

ANTIOXIDANT CAPACITY, PHYSICOCHEMICAL PROPERTIES AND
STABILITY OF *PORTULACA OLERACEA* EXTRACT GEL SUNSCREEN

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ABSTRACT

The purpose this study is to develop sunscreen gel formulation with *P. oleracea* extract which contain natural bioactive and chemical compounds contribute to healthy skin and avoid skin to expose from dangerous UV rays. The main active compound of *P. Oleracea* is identified contains high levels of vitamins E, C, and beta carotene which compounds that have high antioxidant. In this study, three different formulations were carried out with different concentrations of *P. oleracea* extract (0.0%, 5.0% and 10.00%). All samples were analysed with DPPH assay using 2,2-diphenyl-1-picrylhydrazyl (DPPH Free Radical Scavenging Activity). The free radical scavenging activities of the extracts was determined and sunscreen with contains of highest percentage of *P. Oleracea* (10.0%) showed higher antioxidant activity comparing to sunscreen without *P. oleracea* extract and with 5.0% of *P. oleracea* extract. This sunscreen is formulated with sensorial experience which provide high protection from UV and leave a non-sticky on the skin. Sensory analysis findings revealed sunscreen with 10.0% *P. oleracea* extract is the most preferred among panellists. Sunscreen gel without *P. oleracea* extract was the most preferred formulation on the parameters of color and aroma. The colour and aroma of the formula is mostly preferred due to the absence of *P. oleracea* extract which is brown in colour and the original extract have unpleasant smell. Stability test of the sample is also performed to ensure the formulation is stable for a long time. Microbial analysis has been identified for formula with *P. oleracea* extract 10% because it has been preferred from panellist. This is to determine total plate count and total yeast and mold which have not detected in the sample.

ABSTRAK

Kajian ini dilakukan untuk membangunkan gel pelindung tabir suria yang dirumus khas dengan ekstrak *P. oleracea* yang mengandungi sebatian bioaktif dan kimia semulajadi yang menyumbang kepada kesihatan kulit dan melindungi kulit daripada terdedah dari sinaran UV yang merbahaya. Sebatian utama yang terkandung dalam ekstrak *P. oleracea* telah dikenal pasti dengan kandungan vitamin E, C dan beta caratone yang tinggi dengan antioksidasi. Dalam kajian ini, tiga rumusan berbeza telah dijalankan dengan kepekatan ekstrak *P. oleracea* yang berbeza (0.0%, 5.0% dan 10.0%). Semua sampel telah di analisis dengan DPPH assay menggunakan 2,2-diphenyl-1-picrylhydrazyl untuk mengenal pasti kandungan antioksidasi dan pelindung tabir suria dengan kepekatan tertinggi (10.0%) ekstrak *P. oleracea* mengandungi kandungan aktioksidasi yang paling tinggi apabila dibandingkan dengan dengan formulasi ekstrak *P. oleracea* 0.0% dan 5.0%. Pelindung tabir suria ini diformulasikan dengan memberi perlindungan dari sinaran UV yang tinggi dan tidak meninggalkan rasa melekit pada kulit. Penemuan analisis deria mendedahkan pelindung tabir suria dengan ekstrak 10.0% *P. oleracea* adalah paling disukai di kalangan pengguna. Pelindung tabir suria tanpa ekstrak *P. oleracea* pula adalah yang paling disukai dari segi warna dan aroma. Hal ini adalah kerana formula tersebut tidak mengandungi ekstrak *P. oleracea* yang mempunyai warna coklat dan mempunyai bau yang tidak menyenangkan. Ujian stabiliti juga dijalankan untuk memastikan ketiga-tiga formula stabil pada masa yang lama. Analisis microb dijalankan pada formula yang mempunyai ekstrak *P. oleracea* 10.0% kerana formula ini adalah pilihan pengguna dan menjadi pilihan untuk dipasarkan. Berdasarkan ujian microb tersebut, tiada sebarang microb dikesan melalui “total plate count” dan ujian “yeast and mold”.

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LIST OF ABBREVIATIONS

ALA	-	Alphalinolenic acid
DPPH	-	2,2-diphenyl-1-picrylhydrazyl
SSR	-	Sun simulating radiation
UKM	-	Universiti Kebangsaan Malaysia
USFDA	-	US Food and Drug Administration
UTM	-	Universiti Teknologi Mara
UV	-	Ultraviolet
UVA	-	Ultraviolet A
UVB	-	Ultraviolet B
UVC	-	Ultraviolet C

LIST OF SYMBOLS

$^{\circ}\text{C}$ - Degree Celsius

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CHAPTER 1

INTRODUCTION

1.1 Background study

Cosmetic products are defined as any substance or preparation intended to be placed in contact with various external parts of the human body (epidermis, hair system, nails, lips and external genital organs) or with teeth and the mucous membranes of the oral cavity, with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance or correcting body odors or protecting them or keeping them in good condition. Some examples of cosmetic products includes sunscreen, body wash, body lotion, body soap, facial cleansers, creams, toothpaste, hair shampoos and conditioners, hair dyes, perfumes and deodorants, and colour cosmetics including lipsticks, eye shadow, compact powder and nail polish (European Directive 93/35/EEC). Among the commonly used cosmetics are sunscreen.

Herbal cosmetics are more in demand right now because of their compatibility with skin, wide availability, and lack of negative effects. Many herbs are sold commercially as cosmetics with benefits for skin care, hair care, and antioxidants. Herbal cosmetics are natural products containing pure herbs or permissible cosmetic herbal ingredients in crude or extract form to offer beautification. These herbal preparations produce cleansing and beautifying benefits, encourage attractiveness, and enhance general appearance when applied topically or rubbed, poured, sprinkled, or sprayed on body parts. Aloe vera, henna, neem, turmeric, shikakai, rose oil, coconut oil, sunflower oil, and jojoba oil are a few regularly utilized natural herbs or plants that are employed in the cosmetic business. These ingredients are all very helpful to skin. (Rahul et. al., 2018).

Sunscreen is one of skincare routine which need to apply daily to avoid skin problems occur in future. Sunscreen's primary purpose is to prevent skin issues rather than to treat them. Sunscreens were first created to be applied directly to the skin's surface in order to shield it from UV rays and prevent sunburn caused by prolonged exposure to the sun (Jennifer et al., 2017). A good sunscreen must be photostable, offer broad-spectrum protection from ultraviolet A (UVA) and ultraviolet B (UVB) rays as soon as it is applied, and be both affordable to make and appropriate for the general public. Sunburns can be caused by UVB radiation, however UVA radiation may be more harmful to the skin (Ostewalder and Herzog, 2008).

Portulaca olearacea (*P. oleracea*) extract has been widely used in cosmetic products. Based on previous studies conducted, many values added product were created in cosmetic formulation such as antimicrobial, anti-inflammatory, antioxidant, wound healing and anti-wrinkles properties. This plant containing alkaloids that are responsible for anti-inflammatory effect. The compounds of alkaloids identified in the *P. oleracea* is including Oleracimine, Oleracimine A, Oleracone A, Oleracone B, and β -carboline (Mahmoud and Samira, 2016). The antioxidant activity of the methanol extract using methods such as DPPH free radical scavenging, reducing power estimation by ferric chloride, nitric oxide free radical scavenging, super oxide scavenging activity (Sanja et al., 2009). The extract tends to scavenge the free radicals involved in the ageing process and skin wrinkling and thus may provide some photoprotective action (Mishra et al., 2011).

Antioxidants are essential compounds that can protect the body from damages caused by free radical induced oxidative stress, whereas the micro- and macro-minerals are the key components for overall body growth and development. *P. oleracea* also contains high levels of vitamins E, C, and beta carotene. Scientifically, *P. oleracea* provides a rich plant source of nutritional benefits with high antioxidant properties. It is one of the richest green plant sources of omega-3 fatty acids. In areas where this “weed” is eaten, there is a low incidence of cancer and heart disease, possibly due to its naturally occurring omega-3 fatty acids. *P. oleracea* has long been known in Malaysia but still it is underutilized and considered as a weed. To our

knowledge, no data on nutritional quality have been published regarding such many different types of collected *P. oleracea* accessions (Md Amirul Alam et. al., 2014).

1.2 Problem Statement

Skin is the body's largest organ and an essential component of our immune system which serves as our first line of defense against external threats. Therefore, it is important to protect our skin from any injury and damage from sunlight. Sunscreen works at the skin's corneum level to protect the skin from UV radiation damage. The active ingredient in sunscreen should stay on the skin's surface for a suitable amount of time, preserving its action despite perspiration and bathing (Lowe et. al.,1997). Skin exposure to UVA and UVB also can caused aging, wrinkles, pigmentation, dehydrated, sagging skin, acne, sensitive skin, irritate and rashes. With the awareness of the damaging effects of UV rays over the past 10 years, sunscreen products are becoming crucial part of everyday life (Paul R. 2006). Exposure to UV radiation from the sun plays a causal role in acute and chronic skin damage including skin cancers (Francis et al. 1998). Repeated exposure of the skin has been associated with a high risk of developing skin cancers. According to cancer research United States of America (USA), 8 out of 10 cases of melanoma could be prevented through an understanding of the harmful effects of sunlight and how to protect oneself from the harmful rays (Jou and Tomecki, 2014).

The structure of the skin may change both temporarily and permanently because of repeated exposure to the sun. Repeated exposure causes erythema which is reddening of the skin and sometime known as sunburns. (Moore, 2013). The erythema is followed by melanocyte activation, which increases the rate of melanin formation. Increased melanization, often known as tanning, darkens the skin's look. The long-term effects of frequent exposure include an irreversible loss of skin suppleness and may cause both melanomas and non-melanoma skin cancers to form (Harrison and Bergfeld, 2009). The duration of exposure, seasonal fluctuations in incident sunray intensity, geographic location, and host-dependent variables such as age, skin colour, behavioral factors, immunological condition, and others all affect

how much skin damage occurs (Jou and Tomecki, 2014, Harrison and Bergfeld, 2009). Different clinical studies have shown that regular use of sunscreens can promote skin cancer reduction, especially melanoma and squamous cell carcinoma (Green et al., 2011). Evidence towards the protective role of sunscreens against photoaging has also been established (Hughes et al., 2013).

In current trends, there is a high demand for skin lightening products especially in Asia including Malaysia (Boonme et al., 2009). One of the reasons why Malaysian are looking for skin lightening product is because to reduce pigmentation and melasma. Sunscreen is one of product can help to slow down the process of pigmentation before appeared on stratum corneum. As a result, it's important to create sunscreen solutions that are very effective to meet market demand. The efficacy of sunscreen products is often quantified in terms of sun protection factor (SPF), which can be determined using either in vivo or in vitro methods.

UV radiation may cause sunburn, the sunburn is almost exclusively a UVB, however the SPF system measures UVB protection and exclude UVA which is the ageing rays. During sunburn skin turns red, swells and in severe cases blisters. Sunburn will continue to develop for 12 to 24 hours after the exposure, burn or erythema (reddening) and edema (swelling) on our skin from excessive exposure to the sun rays. Sunburn may also occur from exposure to other UV light sources such as solaria or tanning salons. At a cellular level, sunburn is associated with microscopic changes in the skin, and is the formation of UV induced sunburn cells and a reduction in Langerhans cells and mast cells, which play an essential part of the body immune defense system.

Sunscreens have different forms including creams, gels, lotions, spray, wax sticks and liquid which can be found in market and must have protection form harmful UV rays (Korać RR and Khambholja KM, 2011). Gel is topical dose form that are easier to apply and have better stability than liquid, ointments and creams. Stability testing is a testing process used on cosmetics and pharmaceuticals to ensure the product is stable and to assure their strength, quality, and purity from manufacturing date until expiry date. A gel formulation is considered stable if its

features and attributes remain within acceptable limits after being stored at room temperature (25°C) for a period of time (Eff et al, 2019). Gels also provide controlled release compared to other semisolid formulations (Sayuti NA, 2015).

Ideal sunscreen should have good properties includes photostability, nonirritant, inertness, and compatibility with other ingredients. Physical characteristics include low viscosity to promote good spread ability, aesthetic appeal, small particle size, waterproof capability, appropriate solubility and non-odorous. Functional attributes include the ability to afford protection across a wide range of wavelength and limited systemic absorption through the skin to minimize sensitization. The products should also be readily available, inexpensive and contaminant free (Manikrao Donglikar and Laxman Deore, 2016).

Vandana et. al., has revealed that the methanol extract of *P. oleracea* shows good absorption in UVB range. Hence, it can be considered potential natural source for developing UV protective products. Therefore, this study focused on created cosmetic product formulation with active ingredients *P. oleracea* extract in sunscreen. This formulation designed in form of gel types. *P. oleracea* extract is added to identify the natural sunscreen activity. It is also containing antioxidant for anti-aging and anti-inflammatory function to reduce skin inflammatory after applying the sunscreen. *P. oleracea* have powerful antioxidants that stimulate the production of collagen. Collagen is the ultimate anti-wrinkle remedies. Omega-3s are essential for keeping skin youthful. These fats help keep skin-cell walls strong and flexible. *P. oleracea* is rich in one special type of omega-3 fat called ALA (alpha-linolenic acid). Research reveals that ALA is the best type of omega-3 for keeping our skin looking young. Other than that, *P. oleracea* is also rich in vitamins E and C, carotenes, and other antioxidants. These compounds help reduce oxidative damage to skin cells that can lead to fine lines, wrinkles, dark spots and other signs of aging (Garisma et. al., 2017).

1.3 Objectives

The objectives of the research are:

1. To prepare sunscreen gel with *P. oleracea* extract and identify antioxidant activity for the sunscreen gel with different concentration of *P. oleracea* extract.
2. To identify physicochemical properties, sensory attributes and stability of *P. oleracea* extract gel sunscreen

1.4 Scope of Objectives

The scopes of the research are:

1. Preparation sunscreen gel with *P. oleracea* extract with three different concentrations without *P. oleracea* extract, 5% of *P. oleracea* extract and with 10% *P. oleracea* extract. These sample prepared to determine and differentiate antioxidant activity between three concentrations.
2. To check stability of the formulation by perform centrifuge test. The formulation is stable when there are no separation occurred and determination of microbial test for the confirmed best formulation based on sensory evaluation study and performed sensory evaluation of the sunscreen gel in terms of appearance, color, aroma, taste and overall acceptability. The sensory test is performed with 20 panelist from UTM Pagoh and select the most preferred formulation.

1.5 Significance of Study

This study is expected to produce a formulation of a sunscreen gel with *P. oleracea* extract which have high benefits to skin and to protect skin exposure from dangerous UV and help to improve skin problems. It will contribute to a good sunscreen with good texture, easy to absorb, less sticky and greasy. Basically, consumers prefer good absorption of sunscreen. Help to produce a sunscreen gel that have good stability which meet consumer acceptance.

Apart from that, antioxidant property in the sunscreen gel will help to reduce oxidative damage to skin cells that can lead to fine lines, wrinkles, dark spots and other signs of aging.

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