Trop J Nat Prod Res, August 2024; 8(8): 8043 - 8046 **ISSN 2616-0684 (Print)**
ISSN 2616-0692 (Electronic)

Tropical Journal of Natural Product Research

Available online at https://www.tjnpr.org

Short Communication

Antioxidant and Sunscreen Activities of Tamarind (*Tamarindus indica* L.) Rind Ethanol Extract Cream

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ARTICLE INFO

Article history:
Received 3 October 2023
Revised 11 October 2023
Accepted 17 August 2024
Published online 01 September 2024

ABSTRACT

Tamarind (*Tamarindus indica* L.) rind is one of the natural products which has been proven to have antioxidant and sunscreen activities. It has the potential to be developed into cosmetic product such as cream. This study aims to determine the correlation between the antioxidant activity and the Sun Protection Factor (SPF) of tamarind rind ethanol extract cream. Tamarind rind was macerated in ethanol (96%) for 5 days, the extract was concentrated over a water bath to obtain a dried tamarind rind ethanol extract. The tamarind rind ethanol extract was formulated into creams using three different concentrations of tamarind rind ethanol extract as the active ingredient; FI (5%), F2 (10%), and F3 (15%). The sunscreen protection activity of the creams was assessed by determining the sun protection factor (SPF) using the Mansur formula. The antioxidant activity of the creams was evaluated by the DPPH (2,2-Diphenyl-1-picrylhydrazyl) radical scavenging assay. The correlation between the IC_{50} value of the antioxidant activity and the SPF value was analyzed using the Spearman's rank correlation test. Results show that formulation F3 has the highest sunscreen activity with SPF value of 6.469, but all the formulation has very weak antioxidant activity (IC_{50} < 200 ppm). The Spearman's rank correlation analysis showed a significant relationship between the IC_{50} value and the SPF value of tamarind rind ethanol extract cream, which suggests that the higher the antioxidant activity, the higher the SPF value of the cream formulation.

Keywords: Tamarind, Antioxidant, Sunscreen, Cream.

Introduction

Exposure to high intensity UV rays may cause harm to the skin. Sunscreens protect the skin from the harmful effects of solar UV radiation by preventing the absorption of UV radiation by the skin. Tamarind (*Tamarindus indica* L.) rind is one of natural products that has been proven to have antioxidant and sunscreen activities.

Tamarind (*Tamarindus indica* L.) rind ethanol extract has Sun Protection Factor (SPF) of 36.22 which is being categorized as ultra-type protection.[1] The tamarind rind ethanol extract also has strong antioxidant activity with an IC_{50} value of 35.81 µg/mL, along with high flavonoids content of 371.88 ± 6.31 mg QE/g.[2] Flavonoids can potentially be used as sunscreens because of its photoprotective properties. Furthermore, the hydroxyl groups of the aromatic rings of flavonoids can bind to free radicals and prevent lipid peroxidation reactions, making flavonoids act as antioxidants agents.[3]

Its high SPF value and potent antioxidant activity make tamarind rind have the potential to be developed into a cosmetic product.[4] This study aim to determine the correllation between the antioxidant activity and the Sun Protection Factor (SPF) of tamarind (*Tamarindus indica* L.) rind ethanol extract cream.

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Citation: Dewi IK, Ramayani SL, Arsyanah F, Cahyani R. Antioxidant and Sunscreen Activities of Tamarind (*Tamarindus indica* L.) Rind Ethanol Extract CreamTrop J Nat Prod Res. 2024; 8(8): 8043 – 8046.
https://doi.org/10.26538/tjnpr/v8i8.17

Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria

Materials and Methods

Collection and identification of plant material

Tamarind rind was collected in February 2023 from Jatisari Village, Situbondo District, East Java, Indonesia. The plant material was identified and authenticated by Mrs. Isna Jati Asiyah of the Center for Research and Development of Medicinal Plants and Traditional Medicines, Tawangmangu, Central Java, Indonesia. Tamarind rind was dried, grinded, and then sieved using sieves of 60-80 mesh size.[5]

Extraction of tamarind rind

Tamarind rind powder (1 kg) was macerated with 7.5 L of ethanol (96%) at room temperature for five days in a closed container, protected from light. The mixture was stirred every 8 hours, and then filtered. The marc was re-macerated with 2.5 L of ethanol (96%). The combined extract was evaporated over a water bath at 45 - 50ºC until a thick extract was formed.

Formulation of tamarind rind ethanol extract cream

Cream was formulated using three different concentrations of tamarind rind ethanol extract as the active ingredient. The concentrations used include; FI (5%), F2 (10%), and F3 (15%). The oil phase (stearic acid, white vaseline, virgin coconut oil (VCO), and cera alba) and the water phase (propylene glycol, triethanol amine (TEA), and distilled water) were melted separately over a water bath at 70ºC. The water phase was gradually mixed with the oil phase in a hot mortar, with constant stirring until a cream mass was formed.[17] Tamarind rind ethanol extract was added to the cream little at a time, and stirred until the mixture became homogeneous.[6] the composition of the cream is presented in Table 1.

Determination of sun protection factor (SPF)

The cream (250 mg) was dissolved in 25 mL of ethanol (10,000 ppm). A dilution (5,000 ppm) was made by mixing 2.5 mL of the 10,000 ppm solution with 5 mL of ethanol. The absorbance of the diluted solution

was measured at wavelengths of 290 - 320 nm with intervals of 5 nm using a spectrophotometer. The SPF of the cream was calculated using the Mansur formula.[7]

$SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda)$
SPF = Sun Protection Factor
CF = Correction Factor
EE = Erythema Effect
I = Light Spectrum Intensity
Abs = Absorbance
λ = Wavelength (nm)

Determination of antioxidant activity
The antioxidant activity of the formulated cream was assessed using the DPPH (2,2-Diphenyl-1-picrylhydrazyl) radical scavenging assay.

Preparation of DPPH working solution
In this assay, 100 ppm of DPPH solution was made by dissolving 10 mg of DPPH radical in 100 mL of ethanol in a volumetric flask.[8] Then, 50 mL of the 100 ppm DPPH solution was added to 50 mL of ethanol to obtain 50 ppm of DPPH solution. The absorbance of the 50 ppm DPPH solution was measured at 400 - 800 nm using spectrophotometer to obtain the wavelength of maximum absorption of DPPH. The operating time was determined from the wavelength of maximum absorption obtained, and the absorbance was measured every 5 minutes from the first minute until a stable absorbance was obtained.[9]

Evaluation of DPPH scavenging activity of the cream
The cream (100 mg) was dissolved in 10 mL of ethanol to obtain a 10,000 ppm stock solution. Then, 1 mL of the stock solution was mixed with 9 mL ethanol to obtain a 1,000 ppm sample solution. Various concentrations (220, 240, 260, 280, and 300 ppm) were made using the 1,000 ppm sample solution, and 2 mL each of the various dilutions was was mixed with 2 mL of 50 ppm DPPH solution. The mixture was homogenized and incubated at 37ºC according to the operating time. The absorbance was measured using a spectrophotometer at the wavelength of maximum absorption of DPPH.

The radical scavenging activity was calculated as percentage inhibition of DPPH radical using the following equation.[18]

$$\%\ inhibition = \frac{Abs\ DPPH - Abs\ Sample}{Abs\ DPPH} \times 100\%$$

Where; Abs = Absorbance
The antioxidant activity was assessed in terms of the IC_{50} value using the following regression equation;[9]

$$y = a + bx$$

Where; y = % inhibition, x = IC_{50} value (ppm), a = regression constant, b = regression coefficient

Statistical analysis
Data were analyzed using SPSS version 26 with the Shapiro-Wilk test to determine the normality of the data distribution, then analyzed with Spearman's Rank correlation test to find out the significance of the relationship between the IC_{50} value and the SPF. P value < 0.01 was regarded as significant.

Results and Discussion

Sun protection factor (SPF) of tamarind rind ethanol extract cream
The SPF values of the cream formulations of tamarind rind ethanol extract is presented in Table 2. From the results, formulation F1 is said to have no sunscreen effect since the SPF value is below the minimum category stated by U.S. FDA (Food and Drugs Administration).[10] Formulation F2 on the other hand has sunscreen activity with a minimum protection, while formulation F3 was categorized as having extra protection sunscreen activity. The higher the SPF value of a sunscreen, the better the ability to protect the skin from UV rays.[11] The SPF value in the test samples was affected by the amounts of flavonoids in the active ingredients. Flavonoids have chromophoric groups that absorb UV light due to the presence of conjugated aromatic rings.[12] High level of antioxidants can increase the photoprotective activity in a sunscreen.[13]

Table 1: Composition of the formulated cream

Material	Formulas		
	F1 (5%)	F2 (10%)	F3 (15%)
Tamarind rind ethanol extract	2.5	5	7.5
Stearic acid	8.5	8.5	8.5
Propylene glycol	7.5	7.5	7.5
Virgin Coconut Oil (VCO)	5	5	5
White vaseline	5	5	5
Triethanol amine (TEA)	0.75	0.75	0.75
Cera alba	0.25	0.25	0.25
Aquadest	20.5 mL	18 mL	15.5 mL

Table 2: SPF value of tamarind rind ethanol extract cream

Cream Formulation	SPF Value
F1	1.933
F2	3.368
F3	6.469

SPF = Sun Protection Factor

Antioxidant activity of tamarind rind ethanol extract cream

From the antioxidant activity evakuation, it was shown that the higher the extract concentration in the cream, the lower the IC_{50} value, hence, the stronger the antioxidant activity of the sample.[14]

Antioxidant activity in a sample is indicated by a change in the colour of DPPH solution, from an initially purple colour to a light yellow colour. The change in colour is caused by the reduction of DPPH free radicals on reaction with an antioxidant compound.[15] IC_{50} is the parameter that indicates the ability of an antioxidant to inhibit 50% of DPPH free radical. On the basis of the IC_{50} value, the antioxidant activity of a sample can be categorized into five, namely; samples with IC_{50} value < 50 ppm are classified as very strong, IC_{50} values of 50 – 100 ppm are classified as vital, IC_{50} values of 100 – 150 ppm are classified as medium, IC_{50} values of 150 – 200 ppm are classified as weak, IC_{50} > 200 ppm classified as very weak. Based on the IC_{50} value obtained from this study, the antioxidant activity of tamarind rind ethanol extract creams F1, F2, and F3 were all classified as very weak since their IC_{50} values were > 200 ppm. Antioxidant activity of tamarind rind ethanol extract cream can be seen in Table 3.

Correlation between IC_{50} value and SPF value of the tamarind rind ethanol extract cream

Spearman's rank correlation test results showed that there was a significant ($p < 0.01$) relationship between the IC_{50} value and the SPF value of the tamarind rind ethanol extract cream. The correlation coefficient is the value used to determine the strength of the relationship between variables. The categories for the correlation coefficient are; 0.000 – 0.199 classified as very low, 0.200 – 0.399 classified as low, 0.400 – 0.599 classified as moderate, 0.600 – 0.799 classified as strong, 0.800 – 1.000 classified as very strong.[16] The correlation coefficient obtained in this study indicates that there is a very strong negative relationship between IC_{50} value and the SPF value of tamarind rind ethanol extract cream. This means that as the IC_{50} value decreases, the SPF value increases. This can also be interpreted as the higher the antioxidant activity, the higher the SPF value. Spearman's rank correlation data analysis can be seen in Table 4.

Table 3: Antioxidant activity of tamarind rind ethanol extract cream

Formula	IC_{50} Value
F1	383.993 ppm
F2	299.448 ppm
F3	225.508 ppm

Table 4: Spearman's rank correlation data analysis

	IC_{50}	SPF
IC_{50}	1.000	-1.000**
SPF	-1.000**	1.000

**Significant correlation ($p<0.01$)

Conclusion

The findings from the study have shown that tamarind rind ethanol extract cream containing 15% by weight of the extract has high sunscreen activity but with very weak antioxidant activity. A significant relationship was found between the IC_{50} value and the SPF value of tamarind rind ethanol extract cream, which suggest that the higher the antioxidant activity of tamarind rind ethanol extract cream, the higher its sunscreen activity.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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ISSN 2616-0692 (Electronic)

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