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Phytochemical Profile and *in vitro* Sun-Protective Activity of *Polyalthia longifolia* (Sonn.) Thwaites Bark Extracts

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ABSTRACT

Sunscreen formulations are required to protect the skin from damaging ultraviolet radiation, which causes irritation, erythema (sunburn), generalized or localized hyperpigmentation (tanning), skin malignancies, immunosuppression, and inflammation. Efficacious, high-quality products are in high demand currently. There are some sunscreens with broad spectrum UV protection that are inexpensive, safe, and herbal. The present study was conducted to investigate the phytochemical profile and sun-protective properties of *Polyalthia longifolia* (Sonn.) Thwaites extracts. The bark of *P. longifolia* was extracted with water, ethanol, and petroleum ether by the cold maceration method. A preliminary phytochemical screening on the *P. longifolia* bark extracts was conducted. The *in vitro* sun-protective activity of the different *P. longifolia* extracts was assessed by determining the sun protection factor (SPF) using the UV spectroscopic technique. The results of the phytochemical screening revealed the presence of flavonoids, phenols, and tannins in all the *P. longifolia* bark extracts. The SPF values of the different extracts were observed to be 5.24±0.002, 1.07±0.009, and 1.01±0.012 for the ethanolic, petroleum ether, and water extracts, respectively. The findings of this study suggest that the aqueous, ethanol, and petroleum ether extracts of *P. longifolia* bark could be used to make photoprotective formulations that have additive or synergistic effects in a variety of combinations and quantities.

Keywords: Hyperpigmentation, Mansur equation, *Polyalthia longifolia*, Sunscreen, Ultraviolet radiation.

Introduction

Solar radiation is one of the most important factors in the existence of life on earth. However, in addition to its good effects, people are also adversely affected by it, primarily owing to ultraviolet (UV) radiation exposure. The shorter UV wavelengths (290–320 nm) are linked to the formation of vitamin D and melanin, which serve as sunscreens. Longer wavelengths (320–400 nm) can penetrate deeper layers of the skin, producing reactive oxygen and nitrogen species that regulate cell metabolism and function while also causing gene mutations.[1] UV protection can help prevent major health issues such as intracellular DNA damage, premature skin aging, and oxidative stress produced by the formation of reactive oxygen species (ROS).[2] Premature skin aging (photoaging) is a well-known side effect of ultraviolet A (UVA) and ultraviolet B (UVB) exposure. The biochemical profile of photoaged skin is defined by the aberrant elastic fibers observed in the dermis as well as a significant reduction in unique collagen types.[3] In humans, excessive UVA and UVB exposure causes erythema (sunburn), an inflammatory response to UV radiation in the skin, oxidative stress, photoaging, immunosuppression, and photocarcinogenesis.[4]
These negative health impacts can be reduced by using a photoprotective product daily. Although the skin has a sophisticated defense system to deal with UV-induced oxidative stress, humans still need to take additional photoprotective measures. This is to avoid the harmful effects of UV irradiation, such as limiting sun exposure, wearing protective clothing, and applying topical sunscreen.[5] Sunscreens are creams or lotions that are applied to the skin to protect it from the harmful effects of UV radiation.[6] Researchers frequently employ the *in vitro* method with a spectrophotometer in the ultraviolet region to find compounds with ultraviolet filter potential because it includes a formula that makes calculations easier.[7] Sun protection can be achieved in a variety of ways using substances isolated from medicinal plants. For example, the secondary metabolites of some plants have the potential to act as ultraviolet filters, while others act as antioxidants and anti-inflammatory agents, reducing the negative effects of solar radiation.[8]
The ornamental tree, *Polyalthia longifolia* (Sonn.) Thwaites is mostly grown in India, Sri Lanka, and Pakistan. *Polyalthia longifolia* is also known as False Ashoka, Buddha Tree, Indian Fir Tree, and Indian Mast Tree. The tree is an important plant with significant medicinal qualities,[9] and it has been discovered that *P. longifolia* has a wide spectrum of pharmacological actions.[10] *Polyalthia longifolia* has different types of phytochemicals, which are useful for diverse therapeutic activities. The various parts of the plant, such as the leaves, bark, seeds, and roots, contain various phytoconstituents, which have pharmacological activities. *Polyalthia longifolia* also has antimicrobial,[11] antiulcer,[12] analgesic,[13] antioxidant, hepatoprotective,[14] antibacterial,[15] antifungal,[16] anti-diabetic,[17] anti-leishmanial, [18] anti-tumor,[19] antipyretic, [20] and antiplasmodial properties.[21] This, therefore, means that *P. longifolia* contains a variety of phytoconstituents and pharmacological activities that will be useful in future research. *Polyalthia longifolia* plant extracts, which are abundant in organic components, have the potential to have high sun protection factor (SPF) values and provide good UV protection. The presence of flavonoids in *P. longifolia* plant extracts confers photoprotective effects against UV radiation. On the other hand, previous studies on the subject have never gone any further. Various approaches were used to create and study new potentials for *P. longifolia* plant extracts as UV radiation protectors and their qualities.

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The research suggests that *P. longifolia* plant extracts could be used as a photoprotective agent in pharmaceuticals.
The aim of this study was to conduct a phytochemical screening and determine the sun-protective activity of the petroleum ether, ethanol, and water extracts of *P. longifolia* bark.

Materials and Methods

Source of plant material
Samples of the whole plant of *Polyalthia longifolia* were collected in January 2020 from Dehradun for identification & authentication certificate was issued by S. K. Singh of Botanical Survey of India, Dehradun, with reference number BSI/NRC/Tech/Herb(Ident.)/2019-20/695.

Preparation of Polyalthia longifolia bark extracts
The bark of *P. longifolia* was collected and cleansed twice with running tap water. To obtain a consistent weight, the bark was then cut into little pieces and let to air dry for a week. Extraction from *P. longifolia* bark powder (100 g) was done with 1000 mL of individual solvent i.e. water, ethanol, and petroleum ether by the cold maceration method for 72 hrs. The extracts were filtered using Whatman filter paper and concentrated in a water bath until they were completely dried. The dark substance obtained was kept in a sealed beaker in the refrigerator (4°C).[22]

Preliminary phytochemical screening of Polyalthia longifolia bark extracts
Following the procedures previously described, general tests for the presence of alkaloids, carbohydrates, glycosides, tannins, saponin, flavonoids, and phenol were conducted.[23,24]

In vitro estimation of the sun protection factor of extracts by the Mansur equation method
In vitro, sun protection factors (SPFs) were determined by Mansur's method.[25] A 0.2 g extract (ethanol, water and petroleum ether) was weighed and transferred into a 100 mL volumetric flask. Then, the extract was diluted to volume with ethanol and filtered. The first 10 mL were discarded, and 25 mL aliquot were transferred to a 50 mL volumetric flask and diluted with ethanol until the volume was reached. Finally, again 25 mL aliquot was transferred to a 50 mL volumetric flask & final concentration of the samples was diluted in ethanol before being measured with a UV spectrophotometer.[26] Sample absorbance was measured in the UV-B wavelength range (290–320 nm) in 5 nm intervals, with three readings taken at each wavelength. The Mansur equation was used to determine the SPF.[27]

$$SPF_{Spectrophotometric} = CF \; X \sum_{290}^{320} EE(\lambda) \; X \; I(\lambda) X Abs(\lambda)$$

Where CF is the correction factor (10), EE (λ) is the erythmogenic effect of radiation with wavelength λ, I(λ) is the solar intensity spectrum (as a constant), and Abs (λ) is the absorbance values of the test.[28]

Statistical analysis
The data are presented as mean ± standard deviation. All of the experiments were conducted in triplicate.

Results and Discussion

Preliminary phytochemical screening of Polyalthia longifolia bark extracts
The presence of phytoconstituents such as alkaloids, glycosides, flavonoids, and phenols has been known for decades to influence the therapeutic capacities of medicinal plants. The bark of *P. longifolia* was found to contain different varieties of secondary metabolites in extracts (Table 1). Alkaloid was found to be in petroleum ether and ethanol extracts of *P. longifolia* bark. Alkaloids are the phytoconstituents that affect the central nervous system and act as a diuretic.[29] An ethanol extract of *P. longifolia* shows the presence of carbohydrates. It has been discovered that carbohydrates are one of the constituents that has been proved to enhance the immune system by increasing physical strength. Consequently, they work well as dietary supplements.[30] Glycosides were present only in ethanol extract, which was used to treat congestive heart failure and cardiac arrhythmia.[31] All the tannins, flavonoids, and phenols present in all the extracts of *P. longifolia* bark were proven to have free radical scavenging properties. Tannins have been shown to minimize the risk of coronary heart disease, and they have incredibly astringent properties. They are known for speeding up the healing of wounds and inflamed mucous membranes.[32,33]

The sun protection factor of Polyalthia longifolia bark extracts
The SPF of *P. longifolia* bark extracts was determined by the spectrophotometric method through an *in vitro* technique. The Mansur equation method was used for the measurement of the absorption characteristics of the sample solutions. Figures 1-3 display the extract's absorption profiles, which indicate the samples' distinctive UVB absorption. In this study, UVB was chosen for SPF testing because it occurs most frequently during the day and people are exposed to it for longer periods of time. The results of SPF activity of *P. longifolia* bark extracts are presented in Table 2. The SPF values of different extracts were found to be 5.24±0.002 (ethanolic extract), 1.07±0.009 (petroleum ether), and 1.01±0.012 (water extract).

Table 1: Preliminary phytochemical screening of *Polyalthia longifolia* bark extracts

Chemical constituents	Petroleum ether extract	Ethanol extract	Water extract
Alkaloids	+	+	-
Carbohydrates	-	+	-
Glycosides	-	+	-
Tannins	+	+	+
Saponin	-	-	-
Flavonoids	+	+	+
Phenols	+	+	+

+: Present; -: Absent

Table 2: Sun protection factor values of all extracts of *Polyalthia longifolia* bark

Type of extract	Sun protection factor
Ethanolic	5.24 ± 0.002
Petroleum ether	1.07 ± 0.009
Water	1.01 ± 0.012

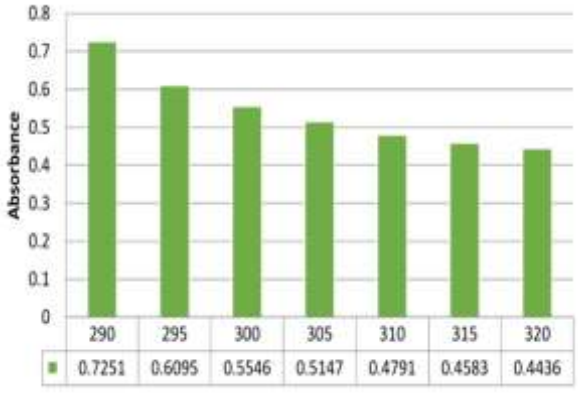

Figure 1: Absorption profile of ethanol extract of *Polyalthia longifolia* bark

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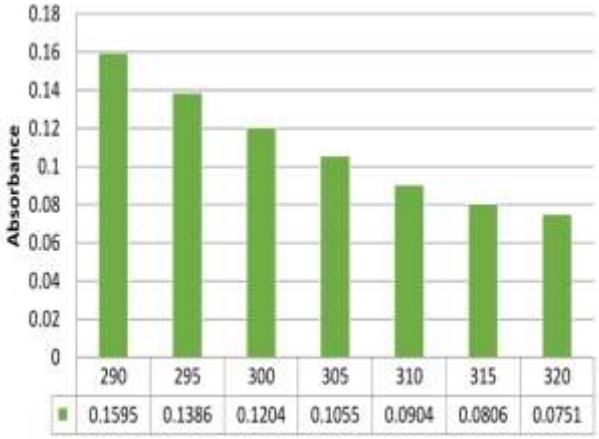

Figure 2: Absorption profile of petroleum ether extract of *Polyalthia longifolia* bark

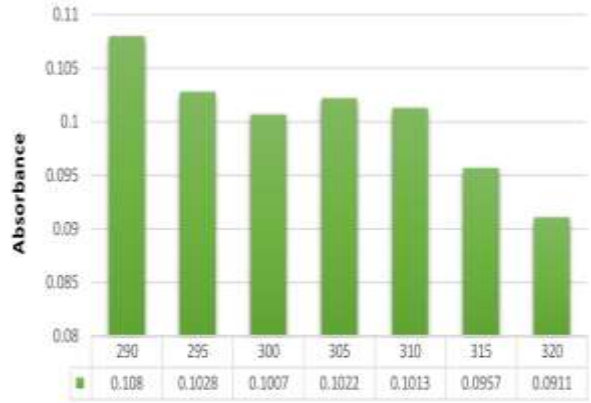

Figure 3: Absorption profile of water extract of *Polyalthia longifolia* bark

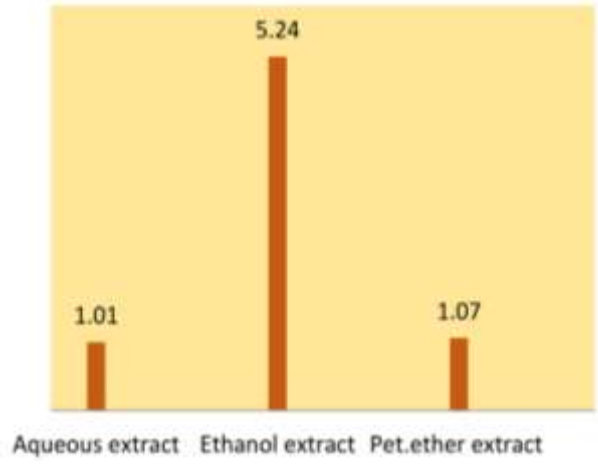

Figure 4: Comparative sun protection factor values of aqueous, ethanol, and petroleum ether *Polyalthia longifolia* bark extracts. UV absorbance was measured between 290 and 320 nm with a 5 nm interval according to the Mansur equation.

The SPF value of water extract was the lowest, followed by that of petroleum ether extract and ethanol extract, which had slightly higher SPF values. This demonstrates that the extract may effectively shield the skin from damaging UV rays when used in cosmetics in its purified form. Several studies have demonstrated the role of phenolics and flavonoids in UV protection. The results (Figure 4) of this study suggest that ethanolic extract of *P. longifolia* bark extract can be used as a photoprotective filter or to enhance the sunscreen action of cosmetic formulations.

Conclusion

The findings of this study reveal that *P. longifolia* extracts have sun-protective activity. The UV spectrophotometer was used to determine the SPF value of the ethanol, water, and petroleum ether extracts of *P. longifolia* bark. Several extracts from this plant have a wide range of applications in skin cosmetics due to their flavonoid content and sunscreen effect. It is hereby recommended that extracts from the bark of *P. longifolia* can be utilized in improving the SPF value of other sunscreen preparations.

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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