Effects Of Addition Of Oleic Acid And Propylene Glycol Enhancer On The Physical Properties And Sunscreen Activity Of Preparations Lotion Carrot Extract (Daucus Carota L.)

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Abstract. Carrots contain β-carotene which can function as an antioxidant which has the ability to fight singlet oxygen and interact with free radicals. Carrot extract lotion is formulated with a variety of oleic acid and propylene glycol enhancers which are used to increase or reduce skin impermeability. The aim of the research was to determine the effect of adding oleic acid and propylene glycol enhancers on the physical characteristics and effect on the sunscreen activity of carrot extract (Daucus carota L.) lotion. The solvent used in the extraction is 96% ethanol. The research was carried out by making differences in the concentrations of oleic acid and propylene glycol in each formula, namely FI (10 oleic acid), F II combination (5% oleic acid and 5% propylene glycol) and F III (10% propylene glycol). Physical characteristic tests include organoleptic (shape, odor, color), homogeneity test, pH test, adhesion test and spreadability test. The extraction obtained from 7500 grams of wet simplicia became 580 grams after drying and then became a thick extract of 67.3 grams with a yield of 11.60%. The results were analyzed using SPSS, the results showed a normal and homogeneous distribution, namely p>0.05. The SPF test results showed p>0.05, which means normal distribution and the homogeneity test was p<0.05, which means the data was not homogeneous and continued with the Kruskal Wallis test and continued Mann Whitney test. Meanwhile, the normality and homogeneity test in the spreadability and stickiness test was p> 0.05 and continued with the Tukey test with a confidence level of 95%.

Key words: [Carrots, Lotion, oleic acid and propylene glycol enhancers, physical properties characteristics.]

INTRODUCTION

Carrots (Daucus carota L.) are a plant that is very easy to grow throughout the year in the rainy and dry seasons, a type of tuber vegetable plant in the form of a bush (shrub) which can grow upright with a height of 30 cm-100 cm (Cahyono, 2002). One plant that has the potential to have SPF activity is the carrot plant. It is known that carrot tubers contain phenol and flavonoid groups which have chromophore groups so they can ward off ultraviolet radiation.

Sunscreen is a substance or material that can protect the skin from exposure to ultraviolet radiation. The effectiveness of sunscreen preparations is based on determining the Sun Protection Factor (SPF) value which shows the sunscreen product's ability to protect the skin from exposure to UV rays (Rusita & Indiarto, 2017). To protect the skin from exposure to UV rays, lotions are made in the form of lotions. Lotion is a semi-solid preparation that is applied to the body, containing one or more medicinal ingredients dissolved or dispersed in appropriate base ingredients and formulated as a water-in-oil emulsion and an oil-in-water emulsion. (Mardikasari et al., 2017)

The use of enhancers or what are also called penetration enhancers, in a preparation plays a role in increasing skin permeability or reducing skin impermeability. The types of enhancers used are oleic acid and propylene glycol (Rahmawati, Sugihartini & Yuwono. 2017). In sunscreen preparations there is often an SPF which shows the sunscreen's ability to protect the skin. The SPF value can be determined using a spectrophotometer in vitro and also in vivo. The SPF value is a comparison of the Minimum Erythema Dose (DEM) on human skin protected by sunscreen with DEM without protection (Zulkarnain, Ernawati & Sukardani 2013).

METHODS

Types of research

The type of research used is experimental research. In research, the analysis of the effect of adding oleic acid and propylene glycol enhancers on the physical properties and sunscreen activity of carrot (Daucus carota L.) extract lotion preparations was tested using a UV-Vis Spectrophotometer.

Research Population and Sample

The population used was a population of carrot plants from Bandungan, Semarang Regency, Central Java, then oleic acid and propylene glycol enhancers were added to the physical properties and sunscreen activity in the carrot extract lotion preparation (Daucus carota L. The sample used in this research was carrots (Daucus carota L.) chantenay type that is ready to harvest with a size of 15-20 cm.

Materials and tools

Carrot tubers (Daucus carota L.), Cetyl alcohol, Stearic acid, Triethanolamine, Glycerin, Methyl Paraben, Propylene Paraben, Aquadest, Oleic Acid Enhancer, Propylene Glycol Enhancer. Maceration vessel, beaker (herma), measuring cup (herma), measuring flask (herma), water bath, volume pipette, Eyela N-1000 rotary evaporator, UV-Vis spectrophotometer Shimadzu UV mini 1240, and analytical balance. cuvette, watch glass, set of spreadability test tools, set of stickiness test tools.

Data collection technique

1. **Plant Determination**: Plant determination was carried out at the Ecology Biosystematics Laboratory, Biology Department, Faculty of Mathematics and Natural Sciences, Diponegoro University, Semarang. By submitting samples in the form of whole plants, from the leaves, tubers and roots of carrot plants.
2. **Carrot Extraction:**The carrots were sorted, then washed and chopped then dried. The dried samples were extracted by maceration. The maserate obtained was concentrated until the solvent evaporated. The weight of the extract obtained was then weighed.
3. **Making Lotion Preparations:***Lotion*made by the melting method where the ingredients are divided into two parts, namely oil-soluble materials (oil phase) and water-soluble materials (water phase). Ingredients in the oil phase include cetyl alcohol, stearic acid, oleic acid and put into a porcelain cup and heated to a temperature of 600C. Then the ingredients included in the water phase are triethanolamine, methyl paraben, propylene glycol which are also dissolved in distilled water and heated at the same temperature. Then the oil phase and water phase are mixed and stirred until homogeneous. After the lotion has cooled, add the carrot extract and stir until the mixture is homogeneous.
4. **Test the Physical Properties of Lotion Preparations**
   a). **Organoleptic Test**: The organoleptic test includes shape, color and odor which are observed visually, which is carried out by observing changes in the shape, odor and color of the lotion preparation
   b). **Homogeneity Test:**The homogeneity test is carried out by smearing the preparation on a piece of transparent glass, the preparation will show a homogeneous composition c). pH test; PH testing is carried out by dipping the pH meter into the lotion preparation, then measuring it with a pH meter. Lotion meets the pH requirements for skin moisturizer products if it ranges between 4.5 – 8.0.
   d). **Spreadability Test:**A total of 0.5 ml of lotion is placed in the middle of the device with a diameter of 15 cm, the other glass is placed on top and left for 1 minute. Then the diameter of the lotion that spreads is measured, then add 50 grams, 100 grams, 250 grams of additional load, let it sit for 1 minute and measure the diameter of the lotion that spreads. This is done repeatedly until a constant distribution diameter is obtained. The treatment is repeated 3 times.
   e). **Adhesion Test:**The adhesion test is carried out by placing lotion (as needed) on a glass object of a predetermined area. Place another glass object on top of the lotion, press it with a weight of 1 kg for 5 minutes. The glass object is installed on the tool. Release a weight weighing 100 g and record the time until the two glass objects are released
   f). **In vitro SPF test:**1 gram of lotion is dissolved in 10 ml PA ethanol. After that, a test absorption curve was made with a wavelength between 290-320 nm with an interval of 5 nm. The results of the absorbance are recorded and then the SPF value is calculated using

the Mansur formula

$$SPF_{spectrophootometric} = CF \times \sum_{290}^{320} EE\,(\lambda) \times I\,(\lambda) \times Abs\,(\lambda)$$

Where :

EE	:spectrum of erythemal effects
I	:solar intensity spectrum
Abs	:absorbance of sunscreen products
CF	:correction factor

Data analysis

The SPF test data and physical property parameters of the lotion were analyzed using the normality test and homogeneity test. If the sample is <50 samples use Shapiro Wilk and if the sample is > 50 using kolmogrov smirnov. If the results of the normality and homogeneity tests show results that are normally distributed and homogeneous, then proceed with a parametric test using One Way Annova statistical analysis, but if the results are not normally distributed and not homogeneous then proceed with a non-parametric test using Kruskall Wallis analysis with SPSS.

RESULTS AND DISCUSSION

Observation results of organoleptic tests, homogeneity tests and lotion pH tests

Table 1. Observations on organoleptic tests, homogeneity tests and lotion pH tests.

Formulation	Color	Texture	Form	Smell	pH
F1	Brownish orange	Soft, homogeneous	Semi runny	Typicalthe smell of carrots	7
F2	Brownish orange	Soft, homogeneous	Semi runny	Typicalthe smell of carrots	7
F3	Brownish orange	Soft, homogeneous	Semi runny	Typicalthe smell of carrots	7
F1 Base	White	Soft, homogeneous	Semi runny	Distinctive smell	7
F2 Base	White	Soft, homogeneous	Semi runny	Distinctive smell	7
F3 Base	White	Soft, homogeneous	Semi runny	Distinctive smell	7

Based on table 1, the organoleptic test is carried out with the aim of looking at the physical appearance of a preparation which includes shape, color and odor. Based on the results obtained, the preparation was semi-solid, brownish yellow in color, consistent with carrot extract and had a characteristic carrot odor.

The homogeneity test in table 1 was carried out to determine whether the lotion preparation that had been made was homogeneous or not. The purpose of the homogeneity test is to see and find out whether the active substances and additional substances are mixed well in the lotion preparation (Dewi & Wirahmi, 2019). Based on the results obtained, each formula showed homogeneous results and because there were no visible coarse grains, this shows that the base and extract concentration had no effect on the homogeneity of the carrot extract lotion.

Based on the results in table 1, all formulas have the same pH, namely 7, this means that the base in each formula does not affect the pH value of the lotion preparation. Standard pH requirements are in the range 4.5-8 (Mulyani, Ariyani, & Rahmi 2018). If the pH is acidic then irritation will occur on the skin and if the pH is alkaline then the skin will become scaly.

Table 2. Spreadability Test

Formulation	Spreadability Test ± SD
F1	5,200±0,200
F2	5.866 ± 0.125
F3	6.350 ± 0.304
BaseF1	5.550 ± 0.150
BaseF2	5.916 ± 0.208
BaseF3	6.566 ± 0.104

The spreadability test was carried out to determine the ability of the sample in the form of a lotion preparation to spread on the skin surface when applied. Spreadability on the skin is related to the concentration and viscosity of the lotion preparation. The requirement for spreadability of lotion is a diameter of 5-7 cm (Dominica & Handayani, 2019). The principle is to calculate the increase in area provided by the preparation when given a load of a certain weight and within a certain time interval. The results of the spreadability test on lotion base F1 had a diameter of 5,550 cm, base F2 had a diameter of 5,916 cm and base F3 had a diameter of 6,566 cm, while F1 had a diameter of 5,200 cm, F2 had a diameter of 5,866 cm and F3 had a diameter of 6,350 cm.

The data was then tested on SPSS to determine its normality and homogeneity and obtained normality test results F1= 1.000, F2= 0.463, F3= 0.463 base F1= 1.000, base F2= 0.780, base F3= 0.157, the data shows the normality test p> 0, 05 which means the data is normally distributed and the homogeneity test obtained a result of 0.310 showing a value of p>0.05 which means the data is homogeneous then after the data is normally and homogenously distributed it continues with the one way anova statistical test using the Tukey test. The resulting data is p<0.05 which means significant data means that in all formulations there are differences in the content and the results obtained are that F1 has a smaller spreadability value because in the base there is 5% oleic acid in a thicker preparation so the spreadability is small, whereas in F2 there is a combination of 5% oleic acid and propylene glycol 5% so that the spreadability is greater than F1, in F3 which contains 10% propylene glycol, it can affect the viscosity so that the preparation becomes thinner compared to F1 and F2 and will increase the spreadability value in the lotion preparation. In accordance with research from (Kurniawan, Sugihartini, & Yuwono 2018) stated that, the results of a comparison of the combination of propylene glycol and oleic acid enhancers, in the spreadability test the greater the proportion of propylene glycol as an enhancer, the greater the spreadability of the lotion.

Table 3. Adhesion Test Results

Formulation	Adhesion Test ± SD
F1	3.326 ±0.057
F2	2.160 ± 0.110
F3	1.123 ±0.126
F1 Base	5.373 ± 0.116
F2 Base	4.393 ± 0.146
F3 Base	2.440 ± 0.055

In this study, the adhesive strength of the lotion met the requirements of the adhesive test on lotion preparations, namely not less than <4 seconds (Ulaen, Banne, & Suatan 2012) because in the lotion formulation the results were obtained at F1=3.326 minutes, F2=2.160 minutes and F3= 1.123 minutes, while in the carrot extract lotion base formulation the results obtained were F1 = 5.373 minutes, F2 = 4.393 minutes and F3 = 2.440 minutes. The adhesion time for all formulations, both base and all formulas, still met the requirements for the adhesion test for topical preparations.

From the data obtained in the SPSS normality test, the P value F1 = 0.567, F2 = 1.000, F3 = 0.694, F1 base = 0.668, F2 base = 0.736 and F3 base = 0.702 are obtained. means the p value>0.05 means the data is normally distributed and the homogeneity test obtained a result of 0.566 which shows p>0.05 which means the data is homogeneous then the data is continued with a one way ANOVA test with a Tukey

follow-up test. The resulting data is p<0.05 which means The data shows that the results are significant, meaning that there are significant differences in each lotion formula, there is a difference in adhesive strength, due to the addition of variations and combinations of oleic acid and propylene glycol enhancers used in each formula which affects the adhesive strength. Where oleic acid will increase adhesion because the higher the concentration of oleic acid in the formula, the longer the lotion will stick to the skin because oleic acid can influence the preparation to become thick and cause the viscosity to be greater. Meanwhile, the addition of a greater concentration of propylene glycol causes the formula to become thinner so that its viscosity becomes lower and its adhesion decreases. In accordance with research from (Kurniawan, Sugihartini, & Yuwono 2018) stated that, the results of the comparison of the combination of propylene glycol and oleic acid enhancers in the adhesion test were the opposite because the higher the consistency level of oleic acid in the preparation, the longer the lotion's adhesion to the skin.

Table 4. Activity Test SPF Values

Formulas	Average SPF Value
F1	5.154 ± 0.068
F2	5.231 ± 0.125
F3	5.101 ± 0.079
F1 Base	-0.123±0.015
F2 Base F3	-0.671±0.004
Base	-0.919±0.002

From the results of measuring the SPF value, it can be seen that the carrot extract lotion has an SPF value of F1 of 5.154, F2 of 5.231, and F3 of 5.101, while the F1 base is -0.113, the F2 base is -0.671 and the F3 base is -0.919, which means the base does not affect SPF value, with an average SPF value of 5. In Prasiddha et al., (2016) research, an SPF value of 5 is included in the moderate protection category because the SPF value is in the average range of 4-6.

Analysis of the SPF data for carrot extract lotion was carried out using the SPSS application, testing the normality of the data and obtained significant data because P <0.05, which means the data was not normally distributed in carrot extract with a concentration of 5% for each formula. Then homogeneity was tested in SPSS, the result was P value 0.029, which means P <0.05 which means the data is not homogeneous. Then proceed to the Kruskal Wallis test.

SPSS data analysis was followed by the Kruskal Wallis test with Mann Whitney because the data was normally distributed but not homogeneous, so the results were continued with the Mann Whitney test. The results showed that between F1 and F2 a P value was 0.127, while F1 and F3 produced a P value of 0.376, and between F2 and F3 a P value was 0.376. so it can be concluded that the results of all data show a P value> 0.05, which means there is no significant difference between F1, F2 and F3, because the addition of oleic acid and propylene glycol enhancers has no effect on the SPF value of lotion preparations and those containing SPF are present. The active substance is carrot extract.In line with research from Herawati (2006) that the use of propylene glycol and oleic acid had no effect on base activity. Meanwhile, the basic SPSS analysis showed a negative value, which means it has no SPF activity. The result was p<0.05, which means there were differences in enhancer variations in the base formulation and F1, F2 and F3 which contained the active substance, namely carrot extract.

CONCLUSION

Conclusion

The combination of oleic acid enhancer and propylene glycol has an effect on the physical characteristics of the carrot extract lotion preparation. The addition of oleic acid and propylene glycol enhancers had no effect on the sunscreen activity of carrot extract lotion

Suggestion

Based on the results of the research that has been carried out, it can be recommended that this be carried out further research regarding: It is necessary to carry out a viscosity test on the carrot extract lotion formula. Further research needs to be done on the addition of oleic acid and propylene glycol enhancers to carrot extract lotion preparations on SPF absorption.

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