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BROCCOLI (*Brassica oleracea L*) ETHANOL EXTRACT: A MOISTURIZER AND ITS EVALUATION IN ASPECTS OF PHYSICAL CHARACTERISTICS

Silvy Aldila[1)]; Ranatri Puruhita [1)]; Syahkhirotul Exma Uliana[1)]; Anifatus Sa'adah[1)]; Fransisca Gloria[1)]

1) *Undergraduate of Pharmacy, STIKES Telogorejo Semarang, Central of Java, Indonesia*
*Correspondence to: *silvy@stikestelogorejo.ac.id*

Abstract: Skin disorders that are dry, dull, scaly, and not fresh affect everyone. Moisturizing cream is a cosmetic product that effectively hydrates and improves dry skin. Broccoli, scientifically known as *Brassica oleracea L*, is rich in vitamin C components, vitamin E (α-tocopherol), and flavonoids, which act as natural antioxidants and provide moisturizing properties for the skin. Producing extracts by the maceration process. Broccoli extract is utilized in the formulation of four moisturizing cream preparation compositions, each with a concentration of F1 (0%), F2 (2%), F3 (3%), and F4 (4%). The moisturizing cream formulation is assessed for its physical properties. Conducting tests to evaluate the dosage characteristics of moisturizing creams, includes organoleptic testing, homogeneity testing, pH testing, dispersion testing, adhesion testing, and viscosity testing. The concentration of broccoli extract in the four moisturizing cream preparation formulations is as follows: F1 (0%), F2 (2%), F3 (3%), and F4 (4%). The moisturizing cream formulation is assessed for its physical properties. Conducting tests to evaluate the dosage properties of moisturizing creams, including sensory evaluation, uniformity assessment, pH measurement, dispersion analysis, adhesion examination, and viscosity measurement.

Keywords: formulations, moisturizing creams, broccoli extract, physical characteristics

INTRODUCTION

According to Achroni (2012), dry skin is a prevalent skin ailment that affects everyone. It appears dull, scaly, and even wrinkled. Decreased water content is the cause of dry facial skin, which is defined as the absence of stratum corneum. As we age, our skin experiences physiological changes that lead to dryness and a loss of moisture and oil. One possible cause of these changes could be improper operation of the skin's oil glands (Muthia, 2019).

Using natural materials to make moisturizer cream products, such as broccoli veggies (*Brassica oleracea L.*), a plant that is commonly ingested by people. The antioxidant content of broccoli is the maximum in comparison to that of cabbage and sprouts. Broccoli is a source of bioactive compounds, including carotenoids, polyphenols, and vitamins A, C, and E (alpha-tocopherol), particularly flavonoids, which function as natural antioxidants (Monero, et al. 2010). Broccoli is a component of antioxidants with an IC50 value of 32.1292 ppm (Sami, 2015). The antioxidant activity of broccoli extract (*Brassica oleracea L.*) was classified as very potent, with an IC50 of 3.63 µg/ml (Lutfita, 2012).

Moisturizing creams are cosmetic preparations that are highly regarded by the general public. These preparations are designed to alleviate parched skin. Moisturiser is responsible for restoring moisture to parched skin. Moisturizing creams are advantageous in that they are simple to apply, provide adequate protection, and are comfortable to use (Hasanah, 2017). Additionally, they do not obstruct skin pores.

The researchers are interested in conducting research on the formulation of moisturizing cream preparations made from broccoli ethanol extract that are excellent and tested for their physical characteristics, as a result of the aforementioned background.

METHODS

Extract Preparing

The broccoli (*Brassica oleracea L.*) is collected and sorted while moist. Subsequently, it is washed by running water until it is clean, and it is subsequently displayed and dried in the oven. Furthermore, broccoli extract is produced through the maceration process. The Simplisia powder was filtered for 24 hours using a 1:10 ratio of 96% ethanol solvent. Thereafter, the material is macerated twice with ethanol (BPOM, 2012). The extract is subsequently evaporated to separate it from the solvent using a rotary evaporator. Afterward, it is evaporated using a water bath to produce a viscous extract (Lutfiyati, 2017).

Phytochemical Screening Analysis

Broccoli extract undergoes phytochemical screening to ascertain the quantity of secondary metabolite compounds present. Screening testing for broccoli extract consists of the following:

a. Flavanoid Test

Broccoli extract, up to 500 mg, and a small amount of magnesium powder (Mg) were combined, and then concentrated hydrochloric acid was added. The mixture was beaten until uniform. Flavonoids that produce favorable outcomes are identified by the appearance of orange, red, or yellow hues (Handayani, 2015).

b. Alkaloid Test

The broccoli extract was placed in a test tube, and 2% HCl was added. Dragendroff reagent was then added. Positive outcomes are achieved through the formation of brick-red, red, and orange deposits by alkaloids (Dragendroff), while positive outcomes for Mayer reagents are indicated by white or yellowish deposits (Lutfiyani, 2017).

c. Tannin Test

Broccoli extract is heated to a boil with 20 ml of water, filtered, and a few droplets of 1% FeCl are added. The extract is considered positive for tannins if it produces a greenish-brown or blackish-blue color (Lutfiyani, 2017).

d. Saponin Test

Broccoli extract 500 mg is dissolved in 0.5 ml of hot water and vigorously agitated for 10 seconds until foaming occurs. Subsequently, 1% HCL is added and the mixture is allowed to stand for 10 minutes. Saponins are detectable in broccoli extract if no foam is present (Lutfiyani, 2017).

e. Steroids and Terpenoids Test

Place broccoli extract in a test tube, then add diethyl ether and allow it to stand for 10 minutes. Finally, add anhydrous acetic acid that has been separated and concentrated H2SO4. The presence of purple-red color indicates the presence of positive triterpenoids, while the presence of light green color indicates the presence of positive steroids (Lutfiyani, 2017).

Testing for Vitamin C

a. Qualitative Analysis

Vitamin C is qualitatively tested using Benedict reagent. Five droplets of broccoli extract were introduced into a test tube, and 15 droplets of Benedict reagent were added in the subsequent step. The mixture was then subjected to gentle heating for a duration of 2 minutes. Vitamin C-positive outcomes are distinguished by the presence of a yellowish-green hue (Fadriyanti, 2015).

b. Quantitative Analysis

Vitamin C is quantitatively assessed through the UV-Vis spectrophotometry method.

1) Formulating a master solution of vitamin C at a concentration of 100 ppm
   In a 500 ml measuring flask that is enveloped in aluminium foil, the solution with aquadest is weighed to the limit mark by adding 50 mg of Vitamin C (Dewi, 2018).
2) Creating a standard solution
   Vitamin C solution is composed of pipettes with a concentration of 100 ppm, with capacities of 2 ml, 4 ml, 6 ml, 8 ml, and 10 ml. Then, transfer the substance to a 100 ml measuring flask that has been enveloped in aluminium foil. Add aquadest to the limit mark to create a vitamin C solution with a concentration of 4ppm, 5ppm, 6ppm, 7ppm, and 8ppm.

3) Determination of the vitamin C solution's maximal wavelength
Inserting a vitamin C solution with a concentration of 6 ppm into the cuvette. Then, aquadest blanks were employed to measure the wavelength between 200 and 400 nm (Dewi, 2018).
4) Measurement of the standard solution Each calibration curve solution, consisting of 4 ppm, 5 ppm, 6 ppm, 7 ppm, and 8 ppm, is introduced into the cuvette to generate the highest possible wavelength measurements. Following this, a linear regression equation is computed and a calibration curve is generated (Dewi, 2018).
5) Analysing the vitamin C concentrations in broccoli extract
Broccoli extract is dissolved in aquadest and subsequently transferred to a 1000 ml measuring vessel. In addition, the sample solution is filtered using filter paper, and the test solution is inserted into the cuvette to measure absorbance at the maximal wavelength (Hendrika & Wijaya, 2023).

Cream Preparation Formula

Melting stearic acid and glyceryl monostearate at 70 °C to create a moisturizing cream formulation using broccoli extract in phase 1 (oil). Methyl paraben and propyl paraben are dissolved in propylene glycol. TEA, glycerin, and propilenglicol are heated to 70°C in Phase 2, which is water. Phases 1 and 2 are combined in a heated mortar, and the mixture is subsequently crushed to create a cream mass. After that, the cream base is gradually thickened by the addition of viscous broccoli extract, which is stirred until it is homogeneous (Ekayanti, 2019). Table 1 for the crème preparation's formulation.

Table 1. Moisturizer Cream Formulation (Eka, 2012 & Ni Luh, 2019)

Ingredients	Formula (% w/v)			
	F1	F2	F3	F4
Broccoli Extract	-	2	3	4
Stearic acid	12	12	12	12
Glyserin	5	5	5	5
Glyceryl Monostearate	4	4	4	4
Propilenglikol	3	3	3	3
Triethanolamine	1	1	1	1
Methyl Paraben	0.18	0.18	0.18	0.18
propyl paraben	0.02	0.02	0.02	0.02
Aquadest	Add 100			

Evaluate the Cream's Physical Properties

a. Organoleptic Test
The organoleptic test of cream preparations is conducted by observing variations in color and aroma (Luhurningtyas 2017 & Elya, et al. 13).
b. pH Test
pH testing is implemented to ascertain the safety of a crème preparation during its application. Dissolve 1 gram of cream in 10 ml of aquadest and measure the solution using a pH meter (Erwiyani, et al. 2017). Cream formulations that are compatible with the skin's pH range from 4.5 to 6.5 (Edy, et al. 2016).
c. Viscosity Test
The Brookfield Viscometer measurement instrument is employed to determine the cream's viscosity. After the cream preparation has been weighed to a maximum of 30 grams, it should be placed in the cup, spindle number 4, and operated at a speed of 10 rpm. The viscosity results should be recorded once the viscometer displays a consistent value (Dina, 2016).
d. Dispersion Test
The dispersion test is conducted by weighing 1 gram of cream, placing it on a glass plate, and adding loads of 50, 100, and 150 grams. The load is then allowed to remain for 1 minute, and the diameter of the spread is measured. Cream preparations typically consist of a 5cm-7cm dispersion (Purwaningsih, et al. 2020).

e. Adhesion Test
   Adhesion testing is conducted by weighing 0.5 grams of preparation, which is then applied to glass and subjected to a 50gr burden every 5 minutes. Once the weight is lifted, the two plates are connected and the time of their release is recorded. The cream adhesion requirement is 2-300 seconds (Purwanto, et al. 2013 & Erwiyani, et al. 2017).

RESULT AND DISCUSSION

Preparation of Broccoli Extract (*Brassica oleracea L*)
In the production of broccoli extract, the flower and stem portions are separated after broccoli harvesting. After that, the damp sorting, display, and drying processes are implemented. Following the drying of a 30 kg broccoli sample, 1.6 kg of broccoli powder was obtained. The powder was extracted using the maceration procedure for 3x24 hours and remaceration for 2x24 hours. To prevent the destruction of vitamin C and flavonoid compounds in broccoli, which are susceptible to damage from high temperatures, the maceration method is employed to produce broccoli extract (Sutomo, et al. 2017).

The reason for the use of 96% ethanol solvent in this study is that it has a high degree of polarity, which enables it to attract a larger number of nonpolar, semi-polar, and more polar chemical compounds than low-concentration solvents. Furthermore, ethanol is 96% more capable of penetrating the sample wall, resulting in a more concentrated extract (Wendersteyt, 2021).

The results of broccoli extraction by maceration method with a dried simplisia and solvent ratio of 1:10 are as under. Broccoli extract yielded up to 24.62%. According to Handayani (2016), the yield value of viscous extract must be at least 10%. The yield attained is reported in accordance with the Indonesian herbal pharmacopeia's specifications, which are greater than 8.2% (Kemenkes RI, 2017).

Figure 1. Broccoli (*Brassica Oleracea L*) Ethanol Extract

The yield value is directly proportional to the content of the compounds withdrawn, and it refers to the amount of active substances in the extract (Budiyanto, 2015). In contrast to Lutfiyati's (2017) previous investigation, which yielded 20.18%, this investigation yields a higher percentage. Due to its dependence on temperature and extraction duration (Sekar, 2019), this is the case.

Broccoli (*Brassica oleracea L*) ethanol extract secondary metabolite compound testing
Phytochemical screening experiments were conducted to identify the active compounds present in broccoli (*Brassica oleracea L*) following the acquisition of a thick extract. Steroids, alkaloids, saponins, terpenoids, and flavonoids comprise active compounds.
a. Flavonoid Test
   The flavonoid test was conducted by introducing an extract of NaOH solution and subsequently observing the color change. Results of flavonoid testing include an alteration in pigmentation to orange. Lutfiyati's (2017) research indicates that broccoli extract contains flavonoid compounds that generate an orange hue, which is consistent with this. According to Azqini (2018), broccoli extract contains flavonoid compounds that exhibit an orange hue. In Figure 2, the results of the examination are illustrated.

Figure 2. Results of the Flavonoid Color Test on Broccoli (*Brassica oleracea L*) Extract

b. Alkaloid Test

The analysis of alkaloid compounds yielded negative results, as evidenced by the absence of a precipitate on the extract that was supplemented with dragendroff. The reason for this is the polarity disparity between solvents and alkaloids (Putri, 2020). Additionally, Lutfiyati (2017) and Azqini (2018) reported that broccoli extract contains alkaloid compounds that are distinguished by the presence of white deposits. The results of the test are illustrated in Figure 3.

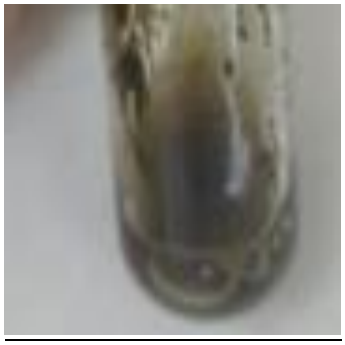

Figure 3. Alkaloid Color Test of Broccoli (*Brassica oleracea L*) Extract

c. Tannin Test

The results of the testing of tannin compounds in broccoli extract are as follows: the blue color changes to a blackish hue, indicating the formation of a complex compound between the tannins and Fe3+. This complex compound results in a strong green or black color. This research is consistent with the findings of Lutfiyati (2017) and Azqini (2018), who found that broccoli extract contains tannin compounds that are distinguished by a change in color to blackish green. Figure 4 illustrates the outcomes of the examination.

Figure 4. Tannin Color Test of Broccoli (*Brassica oleracea L*) Extract

d. Saponin Test

The results obtained indicated that broccoli extract contains saponin compounds, as a stable froth was produced for a period of 15 minutes. These findings are consistent with those of Azqini (2018) and Lutfiyati (2017). According to this assertion, broccoli extract contains saponin compounds due to its ability to generate a sustained foam. The test results are illustrated in Figure 5.

Figure 5. Broccoli (*Brassica oleracea L*) Extract Saponins Test Results

e. Steroids/Terpenoids Test
In this study, the addition of Liebermann-Burchard solution to steroid assays yielded positive results, resulting in a green color. This finding is consistent with the research of Lutfiyati (2017) and Azqini (2018), who asserted that broccoli extract contains steroid compounds that produce a green shade. The results of the test are illustrated in Figure 6.

Figure 6. Results of the Steroid Test on Broccoli (*Brassica oleracea L*) Extract

Testing of vitamin C

Qualitative vitamin C testing is implemented to ascertain the presence of vitamin C in broccoli extract. The Benedict reagent was used. The test was carried out by adding Benedict solution to the extract, which afterwards showed a yellowish-green color change, confirming that broccoli contains vitamin C (Fradiyanti, 2013). A reducing agent, vitamin C reduces Cu2+ ions from Benedict's reagent to CU+ ions when Cu2O deposits appear, resulting in a transition from yellow-green to brick-red coloration (Ratih, 2013). The aldehyde group in vitamin C contributes in the color change (Antonius, 2021). The results of the test are illustrated in Figure 7.

Figure 7. Results of the Vitamin C Broccoli (*Brassica oleracea L*) Extract Test

The Vitamin C levels in broccoli ethanol extract were determined using UV-Vis spectrophotometry at a wavelength of 266 nm. The standard testing results for vitamin C are illustrated in Figure 8. After the concentration series is measured, absorbance values from a variety of concentrations are obtained, and the standard equation of vitamin C is subsequently calculated.

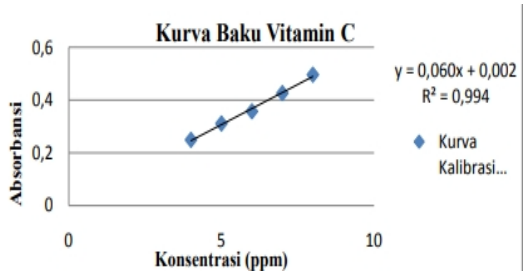

Figure 8. Standard Curve of Vitamin C

According to the linear regression calculation, the correlation coefficient is 0.994, and the equation for y is y = 0.060x + 0.002. The r value is directly proportional to the Lambert-Beer law, as it illustrates the relationship between concentration and absorbance (Primadiamanti, 2019). The average vitamin C level of broccoli was 42.75%, as determined by the measurement results. This study's vitamin C levels are significantly higher than those of Kusumawati's (2017) previous research, which was 13.59%. This is because it is influenced by temperature conditions both before and after harvest (Jones, et al. 2015).

Vitamin C has numerous advantages for the body, including its usage as an antioxidant. The skin is also benefited by vitamin C, which is an extensively used cosmetic product. Antioxidants in vitamin C contribute to the inhibition of free radicals by supplying electrons to them, which in turn generate molecules that can effectively suppress them (Lulu, et al. 2022). Pullar et al. (2017) have demonstrated that vitamin C is involved in the formation of stratum corneum, which is responsible for protecting the skin from water loss and the development of dehydrated skin. Additionally, vitamin C can increase the production of protective lipids and keratinocyte differentiation.

Examination of the preparation's physical characteristics

a. Organoleptic Test

The appearance of texture, color, and aroma in emollient cream preparations is determined through organoleptical tests. Purwaningsih, et al. (2020) have observed that test organoleptis can influence user comfort. The results are illustrated in Figure 9.

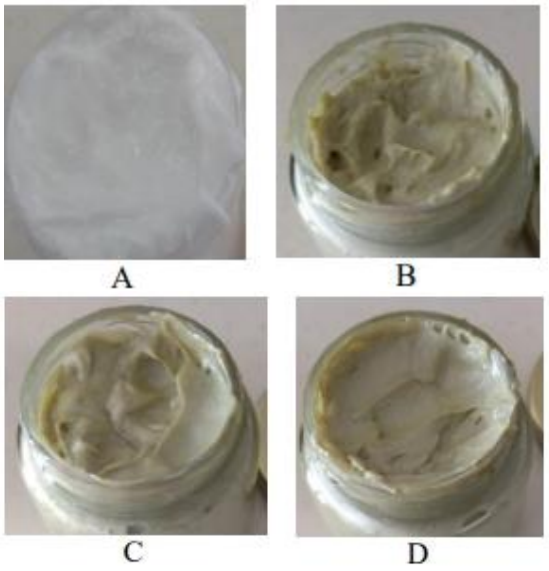

Figure 9. Test Results of Organoleptis Cream Moisturizer Broccoli Ethanol Extract on A (F1), B (F2), C (F3), and D (F4)

b. pH Test

pH testing is conducted to ascertain the safety of moisturizer cream preparations for use. Skin irritation may result from an acidic pH, while dehydrated and scaly skin may result from an alkaline pH (Azkiya, et al. 2017). The pH test results are described in Table 2.

Table 2. Results of the physical evaluation of broccoli extract moisturizer cream preparations on F1 (0%), F2 (2%), F3 (3%) and F4 (4%)

Formula	Average value			
	pH	Viscosity (cPs)	Adhesion (second)	Dispersion (cm)
F1	6,45	33,20	2,22	5,20
F2	6,41	33,33	3,15	5,10
F3	6,39	34,03	3,20	5,10
F4	6,34	34,70	3,23	5,00

The broccoli ethanol extract moisturizer cream's pH test results indicate that it is within the range of 6 and satisfies the pH value requirement of 4.5-6.5. The formula without extract has the highest pH, as it contains flavonoid compounds, a group of acidic phenol compounds. Consequently, F2, F3, and F4 decrease. This is due to the fact that the addition of broccoli extract can result in a decrease in pH in moisturizer cream preparations. Alvianti, et al. (2018) demonstrate that emollient cream preparations continue to possess a pH that is both safe for use and does not induce skin irritation.

c. Viscosity Test

The viscosity of moisturizer cream preparations is determined through viscosity testing to facilitate application and dispensing. The viscosity of a semi-solid preparation is a factor that influences its evenness. As the viscosity increases, the composition becomes denser. According to Swastini et al. (2015), the particle size value will be decreased as a result of the difficulty in applying the composition evenly to the epidermis due to its high viscosity value. The results of the viscosity measurement are presented in Table 2.

The four formulations satisfied the viscosity test requirements within the 2000-50,000 cp range, as shown by the results of the viscosity test. The formula with the highest value is F4, followed by F3, F2, and F1. The viscosity of the preparation increases as the amount of broccoli extract added increases, as the preparation contains less water (Rowe, 2017).

d. Dispersion test

The purpose of testing the spreadability of moisturizer cream preparations is to guarantee that the cream can be evenly distributed on the skin (Arisanty & Anita, 2018). Dispersion is closely associated with the dissemination of cream preparations during their use. The cream's contact power with the skin's surface is wider as the dispersion increases, ensuring that the substance is evenly distributed (Swastika, et al. 2013). The dispersion test results are presented in Table 2. The test results indicated that F1 exhibited the highest dispersion, followed by F2, F3, and F4. All four formulations satisfied the specified scattering test requirements. The cream's spreadability is optimal within the range of 5-7 cm. (Purwaningsih, et al., 2020).

e. Adhesion Test

Adhesion to moisturizer cream preparations is assessed to ascertain their duration on the skin. An effective cream must be able to maintain long-lasting contact with the skin in order to attain its optimum effectiveness. The longer the cream remains on the skin, the more pronounced the effect will be. The viscosity value is directly proportional to the adhesion value. The preparation will adhere to the skin for a prolonged period of time as the viscosity value increases (Princess, 2023). Table 2 displays the outcomes of adhesion. The four formulations surpass the specifications, as proved by the adhesion research results, which show the results range from 2.17 to 3.15 seconds. The adhesion value of cream is optimal at 2-300 seconds (Pohan, 2019).

CONCLUSION

Flavonoid compounds, saponins, tannins, and steroids are present in the viscous broccoli extract as measured by phytochemical screening. The physical characteristics of organoleptis were tested, and the results indicated that the greener the color of the moisturizer cream preparation, the higher the concentration

of extract applied. The formulation is considered homogeneous when there are no lumps in the moisturizer cream, as assessed by the homogeneity testing of F1, F2, F3, and F4. Additional research suggested that broccoli extract moisturizer cream formulations could be implemented in other pharmaceutical preparations, particularly cosmetic products. For future research, it is advised to incorporate a suitable fragrance to mask the aroma of broccoli extract in other cosmetic preparations.

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