World Journal of Pharmaceutical research

Volume 2, Issue 6, 3129-3135. Research Article ISSN 2277 – 7105

PHOTOPROTECTIVE ACTIVITY OF AN INDIGENOUS HERBAL FORMULATION

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Article Received on
06 Sept. 2013,

Revised on 29 Sept. 2013,
Accepted on 31 October 2013

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ABSTRACT

Use of sunscreen agents has become a necessity in recent years due to sunburn and other related problems. There are approved physical and chemical sunscreen agents. Plants have also been used in sunscreen lotions due to their human skin friendly nature. *Cyclea peltata, Tabebuia heterophylla, Kedrostis foetidissima* are plants known for its medicinal properties. The petroleum ether and ethyl acetate extracts of these plants were formulated into sunscreen lotions and were tested for their photoprotective ability by Transpore tape method using an UV light meter (Lutron UV-340A). The results showed that the formulation prepared with the petroleum ether extract of *Tabebuia heterophylla* and the ethyl acetate extract of *Kedrostis foetidissima* leaf to have highest ability in blocking UV rays. The study provided an easy method of determining the UV protecting ability of the substances and also indicates the usefulness of these plants in cosmeceutical industry as UV blockers.

Keywords: sunscreen, formulation, UV, *Tabebuia heterophylla, Kedrostis foetidissima, Cyclea peltata*

INTRODUCTION

Sunrays contain harmful UV rays (UV-A (320-400 nm), UV-B (290-320 nm) and UV-C (200-290 nm)) which causes adverse effects. UVA and UVB are mainly responsible for skin pathologies including skin pathologies such as sunburns, cutaneous degeneration, photosensitivity, phototoxicity, photo-aging, immunosuppression and skin cancer.[1] UV rays when absorbed by human skin produces harmful compounds called free radicals or Reactive Oxygen Species (ROS). These ROS are reported to be the causative species for many

ailments. Hence, protection of human skin from the deleterious UV rays is much essential as it lessens the formation of ROS. ROS can be counteracted by antioxidant molecules by anyone of the known mechanisms. Ever expanding awareness on the damaging effects of sunrays thus warrants the use of sunscreen agents. Sunscreens abet the body's natural defense mechanisms in protecting against harmful UV radiation from the sun. Its function is based on its ability to absorb, reflect or scatter the sun's rays. Many natural and synthetic chemicals have been investigated in the past decade for their efficiency to defend against radiation-induced damage in biological systems. [2] Due to the allergic reactions the synthetic reagents caused in certain individuals, research drifted towards the use of naturally occurring compounds especially plants. Furthermore, a number of people with sensitive skin, such as those suffering from skin hypersensitivity do not prefer chemical sunscreens due to concern about skin exposure to unknown chemicals. Even though a variety of hypoallergenic cosmetic products have been launched for people with sensitive skin, there are still limited options in sunscreen agents. Cosmetics that have herbal components are more suitable for hyperallergic skin as they are reported to be less irritant and more easily adjustable to skin. Herbal cosmetics must have one or more active sunscreening agent with antioxidant properties in order to achieve good photoprotection effect.[3]

Plants are a rich source of antioxidants and almost all plants possess one or more of the antioxidant molecules. When plant extracts are used, those molecules that act as antioxidants enhance the antioxidant activity by synergism in most cases. Many plants have been tested for its efficiency in protecting the human skin from the harmful effects of sunrays. Plants with high antioxidant capacity might be able to offer high ability in preventing UV rays from penetrating the skin. Thus in this study, three plants were chosen and were tested for its efficiency as a sunscreen agent.

Cyclea peltata (CP) is used in the treatment of skin diseases such as allergies, burns, cuts, wounds, inflammation, leprosy, leucoderma, scabies, smallpox.[4] The juice extracted from the flowers of *Tabebuia heterophylla* (TH) is used to keep the skin soft and to remove unsightly calluses from the elbows.[5] *Kedrostis foetidissima* is used in the treatment of skin diseases.[6,7,8,9,10] The antioxidant ability of these plants has been established. Hence in this study, the petroleum ether and ethyl acetate extracts of these plants has been formulated into sunscreen lotions and were tested for its UV protecting efficiency using UV light meter.

MATERIALS AND METHODS

Collection of plant material

The roots of CP, the flowers of TH and the leaves and stem of KF were used for the present study. The plant part of TH and KF were collected from in and around Coimbatore and that of CP was collected from Kerala. The plant parts were shade dried and coarsely ground and were used for the study.

Extraction of plant material

The coarsely ground plants (100 g) were extracted for 6 hours with 1 liter of petroleum ether followed by extraction with ethyl acetate for 6 hours. The extracts were desolvetised using rotary evaporator, concentrated to dryness and were used for the studies.

Preparation of sunscreen lotion

The sunscreen lotion was prepared by mixing the aqueous phase with oil phase. Glycerol (1 mL) together with water (10 mL) constituted the aqueous phase whereas the emulsifying wax (100 mg) was the oil phase. The oil phase and the aqueous phase were heated to ~80°C. The extract (100 mg) was added to the oil phase followed by the addition of aqueous phase with continuous stirring until homogeneity.

Measurement of UV protecting efficiency by Transpore tape method

The ability of the sunscreen formulations were tested using UV light meter by Transpore Tape method. The lotions at varying concentrations (50, 40, 30, 20 and 10 mg) were coated uniformly onto the tape over an area of 1 cm using a melting point tube. After 20 min, the tape was placed over the UV sensor probe and the reading noted in both daylight and UV (365 nm). The amount of UV rays falling on the UV sensor is a measure of the UV protective ability of the lotion. Lower the value, higher is the UV protecting capacity of the lotion.

RESULTS AND DISCUSSION

The photoprotection afforded by topical sunscreen against solar ultraviolet radiation exposure can be determined *in vivo* or *in vitro* and it is idyllically determined by photo-testing in human volunteers. Albeit useful and precise, the method is a time consuming process, complex and expensive, particularly when information regarding the protection against long wavelength is required. As a result, much effort has been devoted to the development of *in vitro* techniques for assessing the photoprotection of sunscreen compounds which are in general of two types. Methods which involve the measurement of absorption or the

transmission of UV radiation through sunscreen product film in Quartz plates or Biomembrane and methods in which the absorption characteristics of the sunscreen agents are determined based on spectrophotometric analysis of dilute solution.[11]

Natural antioxidants present in herbs and spices which contain polyphenols, flavonoids, phenolics, alkaloids, tannins and glycosides [12] are responsible for inhibiting the severe consequences of oxidative stress as they possess radical scavenging activity. [2] Presence of antioxidants contributes to the UV protecting ability of the plants. Hence, it becomes much essential to chose plants with high antioxidant activity for the preparation of topical sunscreen formulations. Many plants with known antioxidant potential such as *Camellia sinensis, Silybum marianum, Spathodea campanulat*, [13] Cucumber, [14] Pomegranate peel, [15]

Aloe vera (Leaf gel), *Camelia sinesis* (leaf),*Cinnamonium burmanii* (bark), *Coffea Arabica* (Seed), *Curcumin longaI* (Rhizome),*Ocimum tenuiflorum* (leaf), *Prunus dulcis, Santalum album* (bark), *Syzygium aromaticum* (Flower), *Theobroma cacao* (Seed), [2] *Luffa cylindrical, Portulaca oleracea, Piper longum, Emblica officinalis, Crocus sativus, Peumus boldus* Molina [3] etc have been tested for their UV protecting ability. All the tested plants were found to contain flavonoids which are effective antioxidants. The primary group of compounds that acts as UV blockers include phenolic acids, flavonoids and high molecular weight polyphenols. [13] Sunscreen prepared from Lutein esters of *Tagetes erecta* have been tested by Transpore tape method using Optometrics Model SPF-290 Analyzer and SPF of this cream is found to be 1.08±0.02 with Boots Star Rating 4. [16]

The results of the present study are given in Table 1 and Table 2. The UV protecting ability of the all the lotions increased with increase in concentration. This might be due to the increase in concentration of the active ingredients spread over an equal area (1 cm). The results showed that the formulation prepared with the petroleum ether extract of *Tabebuia heterophylla* and the ethyl acetate extract of *Kedrostis foetidissima* leaf to have highest ability in blocking UV rays. This might account for the use of the flowers of *Tabebuia heterophylla* in the treatment of skin calluses.

Table 1 UV transmittance of the sunscreen lotions at daylight in μW/cm^2

S.No	Lotions	Transmittance of the sunscreen lotions (μW/cm^2)				
	Concentration of the sunscreen lotions (mg)	50	40	30	20	10
1	CPP	88	102	186	204	214
2	THP	41	93	143	184	201
3	KFLP	99	106	149	174	214
4	KFSP	175	173	234	246	330
5	CPEA	379	445	458	498	385
6	THEA	230	286	298	337	386
7	KFLEA	59	140	204	263	296
8	KFSEA	85	101	178	232	323

Table 2 Transmittance of the sunscreen lotions at UV (365 nm) in μW/cm^2

S.No	Lotions	Transmittance of the sunscreen lotions (μW/cm^2)				
	Concentration of the sunscreen lotions (mg)	50	40	30	20	10
1	CPEA	187	230	237	279	286
2	THEA	33	45	60	143	191
3	KFLEA	22	49	88	120	160
4	KFSEA	42	57	119	153	215
5	CPEA	187	230	237	279	286
6	THEA	33	45	60	143	191
7	KFLEA	22	49	88	120	160
8	KFSEA	42	57	119	153	215

Petroleum ether extract of *Tabebuia heterophylla* contains alkaloids, flavonoids, terpenoids and tannins and ethyl acetate extract of *Tabebuia heterophylla* contains alkaloids, flavonoids, terpenoids, tannins, lignins and carbohydrates . [5] *Tabebuia heterophylla* showed effective UV protective ability as it contains tannins and together with flavonoids which might be attributed to the higher UV protective ability. *Cyclea peltata* contains metabolites like saponin, cardiac glycosides, alkaloids, hydrolysable tannins, flavonoids, steroids and terpenoids. [17] *Kedrostis foetidissima* contain alkaloids, flavonoids, tannins, triterpenoids and

steroids [6][9] and absence of phenols, phlobatannins, anthraquinones, saponins and glycosides. Tannins were found to be present in KFL [9] and not in KFS. The absence of phenols and tannins might be the reason for the lowest activity rendered by KFSP in the present study.

Absorption of UV radiation is the main characteristics for identification of flavonoids in natural sources. [11] In the present study, all the formulations showed effective UV absorption as all the plants studied contain flavonoids. The presence or absence of certain metabolites in the three plants might be the reason for the varied activity of these plants.

CONCLUSION

UV protecting ability determined by Transpore tape method using Lutron UV Light meter for three different plants showed that the petroleum ether extract of *Tabebuia heterophylla* and the ethyl acetate extract of *Kedrostis foetidissima* leaf to be higly effective in blocking UV rays. The presence of UV blocking compounds and antioxidants were attributed to the UV protecting ability of the sunscreen lotions. Thus these plants can be used as human skin friendly UV protecting agents. Further tests may be carried out to confirm the UV protecting ability of the formulated sunscreen lotions.

ACKNOWLEDGEMENTS

The authors thank Avinashilingam Institute for Home Science and Higher Education for Women for providing necessary facilities to carry out this work.

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