas, dan uji freeze thaw serta uji aktivitas antioksidan dengan metode DPPH. Hasil uji stabilitas fisik menunjukkan bahwa sediaan F2a, F2b dan F2c memenuhi persyaratan. Nilai IC50 pada masing-masing formulasi memiliki nilai aktivitas antioksidan yang berbeda. Pada formulasi F2a sebesar 123,59 ppm dan F2b sebesar 107,08 ppm yang tergolong aktivitas antioksidan sedang, sedangkan F2c sebesar 61,74 ppm tergolong aktivitas antioksidan kuat. Formula emulgel ekstrak daun jambu biji khususnya formula kedua (F2c) sangat berpotensi besar untuk dipertimbangkan oleh industri farmasi untuk dikembangkan menjadi produk antioksidan karena hasil dari evaluasi yang telah dilakukan memenuhi syarat dari segi evaluasi fisik maupun potensi kekuatan antioksidan.

Kata Kunci: Antioksidan; Emulgel; Jambu biji; Ekstrak; DPPH

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ABSTRACT

Plants that have the potential to contain antioxidants are guava leaves (Psidium guajava Linn.) which contain one of the compounds, flavonoids, which have antioxidant activity that can reduce free radicals. Emulgel has advantages such as thixotropic, easy to spread, easy to clean, does not leave stains, durable and can be a delivery system for hydrophobic and hydrophilic substances. This study aims to formulate guava leaf extract emulgel and determine antioxidant activity using DPPH method. This research began with guava leaf extraction and base optimization with varying concentrations of stearic acid as an emulsifier consisting of F1 8%, F2 10% and F3 12%. The base that meets the requirements of good physical stability is F2. F2 base was made into emulgel preparations with 3 variations of guava leaf extract concentration, namely F2a 1%, F2b 2% and F2b 3%. The three

formulas were tested for physical stability including organoleptic test, emulsion type, pH test, spreadability, adhesiveness, viscosity test, and freeze thaw test as well as antioxidant activity test with DPPH method. The results of the physical stability test showed that the preparations F2a, F2b and F2c met the requirements. The IC50 value in each formulation has a different antioxidant activity value. F2a formulation is 123.59 ppm and F2b is 107.08 ppm which is classified as moderate antioxidant activity, while F2c is 61.74 ppm which is classified as strong antioxidant activity. Guava leaf extract emulgel formula, especially the second formula (F2c), has great potential to be considered by the pharmaceutical industry to be developed into antioxidant products because the results of the evaluation that have been carried out meet the requirements in terms of physical evaluation and potential antioxidant strong.

Keywords: *Antioxidant; Emulgel; Guava; Extract; DPPH*

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1. Introduction

Exposure to ultraviolet light is more dangerous than other sunlight such as infrared because high ultraviolet radiation can cause sunburn (sunburn), skin redness (erythema) skin darkening (tanning), and can even cause skin cancer. Exposure to ultraviolet light can also trigger the formation of ROS (Reactive Oxygen Species). ROS (Reactive Oxygen Species) is an oxidative stress that can lead to increased production of free radicals. These free radicals are reactive and unstable so they can cause cell damage. Free radicals cannot have a negative effect on the body if the amount is balanced because the antioxidant system can neutralize it, if there is an imbalance between free radicals and antioxidants, it will cause a situation called oxidation stress[1,2].

Compounds that are able to remove, clean, and resist the effects of radicals are called antioxidants. Antioxidants stabilize free radicals by replenishing the electron deficiency of free radicals and inhibiting the chain reaction of free radical formation. In addition, antioxidants are also useful for regulating the continuous oxidation process in the body, so antioxidants are very important for maintaining the immune system in the body to be maintained [3,4].

Antioxidants can be complex molecules such as superoxide dismutase, catalase and peroxiredoxin, as well as simple compounds such as glutathione, vitamins (vitamins A, C, E and β- carotene) and other compounds (such as flavonoids, albumin, bilirubin, seruplasmin and others). Chemical compounds that belong to the antioxidant group and can be found in plants include polyphenols, bioflavonoids, ascorbic acid, vitamin E, beta-carotene, catechins and so on [5–8].

A plant that potentially has many properties and contains antioxidants is guava leaf. Guava (Psidium guajava Linn.) is a popular fruit plant known to many people, belonging to the Myrtaceae family, originating from the tropics of South America. In Indonesia itself guava is often used as a medicine because of the many benefits obtained, one part of guava that is often used is the leaves [9,10].

Guava leaves have long been used for traditional medicine, and there are many herbal products from guava preparations. Guava leaves themselves contain flavonoids, tannins, steroids, alkaloids and terpenoids and have oils including 0.4% volatile oil, 6% fatty oil, psidiolic acid, guajaverin acid, and ursolic acid. The pharmacological effects of guava leaves are antioxidant, anti-inflammatory, antidiarrheal, analgesic, antibacterial, antidiabetic, antihypertensive and platelet enhancer. One of the flavonoid compounds contained in guava leaves is quercetin, which has a melting point of 310°C, so

quercetin is resistant to heating. Flavonoid compounds in guava leaves have antioxidant activity that can reduce free radicals and ward off oxidative stress in the human body by helping to maintain the balance between oxidants and antioxidants [9–12].

One of the dosage forms in the cosmetic industry is topical preparations such as gels, ointments and emulgels. Emulgel is a topical preparation that has many advantages. Emulgels provide advantages for dermatology such as thixotropic, easy to spread, easy to clean, do not leave stains, transparent, durable and can be a delivery system for hydrophobic and hydrophilic substances. Compared to emulsion systems, emulgel preparations have advantages including increased stability of the emulsion system due to the increase in the viscosity of the water phase as the outer phase in the presence of a gelling agent. Emulgel preparations are also known to adhere better than cream preparations, making them suitable for topical applications. Compared to gel preparations, the advantage of the emulgel system is that it can facilitate the delivery of hydrophilic and hydrophobic compounds because emulgels are a two-phase oil and water system [13–15].

Gel preparations have advantages in this regard but due to their hydrophilic nature it becomes difficult for the delivery of hydrophobic substances. Therefore, emulgel preparations are formed which can be a delivery system for hydrophobic substances. Emulgel is a topical preparation that has two phases, namely gel and emulsion, which provides advantages for dermatology such as thixotropic, easy to spread, easy to clean, non-staining, acceptable, transparent, and durable [16–18].

Based on the above research, an emulgel preparation formulation will be carried out with the active substance guava leaf extract (Psidium guajava Linn.) which has been tested phytochemically to see what compounds are contained in guava leaf extract and antioxidant tests of guava leaf extract are carried out, using the DPPH method. DPPH is a purple stable free radical that is widely used for testing the free radical capture ability of some natural components such as phenolic components, anthocyanins or crude extracts. The DPPH method serves to measure the inhibitory activity of free radicals.

2. Methods

Design Study

This study is a laboratory experimental research that formulates guava leaf extract emulgel (*Psidium guajava Linn*.) obtained from the garden in gorontalo district. The study tested the fulfillment of physical stability and tested the activity of emulgel preparations as antioxidants with the DPPH method [19,20].

Materials

The equipment used in this study include porcelain cup, evaporator, beaker, hot plate, micro pipette, mixer, mortar, analytical balance (Osuka®), stamper, UV-Vis spectrophotometer (Genesys®), test tube, Brookfield viscometer (DV-E Viscometer®). The materials used in the study were guava leaf extract, distilled water (Kimia Jaya Abadi®), stearic acid (Merck®), ethanol (Merck®), 2,2-diphenyl-1-picrylhydrazyl, concentrated HCl, glycerin (Merck®), Magnesium powder (Merck®), dimethylol-5-dimethylhydantoin (Sigma Aldrich®), liquid paraffin (Merck®), propylene glycol(Merck®), triethanolamine (Merck®) and viscolam (Kimia Jaya Abadi®).

Sample collection and processing

Guava leaves are collected and washed and wet sorted, then guava leaves are chopped and dried by aerating. After drying, dry sorting is carried out and pulverized into powder. After that, guava leaf powder was extracted by maceration method. Guava leaf samples were collected as much as 1000 g and obtained 400 g of simplisia powder, then macerated with 70% ethanol solvent as much as 1000 ml for 3x24 hours while stirring, then filtered and the residue was remacerated with 70% ethanol as much as 500 ml for 24 hours. The method was repeated once again to get maximum results. after 3 days the extract was filtered using filter paper. Then the filtrate is evaporated until a thick extract is obtained and the percent yield of guava leaf extract is calculated [21–23].

Analysis of Flavonoid Compounds

A total of 2 mL of sample extract was put into a test tube, then added a few milligrams of Mg powder and 1 mL of concentrated HCl solution. Indicates the presence of flavonoids with a change in the color of the solution to orange red or purple red [24].

Solvent Free Test Ethanol Extract

Ethanol-free test can be done by means of 2 drops of concentrated sulfuric acid and 1 ml of potassium dichromate added to the extract, the presence of ethanol if there is a change in orange or bluish green color [25,26].

Emulgel Base Optimization

Optimization of emulgel preparation weighs all the ingredients that will be used. The oil phase consists of liquid paraffin and stearic acid, the water phase consists of propylene glycol, glycerin, DMDM Hydantoin and TEA. The stearic acid was heated. After each phase has been melted, the oil phase is put into the water phase. Then stirred using ultra turrax at 3000 rpm for 3 minutes until an emulgel mass was formed. For the preparation of gel base, develop viscolam with heated distilled water and stir until homogeneous. Add viscolam into the emulsion base then ultra turrax at 3000 rpm for 3 minutes [26,27]. Can be seen in table 1.

Table 1. Concentration variation emulgel base optimization

Component	Component function	Formula (%)		
		F1	F2	F3
Strearic Acid	Emulsyfing Agent	8	10	12
TEA	Emulsyfing Agent	2	2	2
Prophylenegycol	Humektan	10	10	10
Glycerin	Emolien	10	10	10
Liquid Parrafin	Oil Phase	25	25	25
Viscolam	Gelling Agent	10	10	10
DMDM Hydantoin	Antimicrobial Agent	0.5	0.5	0.5

Note : DMDM : Dimethylol-dimethyl, TEA : Trietanolamin Acetate

Guava Leaf Extract Emulgel Preparation

The emulgel formulation was made by weighing all the ingredients to be used. The oil phase consists of liquid paraffin and stearic acid, the water phase consists of propylene glycol, glycerin, triethanolamine, DMDM Hydantoin and guava leaf extract. The stearic acid was heated. After each phase has been melted, the oil phase is then put into the water phase. Furthermore, it was stirred using ultra turrax at 3000 rpm for 3 minutes until an emulgel mass was formed. For the preparation of gel base, develop viscolam with heated distilled water then stir until homogeneous. Add viscolam into the emulsion base then ultra turraxed at 3000 rpm for 3 minutes and dripped with TEA until an emulgel mass is formed [28,29]. The dosage formula can be seen in table 2

Table 2. Formulation Guava Leaf Extract Emulgel

Component	Component function	Formula (%)								
		F1a	F1b	F1c	F2a	F2b	F2c	F3a	F3b	F3c
Guava Leaf Extract	Active Ingredient	1	2	3	1	2	3	1	2	3
Steatric Acid	Emulsyfing Agent	8	8	8	10	10	10	12	12	12
TEA	Emulsyfing Agent	2	2	2	2	2	2	2	2	2
Propyhlengycol	Humektan	10	10	10	10	10	10	10	10	10
Glycerin	Emolien	10	10	10	10	10	10	10	10	10
Liquid Parrafin	Oil Phase	25	25	25	25	25	25	25	25	25
Viscolam	Gelling Agent	10	10	10	10	10	10	10	10	10
DMDM Hydantoin	Antimicrobial Agent	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Aquadest	carrier solvent	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100

Physical stability test

The physical stability of guava leaf extract (Psidium guajava Linn.) emulgel preparation consists of organoleptic test, emulsion type, pH, spreadability, adhesiveness, viscosity test conducted for 28 days at room temperature (40°C). In addition, Freeze-thaw evaluation consisting of organoleptic test, emulsion type, pH, spreadability, adhesiveness, viscosity test for 7 cycles [30,31]

Organoleptic test

Organoleptic testing is done by directly observing the color, smell and consistency of the emulgel physically [32,33].

Emulsion type test

Methylene blue is dripped on the emulgel and if methylene blue dissolves and gives an even color then the oil-in-water type emulgel preparation [27].

pH test

Testing the pH of the emulgel base using a universal pH stick, the emulgel preparation must match the pH of the skin, which is 4.5-7. pH measurement is carried out to determine any changes in the pH of the emulgel preparation during storage time using a pH meter [27].

Spreadability test

Measurement of spreadability is as much as 0.5 grams of preparation is placed on a round glass with a diameter of 15 cm, another glass is placed on it and left for 1 minute, measuring the diameter of the gel spread. After that, 150 grams of additional load was added and allowed to stand for 1 minute and then a constant diameter was measured. The requirement for spreadability for topical preparations is 5-7 cm [30,32,34].

Adhesion test

0.5 g amount of emulgel was placed on the glass slide and covered again with the same glass slide. Then, an additional 300 gram load was placed and allowed to stand for 5 minutes and then the length of time the two glasses were detached was calculated. Good emulgel adhesion is more than 1 second [30,32,34]..

Viscosity test

The viscosity test is carried out to determine whether the preparation is easily smeared on the skin, the lower the viscosity value, the easier the preparation is applied to the skin surface. The test was carried out using a viscometer for testing the viscosity of the emulgel preparation. This viscosity test was carried out using a Brookfield Viscometer tool. According to SNI 16-4319-1996, the viscosity of a good semisolid preparation is 2000 - 50,000 Cps or 2 - 50 Pa.S [30,32,34]..

Preparation of Antioxidant Test Solution

Weighed approximately 10 mg of emulgel, then dissolved in 100 mL of 70% ethanol (1000 ppm concentration) and made a 100 ppm solution. This solution is the parent solution. Several concentrations were made, namely 10, 20, 40, 60 and 80 ppm. From some of these concentrations were pipetted as much as 10 mL into a test tube, in each test tube added DPPH solution (0.1 mM) with a ratio of 1: 1 then wait 30 minutes at room temperature (25 ° C). then measured using a UV-Vis spectrophotometer at a wavelength of 519 nm [35,36].

3. Results and Discussion

Extraction result

Guava leaf simplisia powder (Psidium guajava Linn.) weighing 500 g, then macerated with 70% ethanol solvent as much as 1000 mL produces a thick extract of guava leaves (Psidium guaja Linn.) of 60 g, with a percentage yield of 12%, this is in accordance with the yield presentation where the high active compounds are indicated by the high yield produced.) of 60 g, with a percentage yield of 12%, this is in accordance with the presentation of the yield where that the high active compound is indicated by the high yield produced. The yield is said to be good if it is in the range of 10%-15% percent yield which indicates that the maceration extraction process on guava leaves (Psidium guajava Linn.) takes place perfectly [22,37].

Phytochemical screening

Guava leaf extract (Psidium guajava Linn.) dissolved with 70% ethanol and reacted using magnesium powder and concentrated HCl solution produces a color change from yellow to red or brown, these results indicate that guava leaf extract contains flavonoids. The addition of concentrated HCl in the flavonoid test in the

Wilstater method, to hydrolyze O-glycosyl. Glycosyl will be replaced by H+ from the acid because of its electrophilic nature. Glycosides in the form of sugars that are often found are glucose, galactose and ramnose. This reduction with Mg and HCl produces complex compounds that are red or orange in color on flavonol, flavonon, flavononol and xanthone [38,39]

Solvent free test

Ethanol free test can be done by means of 2 drops of concentrated sulfuric acid and 1 ml of potassium dichromate added to the extract, the presence of ethanol if there is a change in orange or bluish green color. Ethanol-free testing of guava leaf ethanol extract is done to ensure that the extract used for testing the antioxidant activity of ethanol, so that in testing the antioxidant activity works as an antioxidant is the content of secondary metabolites of guava leaf ethanol extract not the ethanol solvent used. Ethanol-free testing is done with the principle of oxidation, namely reacting potassium dichromate (K2Cr2O7) and ethanol in an acidic atmosphere. If the ethanol-free solution will form a mixed color from the extract solution, potassium dichromate solution (K2Cr2O7) and sulfuric acid solution (H2SO4), but if the extract solution contains ethanol then the mixture will form a blue color [40–42].

Emulgel Base Optimization Results

The emulgel formula was made by varying the concentration of stearic acid as an emulsyfing agent to find the optimum emulgel base. Stearic acid concentration variations are F1 8%, F2 10% and F3 12%. Various tests were carried out, namely based on physical stability tests including organoleptic tests, emulsion type tests, pH tests, bar power tests, adhesive power tests, viscosity tests and freeze thaw tests, showing that the F2 base was the optimum base, so that the F2 base (10%) was formulated with guava leaf extract (Psidium guajava Linn.) [43].

Stability physics test

The results of the physical stability test of guava leaf extract (Psidium guajava Linn.) emulgel preparations with room temperature and freeze-thaw tests, namely at cold temperatures (4 ℃) and hot temperatures (40 ℃) in 7 cycles, which include organoleptic observations, emulsion type tests, pH, spreadability, adhesion and viscosity. The results of organoleptic observations on day 0, namely preparations F2a and F2b are faded green in color, made from typical ingredients and thick consistency and while the F2c preparation is solid green in color, smells distinctive and has a thick consistency. After 28 days of storage there was no change in each formula [44].

The results of the emulsion type test showed that F2a, F2b and F2c were emulsions with an oil-in-water emulsion type. This is evidenced by the dissolution of methylene blue in each preparation in the emulgel and if methylene blue dissolves and gives an even color then the oil-in-water type emulgel preparation (Halid et al., 2023).

The pH test results showed that on day 0 to day 28, namely F2a, F2b and F2c had a pH of 7. Testing the pH of the emulgel base using a pH meter, the emulgel preparation must match the pH of the skin, which is 4.5-7 [27].

Spreadability test

The spreadability test showed that preparations F2a, F2b and F2c had spreadability ranging from 5-7 cm. The requirement for spreadability for topical preparations is 5-7 cm. Can be seen in **table 3** and **figure 1** [44].

Table 3. Spreadability test

Freezthaw cycle	F2a (cm)	F2b (cm)	F2c (cm)
1	6	6.5	6.4
2	6.5	7	6.5
3	6	6	6.5
4	7	5.5	6
5	5.5	5.6	5.9
6	6	6	6
7	5.5	6	6
Mean	6.07	6.09	6.19
SD ±	0.53	0.52	0.27

Note : F = Formula, SD = Standard deviation

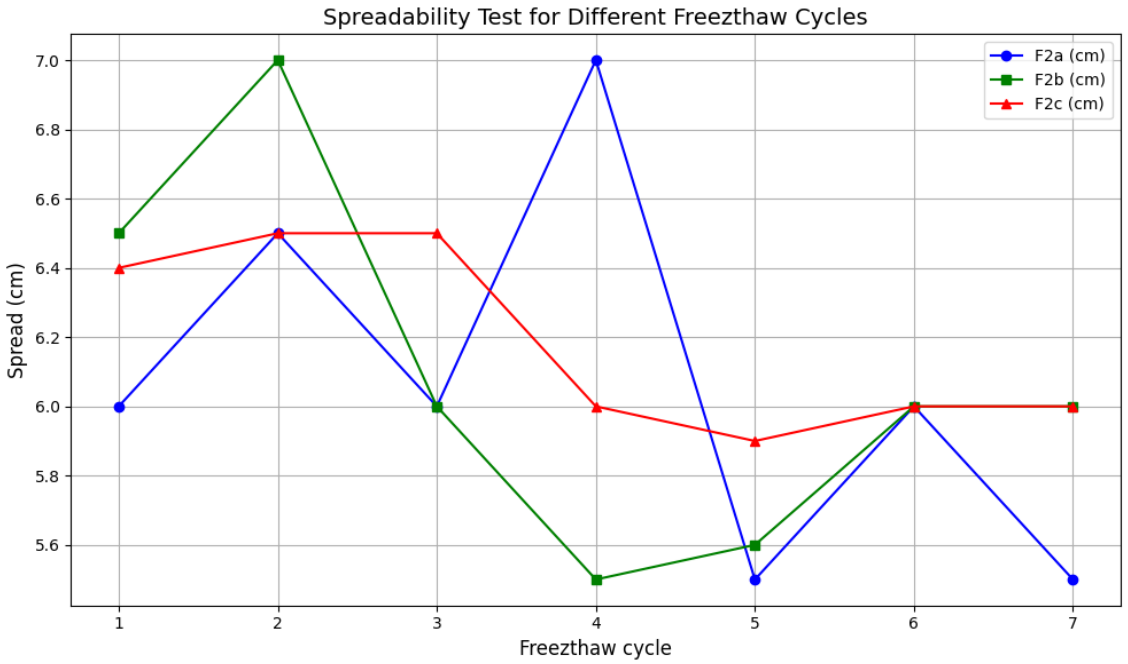

Figure 1. Graph of Spreadability test

The results of the spreadability test on preparations F2a, F2b and F2c experienced changes in spreadability before and after storage for 28 days at cold temperatures (4 ℃) and hot temperatures (40 ℃).

Adhesion test

The adhesion of a good topical preparation is more than 4 seconds, the longer the preparation is attached to the skin, the more active substances are absorbed and the preparation will provide a more optimal therapeutic effect. The adhesion test showed that preparations F2a, F2b and F2c had an adhesion of more than 10 seconds [45]. Good emulgel adhesion is more than 4 seconds. Can be seen in table 4 and figure 2.

Table 4. Adhesion test

Freezthaw cycle	F2a (s)	F2b (s)	F2c (s)
1	12.28	12.66	13.40
2	12.40	13.36	12.70
3	12.35	13.33	13.54
4	13.56	14.45	14.78
5	12.64	13.78	13.89
6	12.76	13.54	14.67
7	13.40	13.50	13.37
Mean	12.77	13.52	13.76
SD ±	0.48	0.58	0.76

Note F = Formula, SD = Standard deviation

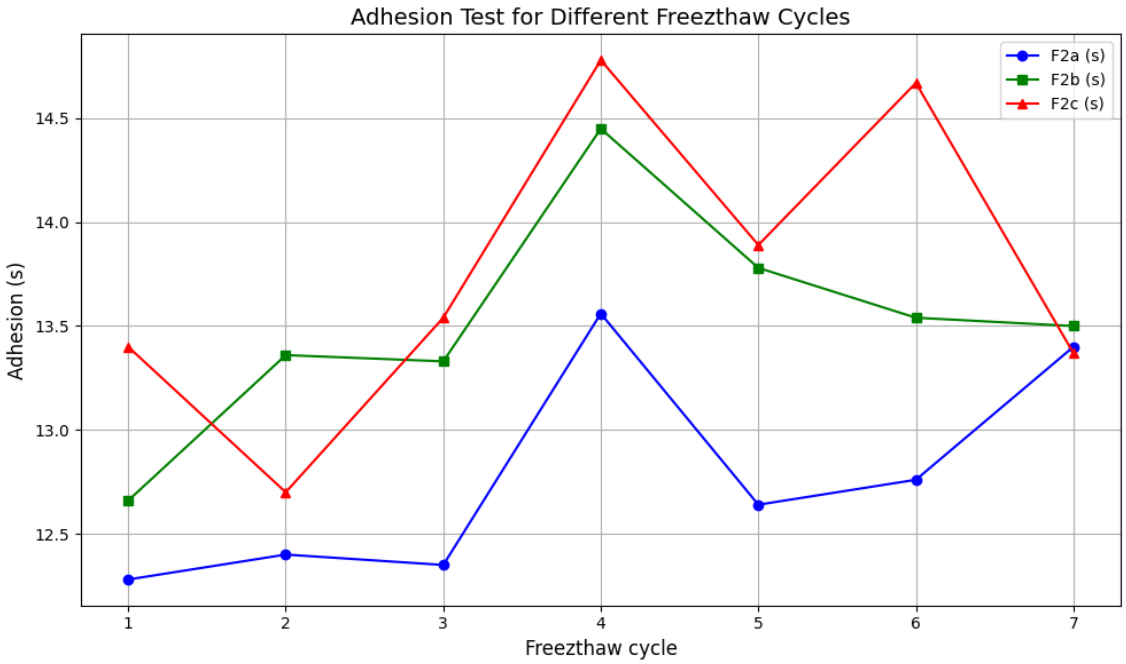

Figure 2. Graph of Adhesion test

Viscosity test

Viscosity test shows that F2a, F2b and F2c preparations have good viscosity. The requirement for good viscosity in semisolid preparations is 4,000-40,000 cPs [45]. can be seen in table 5 and figure 3.

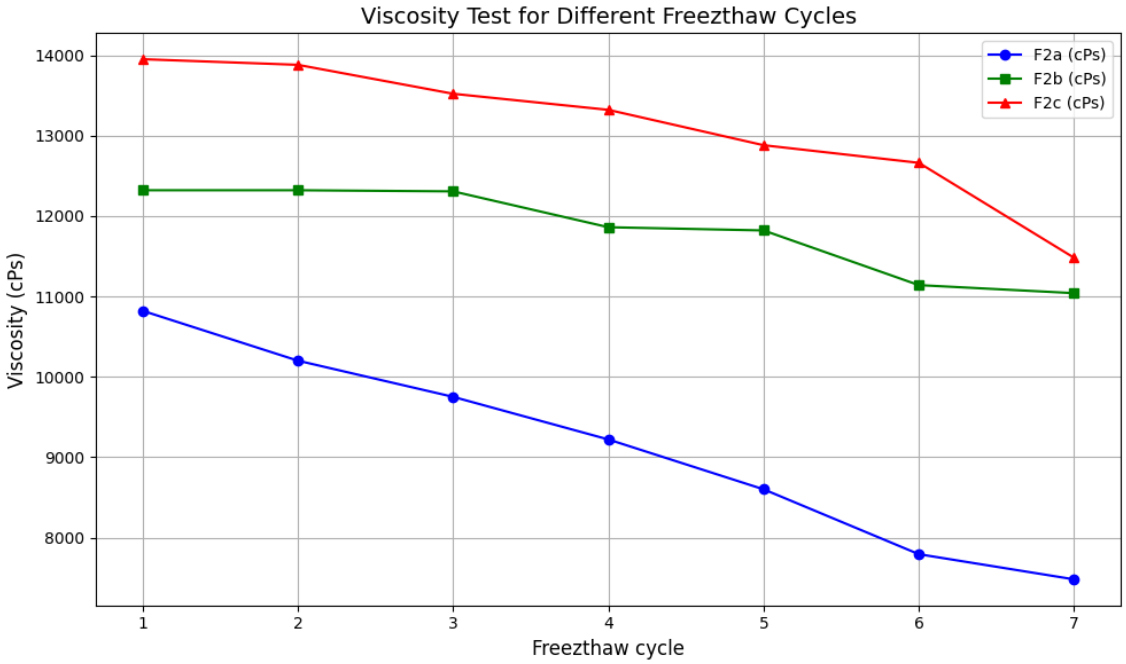

Figure 3. Graph of Viscosity test

Table 5. Viscosity test

Freezthaw cycle	F2a (cPs)	F2b (cPs)	F2c (cPs)
1	10820	12320	13950
2	10200	12320	13880
3	9750	12306	13520
4	9220	11860	13320
5	8600	11820	12880
6	7793	11140	12661
7	7480	11040	11480
Mean	9123.29	11757.43	13127.29
SD ±	1186.73	546.84	883.52

Note F = Formula, SD = Standard deviation

Antioxidant test

The results show that the strength of antioxidant activity of F2a and F2b is moderate because it has an IC50 value between 100-150 ppm. while the antioxidant strength of F2c is strong because it has an IC50 value of 50-100 ppm. can be seen in table 6 and figure 4.

Table 6. Antioxidant test

Formula	IC_{50}	Category
F2a	123.59	Moderate (100-150 ppm)
F2b	106.08	Moderate (100-150 ppm)
F2c	61.74	Strong (50-100 ppm)

Note : IC : Inihibiton concentration , ppm : Part per million

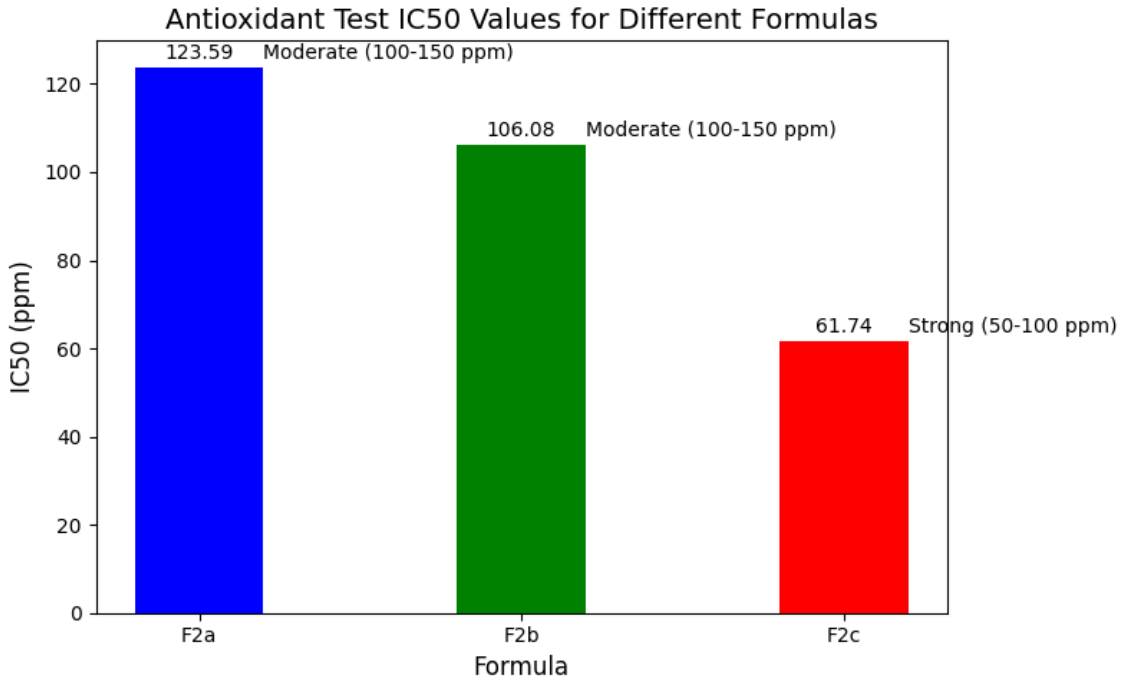

Figure 4. Graph of Antioxidant test

Antioxidant activity test was conducted to determine the capacity of active compounds in the extract to capture free radicals. Antioxidant activity of guava leaf extract (Psidium guajava Linn.) emulgel preparation was measured using DPPH (2,2-diphenyl-1- picrylhydrazyl) method. DPPH is a stable free radical compound and does not form dimers due to delocalization of free electrons throughout the molecule. This antioxidant activity test is based on the loss of purple color due to the reduction of DPPH by antioxidant compounds in the sample, resulting in a yellow DPP Hydrazine (DPPH) compound [46].

The DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical silencing method is based on the reduction of a methanol solution of colored DPPH free radicals by free radical inhibitors. When the purple DPPH solution meets with electron donor material, DPPH will be reduced, causing the purple color to fade and replaced by yellow color derived from the prikil group. The definition of IC50 (Inhibitor Concentration) is the concentration that can reduce 50% of DPPH free radicals. The smaller the IC50 value, the greater the antioxidant activity (Widyasanti et al., 2016). The IC50 value consists of 4 categories, namely the IC50 value <50 ppm which is categorized as very strong, the IC50 value of 50-100 ppm which is categorized as strong, the IC50 value of 100-150 ppm which is categorized as moderate and the IC50 value of 150-200 ppm which is categorized as weak [46].

The emulgel preparation of guava leaf extract (Psidium gujava Linn.) was tested for antioxidant activity using the DPPH method. The result of F2a was 123,597 ppm, F2b was 107,088 ppm and F2c was 61,749. These results illustrate that F2a and F2b are preparations with antioxidant power classified as moderate because they have IC50 values of 101-150 ppm, while F2c is a preparation with antioxidants classified as strong because it has IC50 50-100 ppm [46].

4. Conclusion

Guava leaf extract (Psidium guajava Linn.) can be formulated in emulgel preparations, where preparations F2a, F2b and F2c fulfill physical stability tests including freeze-thaw tests, organoleptic tests, emulsion type, pH adhesion, spreadability and viscosity. Antioxidant activity test of guava leaf extract emulgel preparations (Psidium guajava Linn.) has antioxidant activity with an IC50 value of F2a of 123.59 ppm and F2b of 107.08 ppm which is classified as moderate antioxidant activity, while the IC50 value of F2c of 61.74 ppm is classified as strong antioxidant activity.

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