

SHORT COMMUNICATIONS

AUGMENTATION OF AESTHETIC AND ANTISOLAR ATTRIBUTES OF A SUNSCREEN CREAM BY METHANOLIC EXTRACT OF *RAKTCHANDAN* (*PTEROCARPUS SANTALINUS*)

ABSTRACT

"*Raktachandan*" or *Pterocarpus santalinus* was identified as indigenous to Eastern Ghats of India. This ethnopharmacological drug has been used since ages as a colouring material. It is mentioned in *Charaka Samhita*, which is a sacred treatise based on the Indian system of medicine, "Ayurveda". The drug has been used to passify *Pitta* meaning thereby important digestive "agnis" or fires of the body. It is used as refrigerant and astringent. A paste of the powder is used as a cooling application in headache. More literature revealed its skin depigmentation activity. Based on the information available, an attempt was made to establish its sunprotective property. The present research study collected, analyzed phytochemically and further extracted the heartwood of the drug *P. santalinus* by three methods. This extract was checked for its antioxidant potential and used to colour zinc oxide, a physical sunscreen agent which gave an appearance like calamine. Transmittance properties of all three powders were studied. The purpose was to provide natural colorant for sunscreen cream, which itself has UV absorbing property. This coloured zinc oxide was formulated into a sunscreen cream and its SPF was determined. The highest yield was given by Soxhlet extract. The extract also exhibited significant antioxidant potential. The transmittance spectra of coloured zinc oxide were comparable to calamine. The coloured zinc oxide cream gave a higher SPF (17.2) than zinc oxide cream (15.9). Extract of *P. santalinus* when used in combination with inorganic sunscreen, provided synergistic combination and led to the enhancement of SPF.

Keywords: Lal Chandan, Zinc Oxide, Sunscreen, Photoprotection

INTRODUCTION

Red sandalwood or *Raktchandan* or *P. santalinus* is an indigenous drug mentioned in *Charaka Samhita*, which is a *Granth* i.e. a text compiled by sage *Bhardwaj*. Its literature is mentioned in "Ayurveda", the most traditional medicinal practice of India. "Ayurveda" stands for *Ayu* i.e. age and relates to life. India has a wealthy legacy of medicinal flora of extensive diversity which is still used by the local inhabitants and traditional healers for the cure of diseases¹. International Union for Conservation of Nature and Natural Resources (IUCN) has categorized 560 plant species native to India under the *Red List of Threatened species*². *P. santalinus* is one such endangered species endemic to eastern ghats of India with Andhra Pradesh as its principal geographical range. It is also called as *raktachandan* or *red sanders* or *lal chandan*.

Phytomedicine refers to the use of plants for the treatment of various diseases for the health benefit to mankind. In the quest for natural drugs, newer molecules of conventional plants are being developed on the basis of knowledge of their traditional uses³. *P. santalinus* is a

small to medium sized deciduous tree with dense, round crown and a height of 9 to 16 m. It has a dark brown bark and pinnately compound leaves.

Heartwood of the tree is used in *Ayurveda*, *Siddha*, *Unani*, Tibetan and folk medicines⁴. In pharmacy, it is chiefly used as a colouring agent.

The red sandalwood contains a natural dye called santalin, which is used as a colouring agent in pharmaceutical preparations and in the food industry⁵. The unique red colour of the wood has been added to dermatological preparation to give natural colour of tanning. This invention has been patented in cosmetic composition comprising at least one dye, namely *santalin* or *santarubin*⁶.

Recent phytochemistry and pharmacological experiments have indicated that *santalin*, which is the major active component of *P. santalinus*, has anti-tyrosinase activity⁷. *Santalin* inhibited melanin formation process by down regulation of a critical transcription factor; microphthalmia-associated transcription factor (MITF), tyrosinase, tyrosinase related protein 1 (TRP-1) and tyrosinase related protein 2 (TRP-2). This study indicated the use of *P. santalinus* as depigmentation agent. Uses

of sunscreens have become an important photoprotective measure to prevent the skin from damaging effects of UV radiations. Organic or chemical sunscreens absorb the ultraviolet radiations and inorganic or physical sunscreens transmit or reflect these UV rays⁸. Toxicity of the chemical sunscreens has encouraged the researchers to focus on physical or natural sunscreens. Zinc oxide is a well established physical sunscreen agent. However, the formulation of its sunscreen has disadvantage of skin whitening effect and hence it is nanosized using various techniques. In this work, extract of heartwood of *P. santalinus* has been used to colour zinc oxide to enhance aesthetic appearance of zinc cream. The purpose was to augment antisolar property of physical sunscreen agent.

MATERIALS AND METHODS

Identification, authentication, phytochemical analysis and extraction of Lal Chandan (*P. santalinus* wood)

The heartwood of the drug was obtained from local supplier and authenticated by NISCAIR, New Delhi (NISCAIR/RHMD/Consult/2018/3174-23). The heartwood of the *P. santalinus* was dried at room temperature and was crushed into powder by electric blender. The wood powder was further extracted by three methods, namely, Soxhlation, maceration and microwave extraction.

Phytochemical analysis

Methanolic extract of drug was analyzed for the presence of various secondary plant metabolites such as flavanoids, alkaloids, triterpenoids, tannins, saponins and glycosides using various test reagents as per methods given by Yadav⁹, Soni¹⁰ and Arokyaraj¹¹.

Antioxidant activity determination

Antioxidant activity of the extracts was performed using DPPH scavenging method¹² and scavenging capability of DPPH radical was determined by the formula:

$$\text{Scavenging effect} = [(A_0 - A_1)/A_0] \times 100$$

where A_0 is the absorbance of the control, and

A_1 is the absorbance in the presence of all of the extract samples,

A graph was plotted between scavenging effect and concentration, and a regression equation was obtained to calculate inhibitory concentration 50 (IC50).

FTIR assay

The FTIR of zinc oxide and coloured zinc oxide was done using Bruker FTIR research spectrometer 12060280. About 1–2 mg of sample was mixed with dry potassium bromide and the samples were examined at transmission mode over the wavenumber range of 4,000 to 400 cm^{-1} . The data handling was done using OPUS 7.2.139.1294. spectroscopic software.

SPF determination of Lal chandan

SPF of *P. santalinus* was determined (Table I) by absorbance method given by Mansur et al.¹³

$$\text{SPF}_{\text{Spectrophotometric}} = C.F. * \sum E.E. (\lambda) * I(\lambda) * A (\lambda)$$

Table I: SPF determination of *Pterocarpus* extract

| Wavelength (nm) | EE | Absorbance of Lal chandan |
|-----------------|--------|---------------------------|
| 290 | 0.150 | 0.353 |
| 295 | 0.0817 | 0.315 |
| 300 | 0.2874 | 0.295 |
| 305 | 0.3278 | 0.283 |
| 310 | 0.1864 | 0.71 |
| 315 | 0.0837 | 0.265 |
| 320 | 0.0180 | 0.263 |

Coating of zinc oxide with methanolic extract of Lal chandan (MELC)

100 mg of *P. santalinus* extract was taken in a 100 mL volumetric flask. Methanol was added and the extract was dissolved. Taken 9 mL of this 1 mg mL^{-1} solution and added to 5 g of zinc oxide powder in a petridish. Solvent was allowed to evaporate at room temperature. Coloured zinc oxide was obtained and passed through sieve before use.

Formulation of cream and its SPF

Zinc cream, coloured zinc cream and calamine cream was formulated and were analyzed for their SPF values by transmission method, as given by Diffey and Robson¹⁴.

$$\text{SPF} = \frac{\sum_{290-400} E * e}{\sum_{290-400} E * e / \text{MPF}}$$

E is the spectral irradiance of terrestrial sunlight under defined conditions and e is the relative effectiveness of UVR at wavelength nm in producing delayed erythema in human skin equivalent to “erythema action spectrum”. MPF is monochromatic protection factor. It is calculated as ratio of transmission of blank to the transmission of sample.

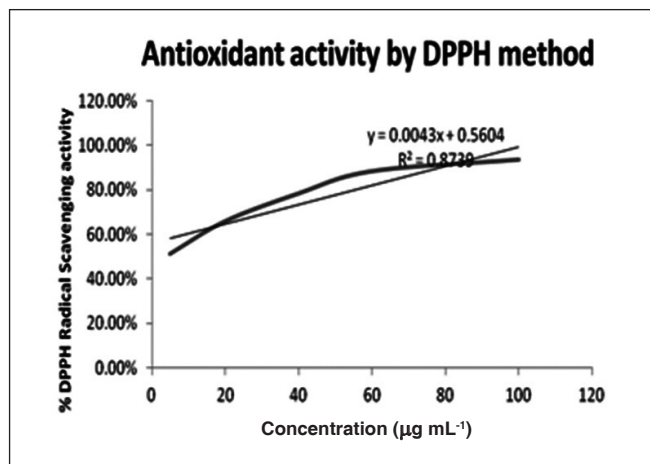
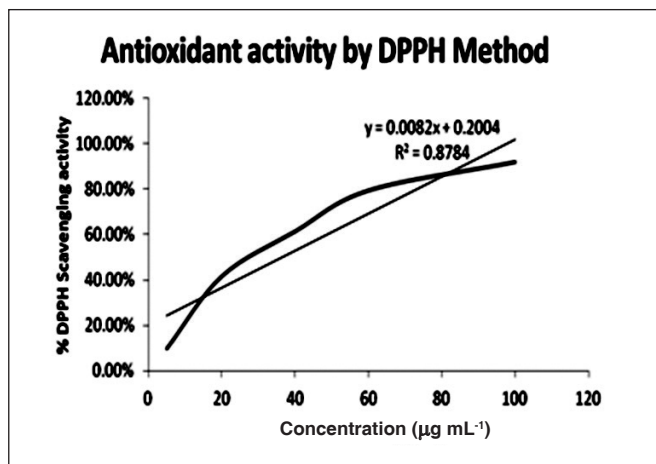


Fig 1: DPPH activity of (a) Ultrasonic extract and (b) Soxhlet extract

RESULT

Phytochemical analysis of methanolic extract confirmed the presence of flavanoids, alkaloids, triterpenoids, tannins, saponins and glycosides. The extraction yield of *P. santalinus* varied with the technique used. The yield of extract made by Soxhlation, maceration and microwave extraction was 19.68 %, 16.56 % and 0.077%, respectively. The highest yield was given by Soxhlation process.

Antioxidant value determination

The Soxhlet extract exhibited the maximum antioxidant activity (Fig. 1).

FTIR results

The FTIR peaks of zinc oxide and coloured zinc oxide reveals that there is no difference in the structure of powder before and after coloration.

SPF determination

The SPF value of 0.01 % hydro alcoholic solution comes out to be 3.3.

Effect of dyeing using MELC

Zinc oxide powder when coloured using 1 mg mL⁻¹ extract of *P. santalinus* gave a pink tinge to the powder similar to calamine. The coloured zinc oxide was further used to formulate zinc cream which is devoid of forming a white layer on the skin.

SPF determination of zinc creams

The SPF value of zinc oxide cream comes to be 15.9 whereas that of coloured zinc oxide cream comes to be 17.1 and that of calamine cream come out to be

8.3. This higher SPF is due to UV protectant nature of "Lal chandan".

DISCUSSION

Sunscreens are often applied topically when going out in the sun. The colour of sunscreen should match the skin. This can be achieved by either incorporating suitable colorant or calamine into it. Calamine is zinc oxide along with a small proportion of ferric oxide. As per *Indian Pharmacopeia*, it contains not less than 98.0 per cent and not more than 100.5 per cent of ZnO, calculated on the ignited basis. However, the use of natural calamine has become outdated in modern cosmetics.

Zinc oxide is a broad spectrum safe inorganic sunscreen which prevents the skin from deleterious effects of ultraviolet rays by transmitting or scattering UV light. However, it has skin whitening effect when applied onto the topical layer of skin. In this research study, *P. santalinus* has been extracted and its antioxidant potential has been determined. The extract exhibited high antioxidant potential as determined by DPPH assay. This is due to presence of polyphenolic and flavanoid components present in it. This methanolic extract of *P. santalinus* has been used to colour zinc oxide particles to give natural colour similar to calamine. The transmission data of coloured zinc oxide powder was comparable to calamine. In the UV-B range (290-320), this drug offered more transmission and hence higher prevention. It also showed higher transmission values in UV-A range (320-400 nm) as well. However, the values at wavelength 390 nm and 400nm were comparably lesser than zinc oxide or calamine. This is due to the lighter colour which is neither white nor pink but matches the skin tone. The zinc oxide cream formulated with the same offers synergistic

combination of a physical sunscreen and a natural UV absorber; *P. santalinus*. It exhibited a higher value of SPF of 17.1 in comparison to 15.9 of zinc oxide cream or 8.3 of calamine cream.

CONCLUSION

The therapeutic properties and various potential applications of heartwood of *P. santalinus* have been well established. Various pharmacological studies of *P. santalinus* have indicated its use in wound healing, hepatoprotective, anti-inflammatory, anti-diabetic and anti-bacterial therapies. Its anti-aging property has also been reported. However, no study has reported its antisolar property. The current research study established its photoprotective and antioxidant potential. In this work, an attempt was made to mask the skin whitening effect of zinc oxide by colouring it with extract of *P. santalinus*. The extract exhibited photoprotective potential with a significant SPF value. The zinc oxide thus coloured resembled calamine and was free from any chelating effect of ferrous oxide present in calamine. This was formulated into zinc cream which showed higher SPF in comparison to zinc cream. It can be concluded that *P. santalinus* can be recommended as a natural photoprotective agent. This ethnopharmacological agent has a great potential to be used in modern day natural sunscreen products. Its skin colouring, depigmentation properties along with its SPF can be of great significance for dermatological purposes.

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