

## Lampiran 1. Pencarian Pustaka

### 1. PubMed

The screenshot shows the PubMed website interface. At the top, the NIH National Library of Medicine logo is visible. The search bar contains the query "antioxidants as photoprotective by natural compounds". Below the search bar, there are options for "Advanced", "Create alert", and "Create RSS". The search results are displayed on page 1 of 13, showing 130 results. A bar chart on the left shows the distribution of results by year, with a peak around 2012. The first result is titled "Polyphenols as natural antioxidants in cosmetics applications" by de Lima Cherubim DJ, Buzanello Martins CV, Oliveira Fariña L, da Silva de Lucca RA. The second result is titled "Natural products as photoprotection" by Saewan N, Jimtaisong A.

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antioxidants as photoprotective by natural compounds

Search

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RESULTS BY YEAR

2012 2022

130 results

1 Polyphenols as natural antioxidants in cosmetics applications.  
de Lima Cherubim DJ, Buzanello Martins CV, Oliveira Fariña L, da Silva de Lucca RA.  
J Cosmet Dermatol. 2020 Jan;19(1):33-37. doi: 10.1111/jocd.13093. Epub 2019 Aug 7.  
PMID: 31389656 Review.  
Share  
Plants play a relevant role as a source of biologically active natural products with cosmetic and dermatological importance. According to this context, polyphenolic extracts are highlighted because they have proven antioxidant, anti-inflammatory, anti-aging, antitumor ...

2 Natural products as photoprotection.  
Saewan N, Jimtaisong A.

Activate Windows  
Go to Settings to activate Windows.

### 2. Wiley

The screenshot shows the Wiley Online Library website interface. At the top, there is a banner for "Working off-campus? Learn about our remote access options". The search bar contains the query "antioxidants as photoprotective by". Below the search bar, there are options for "Login / Register". The search results are displayed on page 1 of 13, showing 498 results. A bar chart on the left shows the distribution of results by year, with a peak around 2012. The first result is titled "Rutin increases critical wavelength of systems containing a single UV filter and with good skin compatibility" by D, A. Peres, C. A. de Oliveira, M. S. da Costa, V. K. Tokunaga, J. P. Mota, C. Rosado, V. O. Consiglieri, T. M. Kaneko, M. V. R. Velasco, A. R. Baby. The second result is titled "Natural products as photoprotection" by Saewan N, Jimtaisong A.

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498 results for "antioxidants as photoprotective by natural compounds" anywhere

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Articles & Chapters (498)

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Sorted by: Relevance

Export Citation(s)

Original Article

Rutin increases critical wavelength of systems containing a single UV filter and with good skin compatibility

D, A. Peres, C. A. de Oliveira, M. S. da Costa, V. K. Tokunaga, J. P. Mota, C. Rosado, V. O. Consiglieri, T. M. Kaneko, M. V. R. Velasco, A. R. Baby

Skin Research and Technology | Volume 22, Issue 3

Activate Windows  
Go to Settings to activate Windows.

## 2. ResearchGate

The screenshot shows the ResearchGate search results page. The search bar at the top contains the query "antioxidan sebagai fotoprotektif kulit dari tumbuhan herbal". Below the search bar, there are tabs for "Research", "People", "Projects", "Questions", "Jobs", and "Institutions". The "Research" tab is selected, showing search results in Research. The results are sorted by relevance. A filter for "Articles" is applied, and the date range is set to "2012-2022". A toggle for "Only full-texts" is visible. The first result is an article titled "Studi Literatur Potensi Aktivitas Antidepresan dari Tumbuhan Suku Valerianaceae" by Muhammad Azis Aulia Rahman, Siti Hazar, and Sri Peni Fitrianiingsih, published in July 2022. The article abstract mentions the medicinal potential of the Valerianaceae family. A sidebar on the right offers tips on refining the search, such as using boolean operators (AND, OR, NOT) and filtering by research type, date range, and full-text availability.

## 3. Google Scholar

The screenshot shows the Google Scholar search results page. The search bar at the top contains the query "antioxidan sebagai fotoprotektif kulit dari tumbuhan herbal". The results are displayed as a list of articles. The first article is "Antioxidan dalam dermatologi" by R. Andarina, T. Djauhari, et al., published in 2017. The second article is "Analisis skrining fitokimia, kadar total fenol-flavonoid dan aktivitas antioksidan ekstrak etanol kulit kayu tanaman galem rawa gambut (Melaleuca cajuputi Roxb)" by BRAAK Wardhani, Q. Akhyar, et al., published in 2018. The third article is "Potensi Tumbuhan dan Tanaman Herbal Indonesia Sebagai Anti SPF" by A. Permana, T. A. Damayanti, et al., published in 2022. The fourth article is "Potensi ekstrak kastuba (Euphorbia pulcherrima) sebagai tabir surya terhadap paparan sinar UV" by E. Veronica, NKS Chrismayanti, et al., published in 2021. The left sidebar shows filters for "Artikel", "Sektor 75 hasil (0,05 detik)", and "MASUK". The bottom of the page features a footer for Universitas Muslim Indonesia.

## Lampiran 2. Artikel

Received: 20 December 2017 | Revised: 25 May 2018 | Accepted: 19 November 2018  
DOI: 10.1111/jocd.12842



## ORIGINAL CONTRIBUTION

WILEY



## In vitro antioxidant activity and solar protection factor of blackberry and raspberry extracts in topical formulation

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## Abstract

**Background:** Berries are known for their antioxidant activity due to the presence of flavonoids. Antioxidants' usage guarantees skin protection against free radicals and, flavonoids, especially, can act as sunscreen. The aim of this paper was to evaluate solar protection factor (SPF) and antioxidant activity in vitro of blackberry and raspberry extracts incorporated in topical formulation and study their stability.

**Results:** Raspberry presented 29.93 mg of anthocyanins/100 g of fruit and blackberry 65.58 mg of anthocyanins/100 g of fruit. In vitro solar protection factor was 54.57 to blackberry and 37.32 to raspberry. When incorporated in O/W emulsions, final formulations showed light pink color, creamy aspect, and typical fruity odor. Formulations submitted to indirect light and stove showed odor and color alterations.

**Conclusions:** Based on the results, formulations containing extracts should be kept under refrigeration in opaque package to ensure stability due to the presence of flavonoids. In addition, blackberry and raspberry extracts are potential natural alternatives to be used as sunscreen and to prevent skin aging.

## KEYWORDS

antioxidant, blackberry, flavonoids, raspberry, solar protection factor

## 1 | INTRODUCTION

Flavonoids are polyphenolic substances with low molecular weight related to the pigments in vegetables.<sup>1</sup> They protect the organism from oxidative damages as ultraviolet rays, environmental pollution, and chemicals substances in food.<sup>2</sup>

One of the most important groups from flavonoids is anthocyanins,<sup>3</sup> a pigment related with pink, red, violet, and blue coloration in different fruits, flowers, and vegetables.<sup>4</sup> This molecule can be found on the vegetable's surface, acting as natural ultraviolet radiation filter, regulating, and improving photosynthesis.<sup>5</sup>

Blackberry (*Rubus* sp) presents large amount of anthocyanins, and it is purple red to blue, tastes sweet acid, and grows in temperate climate. This rustic plant has become a promising element to be in a cosmetic formulation once it presents solar protection factor and

antioxidant activity, as studies have demonstrated the antioxidant activities and health benefits of the anthocyanins.<sup>6-9</sup>

Raspberry, a fruit belonging to the family of Rosaceae, derived its name from the anglo-latin term *raspise*, "a sweet rose-colored wine," it is a source of natural antioxidants due to its phenolic content and the presence of flavonoids,<sup>9</sup> similarly to other berries.

Antioxidants combat skin aging and are widely used in cosmetic formulations. In addition, research shows that the protection factor of these compounds is related to the presence of chromophores, which have the ability to absorb ultraviolet radiation, and flavonoids.<sup>10-12</sup>

Sunscreens absorb or reflect UVA and UVB rays creating a chemical and/or physical barrier on the skin,<sup>13</sup> being able to avoid skin damages caused by solar radiation, and consequently decrease the risks of developing cancer, photoaging, and photodermatitis.<sup>14</sup>

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# ORIGINAL CONTRIBUTION

WILEY | JCD  
Journal of Cosmetic Dermatology

## Cosmeceutical potential of geranium and calendula essential oil: Determination of antioxidant activity and in vitro sun protection factor

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### Summary

The present investigation was aimed to find out the sun protection factor (SPF) and antioxidant potential of geranium essential oil (GEO) and calendula essential oil (CEO) because having a combination of these two properties moves up the oils as an active ingredient of various cosmeceutical formulations for their preventive and protective properties. Essential oils were obtained by hydrodistillation of *Pelargonium graveolens* leaves (GEO) and *Calendula officinalis* flowers (CEO). The composition and identification of chemical constituents of oils were determined by GC/MS analysis. Free radical scavenging activity was measured by nitric oxide scavenging activity and 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity. It was observed that both GEO and CEO have the potential to reduce or prevent oxidative stress and can be used in skin care regimen to slow down skin aging via its antioxidant properties. In vitro SPF was determined by a very simple and rapid spectroscopic method. SPF value of GEO and CEO was found to be 6.45 and 8.36, respectively. The SPF of CEO was higher than GEO, and the results of SPF show that these essential oils can be employed in sunscreen formulations to protect the skin from sunburn. From the results, it can be concluded that the combined antioxidant and SPF property of GEO and CEO can provide synergistic photoprotective effect or lift up the additional value of the cosmeceutical formulation.

### KEYWORDS

antioxidant, calendula oil, essential oil, geranium oil, sun protection factor

## 1 | INTRODUCTION

From time immemorial, natural ingredients, such as plant and flower extracts, have been used traditionally in cosmetics for skin care. These breakthroughs are gaining more popularity as worldwide consumers seek more natural ingredients in their personal care products. Unlike synthetic cosmeceutical ingredients, the natural ingredients are generally hypoallergenic and consumers need not to worry about experiencing skin irritation.<sup>1</sup> Cosmeceutical preparations based on natural ingredients supply the skin with nutrients and enhance skin health. For example, vitamins A, C, E, and phenolic compounds such

as flavonoids, tannins, and lignins, found in plant extracts, act as antioxidants<sup>2-4</sup>; terpenes/terpenoids present in essential oils abundant in flowers, leaves, seeds, rhizomes, and barks possess anti-inflammatory, antimicrobial, antioxidant, antiaging, and anti-melanogenic effects on skin.<sup>5,6</sup> Essential oils have been around for centuries in many cultures for their medicinal and therapeutic advantages and have enhanced lives of thousands of years, offering a variety of benefits from medicinal cosmeceuticals and dietary purposes to religious use. Chemical constituents of an essential oil are one of the factors that determine the purity and therapeutic value of oil. Being a complicated mixture of chemical components, each biological response shown by an essential oil is on account of the actions of one or



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journal homepage: [www.elsevier.com/locate/jphotobiol](http://www.elsevier.com/locate/jphotobiol)

## Photoprotection assessment of olive (*Olea europaea* L.) leaves extract standardized to oleuropein: *In vitro* and *in silico* approach for improved sunscreens



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### ARTICLE INFO

#### Keywords:

Photoprotection  
Sunscreens  
Olive leaves  
Oleuropein  
Yeast  
Molecular modelling

### ABSTRACT

Olive leaves contain higher amount of polyphenols than olive oil and represent a waste product from olive harvest and pruning of olive trees. The most abundant compound in olive leaves is oleuropein. Benefits of the topical application of olive leaves extract were previously reported, but little information is available on its photoprotective potential and the result of the association of this extract with organic UV filters in topical sunscreen formulations. The olive leaves extract photoprotective potential is less explored for both oral and topical photoprotection in comparison with other plant extracts and polyphenols, such as Polyphenol leucosoma extract and resveratrol. There are increasing efforts towards developing more efficient sunscreens and a photoprotection assessment along with a better understanding of the photochemistry of naturally occurring sunscreens could aid the design of new and improved commercial sunscreen formulations. This study was designed to investigate the photoprotective potential of olive leaves extract standardized for oleuropein performing a set of *in vitro* and *in silico* tools as an innovative approach, highlighting yeast assays, *in vitro* Sun Protection Factor (SPF) and molecular modelling studies of UV absorption. This study supports the use of olive leaves extract for photoprotection, as an effective photoprotective, anti-mutagenic and antioxidant active, also showing a synergistic effect in association with UV filters with an improvement on *in vitro* SPF of sunscreen formulations.

### 1. Introduction

Skin cancer is the most common type of cancer reaching epidemic proportions and has become a public health concern worldwide [1–3]. Besides the increased risk of skin cancer, solar radiation also causes harmful effects, such as erythema (sunburn), cutaneous photoaging and immune suppression [4]. Solar radiation includes ultraviolet (UV)

radiation, which is mainly responsible for these harmful effects on the skin [5,6]. The consequences of UV harmful effects on human skin are well known and sunscreen-based photoprotection is an important strategy to prevent photoaging and skin cancer [7].

Photoprotection can be achieved with topical and oral sunscreens. Although oral photoprotection shows benefits against solar radiation damage, complementing topical protection, it does not directly protect

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## Article

# Moringa oleifera Leaf Extracts as Multifunctional Ingredients for “Natural and Organic” Sunscreens and Photoprotective Preparations

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**Abstract:** *Moringa oleifera* has gained increasing popularity as a food supplement but not in the pharmaceutical and cosmetic area. The aim of this study was the preparation, characterization, and evaluation of extracts from the leaves of *Moringa oleifera* as a herbal sun care phytocomplex. Three different extracts of *Moringa oleifera* leaves, from Senegal, have been prepared and chemically characterized in the phenolic fraction by HPLC-DAD and Folin-Ciocalteu test. To explore photoprotective properties, an extensive evaluation of UV filtering, antioxidant (DPPH, FRAP, ORAC, PCL), and anti-hyperproliferative (human melanoma Colo38 cells) capacities have been conducted. Furthermore, a formulation study regarding cosmetic prototypes has been carried out in order to determine the Sun Protection Factor (SPF), which was assessed in vitro. The extracts were demonstrated to confer significant values of protection, with an SPF 2, that corresponds to a 50% protection against UV-B rays, at concentrations as low as 2% to 4%. Finally, the evaluation on potential irritation of the finished formulations was conducted by Patch Test and no significant irritant potential was observed. These evidence enlarged the already significant number of activities and potential uses of this plant, which is well-known for its importance in the medicinal and nutritional fields.

**Keywords:** *Moringa oleifera*; natural sunscreen; sustainable sources; SPF determination; dermo-cosmetic safety; anti-proliferative activity

## 1. Introduction

Daily photoprotection is becoming a very important health issue in view of the ever-increasing number of skin neoplastic diseases, but customers are also concerned by the level of risk that may be held by synthetic chemical sun filters. This increases the demand for natural products that are very rarely supported by sound investigations and may induce higher risks than traditional sun filters. Plant extracts contain many active compounds that may work as radicals scavengers being thus able to protect skin matrix from enzymatic degradation. Furthermore, phytochemicals as flavonoids and phenolic compounds possess a structure that allows them to absorb protons and rapidly return to ground state just like chemical UV filters. The association in sunscreen formulations of UV filters with plant extracts can be a valuable natural strategy to extend skin protection against UV radiation damage. In this context, many plant species have been investigated for their potential





## Photoprotective, antioxidant, anticholinesterase activities and phenolic contents of different Algerian *Mentha pulegium* extracts

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### ARTICLE INFO

#### Keywords:

*Mentha pulegium*  
Phenolic compounds  
Antioxidant activity  
Anticholinesterase effect  
Sun protection factor

### ABSTRACT

In this study, extracts of chloroform, ethyl acetate, n-butanol, and water were prepared from leaves of *Mentha pulegium* L. To assess their potential application as a source of bioactive compounds, the different extracts have been studied for their polyphenol content and for certain biological properties that might confer. Total phenolic (TPC) and total flavonoid (TFC) contents were estimated using colorimetric methods. 1,1-diphenyl-2-picrylhydrazyl (DPPH), [2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)] (ABTS), galvinoxyl radical (GOR), Cupric reducing antioxidant capacity (CUPRAC), reducing power,  $\beta$ -carotene bleaching, and O-phenanthroline assays were used to evaluate the antioxidant activity of the extracts. The inhibitory capacities of the extracts against acetylcholinesterase (AChE) and butyrylcholinesterase (BChE), as well as their photoprotective effect, were determined. The highest TPCs and TFCs were recorded in the extract of n-butanol ( $451.22 \pm 1.54$   $\mu$ g GAE/mg of extract and  $268.59 \pm 2.65$   $\mu$ g QE/mg of extract, respectively), which had the highest antioxidant activity followed by ethyl acetate and water extracts. Most of the extracts studied were found to be inactive against AChE and BChE and only the chloroform extract showed a moderate inhibitory effect with percentages of inhibition of  $13.16 \pm 1.64$  and  $24.34 \pm 1.12\%$ , respectively at  $200$   $\mu$ g/mL. High values of sun protection factor (SPF) were recorded with the extracts ranging from  $33.86 \pm 0.25$  to  $36.31 \pm 0.40$  corresponding respectively to the chloroform and aqueous extracts. The results of this work have shown that the phenolic extracts of *Mentha pulegium* can constitute a good choice for their application as antioxidant and photoprotective phytoconstituents.

### 1. Introduction

Oxidative stress resulting from the loss of cellular redox balance is thought to play a major role in the pathogenesis of several chronic diseases including cancer and neurodegenerative diseases through damaging biological molecules such as proteins, nucleic acids, and lipids (El Aouadi et al., 2021; Güllün, 2020). Alzheimer's disease (AD) is the most abundant form of dementia, which characterized by memory loss and cognitive impairment (Yakoubi et al., 2021). The progressive decrease in the cognitive capabilities of the patients is mainly attributed to the decrease in the neurotransmitter acetylcholine (ACh) due to

neuronal degeneration (Mazouz et al., 2020). Excessive production of reactive oxygen species (ROS) was also observed in the brain of patients (Wang et al., 2006). It has been reported that several plant extracts or molecules isolated from plants may constitute an alternative for the treatment of AD, on the one hand by their ability to inhibit AChE and BChE, one of the approaches used to improve the cognitive properties of patients, and on the other hand by their antioxidant effect, thus limiting the rapid progression of the disease by neutralizing free radicals and preventing damage to brain tissue (Gali and Bedjou, 2019; Yakoubi et al., 2021; Zengin et al., 2014).

The oxidative stress also occurs in skin ulterior to long exposure to

Abbreviations: TPC, total phenolic contents; TFC, total flavonoid contents; DPPH, 1,1-diphenyl-2-picrylhydrazyl; ABTS, [2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)]; GOR, Galvinoxyl radical; CUPRAC, Cupric reducing antioxidant capacity; AChE, acetylcholinesterase; BChE, butyrylcholinesterase; SPF, Sun protection factor; AD, Alzheimer's disease; ACh, acetylcholine; ROS, Reactive oxygen species; UV, Ultraviolet; BHA, 2,6-di-tert-butyl-4-hydroxytoluene; BHT, 2,6-di-tert-butyl-4-methylphenol; PCR, Polin-Cloacatu.

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