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Original Article

Formulation of Emulgel Preparation Combination of Sunflower (*Helianthus annuus* L.) Seed Oil and Ethanol Extract of Kersen Leaves (*Muntingia calabura* L.) and Determination of Sunprotection Factor

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Abstract

The antioxidant activity of kersen leaf extract in the very strong category makes kersen leaves have potential as a sunscreen because they contain flavonoid and tannin compounds. High antioxidant content is also found in sunflower seed oil because it contains vitamin E, which acts as a sunscreen. To increase the effectiveness of both plants, it was developed into an emulgel preparation that can facilitate the delivery of hydrophilic and hydrophobic compounds. This study aims to determine the physical stability of the emulgel preparation and the *Sun Protection Factor* value of the combined emulgel preparation of sunflower (*Helianthus annuus* L.) seed oil and kersen *(Muntingia calabura* L.) leaf extract. This research is a type of experimental laboratory research. Samples were extracted by maceration method, using 96% ethanol solvent and formulated in the form of emulgel preparations with variations in sunflower seed oil concentrations of 2.5%, 5%, and 7.5% and 3% concentrations of kersen leaf extract. Then, physical stability tests were carried out, which included an organoleptic test, a homogeneity test, a pH test, a viscosity test, a spreadability test, an emulsion type test, a *cycling* test, and the determination of the SPF value of emulgel preparations in vitro. The results stated that all emulgel preparations met the criteria of organoleptic, homogeneity, pH, viscosity, spreadability, emulsion type, and *cycling test,* which were physically stable, and based on the results of determining the SPF value, it was shown that the emulgel preparation had activity as a sunscreen with the SPF values F1 6.55, F2 7.15, and F3 7.68.

Keywords: *Emulgel, Kersen (Muntingia calabura L.) leaf, SPF, Sunflower (Helianthus annuus L.) seed oil.*

Introduction

An electromagnetic radiation in sunlight called ultraviolet (UV) has long been renowned as a main factor causing skin damage. Three categories of UV based on wavelength include UVC (270 to 290 nm), UVB (290 to 320 nm), and UVA (320 to 400 nm) (Ahmed and Mikail, 2024). Sunscreens are cosmetic components that physically or chemically prevent UV rays from penetrating the skin. The effectiveness of sunscreens is expressed by the SPF *(Sun Protection Factor*) value. SPF is a unit of sunscreen used to indicate how long we can be exposed to sunlight without burning the skin (Sineke, 2016). The development of sunscreens is currently heading towards the use of natural ingredients because they are more easily accepted by the public. This is because the use of natural ingredients is

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considered safer and has fewer side effects compared to chemicals. Therefore, a number of studies have focused on the use of natural ingredients that can reduce solar radiation and increase protection against the harmful effects of solar radiation on the skin (COLIPA, 2006).

Kersen leaves *(Muntingia calabura* L) have activity as a natural sunscreen. Flavonoids, saponins, polyphenols, and tannins are secondary metabolite compounds found in kersen leaves that function as antioxidants and sunscreens. Previous research by Puspitasari (2018) revealed that the SPF results of sunscreen creams containing kersen leaf extract were considered very good, with the highest SPF value obtained at a concentration of 3% of 19.08 (ultra protection), which was able to provide an ultra-protective effect against sun exposure. In the research of Putri and Najid (2022), it is stated that kersen leaf extract has an $_{IC50}$ value of 43.29 ppm, further supporting the effectiveness of kersen leaves as antioxidants.

Another plant that has activity as an antioxidant and sunscreen is sunflower *(Heliantus annuus* L.) seeds because they contain active substances like omega 9, omega 6, vitamin E, tocopherol, lecithin, and carotenoids (Kulkarni *et al.,* 2014). Sunscreen activity in lotion formulations can be increased by adding 1% sunflower seed oil, according to previous research by Tamara *et al.* (2019). This is because sunflower seed oil contains vitamin E, which is an antioxidant. Vitamin E also acts as a photoprotective sunscreen on skin cell membranes by absorbing strongly in the region in the UV-B range of 290–320 nm.

The combination of two active substances has two objectives, namely, activity and dosage form. The preparation made is an emulgel, which is a combination of emulsion and gel systems, where sunflower seed oil will be dissolved in an emulsion and kersen leaf ethanol extract is dissolved in a gel base so that the entire phase combines the effects of the active substances. Because sunflower seeds and kersen leaves both have antioxidant and sunscreen activity, it is hoped that the combination can provide synergy and obtain a high SPF value. Sunscreen with a higher SPF content provides more protection for the skin from sunlight.

The advantages of emulgel preparations compared to emulsion systems are that emulgel preparations have advantages, including the stability of the emulsion system, which increases 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 sunscreen preparations (Sreevidya, 2019). Because emulgels are a two-phase system of oil and water, they have advantages over gel preparations because they can improve the delivery of hydrophilic and hydrophobic compounds (Mohite, 2019).

The purpose of this study is to produce an emulgel formula containing a combination of sunflower seed oil extract and ethanol extract from kersen leaves that is expected to have activity as a UV protector.

Material and Methods

The type of research used is experimental laboratory research to determine the *Sun Protection Factor* (SPF) value and physical stability of emulgel preparations from sunflower *(Helianthus annuus* L.) seed oil and kersen *(Muntingia calabura* L.) leaf extract.

Extraction method

Kersen leaf powder was extracted using the maceration method by weighing first, obtaining 500 g of kersen leaf powder, and then in a maceration vessel, then immersed in a 96% ethanol solvent. This maceration process was carried out for 3 x 24 hours and occasionally stirred. A new solvent was replaced every 24 hours and filtered, so that a liquid extract was obtained and collected in a glass vessel. The liquid extract was evaporated using a rotary vacuum evapator until a thick extract was obtained, and evaporation was carried out again using a water bath so that the kersen leaf extract was obtained.

Figure1. Leaf Kersen

Phytochemical Screening

Phytochemical screening was conducted on all filtrates to determine the solvent's capability for extracting secondary metabolite compounds from leaf kersen. The phytochemical tests performed represent the primary synthesis pathways of secondary metabolites. Filtrate testing was carried out for each solvent repetition, including alkaloids, saponins, flavonoids, tannins, triterpenes, and terpenoids.

1. Alkaloid Test :

A sample weighing 0.5 g was measured and subsequently introduced into 5 mL of ethanol. The mixture was then heated in a water bath for a duration of 2 minutes, followed by filtration. The resulting filtrate underwent further treatment with 3 drops of concentrated HCl and 5 drops of Mayer's reagent (K_2HgI_4). The formation of a white precipitate indicates the positive presence of alkaloids.

2. Flavonoid Test :

A 0.5 g sample was measured and introduced into 5 mL of ethanol, followed by heating and filtration. The resulting filtrate was then combined with 0.1 g of Mg metal and 5 drops of concentrated HCl. A positive reaction is identified by the development of an orange-to-red color, signifying the reduction of flavonoids.

3. Saponin Test :

A sample weighing 0.5 g was measured and placed into a test tube, followed by the addition of 10 mL of hot distilled water. The mixture was then filtered and allowed to cool. Through vigorous shaking, a stable foam with a height ranging from 1 to 10 cm was generated. This foam persisted for at least 10 minutes and remained unchanged even with the addition of 2 drops of 2 NHCl, indicating the presence of saponins.

4. Tannin Test :

Following measurement and introduction of a 0.5 g sample into 5 mL of ethanol, heating for 5 minutes, and then filtering came next. The resulting filtrate was then subjected to the addition of 5 drops of 1% $FeCl_3$. The formation of a dark greenish-black color signifies the positive presence of tannins.

5. Triterpenoid and Steroid Test :

0.5 g sample was weighed and added to 5 mL of ethanol, then filtered. The filtrate was added with 3 drops of concentrated HCl and 1 drop of concentrated H_2SO_4 (Salkowsky reagent). If triterpenoids are present, a red or purple color will form, and if steroids are present, a green color will develop.

Emulgel preparation

Different formulations are made using varying amounts of gelling agents and penetration enhancers. These methods differ only in the process of making gel in different formulations. The emulsion preparation was the same in all formulations. The gel phase of the formulation was prepared by

dispersing Carbopol 940 in purified water with constant stirring at medium speed using a mechanical shaker, and then the pH was adjusted to 6-6.5 using triethanolamine (TEA). The oil phase of the emulsion was prepared by dissolving span 20 in light liquid paraffin, while the water phase was prepared by dissolving tween 20 in purified water. Methyl and propyl parabens were dissolved in propylene glycol, while kersen leaf extract and sunflower seed oil were dissolved in ethanol, and both solutions were mixed with the aqueous phase. Clove oil and mentha oil were mixed in the oil phase. The two oily phases and the water phase were heated separately to 70-80°C, then the oily phase was added to the water phase with continuous stirring until it was cooled to room temperature. The emulsion obtained is mixed with the gel in a ratio of 1:1 with gentle stirring to obtain an emulgel (Jain *et al*., 2011).

Stability Evaluation of Emulgel Preparation

Evaluation of the physical stability of the preparation was carried out over a period of time at room temperature (25˚C - 28˚C) for 4 weeks and at extreme temperatures of 4˚C and 40˚C for 6 cycles. The parameters used include:

1. Organoleptic:

The organoleptical tests are carried out visually and show directly the shape, color, and smell of the emulgel preparation (Bhaware & Wankhade, 2022). The color of the emulgel should not change during storage, because if there is a change or loss of color, it can be caused by the growth of microorganisms. During storage of the emulgel, there should be no change in odor, starting from the beginning to the end of the test. If there is a change in odor that causes an unpleasant odor in the emulgel preparation, it will interfere with comfort in use (Harbiyah, 2019).

2. pH Test:

pH is a number that expresses the acidity/basicity of a water-soluble substance. The more alkaline or acidic the material on the skin, the more difficult it is for the skin to accept it, and the skin can become dry, cracked, and easily affected. The emulgel preparation, weighing 0.5 grams, was dissolved in 5 ml of aquadestilata and then measured using universal pH indicator paper. A good pH is one that is close to the pH value of the skin, which is 4.5-6.5 (Zhang *et al*., 2020).

3. Homogeneity Test:

The homogeneity test is carried out to see the mixing of each of the components in the emulgel preparation, with the aim of determining whether the emulgel preparation is evenly mixed or not. In this method, the emulgel is applied to a transparent glass, where the preparation is taken in three parts, namely the top, middle, and bottom. Homogeneity is indicated by the absence of coarse grains (Bhaware & Wankhade, 2022).

4. Spreadability:

If the diameter of the spread is less than 5 cm, the spreadability of the semisolid preparation can be classified as semisensitive (high viscosity), and if between 5-7 cm, it can be classified as semifluid (viscosity tends to dilute). The measurement of spreadability is as much as 0.5 grams of preparation 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 emulgel spread. After that, 150 grams of additional weight were added and allowed to stand for 1 minute, and then a constant diameter was measured. The expected spreadability results for emulgel preparations range from 3–5 cm. Because of this value, the emulgel can be used properly (Karafyllakis, 2019).

5. Viscosity test:

Viscosity measurement of the preparation was carried out using a Rion VT-06 viscometer. The emulgel preparation was placed in the viscometer container and mounted on a portable viscotester, then the spindle was lowered until it was submerged in the sample. The spindle was allowed to rotate for 30 seconds. The viscosity of the emulgel was determined by observing the movement of the

viscosity needle. A good emulgel viscosity is expected to be between 200-350 dPa.s. The viscosity requirement is said to be so because the viscosity of 200 dPa.s. is not felt to be too dilute, as is the viscosity of 350 dPa.s., which is not so thick (Rivai *et al*., 2018).

6. Emulsion Type Test:

a. Methylene Blue Method:

If methylene blue dissolves and produces an even color after being dripped on the emulgel, then the emulgel preparation is of the oil-in-water (M/A) type.

b. Method by Dilution:

Performed using the dilution technique, where the emulsion that has been made is placed in a cup and diluted by adding water. If the emulsion can be diluted, then the emulsion is oil in water (Nonci *et al*., 2016).

c. Cycling Test:

The emulgel preparation was stored at a cold temperature of 4˚C for 24 hours and then removed and placed at 40˚C, this process was counted as 1 cycle. This test is one of the accelerated stability tests on preparations to see the durability of emulgel preparations during storage (Suryani, 2017). The pH value, homogeneity, and spreadability were checked and observed for 6 cycles or 12 days.

Determination of SPF Value of Preparations

Determination of the *sun protection factor* value of emulgel can be done in vitro using a UV-Vis spectrophotometer by reading the absorption of the sample at a wavelength of 290-320 nm. The determination of SPF value aims to determine sunscreen activity or measure the amount of sun protection factor.

Then the data obtained is processed with the Mansur equation (Puspitasari *et al*., 2018).

$$\mathrm{SPF} = \mathrm{CF}\,\mathrm{x}\sum_{290}^{320}\mathrm{EE}\,(\lambda)\,\mathrm{x}\,\mathrm{I}\,(\lambda)\mathrm{x}\,\mathrm{Abs}\,(\lambda)$$

Description:

EE	: Erythema Effect Spectrum
I	: Intensity Spectrum of the Sun
Abs	: Absorbance of Sample
CF	: Correction Factor

The value of EE x I is a constant, where the value is fixed.

The procedure for measuring the SPF value of emulgel preparations is that a 0.5-gram sample is dissolved in 50 ml of 96% ethanol for each concentration. After that, a test absorption curve was made with a wavelength between 290 nm and 320 nm with an interval of 5 nm. The absorbance results were recorded, and then the SPF value was calculated using the Mansur method.

Data Processing and Analysis

The collection techniques used were descriptive and statistical analysis methods. Descriptive analysis was used for data from organoleptic testing, homogeneity, spreadability, emulsion type, pH, viscosity, and *cycling tests.* Statistical analysis was used for data on the results of determining the SPF value using *SPSS* (Statistical Product and Service Solution) *software* with the *One-Way ANOVA* method

Results

***Extraction Results of Kersen Leaf* (*Muntingia calabura* L.)**

The results of the extraction of kersen leaves (Muntingia calabura L.) using 96% ethanol solvent obtained the weight of the extract with the yield results can be seen in the table as follows.

Table1. Yield of Kersen Leaf Extract

Solvent	Powder Weight	Eight Extract	Yield (%)	Organoleptic
Ethanol96%	500 gram	75 gram	15 %	Color: Deep Green Odor: Typical Extract Form: Thick liquid

From the results of extraction using 96% ethanol solvent and the weight of 500 grams of simplisia powder produced a concentrated black extract color and the weight of the concentrated extract was 75 grams and the percent yield of the extract was 15%.

***1. Phytochemical Screening of Kersen Leaves* (*Muntingia calabura* L.)**

Based on the identification of the chemical compound content of kersen leaf extract, the results of the compound examination can be seen as follows

Table 2. Phytochemical Screening Test Observation Results

No	Compound Check	Reagents	Result (+/-)	Description
1.	Flavonoid I	HCl + Powder Mg	+	Orange red
	Flavonoid II	H_2SO_4	+	Reddish yellow
	Flavonoid III	NaOH 10%	+	Brownish yellow
2.	Phenolic	FeCl3	+	Greenish black
3.	Saponin	Hot air + HCl	+	Permanent foam
4.	Alkaloid	Dragendroff	+	There is orange precipitate
5.	Tanin	FeCl3	+	Blue-black
7.	Triterpenoid	Liebermann-Buchard	+	Brownish red

Description:
(+) = Contains secondary metabolite compounds
(-) = Does not contain secondary metabolite compounds

2. Stability Testing Results of Emulgel Preparation

a. Organoleptic Test:

Based on the organoleptic test of emulgel preparations, the following observations can be seen.

Table 3. Organoleptic Test Results of Emulgel Preparations Combination of Sunflower Seed Oil and Ethanol Extract of Kersen Leaves

Preparation	Obsevation	Week 1 Observation			
		I	II	III	IV
F0	Color	White	White	White	White
F1		Brownish green	Brownish green	Brownish green	Brownish green
F2		Brownish green	Brownish green	Brownish green	Brownish green
F3		Brownish green	Brownish green	Brownish green	Brownish green
Control Positive		White	White	White	White
F0	Odor	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae
F1		Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae
F2		Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae
F3		Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae	Characteristic scent of oleum rosae
Control Positive		Odorless	Odorless	Odorless	Odorless
F0	Shape	semi-solid	semi-solid	semi-solid	semi-solid
F1		semi-solid	semi-solid	semi-solid	semi-solid
F2		semi-solid	semi-solid	semi-solid	semi-solid
F3		semi-solid	semi-solid	semi-solid	semi-solid
Control Positive		semi-solid	semi-solid	semi-solid	semi-solid

Description:
F0 : Emulgel Formula Without Extract
F1 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 2.5%
F2 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 5%
F3 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 7.5%
Positive control: Emulgel Voltaren

a. pH Test:

Based on the pH test of the emulgel preparation, the following observations can be seen.

Tabel 4. pH Result of Emulgel Preparation of Combination of Sunflower Seed Oil and Kersen Leaf Ethanol Extract

Preparations	Week 1 Observation			
	I	II	III	IV
F0	6±0,00	6±0,00	6±0,00	6±0,00
F1	6±0,00	6±0,00	6±0,00	6±0,00
F2	6±0,00	6±0,00	6±0,00	6±0,00
F3	6±0,00	6±0,00	6±0,00	6±0,00
Control Positive	6±0,00	6±0,00	6±0,00	6±0,00

Description:
F0 : Emulgel Formula Without Extract
F1 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 2.5%
F2 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 5%
F3 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 7.5%
Positive control: Emulgel Voltaren

b. Homogeneity Test:

Based on the homogeneity test of the emulgel preparation. The observation results can be seen as follows.

Table 5. Homogeneity Test Results of Emulgel Preparations of Sunflower Seed Oil and Kersen Leaf Ethanol Extract Combination

Preparations	Week 1 Observation			
	I	II	III	IV
F0	Homogeneous	Homogeneous	Homogeneous	Homogeneous
F1	Homogeneous	Homogeneous	Homogeneous	Homogeneous
F2	Homogeneous	Homogeneous	Homogeneous	Homogeneous
F3	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Control Positive	Homogeneous	Homogeneous	Homogeneous	Homogeneous

Description:
F0 : Emulgel Formula Without Extract
F1 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 2.5%
F2 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 5%
F3 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 7.5%
Positive control: Emulgel Voltaren

c. Spreadability Test :

Based on the dispersion test of the preparation, the observation results can be seen as follows.

Table 6. Scatter ability Test Results of Emulgel Preparations Combination of Sunflower Seed Oil and Ethanol Extract of Kersen Leaves

Preparations	Mean SD Week 1 Observation (cm)			
	I	II	III	IV
F0	3,7±0,00	3,7±0,00	3,93±0,05	4,0±0,00
F1	4,1±0,00	4,13±0,05	4,43±0,05	4,66±0,05
F2	4,33±0,05	4,43±0,05	4,63±0,05	5,16±0,05
F3	4,56±0,05	4,63±0,05	4,9±0,00	5,36±0,05
Control Positive	5,5±0,00	5,5±0,00	5,5±0,00	5,5±0,00

Description:
F0 : Emulgel Formula Without Extract
F1 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 2.5%
F2 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 5%
F3 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 7.5%
Positive control: Emulgel Voltaren

d. Viscosity Test:

Based on the viscosity test of the emulgel preparation. The observation results can be seen as follows.

Table 7. Viscosity Test Results of Emulgel Preparations Combination of Sunflower Seed Oil and Ethanol Extract of Kersen Leaf

Preparations	Mean SD Week 1 Observation			
	I	II	III	IV
F0	240±0,00	240±0,00	226±5,77	226±5,77
F1	216±5,77	213±5,77	210±0,00	210±0,00
F2	190±0,00	186±5,77	180±0,00	180±0,00
F3	166±5,77	166±5,77	160±0,00	160±0,00
Control Positive	140±0,00	140±0,00	140±0,00	140±0,00

Description:
F0 : Emulgel Formula Without Extract
F1 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 2.5%
F2 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 5%
F3 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 7.5%
Positive control: Emulgel Voltaren

e. Emulsion Type Test:

Based on the emulsion type test, the following observations can be seen.

Table 8. Emulsion Type Test Results of Emulgel Preparation of Sunflower Seed Oil and Kersen Leaf Ethanol Extract Combination

Preparations	Emulsion Type		
	Methods Water Dilution	Methods Oil Dilution	Solvent Methylene Blue
F0	Dissolve	Insoluble	Dissolve
F1	Dissolve	Insoluble	Dissolve
F2	Dissolve	Insoluble	Dissolve
F3	Dissolve	Insoluble	Dissolve
Positive control	Dissolve	Insoluble	Dissolve

Description:
F0 : Emulgel Formula Without Extract
F1 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 2.5%

F2 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 5%
F3 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 7.5%
Positive control: Emulgel Voltaren

f. Cycling Test:

Based on the *cycling test of* emulgel preparations, the following observations can be seen.

Table 9. *Cycling Test* Results of Emulgel Preparations Combination of Sunflower Seed Oil and Ethanol Extract of Kersen Leaves

Preparations	Observation	Before	After
		Cycling Test	***Cycling Test***
F0	Organoleptic	Color: White	Color: White
		Odor: Typical oleum rosae	Odor: Typical oleum rosae
		Form: Semi-solid	Form: Semi-solid
	pH	6±0,00	6±0,00
	Spreadability	3,7±0,00	4,0±0,00
	Homogeneity	Homogeneous	Homogeneous
F1	Organoleptic	Brownish green	Brownish green
		Odor: Typical oleum rosae	Odor: Typical oleum rosae
		Form: Semi-solid	Form: Semi-solid
	pH	6±0,00	6±0,00
	Spreadability	4,1±0,00	4,83±0,05
	Homogeneity	Homogeneous	Homogeneous
F2	Organoleptic	Brownish green	Brownish green
		Smell: Typical oleum rosae	Smell: Typical oleum rosae
		Form: Semi solid	Form: Semi solid
	pH	6±0,00	6±0,00
	Spreadability	4,33±0,05	5,0±0,00
	Homogeneity	Homogen	Homogen
F3	Organoleptic	Brownish green	Brownish green
		Odor: Typical oleum rosae	Odor: Typical oleum rosae
		Form: Semi-solid	Form: Semi-solid
	pH	6±0,00	6±0,00
	Spreadability	4,56±0,05	5,26±0,05
	Homogeneity	Homogeneous	Homogeneous

Description:
F0 : Emulgel Formula Without Extract
F1 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 2.5%
F2 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 5%
F3 : Emulgel Formula Concentration of Kersen Leaf Extract 3% and Sunflower Seed Oil 7.5%
Positive control: Emulgel Voltaren

g. Test Results of Sun Protection Factor (SPF) Value of Emulgel Preparations:

Table 10.SPF Value of Emulgel Preparation

Formula	SPF Value	Sunscreen Protection Level
F0	1,79016	Weak Protection
F1	6,55854	Extra Protection
F2	7,156483	Extra Protection
F3	7,684386	Extra Protection
Positive control	39,277216	Extra Protection

Discussion

Kersen leaves contain compounds including flavonoids, phenolics, alkaloids, triterpenoids, saponins, and tannins that have activity as sunscreens and antioxidants. Phenolic compounds, especially flavonoids and tannins, have sunscreen potential due to the presence of chromophore groups that

can absorb UV rays, both UV A and UV B (Geraldine & Hastuti, 2018). Based on the identification of flavonoids, alkaloids, tannins, saponins, phenolics, and terpenoids, positive results were obtained.

Organoleptic tests on emulgel preparations are done visually using the five senses, including color, odor, and shape of the preparation. The observation results of the emulgel combination of sunflower seed oil *(Helianthus annuus* L.) and ethanol extract of kersen leaves *(Muntingia calabura* L.) had a brownish green color, and formula F0 had a white color. While the positive control has a white color, Based on observations for 4 weeks, it shows that the emulgel preparation has not changed in color, odor, and shape, so it can be concluded that the preparation made is stable during storage. Based on the observation results, it shows that all emulgel preparation formulas that have been made and positive controls remain homogeneous during storage time because there are no coarse grains and the surface is evenly smooth. According to Mulukuri *et al.* (2023), the preparation can be said to be homogeneous if there are no coarse grains in it. This also indicates that the base and other components in the emulgel are evenly mixed so that all components in it can provide the same and maximum effectiveness.

All emulgel formulas and positive controls are in accordance with skin pH requirements of 4.5–6.5 (SNI, 16–4399–1996). Thus, the resulting emulgel is stable and safe to apply to the skin. The pH of the preparation must be within the pH range of the skin to prevent skin irritation. According to Khullar *et al.* (2012), a pH value of more than 7 will cause the skin to become dry and lose moisture, while a pH value of less than 4 can cause skin irritation.

Viscosity test on emulgel preparations, where the provisions for good emulgel viscosity are expected to be between 200-350 dPa.s (Mita *et al,* 2020). Based on the observation results, they can be seen in Table 10, where the values of F0 and F1 are in accordance with the emulgel requirements of 200–350 dPa.s, different results for F2 and F3, which are below the required range, but the viscosity value is better than the viscosity of the positive control on the market. The viscosity value of each emulgel formula is different due to differences in the concentration of sunflower seed oil. Based on previous research by Kusumawati *et al.* (2018), which states that the higher the concentration of essential oil added to the emulgel preparation, the lower the viscosity, because the concentration of oil is more liquid than the preparation base, causing the viscosity to be lower. The decrease in viscosity can occur because the longer the storage time, the longer the preparation is affected by the environment, such as air. Less impermeable packaging can cause the emulgel to absorb water from outside, thus increasing the volume of water in the emulgel. This is based on components contained in hygroscopic formulas such as carbomer and propylenglycol (Sheskey *et al*., 2017).

The spreadability test on emulgel preparations aims to determine the ability of the speed of emulgel spread on the skin so that it can see the ease of application. Generally, the spreadability of topical preparations is 5-7 cm (Rachmalia *et al*., 2016). The expected spreadability for emulgel preparations ranges from 3-5 cm (Laverius, 2011). Based on the observations that can be seen in Table 10, there are differences in the results of each formula. This is due to variations in the concentration of sunflower seed oil affecting the resulting spreadability, which shows the diameter of the spread of F3 is greater than F1 and F2. The positive control gives the same spreadability during storage. There is an increase in spreadability every week, this is influenced by the viscosity of the emulgel, because spreadability has an inversely proportional relationship with viscosity. The higher the viscosity, the lower the spreadability, and vice versa (Mohammed *et al*., 2013).

The emulsion type test was carried out with 2, namely the dilution method and the substance solubility test method. Based on the results of observations on the emulgel preparation, it shows the type of oil-in-water emulsion (M/A) in dilution with water because the emulsion can dissolve evenly, while different results for dilution with oil are insoluble emulsions, which state that the emulgel preparation is not a type of water-in-oil emulsion (A/M). This is supported by the results of the substance solubility test using methylene blue, which is soluble in water. If the emulgel is dripped with methylene blue, it can dissolve and give an even color, so the preparation is of the M/A type. Based on the observation, it shows the type of oil-in-water emulsion (M/A) because all preparations that have been made can

dissolve homogeneously. The purpose of determining this type is done for cosmetic purposes which is more suitable for the M/A type because this type provides a comfortable, cool, and easy to wash feeling. According to Mutakin and Maya (2018), the M/A type has good drug release properties because when the medicinal material is applied to the skin, there will be evaporation and an increase in the concentration of water-soluble drugs, which can encourage the absorption of medicinal ingredients through skin tissue. The determination of emulsion type carried out for 4 weeks gave the same results, namely type M/A. It is said that a good emulsion does not change type during storage (Voight, 1995).

Cycling tests on emulgel preparations are carried out by storing the preparation alternately at different temperatures, namely at a temperature of (4˚C) and a temperature of (40˚C) for 6 cycles. Based on the observation results, which can be seen in Table 13, the results of the organoleptic test and homogeneity test before and after the *cycling* test show the same results in color, odor, shape, and homogeneity, indicating that the components in the formula are evenly dispersed and stable. In the pH test before and after the *cycling test* , each formula shows the same pH value, namely pH 6 and is still in the good pH range for the skin, namely 4.5–6.5 in accordance with SNI standards (1996). In the results of the spreadability test before and after the *cycling test*, each formula has a spreadability in the range of good emulgel spreadability values, namely 3-5 cm so that it is comfortable when applied to the skin. It can be concluded that the emulgel preparation that has been made still has good physical stability despite experiencing extreme temperature changes, so the results of this test support the durability of the emulgel preparation during storage.

The determination of the SPF value of the emulgel preparation was carried out in vitro by reading the absorption of the sample at a wavelength of 290-320 nm because the wavelength is the UV-B range. About 70% of UV-B radiation enters the skin and is absorbed by the stratum corneum, 20% reaches the epidermis, and 10% penetrates the top layer of the dermis. As a result, UV-B radiation can cause major damage to the epidermis layer in the form of burning and browning. The division of sunscreen ability levels according to Damogalad (2013) is minimal protection (1-4), medium (4-6), extra (6-8), maximum (8-15), ultra (>15). In this test, emulgel preparations that have passed the stability test at room temperature are used. Based on the test results on the preparation of an emulgel combination of sunflower seed oil and ethanol extract of kersen leaves, it was found that increasing the concentration of sunflower seed oil can increase the SPF value of the emulgel.

The results obtained can be seen in Table 10, namely that F1 obtained an SPF value of (6.55) has an extra level of ability. F2 obtained SPF value (7.15) including extra protection. F3 obtained SPF value (7.68) including extra protection. F0 (blank) obtained SPF value (1.79) has a weak protection ability that cannot be used as a sunscreen. Wardah *sunscreen* gel was used as a positive control with ultra-protective ability. However, the results of the expected combination do not match the results obtained, where previous research by Puspitasari (2018) showed that the results of the SPF value of kersen leaf extract sunscreen cream were classified as very good, namely that the highest SPF value was obtained at a concentration of 3% of 19.08 (ultra protection). Then the combination results do not show an increase when compared to single use. According to Adwan and Mhanna (2008), the combination is better done on extracts that have been diffracted or pure compounds than using extracts because it can allow interactions between chemical compounds contained in each extract.

The test results of SPF values on emulgel preparations show that F1, F2, and F3 have extra protection categories. The SPF value of emulgel preparations was obtained, and statistical analysis was carried out, namely *one-way Anova.* This test was conducted to determine if there was a significant difference in the SPF value of each emulgel preparation formula. The normality test obtained a significance value > 0.05, which indicates that the data is normally distributed. The homogeneity test has a significance value = 0.956, which indicates that the data variance is homogeneous. then the *One-Way Anova* test can be carried out, and a significance value of 0.006 is obtained, which indicates that there is a significant difference in the SPF test data of emulgel preparations with the addition of sunflower seed oil. The *Post-Hoc* test is LSD; the test data shows

significant differences between formulas except for F1 against F2 and vice versa, and F3 against F2 and vice versa.

Based on these results, the emulgel combination of sunflower seed oil and ethanol extract of cherry leaves has activity as a sunscreen, with the highest SPF value obtained in formula 3 of 7.68 (extra protection), which can be used to protect the skin from the bad effects of sunlight. According to data (SNI 16-4399-1996), which states that the minimum level of solar protective factor is 4, In order to increase the comfort and effectiveness of using sunflower seed oil and cherry leaf extract, it was developed into an emulgel preparation, which has the advantage of being able to facilitate the delivery of compounds. is hydrophilic and hydrophobic because emulgel is a two-phase system of oil and air.

Conclusion

Based on the results of this research, it can be concluded that the emulgel preparation combined with sunflower seed oil and ethanol extract of cherry leaves, both F0, F1, F2 and F3, meets the requirements for physical stability of the preparation which includes organoleptic tests, pH, homogeneity, spreadability, emulsion type, viscosity. and Cycling test. The results of determining the SPF value show that the emulgel preparation has activity as a sunscreen with the values obtained being F1 of 6.55 (Extra Protection), F2 of 7.15 (Extra Protection), and F3 of 7.68 (Extra Protection). Based on this data, it shows significant differences between the formulas except for F1 versus F2 and vice versa, F3 versus F2 and vice versa.

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Conflict of Interest

No conflict of interests.

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