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Research Article

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Presence of Sun Protection Factor (SPF) in the *Tagetes* Plants

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ABSTRACT

Background: The marigold plant is widely used as herbal medicine due to presences of many phyto constituents. In ancient time extract of marigold flower used as the remedy against various skin problems.
Method: The aim of this study was determining the photo-protective activity of *Tagetes* Leaves and Flower by using UV-Spectrophotometer. UV-Vis spectrophotometry measured the absorption rate of UV rays at different wavelength of each sample. To calculate the final sun protection factor (SPF) value, Mansur equation was appropriated method.
Results: The result of study demonstrates that the marigold plants having for 15 and 10 SPF for flowers and leaves respectively
Conclusion: Marigold plant having natural SPF and it become a good source for formulation of bio-cosmetics.

Key-words: Photo-protective, Solar radiation, Sun Protection Factor, *Tagetes* plants, UV-Spectrophotometer

INTRODUCTION

Sunlight consists of a variety of wavelengths ranging from ultraviolet light to infrared and visible light. Direct skin exposure to solar radiation has some adverse effects. Excluding all sun rays, ultraviolet light has the more deleterious effects on the skin such as sunburns, skin ageing and over the long term exposure of UV light even causes skin cancer. These harmful radiations causes' deleterious effects in skin like sarcoma due to oxidative free radicals presence in an excessive amount and this amount raises continuously as the amount of UV-B radiation is constantly exposed [1]. The electromagnetic spectra of UV sun radiation can be further classified into three different regions: UVA, from 320 to 400 nm; UVB, from 290 to 320 nm and UVC, from 200 to 290 nm [2]. Usually when sunrays approach to earth atmosphere only UVB radiation partially filtered by outer ozone layer and UV-A completely reaches to earth atmosphere while UV-C is completely absorbed at outer atmosphere. UV-A causes skin ageing, rashes in epidermal layer of skin, while UV-B having higher penetration power as compare to UV-A actually responsible for causing cancer in skin [3].

Due to these facts, UV-B radiations exposure can be cut off by developing naturally synthesized cosmetics products, which has photo-protective action and provide nourishment to the skin tissues. This is possible owing to the presence of antioxidants, which restricts the formation of free radicals and help to reduce the chance of destructive skin effects of ultraviolet radiation. However, it is necessary to include such photo protective bioactive active compounds in the cosmetic formulation and measures their efficiency against UV-rays. The sunscreen efficacy is usually decided on the basis of Sun Protection Factor (SPF), defined as the UV energy required causing minimal erythema dose (MED) on protected skin to the UV energy required to produce a MED on unprotected skin [4]. The minimal erythemal dose (MED) is defined as the minimum dosage of UV light irradiation sufficient to produce a minimal, perceptible erythema on unprotected skins [5] for

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shortest time interval. It means higher the SPF value containing cosmetic products are beneficial and more effective against UV-B rays.

SPF = Minimal erythema dose in sunscreen – protected skin / Minimal erythema dose in non sunscreen – protected skin

Various synthetic products are available in the markets which are generally useful to protect skin from harmful UV rays. But these chemically synthesized products are usually not safe and effective [5-7]. This is big disadvantage of synthetic cosmetic products. Synthetic products are available in the market containing various harmful effects and not so much effective. To avoid this problem researcher's criteria were shifted towards the naturally synthesized products [8]. Many Researchers were focusing on naturally synthesized products, used as a cosmetic product like synthetic cosmetics. But the foremost criteria for naturally synthesized cosmetics are the presence of bioactive compounds [9] generally found in natural resources and still some researchers were investigate to find out unknown and novel bioactive compounds, which has a protective action against harmful UV radiations. This can be possible by discovering new reaction mechanisms, which is helpful to search out these interesting bioactive compounds, and easier to study their structure function relationships in order to develop naturally synthesized photo protective active compounds and restrict an unwanted inhibitory product formation. Furthermore, the natural synthesized active compounds are already known and widely occurring, then it is possible to produce a high quality cosmetics product with significant SPF value characteristics available relatively at a low price [10,11].

MATERIALS AND METHODS

Reagents and samples- Ethanol AR. Marigold plants were collected from the field of SHUATS, Allahabad.

Apparatus- Cistronic UV/Visible spectrophotometer 2202.

Methods

Sample preparation- Weighed (100 mg) sample ultrasonicated with 100 ml analytical grade ethanol for 5 minutes. Sonicated samples were filtered. First 10 ml sample was discarded, out of remained filtrated 5 ml was relocated to volumetric flask and make up volume up to 50 ml with diluted ethanol. Then take 5 ml sample and further 5 times diluted with ethanol. Prepared sample was read at the range from 290–320 nm to take absorption spectra at every 5 nm against ethanol blank in triplicate manner for 30 minutes. Obtained data was calculated by using Mansur equation mentioned below-

$$\text{SPF (spectrometry)} = CF \times \Sigma_{290}^{320} EE(\lambda) \times I(\lambda) \times abs(\lambda)$$

Where CF= correction factor (= 10), EE (λ)= Erythemal effect spectrum; (λ); I (λ)= intensity of the sunlight at a wavelength (λ); abs (λ)= sample absorbance at wave-length (λ)

The values of EE (λ) and I (λ) were calculated as previously by Sayre *et al.* [12] as described in Table 1.

Table 1: Erythemogenic effect relationship (EE) versus radiation intensity (I) according to the wavelength (λ)

λ (nm)	EE x I (normalized)
290	0.0150
295	0.0817
300	0.2874
305	0.3278
310	0.1864
315	0.0839
320	0.0180

Statistical Analysis- The present data/results were analyzed the variance through a post hoc (ANOVA) multiple evaluation t-test ($p \leq 0.01$) by using STAT PAC Version 14.

RESULTS

The SPF values for marigold leaves and flower were determined through the spectrophotometric method and calculated by Mansur equation. The results were represented in Fig. 1. A quantitative method to ensure the formulation of sunscreen is sun protection factor. It is efficient to avoid and heal skin against sunburn and different other skin damages. SPF containing cosmetics products absorbed or reflected a wide range UV rays in between 290-320 nm. Graphically it shows the sun protection factor (SPF) was found at maximum at 305 nm and minimum at 290 nm (Fig. 2).

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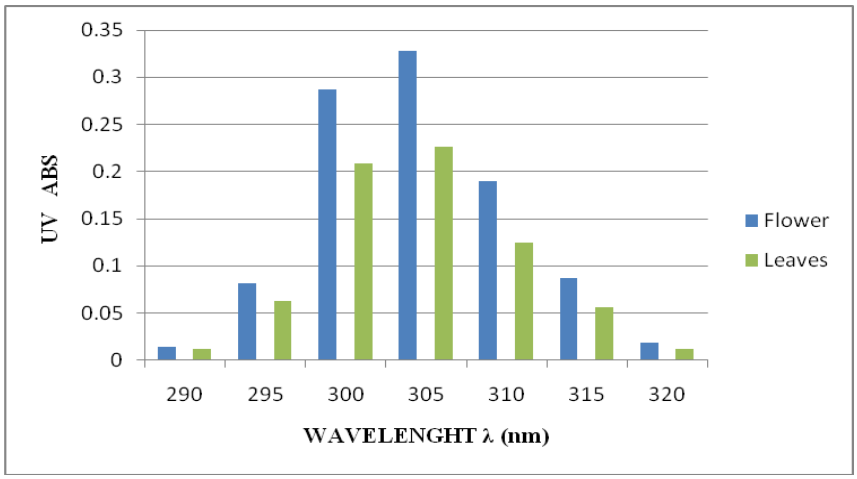

Fig. 1: UV radiation absorbance for *T. patula* Flower and Leaves at wavelength range 290-320 nm

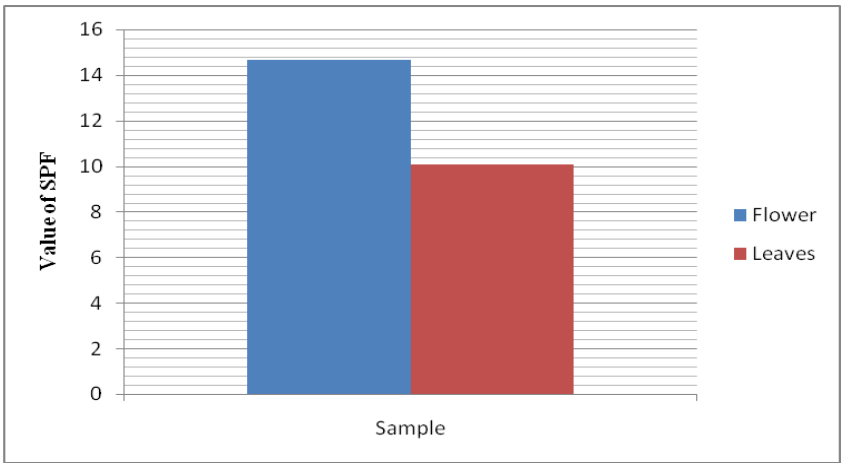

Fig. 2: Sun Protection Factor (SPF) for *Tagetes patula* Flower and Leaves

SPF factor significant value lies at (P≥0.01) level; checked value was significant at (P≥0.01) level. In this study, lesser absorption value of sun protection factor was observed in leaves as compare to flowers. In this respect, reflectance capacity of leaves is observed higher than flower by employing spectrophotometric methods. Spectrophotometrically SPF value of marigold flower and leaves is calculated and significantly value was obtained which is equivalent to 15 and 10 at (P≥0.01) level. An evaluated SPF value showed the significant differences in SPF value of flower and leaves of marigold. Hence, developed cosmetic product from marigold containing SPF values in the range of 10-15 considered to be safe for human with sensitive skin against directly exposed sunlight condition. This study supports photoactive in gradients of marigold which help reduces the harmful effects of UV irradiation on human skin.

DISCUSSION

The protection of human skin against the UV induces radiation sunscreen has used [12,13]. Plants having different types of active constituents, which worked as shield to protect the skin from UV rays [14]. Eco-friendly cosmetics are prepared with naturally extracted ingredients known as vegan cosmetics. These compounds are isolated from different parts of plants. These vegan cosmetics are a good source of different type of metabolites [15] and antioxidant, having skin protection properties SPF [16]. In plants several types of secondary metabolites are presents such as ascorbic acid, catechins, triterpenes [16], tannins, isoflavones, xanthophylls [17], flavones, coumarins, flavonoids, flavanones, phytoestrogens, anthocyanidines, carotenoids [18], Volatile oils have been used as active compounds for sunscreens. These active compounds are also obtained from marine sources used as a preparation of anti-photo-ageing commercial products [19]. Different mechanisms are accountable for protection. UV rays scattered and reflected by inorganic substances alternatively organic molecules absorbed the radiation [20]. Cyclic or conjugated bonds and aromatic rings are dependable for the advancement of UV absorption

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profile [21]. The soluble polyphenols absorbed radiation from 304-350 nm while insoluble phenol from 352-385 nm [22]. UVB radiation was absorbed by ferulic acid and its derivatives [23]. Two aromatic rings containing compounds and flavonoids absorbed the UV rays in the range between 240-420 nm [24]. The present study demonstrates that the marigold plants having SPF's factors become a good source for the formulation of biocosmetics. This formulation was tested for long period and did not found any types of allergic reaction. Thus marigold extracts are suitable for use as natural sunscreen.

CONCLUSIONS

The SPF represents the effectiveness of a cosmetic product formulation specially sunscreens. The marigold should absorb the majority of UV radiation (290 to 320 nm) so as to be effective in preventing skin cancer, wrinkle formation, photo ageing, sunburn and other skin damages. This study concluded that marigold plants are better alternative of cosmetic products to protect the skin from UV radiations. The method used in this work is simple, fast, not expensive and easy-to-use. Therefore, it could be used more often to monitories and evaluate the SPF value on sunscreens and other cosmetic products.

In future studies presence of secondary metabolites which are found in marigold plants must be good source for formulation of multifunctional sunscreen and other cosmetics, will not showed any adverse effect on skin.

CONTRIBUTION OF AUTHORS

Research concept- Deepshikha Kushwaha
Research design- Deepshikha Kushwaha
Supervision- Yashodhara Verma
Materials- Deepshikha Kushwaha
Data collection- Deepshikha Kushwaha
Data analysis and Interpretation- Deepshikha Kushwaha and Prashant Katiyar
Literature search- Deepshikha Kushwaha
Writing article- Deepshikha Kushwaha
Critical review- Prashant Katiyar
Article editing- Deepshikha Kushwaha
Final approval- Yashodhara Verma

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