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Evaluation of Sunflower Seed Oil Emulgel with Carbopol 940: Physical Properties and Moisturizing Effectiveness

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ABSTRACT

Sunflower seed oil is sourced from *Helianthus annuus* L., which is a plant that is extremely rich in essential fatty acids and antioxidants, so it can be used as a natural moisturizer that helps prevent, reduce, and protect skin from dryness. The purpose of this study was to evaluate the effect of variations in Carbopol 940 concentration on the physical properties and moisture effectiveness of sunflower seed oil emulgel dosage forms. The formulas were made into 3 formulas, with each concentration of Carbopol 940 for each formula, namely F1 (1%), F2 (1.5%), and F3 (2%). Furthermore, organoleptic, homogeneity, pH, viscosity and spreadability tests were carried out, as well as irritation and moisture effectiveness tests. The results of statistical analysis using one-way ANOVA showed a significant difference ($P < 0.05$) which clarified that F1 provided an optimal increase in skin moisture (50.00%) compared to F2 (42.75%) and F3 (45.55%) and had good and stable physical properties evaluation results. In addition, increasing the concentration of Carbopol 940 in F2 and F3 can increase viscosity, but this actually affects the stability of the physical properties and moisture effectiveness of the preparation. This research concluded that F1 is the best formula and this study provides important information for the development of effective and stable skin moisturizing products, with recommendations for the use of effective concentrations of Carbopol 940 in the formulation of emulgel dosage forms.

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ABSTRAK

Minyak biji bunga matahari bersumber dari *Helianthus annuus* L., yang merupakan tanaman yang sangat kaya akan asam lemak esensial dan antioksidan, sehingga dapat digunakan sebagai pelembab alami yang membantu mencegah, mengurangi, dan melindungi kulit dari kekeringan. Tujuan dari penelitian ini adalah untuk mengevaluasi pengaruh variasi konsentrasi Carbopol 940 terhadap sifat fisik dan efektivitas pelembab dari bentuk sediaan emulgel minyak biji bunga matahari. Formula dibuat menjadi 3 formula, dengan masing-masing konsentrasi Carbopol 940 untuk setiap formula, yaitu F1 (1%), F2 (1,5%), dan F3 (2%). Selanjutnya dilakukan uji organoleptis, homogenitas, pH, viskositas dan daya sebar, serta uji efektivitas iritasi dan kelembaban. Hasil analisis statistik menggunakan *one-way* ANOVA menunjukkan perbedaan yang signifikan (P<0,05) yang menjelaskan bahwa F1 memberikan peningkatan kelembaban kulit yang optimal (50,00%) dibandingkan dengan F2 (42,75%) dan F3 (45,55%) serta memiliki hasil evaluasi sifat fisik yang baik dan stabil. Selain itu, peningkatan konsentrasi Carbopol 940 pada F2 dan F3 dapat meningkatkan viskositas, namun hal ini justru mempengaruhi kestabilan sifat fisik dan efektivitas kelembaban sediaan. Penelitian ini menyimpulkan bahwa F1 merupakan formula terbaik, dan penelitian ini memberikan informasi penting untuk pengembangan produk pelembab kulit yang efektif dan stabil, dengan rekomendasi penggunaan konsentrasi Carbopol 940 yang efektif dalam formulasi bentuk sediaan emulgel.

Kata Kunci: Carbopol 940; Emulgel; Sifat fisik; Efektivitas kelembaban; *Moisturizer*

1. Introduction

Skin is the largest organ of the outer part of the human body or located on the surface of the body which has a role to protect the body from physical and chemical injury, as an initial protection in warding off germs, allergens, radiation and toxins, can also be a natural body temperature regulator against the surrounding environment and can provide a tactile sensation that can interact directly with the environment. Healthy skin requires sufficient moisture to maintain the skin's barrier function. However, various factors such as UV exposure, extreme air exposure and the use of inappropriate skincare products can cause skin dryness and damage [1]. Other factors that cause skin dryness are dehydration, lack of sebum production in the skin, free radicals that damage skin cells and the use of certain drugs and chemical products [2]. Among these factors dehydration is the most common and frequent factor of skin dryness of each individual [3]. One way to overcome dry skin is to use moisturizing products or moisturizers [4].

Moisturizer is a cosmetic skin care product designed for the purpose of moisturizing, protecting and maintaining skin moisture by increasing or maintaining water content in the skin [5]. One of the natural ingredients that can function as a moisturizer is sunflower seed oil [6,7].

Sunflower seed oil (*Helianthus annuus* L.) is an oil rich in high content of essential fatty acids and antioxidants, such as tocopherols, phytosterols, triterpene glycosides, α-tocopherol, flavonoids, phenolic acids, carotenoids, chlorogenic acid, and caffeic acid, these compounds contribute to the development of functional and nutritional [8,9], as well as having many pharmacological effects such as anti-inflammatory, analgesic, antimicrobial, antidiabetic, antidiarrheal, antihistamine and anticancer [10]. One of the main reasons for choosing sunflower seed oil is its ability as a natural moisturizer that can be used to prevent, reduce, and protect the skin from dryness [11]. Its linoleic acid content has been reported to improve the skin barrier and maintain moisture [12,13]. Moreover, it can improve skin hydration and reduce trans epidermal water loss, which makes it an ideal choice for skincare products [14].

Emulgel is one of the more popular topical dosage forms applied in cosmetic products. Emulgels combine the advantages of emulsion and gel systems, provide better stability and a more comfortable sensation when applied to the skin, and can improve drug stability and have a drug release control system [15,16]. The advantage of emulgels over other topical formulations, such as creams or ointments, lies in their ability to provide better hydration and faster absorption without leaving a sticky feeling [16]. This makes emulgels an attractive option for effective moisturizing preparations.

In this study, the main focus was on optimizing the concentration of Carbopol 940, which is an important thickening agent in emulgel formulations, which serves to provide the desired viscosity, which affects the stability and consistency of the preparation [17]. Carbopol 940 belongs to the category of hydrophilic polymers, so it is easily dispersed in water at a certain concentration to produce a gel with the desired consistency [18]. Determining the right concentration of Carbopol 940 is very important, because too low a concentration can result in an unstable emulgel, while too high a concentration can cause an uncomfortable texture when applied [17]. So, it is important to consider in achieving optimal physical properties stability and moisture effectiveness in emulgel preparations.

This study investigated the effects of Carbopol 940 concentration on the physical properties and moisture effectiveness of sunflower seed oil emulgel preparations. This study is expected to provide useful scientific information for the manufacturing process of effective and stable skin moisturizing products.

2. Methods

Tools and Materials

Tools used include analytical scales, homogenizer (IKA RW 20, Germany), pycnometer (Pyrex, Germany), pH meter (Mettler Toledo, Switzerland), Lamy Rheology Viscometer (B-One Plus, France) and skin moisture analyzer (U-Trak CR-302, China). While the ingredients used include sunflower seed oil (PC180010, Importer of Essential oils, Nourish Indonesia), Carbopol 940, triethanolamine (TEA), propylene glycol, tween 80, span 80, methyl paraben, propyl paraben, liquid paraffin, water, 96% ethanol, chloroform and sodium thiosulfate, which are pharmaceutical quality ingredients and analytical quality solvents.

Research Procedure

Determination of Purity of Sunflower Seed Oil

Organoleptic

Organoleptic examination is carried out by visual observation of the sample including aroma, shape, color and taste. Testing is done by placing the sample on a cup and observing changes in the shape, color, aroma, and taste of sunflower seed oil [7].

Determination of Specific gravity

Determination of specific gravity using a 25 mL pycnometer (v). Weigh the empty pycnometer that has been cleaned and dried along with the lid (W_1), record the weight obtained. Then put the sample liquid into the pycnometer until it is full and clean the liquid that spills on the outside of the pycnometer to dry, then weigh the weight of the pycnometer again (W_2) and record the weight obtained. Furthermore, the specific gravity of the sample is calculated by the following formula [19]:

$$\rho = \frac{w_2 - w_1}{v}$$

Determination of Moisture Content

Determination of moisture content was done by gravimetric method. A 150 mL empty vaporizer cup was dried for 30 minutes in an oven at 105°C ± 2°C. After that, the cup was removed and cooled in a desiccator for 15 minutes before being weighed to obtain the initial cup weight (W0). Next, 5 g of sample liquid was weighed in a vaporizer cup (W1) and placed in an oven for 3 hours at 105°C ± 2°C. After that, the cup is removed and cooled, weighed until a fixed weight (W2) is reached. To determine the moisture content, the following formula can be used [20]:

$$Moisture\ Content = \frac{W_1 - W_2}{W_1 - W_0}\ x\ 100\ \%$$

Determination of Free Fatty Acid Content

Determination of free fatty acid concentration was done through acid-base titration method. A total of 2 g of sample was weighed and put into an erlenmeyer with a capacity of 250 mL. Next, 5 mL of alcohol at 50°C was added. After the sample was fully dissolved, 2-3 drops of phenolphthalein (PP) indicator were added, and titration was carried out with 0.1 N sodium hydroxide solution until there was a color change from colorless to pink solution that lasted for about 30 seconds. Titration was carried out three times following identical procedures. The amount of free fatty acids can be calculated using the following formula [21]:

$$Free\ Fatty\ Acid\ Content = \frac{V_{sodium\ hydroxide}\ x\ N_{sodium\ hydroxide}\ x\ BM_{Fatty\ Acid}}{sample\ (gr)\ x\ 1000}\ x\ 100\ \%$$

Preparation of Emulgels

The formulation of emulgel preparation of sunflower seed oil (*H. annuus* L.) was done by first preparing the gel base. Carbopol 940 as a gel base was developed through a dispersing process in hot water, followed by the gradual addition of TEA until a gel mass was formed. Add methyl paraben and propyl paraben into propylene glycol in a separate beaker, then add tween 80 as the water phase. Add sunflower seed oil, span 80, and liquid paraffin into different beakers (oil phase), then stir until mixed and homogeneous.

Table 1. Formulation of sunflower seed oil emulgel preparation

Materials	Concentration (%)		
	F1	F2	F3
Sunflower seed oil	20	20	20
Carbopol 940	1	1.5	2
TEA	0.22	0.22	0.22
Tween 80	5	5	5
Span 80	5	5	5
Methyl paraben	0.06	0.06	0.06
Propyl paraben	0.03	0.03	0.03
Liquid paraffin	5	5	5
Propylene glycol	10	10	10
Water until	100 mL	100 mL	100 mL

The aqueous phase was added gradually into the oil phase and stirred until homogeneity was achieved, resulting in an emulsion. The emulsion mass was added

gradually into the gel base and stirred homogeneously using a homogenizer until fully dispersed, forming a stable emulgel mass [22]. Table 1 showed the formulations used in the preparation of sunflower seed oil emulgel, which included variations in the concentration of Carbopol 940 for each formula.

Evaluation of Physical Properties of Emulgel Preparations

Organoleptic

Organoleptical examination was carried out by examining changes in shape, color, and aroma of each emulgel preparation formula containing sunflower seed oil [23].

Homogeneity

Homogeneity testing is carried out by applying 1 g of preparation sample on an objective glass and then covered with another transparent glass. The preparation should have a homogeneous arrangement and not show coarse grains [24].

pH test

Measurement of the pH value of the preparation to determine whether the pH of the emulgel changes during the storage period. The pH measurement uses a pH meter with a glass electrode dipped in the sample, and the pH value is observed and recorded [25].

Viscosity Test

Viscosity determination was carried out using a rotation-based viscometer. In a 100 mL beaker, 100 g of the preparation sample was placed. Then, the spindle rod is mounted on the device of the appropriate size and the appropriate speed is set. Subsequently, the results will appear on the viscometer screen [25].

Spreadability Test

The spreadability measurement was carried out by weighing 0.5 g of the sample and placing it on an objective glass plate and covering it with another glass. Then, a weight of 150 g was added to the glass and left for one minute. After that, measurements were made by measuring the length of each side of the glass [26].

Irritation Test

A total of 12 volunteers were subjected to the irritation test. Testing by applying 0.5 grams of the preparation sample on a predetermined inner forearm allows visual observation. Observations were made for one hour after application, and twice a day for five consecutive days. The presence of redness, itching, or swelling on the skin area to which the emulgel is applied indicates that there is an irritation reaction [27].

Moisture Effectiveness Test of Emulgel Preparation

The moisture effectiveness test of the emulgel preparation was carried out for 5 consecutive days, by comparing the skin condition before and after using the emulgel, measuring the moisture value using a skin analyzer. The test was conducted on 12 volunteers, who were determined not to use any topical products during the test, such as moisturizers, body lotions, sunscreens, or anti-aging formulas during the test. The application site of the preparation sample was on the back of the hand with a skin area size of approximately 2x2 cm with the application of the preparation sample twice a day. Before measurement, volunteers have been in the testing room for at least 15 minutes to ensure temperature and humidity adaptation [28,29].

Statistical Analysis

Statistical analysis of research data using GraphPad Prism Ver. 9.3. To compare mean differences among groups, data were processed using the one-way ANOVA method. The significance level difference was $P<0.05$ [24]. However, previously the data obtained was carried out the Kolmogorov-Smirnov normality test and Levene's homogeneity test, this aims to determine whether the data follows a normal distribution and also to verify the assumption of homogeneity of data variance for further analysis [30,31].

3. Results and Discussion

The study began with an organoleptic examination of all raw materials used based on official compendia and other supporting references, with observations including the shape, color, and aroma of the raw materials. Based on the results of organoleptic observations, it shows that all the ingredients used are in accordance with the observations of shape, color, aroma and taste, with the provisions of the Indonesian Pharmacopoeia VI Edition and Handbook of Pharmaceutical Excipients 8th Edition [32,33].

Table 2. Results of sunflower seed oil purity determination

Inspection	Certificate of Analysis	Observation Results
Organoleptics		
– Shape	Liquid	Liquid
– Color	Light yellow	Light yellow
– Smell	Almost odorless	Almost odorless
Specific gravity (g/mL)	0.9100 – 0.9300	0.9219 ± 0.03
Water Content (%)	Max. 0.3	0.1854 ± 0.06
Free Fatty Acid Content (%)	Max. 0.3	0.26 ± 0.05

Determination of Purity of Sunflower Seed Oil

Furthermore, the purity of sunflower seed oil (*H. annuus* L.) raw materials was determined, including organoleptic examination, specific gravity, moisture content, and free fatty acid content. The purpose of this examination is to ensure that the purity of the sunflower seed oil raw material used meets the quality standards. The molecular weight, number of components, and unsaturation of the oil's fatty acids affect the determination of specific gravity. The more components in the oil, the greater the specific gravity [34]. Since moisture content is strongly related to the organoleptic properties and storage life of oil raw materials, the determination of moisture content is very important to determine the quality of raw materials because excessive water content can trigger and accelerate the process of oxidation and hydrolysis reactions, which can cause the oil to become damaged or rancid [35]. In addition, the measurement of free fatty acid content is also carried out to determine how much free fatty acid is contained in sunflower seed oil. Higher acid values and free acid contents indicate lower oil quality, and higher free fatty acid levels can lead to poor flavor and quality. If there is too much of this content, the oil will be easily damaged due to the breakdown of triglycerols and fatty acid oxidation reactions [36]. The results of verifying the characteristics of several purity determinations of sunflower seed oil are shown in **Table 2**. The results show that the sunflower seed oil raw materials used meet the specifications listed on the Certificate of Analysis (CoA) received.

Preparation of Emulgels

To make emulgel preparations containing sunflower seed oil (*H. annuus* L.), the preparations were made into three formulas, each with different variations in the concentration of Carbopol 940 as a gelling agent or thickening agent. This formulation aims to determine the effect of variations in Carbopol 940 concentration on the physical stability and moisture effectiveness of a good emulgel preparation. In this study, the active ingredient used as a natural moisturizer is sunflower seed oil with the same content in each formulation, namely 20% (b/v), determining this concentration based on a literature review that at a concentration of 5 - 30% the use of sunflower seed oil in several applications in topical dosage forms, has provided optimum potential as a moisturizer or as a natural emollient [37–39]. The physical appearance of sunflower seed oil emulgel preparations for each formula is presented in Figure 1a.

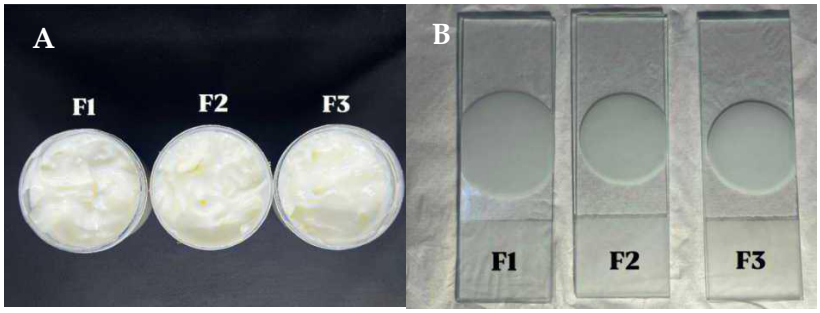

Figure 1. Physical appearance of sunflower seed oil (*H. annuus* L.) emulgel preparations from each formula (A); and physical appearance during the homogeneity test (B)

Organoleptic Test

Organoleptic examination of emulgel preparations is carried out by seeing how the physical appearance of the preparation changes, including shape, color, and aroma. The results show that the dosage form in each formula from F1 to F3 is an emulgel or semi-solide with a certain consistency of viscosity, white in color, and has a distinctive aroma to almost odorless. This test is an important method in visually assessing the quality standards of a preparation, and ensuring the stability of product consistency during storage [40]. Organoleptic examination of emulgel preparations was carried out weekly during 28 days of storage at room temperature.

Homogeneity Test

The homogeneity check of the emulgel preparation is carried out by placing the sample on a piece of objective glass and covering it with another glass. This test ensures that the active substance is evenly distributed in the preparation and knows whether the particles are clumped or separated. The results of the homogeneity test evaluation showed that the emulgel preparation prepared from sunflower seed oil did not have clumped and separated particles and showed a preparation with good and stable homogeneity, as shown in Figure 1b.

pH test

Measurement of the pH of the emulgel preparation was carried out to determine the pH level of each dosage formulation made. The pH value must be in accordance with the pH of normal skin, which ranges from 4.5 - 6.5 [41,42], so that no pH is too acidic or basic. A pH value that is too basic will cause scaly skin because the outer layer or epidermis layer becomes damaged, a pH value that is too acidic can cause skin irritation [43]. The results of the evaluation of pH measurements carried out from the three formulas can be seen in Figure 2a. The results show that the pH value of the emulgel preparation is in the range of 4.65 - 5.54. If observed on the average pH value based on observations for 28 days, the pH value of each formula is F1 (5.13 ± 0.25); F2 (4.96 ± 0.31); and F3 (4.91 ± 0.29). While the pH value of the emulgel preparation of each formula in the final observation is F1 (4.98); F2 (4.78); and F3 (4.77). Each formula added TEA which has a function as an alkalizing agent so that it can neutralize Carbopol 940 so that the pH of the preparation is not too acidic or does not irritate the skin. TEA can also function as an aqueous phase emulgator that can increase the resistance of the emulsion system and produce a homogeneous and stable emulsion [44,45]. Therefore, in this study, the pH value of each formula was recorded weekly with initial observations made starting from after the preparation was made until 28 days of storage at room temperature. These pH values show variations that meet normal skin pH standards (4.5 - 6.5).

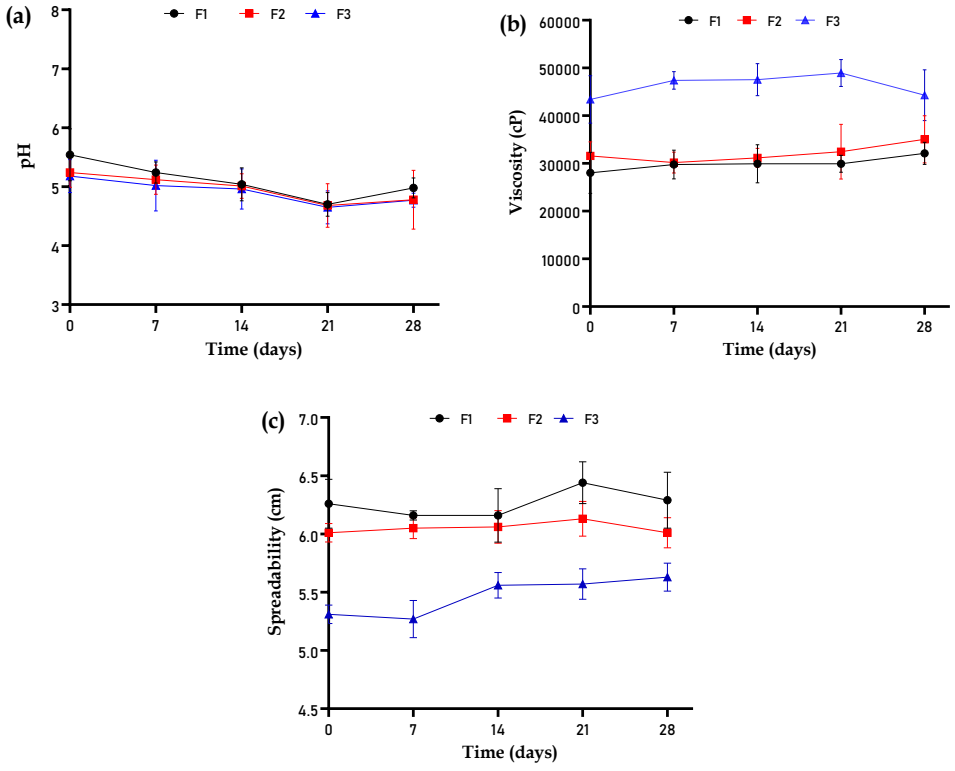

Figure 2. Physical evaluation of sunflower seed oil (*H. annuus* L.) emulgel preparation on: (a) measurement of pH; (b) determination of viscosity; and (c) measurement of spreadability during 28 days storage at room temperature.

Viscosity Test

Determination of the viscosity of emulgel preparations is carried out to determine the viscosity level of each dosage formulation made. Viscosity measurement using a Brookfield viscometer is a method of measuring viscosity by providing torque or power to rotate the spindle in the sample. This method works on the principle of rotation. In this study used spindle number R7 at a rotation speed of 10 rpm for 10 seconds. The results of the viscosity determination evaluation carried out from the three formulas can be seen in Figure 2b. The results showed that the viscosity value of the emulgel preparation was in the range of 28,000 - 48,000 centipoise (cP). The standard value of viscosity for semi-solid preparations is 6,000 - 50,000 cP (Kusmita et al., 2024) . Based on observations every week for 28 days, the average viscosity value of each formula was obtained, namely F1 (± 29,000 cP); F2 (± 32,000 cP); and F3 (± 46,000 cP). While the results of measuring the viscosity of the emulgel preparation of each formula in the final observation are F1 (32,090 cP); F2 (35,060 cP); and F3 (44,290 cP). The viscosity determination of each formula shows different viscosity values, this is due to the use of Carbopol 940 concentration as a thickening agent or gel base in emulgel preparations using variations in Carbopol 940 concentration. The viscosity value will be directly proportional to the increasing use of Carbopol 940 concentration, where the Carbopol 940 concentration of each formula is F1 (1%); F2 (1.5%); and F3 (2%). This study confirmed the findings of previous studies, in which the concentration of Carbopol 940 used in emulgel preparations was related to the increase in viscosity values obtained, impacting on the physical properties of semi-solid preparations [46,47]. In addition, the use of optimal concentration of Carbopol 940 in emulgel preparations has good viscosity and also shows desirable physical properties such as ease of application and better ability to adhere to the skin [48–50]. The viscosity values obtained from each formula still meet the criteria for ideal viscosity values for emulgel preparations (6,000 - 50,000 cP).

Spreadability Test

Measurement of emulgel spreadability is done to determine how quickly the drug is spread on the skin. Good spreadability makes the drug more widely in contact with the skin, so it is absorbed more quickly. Figure 2c shows the results of the evaluation of the spreadability of emulgel preparations from the three formulas. The spreadability value of F1 was 6.26 ± 0.18 cm; F2 was 6.052 ± 0.11 cm; and F3 was 5.46 ± 0.12 cm. The spreadability values of the emulgel preparations during the 28-day observation were 5.27 to 6.44 cm on average. The study confirmed previous research showing that the concentration of Carbopol 940 affects the resulting spreadability value [51,52]. This study found that despite the higher concentration of Carbopol 940 used, the preparation had lower spreadability, which is contrary to the expected spreadability value. good emulgel spreadability values are around 5-7 cm [53,54].

Irritation Test

Irritation test observations were made to see the skin response to the emulgel preparation applied to the skin area, whether there was a positive reaction to irritation from symptoms that arose on the skin such as redness, itching, pain and swelling [55]. Observations were made by applying emulgel preparation samples on the inner forearm of the hand that had been determined to 12 volunteers for 5 consecutive days. The results of the irritation test evaluation obtained that after applying the preparation sample to

the skin area and observed after standing for one hour showed no signs that could cause a positive skin irritation reaction in 12 volunteers.

Moisture Effectiveness Test of Emulgel Preparation

Moisture effectiveness testing of emulgel preparations containing sunflower seed oil (*H. annuus* L.) to determine how effective the preparation is in moisturizing the skin, a skin moisture analyzer is used to measure the percentage of skin moisture that has been applied to the test sample on a predetermined skin area. The moisture effectiveness test of the three emulgel preparation formulas was conducted on 12 volunteers, who were divided into 3 (three) groups based on each preparation formula. Each group consisted of four volunteers who did not know the type of dosage formula when given. A total of 12 volunteers received the test preparation and were tested for five consecutive days. The preparation was applied to the back of the participants' hands and left on for thirty minutes. The emulgel preparation was used twice daily.

Furthermore, the one-way ANOVA (Analysis of Variants) method was used to statistically analyze the data obtained. Kolmogorov-Smirnov normality test and Levene's homogeneity test were conducted at the beginning of data analysis which aims to test the normality of data distribution and ensure that there are no basic variables or data homogeneity that cause differences [56]. The results of the normality and homogeneity tests show a normal and homogeneous distribution with a significance value (P>0.05) [57], where the significance value is 0.10 and 0.36 respectively.

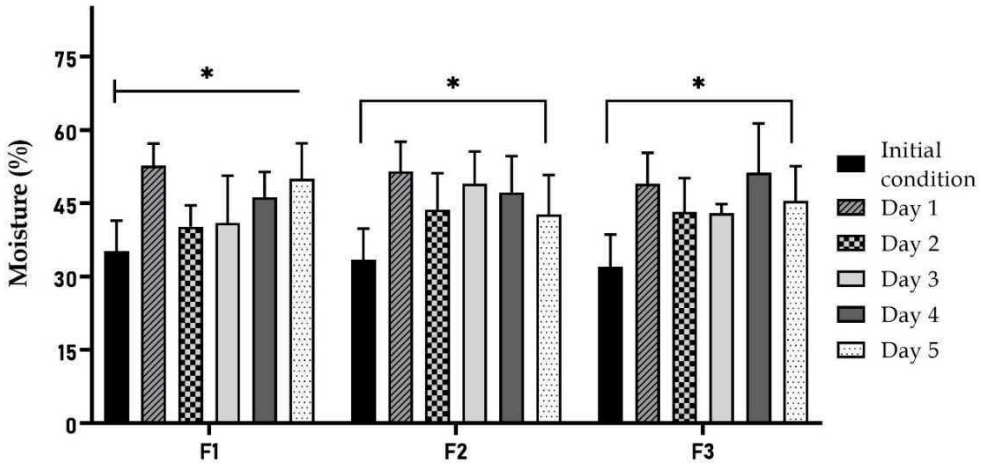

Figure 3. Representation of moisture effectiveness test of sunflower seed oil (*H. annuus* L.) of emulgel preparation before (initial condition) and after treatment for five days from each formula. Data represent mean ± SD, n = 12 panelists, with significance * P < 0.05 using one way ANOVA.

The results of the moisture effectiveness test of sunflower seed oil emulgel preparations (*H. annuus* L.) at the time before and after treatment for 5 days can be seen in Figure 3. The results show that the average moisture value before treatment (initial condition) of each group based on three variations of the formula is F1 (35.25 ± 7.14%); F2 (33.5 ± 7.33%); and F3 (32.00 ± 7.62%). While the average moisture value at the final observation (day 5) or after the use of emulgel preparations shows each group, namely F1 (50.00 ± 8.41%); F2 (42.75 ± 9.32%); and F3 (45.55 ± 8,19%). Based on one-way ANOVA test analysis of moisture effectiveness data before (initial condition) and after treatment for 5 days. The significance value (P<0.05) was 0.0001 which showed a significant

difference from each formula and effectiveness before and after the use of sunflower seed oil emulgel preparations. Based on the results of the last observation, all formulas are included in the category of ideal moisture values on normal skin, but F1 provides the optimum effectiveness value compared to F2 and F3, where the ideal moisture value of human skin is around 40 - 60% [58,59].

This indicates a possible relationship to the effect of the concentration of Carbopol 940 used in the emulgel preparation which can affect the physical stability and moisture effectiveness of the preparation. Increasing the concentration of Carbopol 940 used in F2 (1.5%) and F3 (2%) can reduce the spreadability of the preparation which indicates the low dispersion of the emulgel so that absorption is small on the skin [60]. This study confirms previous studies that reported that high Carbopol concentrations result in lower drug permeation compared to formulations with lower Carbopol concentrations, which inhibits drug release, and that high Carbopol concentrations can reduce the ability of the product to spread on the skin surface [48,61,62]. Although the use of higher concentrations of Carbopol 940 can increase viscosity and adhesion, it can also slow down the rate of drug release due to increased gel matrix thickness and reduced permeability, so these effects need to be balanced to ensure better and effective [63,64].

4. Conclusions

This study shows that sunflower seed oil (*Helianthus annuus* L.) emulgel preparations made with varying concentrations of Carbopol 940 has a significant effect on the physical properties and moisture effectiveness of the preparation. The Carbopol 940 content in F1 (1%) proved to be the best formula of the three formulas tested, F1 had the best skin moisture effectiveness of 50% and had good physical stability evaluation results based on the evaluation of homogeneity, pH, viscosity, and spreadability, and met the criteria for emulgel preparations. Although the higher concentration of Carbopol in F2 (1.5%) and F3 (2%) can increase the viscosity, it reduces the effectiveness and physical stability of the preparation, which indicates that higher concentration does not always result in better preparation. In addition, we suggest future research to adjust the concentration of the combination of Carbopol 940 with other gelling agents that may be able to overcome the existing problems. This study provides important information on the manufacture of effective and stable skin moisturizing products, and offers recommendations on the ideal concentration of Carbopol 940 for cosmetic preparations.

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