IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
Research Article
July 2022 Vol.:22, Issue:1

Evaluation of the Sun Protection Factor of the Aqueous Extract of *Malpighia emarginata* DC

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Jucihermes de Almeida Mariano [1], Lucas de Brito Silva[2], João Henrique Anizio de Farias[3], Maria Alice Araújo de Medeiros[4], Millena de Souza Alves[5], Bernadete Santos[6], Gean Carlos Xavier Campos[7], Rosália Severo de Medeiros[8], Raline Mendonça dos Anjos[9], Maria das Graças Veloso Marinho[10], Marcos Antônio Nobrega de Sousa[11], Luciano de Brito Junior[12], Veneziano Guedes de Sousa Rêgo [13], Abrahão Alves de Oliveira Filho*[14]

[1,2,3,7] Undergraduate student at the Federal University of Campina Grande - UFCG, Brazil*

[4,5,6] Master's student at the Federal University of Campina Grande - UFCG, Brazil

[8,9,10,11,12,13,14] Professor at the Federal University of Campina Grande - UFCG, Brazil

Submitted: 20 June 2022
Accepted: 25 June 2022
Published: 30 July 2022

Keywords: Biochemistry. Medicinal Plant. Phytotherapy. Photoprotection

ABSTRACT

The skin is the main area of interaction between the body and the ecosystem. Therefore, the epidermis and dermis layers are targets of photobiological effects of UV radiation, such as inflammation, deregulation in cell signaling pathways, and photocarcinogenesis. Some species, such as *Malpighia emarginata* DC., stand out for having a chemical composition with photoprotective highlights. The present article aims to evaluate whether the aqueous extract of this plant contains photoprotective activity, through an in vitro study. The experiment was performed from the dilution in different concentrations of the extract and analyzed by scanning spectrophotometry in the ranges 290 - 320 nm. Thus, the aqueous extract of *Malpighia emarginata* DC. species showed SPF results ranging from 9.67 to 13.16. The study showed that the plant species has a photoprotective potential to be used as photo cosmetics.

INTRODUCTION

The skin corresponds to the main area of interaction between the body and the ecosystem, establishing itself, because this, is the first line of defense against aggressions from the external environment [1]. Therefore, the epidermis and dermis layers are targets of the photobiological effects of UV radiation [2] and are divided into UVA (from 320 to 400 nm), UVB (from 290 to 320nm), and UVC (from 100 to 290 nm) [3]. However, UVC radiation is absorbed by the atmosphere, through the ozone layer [4].

UVB radiation is mostly absorbed in the epidermis by cellular DNA, generating direct damage to it. In addition, it can cause inflammation, deregulation in cell signaling pathways, and photocarcinogenesis [5]. Taken together, UVA radiation is responsible for inducing the production of reactive oxygen species, DNA damage, immunosuppression, collagen alteration, and cell apoptosis [6].

Thus, when UV radiation is absorbed by cells present in the dermis or epidermis, it is responsible for causing reactions in the nitrogenous bases of deoxyribonucleic acid or ribonucleic acid, changing the function and original structure of these components. The continuous modification of the genetic material can culminate in disordered replication by the cells of the tissue, leading to the appearance of benign lesions that can later become cancer [7].

Among the different health problems provided by prolonged and continuous exposure to the sun's rays, such as light sensitivity, skin depigmentation, skin blemishes, sunburn, suppression of the immune system, skin aging, and skin cancer is the most serious clinical picture [8].

To combat these effects of UV radiation preparations were developed for topical or external use responsible for attenuating ultraviolet radiation before it causes damage to the skin [9]. These preparations are called photo protectors and have their effectiveness defined by the ability to protect the skin against burns from UV radiation. Sunscreens are theoretically defined using the ratio between the Minimal Erythematogenous Dose on the protected skin and the Erythematogenous Dose on the unprotected skin [10].

Sunscreens can be divided into two groups: chemical, encompassing the synthetic and natural ones; and physical [11].

Additionally, organic sunscreens have as a mechanism of action the absorption of UV radiation, dissipating it in the form of heat. Whereas, inorganic sunscreens are opaque substances that form a film on the skin and reflect light [12]. In addition, it is worth noting that there are oral antioxidants that reduce oxidative stress, the main cause of collagen loss and rapid aging of the skin, highlighting beta-carotene, vitamin C, and E. Such antioxidants act in conjunction with topical sunscreens [13].

In parallel, it is estimated that approximately 40% of the currently available drugs were elaborated from the direct or indirect use of natural sources [14]. Thus, the interest in new sun protection technologies is observed, and many of them seek the use of natural compounds [15].

According to Orlanda and Vale [16], the photoprotective activity makes it possible to observe the ability of active components extracted from plants to succeed in protecting the skin from erythema, edema, and the risk of carcinoma of the cells of the basal and spinous layer.

In this sense, lutein is a carotenoid that acts as an effective antioxidant, being responsible for protecting cells from oxidative damage and acting in the prevention of cancer. In addition, carotenoids are precursors of vitamin A, prevent photosensitization in some skin diseases, increase immune response, and have anti-aging properties [17]. Additionally, studies indicate that carotenoids are related to the regulation of cell growth and modulation of gene expression [18].

According to De Araújo Magalhães et. al [19], vitamin C is a compound commonly used in after-sun products, because it can interfere with the occurrence of reactive oxygen species induced by ultraviolet rays.

Furthermore, phenolic compounds have a high antioxidant property, which is related to the sequestration of free radicals [20]. Among the group of phenolic compounds, flavonoids stand out because they are consumed in large proportions in a regular human diet [21].

De Souza et. al. [22], evidenced that the substances used to provide a broad cutaneous photoprotection to formulations are, vitamins C and E, tannins, flavonoids, and alkaloids.

Following this, the plant *Malpighia emarginata* DC. is a species belonging to the Malpighiaceae family [23]. This presents in its chemical constitution phenolic compounds such as quercetin, kaempferol, anthocyanins, phenolic acids, carotenoids, and vitamin C [20]. Quercetin, in particular, exhibits the property of inducing apoptosis of tumor cells, acting as an antitumor agent [24]. While anthocyanins are compounds known to be present in the epidermal layers of leaves and stems, absorbing light in the UVB region [25].

Knowing that flavonoids can absorb solar radiation and antioxidant action, plant extracts rich in phenolic compounds have been added to photoprotective formulations, commonly associated with UV filters. This way, an intensification in the final protection of the product and or neutralization of free radicals produced in the skin after sun exposure is obtained [22].

Thus, experiments have shown the metabolites of *Malpighia emarginata* DC. showed effects on genotoxicity, preventing DNA damage and subsequent cell death [26]. Therefore, it would be a promising object of study for protection against ultraviolet solar radiation, because it is a natural material and has in its chemical composition compounds that combat the evils generated by this type of radiation. Furthermore, Silva and Castro (2014) [27] found that anthocyanins from blueberries do not alter the stability of photoprotective emulsions.

In this context, this work aimed to evaluate the probable photoprotective activity of the aqueous extract of *Malpighia emarginata DC.*

MATERIALS AND METHODS

Plant Extract

To perform the in vitro study of *Malpighia emarginata DC*. Species, the plant parts were collected and identified by Prof. Dr. Maria de Fátima de Araújo Lucena. Moreover, an exsiccate of the plant numbered 7600, is deposited in the CSTR Herbarium (Center of Health and Rural Technology) of the Federal University of Campina Grande, Patos Campus - PB. To produce the aqueous extract from the plant sample, the methodology described by Ferris and Zheng (1999) [28] was used, with the presence of some modifications. The project followed the rules of CGEN - Genetic Heritage Management Council, registered in the SISGEN platform under protocol number A119A6C.

Evaluation of the Sun Protection Factor of the aqueous extract of Malpighia emarginata DC.

The spectrophotometric analysis of absorbance of the aqueous extract of *Malpighia emarginata* DC. Occurred in the spectrum of ultraviolet radiation proposed by Mansur et al. (1986) [29]. Thus, scans from 290 to 320 nm were performed at 1-minute intervals for absorbance measurements.

For the reading, a digital spectrophotometer (Biospectro®) with a 1cm quartz cuvette was used, and the data collected were submitted to the equation of MANSUR et al [29]. to measure the SPF in vitro. This method is responsible for listing the eitematogenic effect and the intensity of the radiation (EE X I) that were measured by Sayre et al. (1979) [30]. These are shown in table 01, below:

Table No. 1: Relationship between entheogenic effects (EE) versus intensity of the radiation (I) according to wavelength (λ)

Source: SAYRE *et al*., 1979.

λ/nm	EE x I
290	0,0150
295	0,0817
300	0,2874
305	0,3278
310	0,1864
315	0,0839
320	0,0180

The formula of Mansur et al. (1986) [29] is also composed of the spectrophotometric reading of the absorbance of the solution and a correction factor (=10). This equation can be seen below:

$$FPS\ spectrophotometric = FC. \sum_{290}^{320} EE\ (\lambda).\ I(\lambda).\ Abs\ (\lambda)$$

Which: SPF = sun protection factor; FC = correction factor, calculated according to two sunscreens of known SPF tested on humans such that a cream containing 8% homosalate would result in SPF 4; EE(λ) = erythemal effect spectrum; I (λ) = the intensity of sunlight at wavelength and Abs (λ) = the absorbance of the formulation at wavelength.

RESULTS AND DISCUSSION

New photo protectors, with plant extracts in their formulation, are of extreme importance for cosmeceutical development and cancer prevention [31].

From this perspective, it can be observed in table 2 the analysis of the photoprotective activity of the aqueous extract of Malpighia emarginata DC., performed in the spectrum of UVB radiation (290 to 320 nm).

Table No. 2: SPF values of *Malpighia emarginata* DC. Extract at different concentrations.

Concentrations (µg.mL-1)		50µg/mL	100µg/mL	500µg/mL	1000µg/mL
FPS		10,70	9,67	10,98	13,16

Source: Experimental data, 2021.

The resolution - RDC No. 30, dated June 1, 2012, of the National Health Surveillance Agency (ANVISA), the one responsible for approving the MERCOSUR technical regulation, regarding sunscreens in cosmetics and other provisions, stipulates a minimum SPF of 6 (BRASIL, 2012) [32]. Therefore, all concentrations used in this in vitro study indicated the aqueous extract of *Malpighia emarginata* DC. Presents a photoprotective potential to be used in the future as a phytocosmetic.

Thus, other studies have shown promising results in plant species, for example, Torres-Contreras et al. (2022) [33] reported the antioxidant and photoprotective capacity in vitro of the dry extract of *Malpighia Glabra*. In that study, emulsions with chemical filters, evidenced free radical scavenging and synergistic effect on skin protection when used with commercial UV filters, pointing out that formulations that combined fruit extracts with chemical filters in emulsion proved more stable.

Moreover, Simões et al. (2020) [34] suggested a possible application of the species Plectranthus amboinicus (Lour.) Spreng. as photoprotector, since the plant showed SPF 7.74 and 12.53 at concentrations of 500 µg.mL-1 and 1000 µg.mL-1, respectively. While the species Tamarindus indica L. showed relevant results at concentrations of 50 µg.mL-1 and 500 µg.mL-1 [35].

Hanamura and Aoki (2008) [36], indicated that the polyphenols from *Malpighia emarginata* DC. did not show toxicity against human organism cells. In addition, it is worth noting that, the crude polyphenols from *Malpighia emarginata*DC., were responsible for suppressing melanogenesis, and reducing melanin content in melanoma B-16 cells [37].

CONCLUSION

The results obtained in this in vitro work, express the sun protection factor of the aqueous extract of *Malpighia emarginata* DC., thus suggesting a possible use for therapeutic purposes in Phyto cosmetics. However, more studies are needed, such as in vivo, for the production of sunscreen.

REFERENCES

1. ADDOR, FLAVIA ALVIM SANT'ANNA et al. Protetor solar na prescrição dermatológica: revisão de conceitos e controvérsias. **Anais Brasileiros de Dermatologia**, v. 97, n. 2, p. 204-222, 2022.
2. LOPES, Leandro Gonçalves; DE SOUSA, Cláudio Ferreira; DALLA LIBERA, Larisse Silva. Efeitos biológicos da radiação ultravioleta e seu papel na carcinogênese de pele: uma revisão. **Revista Eletrônica da Faculdade de Ceres**, v. 7, n. 1, p. 117-146, 2018.
3. RAMOS, Renata Magalhães et al. Estudo comparativo da composição fitoquímica, citotoxidade e potencias antioxidante e fotoprotetor da casca e folha de Erythrina velutina. **Brazilian Journal of Development**, v. 6, n. 6, p. 33140-33158, 2020.
4. COSTA, Damien Oliveira da. **Antocianinas como fotoprotectores naturais**. 2012. Tese de Doutorado.
5. COSTA, Rafaela Marques da et al. **Novos avanços tecnológicos na fotoproteção**. 2017. Dissertação de Mestrado.
6. TREVISAN, Paula; ÁVILA, Daiana Silva. INDUÇÃO DE FOTOENVELHECIMENTO POR RADIAÇÃO ULTRAVIOLETA EM CAENORHABDITIS ELEGANS. **Anais do Salão Internacional de Ensino, Pesquisa e Extensão**, v. 13, n. 3, 2021.
7. LOPES, Leandro Gonçalves; DE SOUSA, Cláudio Ferreira; DALLA LIBERA, Larisse Silva. Efeitos biológicos da radiação ultravioleta e seu papel na carcinogênese de pele: uma revisão. **Revista Eletrônica da Faculdade de Ceres**, v. 7, n. 1, p. 117-146, 2018.
8. DO NASCIMENTO, Luciano F.; DOS SANTOS, Elisabete P.; DE AGUIAR, Alcino P. Fotoprotetores orgânicos: Pesquisa, inovação e a importância da síntese orgânica. **Revista Virtual de Química**, v. 6, n. 2, p. 190-223, 2014.
9. TOFETTI, Maria Helena de Faria Castro; DE OLIVEIRA, Vanessa Roberta. A importância do uso do filtro solar na prevenção do fotoenvelhecimento e do câncer de pele. **Investigação**, v. 6, n. 1, 2006.
10. MILESI, Sabrine da S.; GUTERRES, Silvia Stanisçuaski. Fatores determinantes da eficácia de fotoprotetores. **Caderno de farmácia. Porto Alegre, RS. Vol. 18, n. 2 (jul./dez. 2002), p. 81-87**, 2002.

11. VIOLANTE, Ivana MP et al. Avaliação in vitro da atividade fotoprotetora de extratos vegetais do cerrado de Mato Grosso. **Revista Brasileira de Farmacognosia**, v. 19, p. 452-457, 2009.
12. RENNÓ, FERNANDA CUNHA; RENNÓ, RAQUEL CUNHA; NASSIF, PRISCILA WOLF. Atualização em fotoprotetores. **Uningá Review Journal**, v. 18, n. 3, 2014.
13. DANTAS, Janedson Chaves et al. ANTIOXIDANTES ORAIS UTILIZADOS NA FOTOPROTEÇÃO. **Mostra Científica da Farmácia**, v. 4, n. 2, 2018.
14. DA SILVA, Adalberto Manoel; FRARE, Eloisa Gabriela. AVALIAÇÃO DA ATIVIDADE FOTOPROTETORA DOS ÓLEOS ESSENCIAIS E DOS EXTRATOS DE ESPÉCIES DE PLANTAS DA MATA ATLÂNTICA. **Anais da Mostra Nacional de Iniciação Científica e Tecnológica Interdisciplinar (MICTI)-e-ISSN 2316-7165**, v. 1, n. 12, 2019.
15. MAYER, Mariana Spanamberg et al. MECANISMOS ANTIOXIDANTES E FATOR DE PROTEÇÃO SOLAR DO EXTRATO HIDROETANÓLICO DE ERVA MATE. **Anais do Seminário Interinstitucional de Ensino, Pesquisa e Extensão**, 2021.
16. ORLANDA, J. F. F.; VALE, V. V. Análise fitoquímica e atividade fotoprotetora de extrato etanólico de Euphorbia tirucalli Linneau (Euphorbiaceae). **Revista Brasileira de Plantas Medicinais**, v. 17, p. 730-736, 2015.
17. STRINGHETA, Paulo Cesar et al. Luteína: propriedades antioxidantes e benefícios à saúde. **Alimentos e Nutrição Araraquara**, v. 17, n. 2, p. 229-238, 2009.
18. CATANIA, Antonela Siqueira; BARROS, Camila Risso de; FERREIRA, Sandra Roberta G. Vitaminas e minerais com propriedades antioxidantes e risco cardiometabólico: controvérsias e perspectivas. **Arquivos Brasileiros de Endocrinologia & Metabologia**, v. 53, n. 5, p. 550-559, 2009.
19. DE ARAÚJO MAGALHÃES, Mayhara et al. VITAMINA C E SEUS BENEFÍCIOS NA PREVENÇÃO DO ENVELHECIMENTO CUTÂNEO: REVISÃO DE LITERATURA. **Mostra Científica da Farmácia**, v. 6, n. 1, 2019.
20. ROCHA, Ana Júlia Almeida César et al. Avaliação do Potencial Antimicrobiano do Extrato da Acerola. 2019.
21. LOBÃO, Ana Graziela Soares Rêgo; COÊLHO, Mayara Ladeira; SOARES, Lara Eunice Cândido. ANÁLISE DA AÇÃO FOTOPROTETORA DOS FLAVONOIDES. **Revista Multidisciplinar em Saúde**, v. 1, n. 2, p. 32-32, 2020.
22. DE SOUZA, Franciele Piovesana; CAMPOS, Gabriela Rached; PACKER, Janaina Fernanda. Determinação da atividade fotoprotetora e antioxidante em emulsões contendo extrato de Malpighia glabra L.–Acerola. **Revista de Ciências Farmacêuticas básica e aplicada**, v. 34, n. 1, 2013.
23. MONDIN, Mateus; OLIVEIRA, Carlos Alberto de; VIEIRA, Maria Lúcia Carneiro. Karyotype characterization of Malpighia emarginata (Malpighiaceae). **Revista Brasileira de Fruticultura**, v. 32, p. 369-374, 2010.
24. BEHLING, E. V. et al. Flavonóide quercetina: aspectos gerais e ações biológicas. **Alimentos e Nutrição Araraquara**, v. 15, n. 3, p. 285-292, 2008.
25. DO CARMO ARAÚJO, Saulo Alberto; DEMINICIS, Bruno Borges. Fotoinibição da fotossíntese. **Revista Brasileira de Biociências**, v. 7, n. 4, 2009.
26. SOUZA, Natália Cabral, et al. Anti-inflammatory and antioxidant properties of blend formulated with compounds of Malpighia emarginata DC (acerola) and Camellia sinensis L.(green tea) in lipopolysaccharide-stimulated RAW 264.7 macrophages. **Biomedicine & Pharmacotherapy**, v. 128, p. 110277, 2020.
27. SILVA, Bruna Caroline Andrade; CASTRO, Mariana Seraphim de. Avaliação da estabilidade de formulação fotoprotetora contendo extrato de Vaccinium Uligosum. 2014.
28. H. Ferris, L. Zheng, Plant sources of Chinese herbal remedies: effects on Pratylenchus vulnus and Meloidogyne javanica. Journal of nematology, Lawrence, 31(3), 241-263 (1999).
29. J.S. Mansur, M.V.R. Breder, M.C.A. Mansur, R.D. Azulay, Correlação entre a determinação do fator de proteção solar em seres humanos e por espectrofotometria. Anais Brasileiros de Dermatologia, 61, 121-124 (1986).

30. R.M Sayre, P.P Agin, G.J LeVee, E. Marlowe, A comparison of in vivo and in vitro testing of sunscreen formulas. Photochemistry and Photobiology, 29(3), 559-566 (1979).
31. POLONINI, Hudson Caetano; RAPOSO, Nádia Rezende Barbosa; BRANDÃO, Marcos Antônio Fernandes. Fotoprotetores naturais no contexto da saúde pública brasileira. **Revista de APS**, v. 14, n. 2, 2011.
32. Brasil, 2012. Resolução RDC nº 30, de 1º de junho de 2012. Aprova o regulamento técnico "Mercosul sobre Protetores Solares em Cosméticos e dá outras providências." Diário Oficial da República Federativa do Brasil, Brasília, DF, 4 de Junho de 2012.
33. TORRES-CONTRERAS, Ana Mariel, et al. Plant Secondary Metabolites against Skin Photodamage: Mexican Plants, a Potential Source of UV-Radiation Protectant Molecules. **Plants**, v. 11, n. 2, p. 220, 2022.
34. SIMÕES, Mylena Medeiros et al. Avaliação in vitro do perfil fitoquímico e fator de proteção solar do extrato aquoso de Plectranthus amboinicus (Lour.) Spreng. **Revista Brasileira de Educação e Saúde**, v. 10, n. 1, p. 150-155, 2020.
35. SANTOS, Bernadete et al. Análise fitoquímica e avaliação da atividade fotoprotetora do extrato aquoso de Tamarindus indica L.(Tamarindo). **Research, Society and Development**, v. 10, n. 9, p. e25810917985-e25810917985, 2021.
36. HANAMURA, T.; AOKI, H. Toxicological evaluation of polyphenol extract from acerola (Malpighia emarginata DC.) fruit. **Journal of food science**, v. 73, n. 4, p. T55-T61, 2008.
37. HANAMURA, Takayuki; UCHIDA, Eriko; AOKI, Hitoshi. Skin-lightening effect of a polyphenol extract from Acerola (Malpighia emarginata DC.) fruit on UV-induced pigmentation. **Bioscience, biotechnology, and biochemistry**, v. 72, n. 12, p. 3211-3218, 2008