International Journal of Applied Pharmaceutics

ISSN- 0975-7058 Vol 15, Special Issue 2, 2023

Original Article

FORMULATION AND EVALUATION OF HAND AND BODY LOTION FROM PURPLE SWEET POTATO (*IPOMOEA BATATAS* L.) PEEL EXTRACT AND ITS ANTIOXIDANT ACTIVITY

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Received: 19 Aug 2023, Revised and Accepted: 03 Oct 2023

ABSTRACT

Objective: This study aims to investigate the antioxidant activity of purple sweet potato (*Ipomoea batatas* L.) peel extract. The goal is to determine the levels of antioxidant activity in hand and body lotion formulas that use purple sweet potato peel extract as an antioxidant agent and to evaluate the formulas to identify the one with the best physical stability.

Methods: The antioxidant activity was assessed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical inhibition method. Physical stability of the hand and body lotion formula was evaluated within 4 w storage at room temperature, the evaluation was based on measurements of various lotion characteristics such as organoleptic properties, pH, homogeneity, viscosity, phase separation, and spreadability.

Results: The results of this study showed that the purple sweet potato peel extract exhibited antioxidant activity, with an IC_{50} value of 44.582±1.19 ppm. The antioxidant activity of the hand and body lotion formulas had IC_{50} values of 83.319±1.01, 63.181±0.97, and 24.107±0.63 ppm for formulas containing 1,3, and 5% extracts, respectively. The hand and body lotion formula containing 3% extract demonstrated the best physical stability, as it remained physically stable after being stored at room temperature for 4 w.

Conclusion: The extract of purple sweet potato peel presented very strong antioxidant activity and has great potential for use in hand and body lotion formulas as an antioxidant agent.

Keywords: Antioxidant, *Ipomoea batatas* L., Purple sweet potato peel, Lotion

DOI: https://dx.doi.org/10.22159/ijap.2023.v15s2.22 Journal homepage: https://innovareacademics.in/journals/index.php/ijap

INTRODUCTION

Purple sweet potato (*Ipomoea batatas* L.) is one of the various types of sweet potatoes commonly found in Indonesia, alongside yellow, red, and white varieties [1]. The use of purple sweet potato as a food ingredient has been widely implemented. However, its use is typically limited to the tuber part, while the peel, which is often discarded as waste, is rarely used even though it is known that the peel of the purple sweet potato contains numerous beneficial chemical compounds. One such compound is the flavonoid anthocyanin. Which functions as an antioxidant and free radical scavenger, an antioxidant known has role in preventing aging, some degenerative diseases, and cancer [2].

The skin, as the outermost organ of the body, is often directly exposed to pro-oxidant environments such as air pollution and radiation, which trigger the formation of free radicals. Antioxidants are compounds that can support the body's protection from cell damage due to exposure to free radicals, because antioxidants can play a role in inhibiting the aging process by helping to replace body cells with new cells more quickly. The benefits of antioxidants are very appropriate when applied in the form of preparations to protect the skin from the dangers of free radicals [3]. Most natural antioxidants are isolated from natural materials such as plants. An example of a plant that can be used for natural antioxidants is purple sweet potato. Important content in purple sweet potatoes such as phenolic flavonoids, β-carotene, vitamins and anthocyanins have higher antioxidant activity compared to white and red sweet potatoes [4]. The purple sweet potato is also richer in antioxidant vitamin A content, hundreds of times greater than that contained in beets and three times greater than the content in tomatoes. The anthocyanin compound content in purple sweet potatoes plays a significant role in the antioxidant activity of purple sweet potatoes; according to previous study, the anthocyanin content in the peel of purple sweet potatoes is more abundant compared to the tuber flesh of purple sweet potato with the total anthocyanin content in its ethanol extract averaging 4 times greater than the content in the flesh extract [5]. Due to the high flavonoid content, which has antioxidant benefits in the skin extract of purple sweet potatoes (*Ipomoea batatas* L.), it has a higher potential to be formulated into cosmetic preparations by utilizing it as an antioxidant.

The use of antioxidants can be applied topically in the form of cosmetics to help protect the body from cell damage caused by exposure to free radicals. One type of cosmetic that can be use is lotion, which is more practice and easy to apply directly to the skin. The addition of active natural ingredients is expected to increase the added value and function of hand and body lotion. In addition, the use of lotion leaves a cool sensation due to the evaporation of water components, making it an appropriate choice as a light skin protector that does not leave residue. It can be use at any time without worrying about sticking to clothes, and can also be use in an area with a humid climate or when the weather starts to heat up [6]. Based on the description, this study was conducted with the aim of developing a hand and body lotion formulation by optimizing the use of extracts from parts of the purple sweet potato that are rarely used, namely the peel of the purple sweet potato as an antioxidant.

MATERIALS AND METHODS

Materials

The purple sweet potato peel was collected from Pasundan, Samarinda, East Borneo and identified at the Mulawarman Herbarium, Laboratory Ecology and Conservational Tropical Forest Biodiversity, Forestry Faculty, University of Mulawarman, Samarinda, East Borneo (101/UNI17.4.08/lL/2021). Gliceryn, triethanolamine (TEA), methylparaben, and oleum rosae were purchased from CV. Amoeba biosintesa (Bandung, Indonesia). Liquid paraffin, stearic acid, and cetyl alcohol were purchased from PT.

Brataco (Jakarta, Indonesia). DPPH was purchased from Sigma Aldrich (Jakarta Indonesia). Distilled water, ethanol, and methylene blue were purchased from Merck Chemicals and Life Sciences Co (Jakarta, Indonesia).

Extract preparation

The peels of the purple sweet potato sample were cut into smaller pieces and continuously dried using an oven at a temperature of 50 °C until they were completely dry. The dried sample was then ground into a powder. Furthermore, the powder obtained was macerated with 96% ethanol at a ratio of 1:6 for 3 d and then filtered through filter paper. The resulting mixture was processed and concentrated using a rotary evaporator to obtain the extract [7].

Phytochemical screening

A phytochemical screening test experiment was conducted to detect any secondary metabolite compounds such as alkaloids, steroids, terpenoids, flavonoids, tannins, and saponins. The phytochemical screening of the purple sweet potato (*Ipomoea batatas* L.) peel extract was performed using a qualitative phytochemical screening test [8].

Antioxidant activity test

The experiment conducted with the DPPH method by calculating scavenging effect ability of DPPH. Antioxidant activity determined by the IC_{50} value by a UV-Visible spectrophotometer [9]. To made stock solution, samples was prepared in ethanol as the solvent, the stock solution then diluted into a series of test solutions with concentrations of 10, 50, 100, 150, and 200 ppm, followed by added 40 ppm DPPH solution to each sample test solution and solvent without extract as a blank at 1:1 ratio, the samples were incubated first for 30 min at the 37 °C temperature in the dark room, furthermore absorbance are measured at the maximum wavelength between λ 510-520 nm by a UV-Visible spectrophotometer. The free radical suppression activity then calculated as inhibition of percentage using this following equation:

$$\text{Inhibition percentage (\%)} = \frac{\text{Control absorbance} - \text{Sample asorbance}}{\text{Control absorbance}} \times 100$$

Then IC_{50} value furthermore can be calculated by linear regression plot. The analysis of antioxidant activity data of purple sweet potato (*Ipomoea batatas* L.) peel extract was conducted quantitatively by determining the percentage of antioxidant activity of the extract and then determining the probit value. From the absorbance data obtained, the percentage of antioxidant activity and IC_{50} value were calculated. Furthermore, its linear regression and IC_{50} value were determined. The IC_{50} value was calculated using a linear regression equation between concentration and percentage of antioxidant activity to obtain the x-axis and y-axis values between inhibition percentage and concentration value [9].

Preparation of hand and body lotion

Table 1: Formula of hand and body lotion

Ingredients	Function	Percentage of amount (%)			
		F0	F1	F2	F3
Extract	Active ingredients	0	1	3	5
Glycerin	Humectant	5	5	5	5
Triethanolamine	Emulsifier	2	2	2	2
Liquid paraffin	Emolient	5	5	5	5
Stearic acid	Emulsifier	3	3	3	3
Cetyl alcohol	Emulsifier	5	5	5	5
Methyl paraben	Preservative	0.1	0.1	0.1	0.1
Oleum rosae	Perfume	0.1	0.1	0.1	0.1
Aquadest	Solvent	100	100	100	100

The formula design used is as shown in table 1. For the purple sweet potato peel extract hand and body lotion, total of 4 preparation formulas were made by varying the extract concentration of each formula as F (formula) 0, which the lotion base without extract, F1 that, contain 1% extract, F2 contain 3% extract, and F3 with 5% extract. The ingredients were weighed and separated into two parts: the water phase (glycerin, distilled water, and methylparaben) along the oil phase (stearic acid, liquid paraffin, and cetyl alcohol); each phase was placed in a separate porcelain dish and heated on a hotplate, the oil phase melted at 70 °C while the water phase dissolved at 40 °C, After all the ingredients melted, the oil phase ingredients then poured into the ingredients water phase slowly while stirred continuously, then triethanolamine, oleum rosae, and the active ingredient purple sweet potato peel extract were added stirred slowly at a constant speed until homogeneous. Preparations then stored in a container and labeled.

Evaluation of hand and body lotion

Physical stability evaluation of the hand and body lotion formula is carried out for 4 cycles at room temperature storage, where each cycle lasts for 7 d. The testing was carried out continuously from week 0 to week 4 within testing parameters including (n = 3).

Organoleptic

Organoleptic evaluation was done by direct observation of hand and body lotion, including examination of aroma and color of each sample formulas [10].

pH

The pH measured with a pH meter, the instrument calibrated firstly with a neutral buffer solution and an acidic buffer solution [10].

Homogeneity

Homogeneity test performed by applied 0.5 g sample to a glass slide then covered with another glass slide to see if there are any coarse grains in the homogeneity of the preparation [10].

Viscosity

Viscosity test carried out with a rheosys viscometer, 1 g of the sample applied on the tool, a spindle cone and plate 5/30 mm attached within speed of 10 rpm [11].

Phase separation

The phase separation of preparations is determined using a centrifuge tool. A sample of approximately 1.5 g is placed into the centrifuge, ensuring that the volume of the sample in each tube is equal. The test is conducted at a speed of 3,500 rpm for a duration of 5 h. Subsequently, the condition of the preparation is observed to ascertain whether it undergoes phase separation [11].

Spreadability

The spreadability test were done by applying 0.5 g of sample in the middle of 2 transparent glass (20 x 20 cm); after that add 125 g load on top, let it stand for 1 minute, lastly measure the sample spread diameter using a ruler [11].

Emulsion type

Emulsion type test done by dropping methylene blue solution on the preparation. If the entire preparation is not uniformly colored, then the emulsion from the tested preparation type are water-in-oil (W/O), but if the entire preparation is uniformly colored, then the emulsion type are oil–in-water (O/W) [12].

RESULTS AND DISCUSSION

Phytochemical screening

The phytochemical screening of purple sweet potato peel extract revealed positively detect alkaloids, flavonoids, tannins, and saponins as shown in table 2. Similarly, in another study, the phytochemical screening test on purple sweet potato (*Ipomoea batatas* L.) extract also detect some of these metabolite compounds, this phenomenon is in accordance to the same eluent used, which is ethanol, the number of substances found with the different kind of eluent could be different for each kind of extract and vice versa [7]. However, these four compounds are known to have the ability as exogenous antioxidants with their ability to donate one of their electrons to free radicals that have unpaired electrons, thus inhibiting oxidation reactions [13].

Table 2: Phytochemical screening result (n=3)

Secondary metabolites	Results
Alkaloid	Presence
Flavonoid	Presence
Tannin	Presence
Saponin	Presence
Steroid	Absence
Terpenoid	Absence

Antioxidant activity

This DPPH method that used is based on the ability of antioxidants (from the tested sample with concentrations of 10, 50, 100, 150, and 200 ppm for each formula) to donate its atoms hydrogen straight to the DPPH (40 ppm) radical. The DPPH reaction with antioxidants will form reduced DPPH itself which is non-radical. The dark purple color of DPPH will change to pale purple or yellow (the color of reduced DPPH). The color change can be observed using a UV-Vis spectrophotometer to surely resolve the antioxidant activity ability of the sample in quenching free radicals [14]. The activity antioxidant test with this DPPH method to measure the absorbance of the samples against the blank at a maximum of 510 nm wavelength with a Spectrophotometer UV-Vis and determined linear regression, percent antioxidant ability activity, also IC_{50} value. The efficiency of antioxidant activity ability expressed in the form of a percentage of antioxidant activity to describe the percentage inhibition of DPPH by the extract it is expressed in the IC_{50} value, which is the concentration that able to causes as much as 50% loss of the DPPH activity. More high the IC_{50} value of a compound, more low its antioxidant activity ability. For the antioxidant activity value classification, the compound considered very strong, indicated by IC_{50}<50 ppm, classified as strong, indicated by IC_{50} within the range of 50-100 ppm, point out as moderate if its IC_{50} value is within 100-150 ppm, lastly weak if its IC_{50} between the 150-200 ppm [15].

The results showed that the extract of purple sweet potato tuber peel has potent antioxidant ability; based on the results obtained, it appears that the purple sweet potato tuber peel extract has a very strong antioxidant, point by its IC_{50} value of 44.582 ppm. The reaction process between the antioxidant compounds contained in the purple sweet potato peel extract in quenching DPPH radicals occurs through the mechanism of hydrogen atom donation. The hydrogen atoms in the extract act as hydrogen atom donors, reducing the DPPH radical and reducing the conjugated double bonds in DPPH, causing color of test sample solution to change from purple to yellow [4]. The shown antioxidant activity ability from samples extract is indeed related to the compounds contained in the sample extract that have been tested for their secondary metabolite content, as shown in table 2. Positive results were obtained for the presence of some secondary metabolite compound groups, include alkaloids, flavonoids, saponins, and tannins, which also known to have various biological antioxidant effects. These three compounds have an-OH group associated with an aromatic ring. The hydrogen atoms in the compound act as hydrogen donors, reducing the DPPH radical to a non-radical and stabilizing it [13].

Based on the tests that have been conducted on the preparations (table 3 and fig. 1), it was known that purple sweet potato tuber peel extract hand and body lotion antioxidant activity samples formula 1 with 1% extract and formula 2 with 3% extract were classified as strong antioxidant activity, while the IC_{50} value formula 3 with 5% extract and the purple sweet potato peel extract itself indicates very strong antioxidant activity. The significant difference (*p>0.05) in antioxidant activity values for each formula is clearly due to the difference in the amount of active ingredient concentration used in this research formula, which is purple sweet potato peel tuber extract as an antioxidant agent for the preparation. It can be concluded that the more of concentration amount of extract formulated, the stronger the antioxidant activity produced by its preparation.

Table 3: Antioxidant activity result (n=3)

Sample	IC_{50} (ppm)
Extract	44.582±1.19
F1	83.319±1.01
F2	63.181±0.97
F3	24.107±0.63

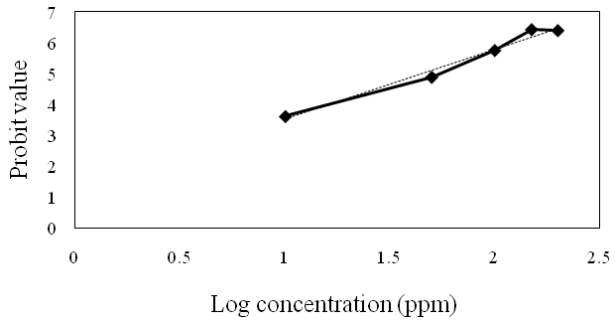

Fig. 1: Linear regression of purple sweet potato peel extract (n=3)

Evaluation of hand and body lotion

Organoleptic

Organoleptic test is carried out through direct observation of aroma and color periodically to see organoleptic changes [10]. The results obtained showed that F0 has a characteristic oleum rosae aroma, white color, the F1 sample has a characteristic oleum rosae aroma in light brown color, the F2 characteristic is oleum rosae aroma and brown color, and lastly F3 characteristic oleum rosae aroma, dark brownish color. All of the samples observed consecutively have consistent characteristics without changed within 4 cycles storage experiment, so it can be said that the organoleptic properties of each formula are stable.

pH

This pH test was conducted to ensure that the pH of the sample preparation is safe for the skin. Preparations with a low pH or acidic

risk to damage by irritate the skin, while if the pH of the test sample preparation is over high, it surely able to cause the skin into become dry when used [15]. As shown in table 4, which shows different pH values for each formula. It appears that the more the amount of extract concentration in the preparation, the lower its pH. However, in terms of stability, the pH of the preparation did not change much during 4 cycles of storage time, this is expected to be due to the lotion preparation being stored at a constant room temperature without significant fluctuations, therefore, there is no significant change in the pH of the preparation during storage. These results indicate that variations in the concentration of active ingredients in the form of purple sweet potato tuber peel extract in the formula for purple sweet potato tuber peel extract hand and body lotion have a pH that is within the normal skin pH range of 4.5-8.0 [10].

Table 4: pH test result

Sample	Cycle 0	Cycle 1	Cycle 2	Cycle 3	Cycle 4
F0	7.52±0.03	7.49±0.02	7.45±0.03	7.42±0.02	7.38±0.03
F1	7.18±0.05	7.13±0.05	7.14±0.03	7.11±0.03	7.13±0.05
F2	7.06±0.11	7.07±0.06	7.05±0.09	7.03±0.07	7.03±0.08
F3	6.64±0.01	6.51±0.02	6.50±0.04	6.49±0.03	6.49±0.01

Data were expressed as mean±SD, n=3

Homogeneity

The homogeneity test of the samples was conducted with the aim of determining whether the ingredients of the preparation were well mixed appearance of the preparation was observed to see if there were any coarse grains in the preparation [10]. Based on the test results, all physical formulas of the preparation appeared to be stable, homogeneous, and did not show any changes in homogeneity during storage from cycle 0 to cycle 4. The homogeneity stability of the preparation is closely related to the mixing process during the initial preparation. If the ingredients are mixed well and evenly from the beginning or not, as long as the storage temperature keep stable, Therefore, it is suspected that there will not be many changes in the homogeneity of the preparation. This indicates that variations in extract concentration did not affect the homogeneity of the ingredients in the preparation, so the preparation was well mixed.

Viscosity

A good viscosity will have a high value. The higher the viscosity of the cream, the more it is difficult for particles to move, making it more stable. The good viscosity parameter for lotion preparations is in the range of 2,000-50,000 cPs [11]. As also shown in table 5. the physical evaluation results of all preparation formulas show that the formula with the highest to lowest viscosity in order is formula 0 or base, then formula 1, formula 2 and finally formula 3, but all 4 formulas are within the expected viscosity range of 2,000-50,000 cPs. The viscosity value of the preparation with the highest active ingredient concentration, formula 3 with 3% active ingredient, has the lowest viscosity, so concluded that the less extract active ingredient concentration amount used in the formula, the greater its viscosity value of the resulting hand and body lotion.

Tabel 5: Viscosity test result

Sample	Cycle 0 (cPs)	Cycle 1 (cPs)	Cycle 2 (cPs)	Cycle 3 (cPs)	Cycle 4 (cPs)
F0	9.39±0.17	8.99±0.19	8.88±0.62	9.51±0.24	9.89±0.74
F1	9.27±0.12	9.21±0.87	8.48±0.48	8.22±1.20	8.36±1.81
F2	5.62±0.50	6.23±0.84	6.72±0.13	6.54±0.98	7.88±1.03
F3	4.63±0.80	5.03±0.60	5.07±0.06	5.02±0.67	4.42±0.67

Data were expressed as mean±SD, n=3

Phase separation

The phase separation test was conducted to test the stability of the emulsion preparation. This test was performed using a centrifuge. The results obtained that the phase separation evaluation for all 4 samples indicated that all variations in the concentration of the active ingredient, purple sweet potato peel extract, in the preparation formula did not affect the stability of the samples phase due the stable storage temperature and the preparation did not experience any contamination or significant changes during storage, so each preparation formula remained stable and did not undergo phase separation during 4 cycles of storage.

Spreadability

The spreadability test was conducted to evaluate the ability of the cream to spread on the skin. Spreadability describes the consistency of the preparation, and a good consistency can provide comfort to the user of the preparation because the preparation can adhere well [16]. Table 6 shows that the results of the spreadability test for the preparation are still within the standard range used, which is 5-7 cm, except for formula 3 in cycle 4, where the spreadability of the preparation is exceeding the expected standard range. The increase in spreadability that occurred may be due to a decrease in the viscosity of the preparation. This is because viscosity which indicates the consistency of the preparation, affects the spreadability of the preparation.

Tabel 6: Spreadability test result

Sample	Cycle 0 (cm)	Cycle 1 (cm)	Cycle 2 (cm)	Cycle 3 (cm)	Cycle 4 (cm)
F0	6.1±0.02	6.6±0.20	6.8±0.07	5.7±0.04	5.4±0.19
F1	6.5±0.11	6.7±0.42	6.7±0.96	6.5±1.30	6.7±0.06
F2	6.7±0.05	5.9±0.06	6.3±0.13	6.1±1.08	6.5±0.29
F3	6.8±0.08	6.8±0.65	6.5±1.08	6.8±0.05	7.3±0.04

Data were expressed as mean±SD, n=3

Emulsion type

The emulsion type test was conducted by staining the samples with methylene blue, that able produces a uniform blue color because the hydrophilic methylene blue dissolves in the outer water phase of the emulsion that surrounds the oil phase [10]. the results obtained were

that all 4 preparation formulas were uniformly stained, indicating that the emulsion type of the preparation is oil-in-water (O/W).

CONCLUSION

Purple sweet potato tuber peel extract has potent antioxidant effectiveness where an IC_{50} value of 44.582±1.19 ppm was obtained, which is a very strong ability antioxidant activity. This study explains the antioxidant activity levels formulation of hand and body lotion from purple sweet potato tuber peel extract have good antioxidant activity, with IC50 antioxidant activity values for F1 83.319±1.01 ppm, and F2 63.181±0.97 ppm both are classified as strong antioxidant ability, while F3 indicates very strong antioxidant activity with IC50 24.107±0.63 ppm. The extract can be well formulated in the composition of hand and body lotion preparations, with the results of stability testing of the physical preparation within 4 cycles storage time at room temperature that has been obtained, it is concluded that formula 2, which has an extract concentration of 3% as a formula with the best physical stability of the preparation, because it meets all the standard values of physical quality requirements for lotion expected, and more stable than formulas 1 and 3.

FUNDING

Nil

AUTHORS CONTRIBUTIONS

All of the authors have made equal contributions. ACN, AF, and NW made a contributions in lotion formulation and evaluation. SIG and MM author made contribution in extraction and antioxidant activity of Ipomoea batatas (L.).

CONFLICT OF INTERESTS

Declared no conflict of interest

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