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FORMULATION AND *IN-VITRO* EVALUATION OF SUN PROTECTION FACTOR IN A POLYHERBAL CREAM

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ABSTRACT: Sunscreens aid the body's natural defense mechanisms to protect against harmful UV radiation from the sun. The present study involves the formulation of sunscreen cream with herbal active ingredients and evaluation for its effectiveness. Naturally occurring traditional substances are gradually replacing synthetic counterparts due to their effectiveness and absence of adverse effects. The herbal drugs selected for the study were roots of *Glycyrrhiza glabra* Linn. (Yashtimadhu), *Hemidesmus indicus* R.Br. (Anantmul) and heartwood of *Santalum album* Linn. (Chandana). Creams were prepared with each individual herb and combination of all three herbs with varying concentration of herbal extracts. The evaluation included determination of Sun Protection Factor for all the formulated creams. The SPF was calculated using the spectrophotometric method and then applying the Mansur equation. The results of the study indicated that the 25% combination cream showed maximum sun screening activity.

INTRODUCTION: Sunshine is beautiful and feels great on our skin. However excessive exposure can result in several adverse effects including mutagenicity immune depression of skin, accelerated skin ageing and photodermatoses.^{1, 2} The UV spectrum is divided into three groups based on wavelength: UVC (100 - 290 nm), UVB (290 - 320 nm) and UVA (340 - 400 nm). Solar UV radiation reaching the earth's surface approximately consists of 90-99% UVA and 1-10% UVB.³

Exposure to UV-A radiation results in damage to the elastic and collagen fibers of connective tissue of skin, which causes premature ageing (photo-ageing), while UV-B radiation bring about acute inflammation (sun burn) and intensification of photo- ageing (United State-Environmental protection Agency). UVC radiation is filtered by the atmosphere before reaching earth. UVB radiation is not completely filtered out by the ozone layer and is responsible for the skin damage due to sunburn. UVA radiation reaches the deeper layers of the epidermis and dermis and provokes the premature aging of the skin.^{4, 5} Ultraviolet radiations have been implicated as a causative factor of skin cancer. Due to these facts, sunscreens substances are now incorporated into everyday products such as moisturizers, creams, lotions, shampoos, mousses, and other hair and skin preparations.

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With the growing awareness of the consumer to protect their skin from the harmful radiations, the market is flooded with numerous sunscreen formulations. Most of them were mainly from chemical/synthetic origin. These were accompanied by their own adverse effects in long-term use.⁶

Synthetic UV filters are known to have potential toxicity in humans and also showed ability to interfere only in selected pathways of multistage process of carcinogenesis.⁷⁻⁹

The recent years have shown considerable shift of choice of sunscreens with herbal actives. Most commonly used herbs in herbal sunscreens are aloe vera, basil, green tea, almond, olive, jojoba and cucumber.^{10, 11}

Studies have also proved that naturally occurring traditional substances show better effectiveness than the synthetic counterparts. The herbal ingredients are better absorbed into the deeper layers of the cells and hence prove to be more effective at milder concentrations. This in turn also reduces side effects, which are more pronounced in synthetic sunscreens.

For the present research three naturally occurring traditional substances have been selected. They are *Glycyrrhiza glabra* Linn. (Yashtimadhu), *Hemidesmus indicus* R.Br. (Anantmul) and *Santalum album* Linn. (Chandana).

MATERIALS AND METHODS: The crude drugs for the present research were procured from Total Herb Solutions, Mumbai. The roots of *Glycyrrhiza glabra* Linn. (Yashtimadhu) and *Hemidesmus indicus* R.Br. (Anantmul) and heartwood of *Santalum album* Linn. (Chandana) were ground into a coarse powder.

Chemicals and Materials: All the chemicals used for formulation and evaluation was obtained from SD fine chemicals (Mumbai).

Apparatus: Blue star UV spectrophotometer equipped with 1 cm quartz cell.

Formulation of the sunscreen cream: The aqueous extracts of *Glycyrrhiza glabra* Linn. (Yashtimadhu), *Hemidesmus indicus* R.Br. (Anantmul) and *Santalum album* Linn. (Chandana)

were prepared by soaking these coarsely ground crude drugs overnight, boiling them and concentrating them to obtain different concentrations. These extracts were further incorporated into vanishing cream base prepared by boiling and fusion method. Creams containing individual herbal extracts as well as cream containing their combination were prepared.

Evaluation of the cream for suncreening activity:

Effectiveness of sunscreen: The effectiveness of a sunscreen is usually expressed by sun protection factor (SPF), which is the ratio of UV energy required to produce a minimal erythemal dose (MED) in protected skin to unprotected skin. A simple, rapid and reliable *in vitro* method of calculating the SPF is to screen the absorbance of the product between 290-320 nm at every 5 nm intervals. SPF can be calculated by applying the following formula known as Mansur equation. Mishra et al., 2012):

$$\text{SPF}_{\text{spectrophotometric}} = \text{CF} \times \sum_{290}^{320} \text{EF}(\lambda) \times \text{I}(\lambda) \times \text{Abs}(\lambda)$$

Where CF = correction factor (10), $\text{EE}(\lambda)$ = erythmogenic effect of radiation with wavelength λ , $\text{Abs}(\lambda)$ = spectrophotometric absorbance values at wavelength λ .

The values of $\text{EE} \times \text{I}$ are constants.¹²⁻¹⁵

Sample preparation: 1.0 g of all samples of the cream was weighed, transferred to a 100 mL volumetric flask, diluted to volume with ethanol, followed by sonication for 5 min and then filtered through cotton, rejecting the ten first mL. A 5.0 mL aliquot was transferred to 50 mL volumetric flask and diluted to volume with ethanol. Then a 5.0 mL aliquot was transferred to a 25 mL volumetric flask and the volume completed with ethanol.

The absorption data were obtained in the range of 290 to 320, every 5 nm, and 3 determinations were made at each point, followed by the application of Mansur equation.

The absorbance and SPF values of the samples calculated through UV-Spectrophotometric method are shown in **Table 1** and **2**.

TABLE 1: ABSORBANCE READINGS OF VARYING CONCENTRATIONS OF ACTIVES IN HERBAL CREAM

Wavelength	EE*I	10%	25%	10%	25%	10%	25%	10%	25%
		<i>Glycyrrhizaglabra</i> Linn.	<i>Glycyrrhizaglabra</i> Linn.	<i>Hemidesmusindicus</i> R.Br.	<i>Hemidesmusindicus</i> R.Br.	<i>Santalumalbum</i> Linn.	<i>Santalumalbum</i> Linn.	Combined	Combined
290	0.0150	0.699±0.001	0.896 ±0.042	0.064±0.006	0.112±0.041	0.011±0.057	0.025±0.001	0.646±0.018	0.818±0.009
295	0.0817	0.606±0.021	0.813 ±0.064	0.094±0.023	0.152±0.034	0.017±0.004	0.036±0.013	0.708±0.020	0.851±0.001
300	0.2874	0.502±0.004	0.777 ±0.003	0.107±0.031	0.196±0.082	0.026±0.051	0.048±0.019	0.788±0.012	0.961±0.041
305	0.3278	0.468±0.054	0.695 ±0.012	0.139±0.027	0.211±0.069	0.042±0.015	0.083±0.020	0.731±0.011	0.916±0.031
310	0.1864	0.362±0.001	0.523 ±0.016	0.176±0.078	0.236±0.072	0.068±0.017	0.096±0.062	0.661±0.056	0.869±0.012
315	0.0837	0.271±0.031	0.509 ±0.076	0.164±0.003	0.201±0.045	0.098±0.021	0.112±0.014	0.586±0.032	0.798±0.006
320	0.0180	0.235±0.033	0.463 ±0.001	0.134±0.008	0.186±0.079	0.101±0.034	0.127±0.034	0.496±0.019	0.721±0.003

TABLE 2: SPF OF VARYING CONCENTRATIONS OF ACTIVES IN HERBAL CREAM

Sr no.	Active ingredient in Cream	Concentration in %	SPF Values
1.	<i>Glycyrrhiza glabra</i>	10	4.52 ±0.014
	<i>Linn.</i> (Yashtimadhu)	25	7.55 ±0.009
2.	<i>Hemidesmus indicus</i> R.Br.	10	1.34 ±0.071
	(Anantmul)	25	2.04 ±0.032
3.	<i>Santalum album</i>	10	0.45 ±0.001
	<i>Linn.</i> (Chandana)	25	0.73 ±0.043
4.	Combined	10	7.14 ±0.014
		25	9.05 ±0.079

The SPF values of the herbal formulations prepared ranged from 0.45 in 10% *Santalum album* Linn. (Chandana) to 9.02 in the 25% Combined cream. The highest SPF was found in 25% concentration cream consisting of 25% each of *Glycyrrhiza glabra* Linn. (Yashtimadhu), *Hemidesmus indicus* R.Br. (Anantmul) and *Santalum album* Linn. (Chandana) (Combination cream). The SPF values of creams containing only one of the actives depicts highest sun protection being offered by *Glycyrrhiza glabra* Linn. (Yashtimadhu) followed by *Hemidesmus indicus* R.Br. (Anantmul). The herbal cream with aqueous extract of *Santalum album* Linn. (Chandana) showed very low values of SPF, but its inclusion in the formulation would to the fragrance and coolness of the product on the skin.

The suggested mode of action of the cream as an effective sunscreen could be attributed to UV block by the herbs dispersed in the cream base and also the UV absorption by these naturally occurring herbal ingredients. Moreover *Glycyrrhiza glabra* Linn. (Yashtimadhu) and *Hemidesmus indicus* R.Br. (Anantmul) has been reported earlier for their good skin lightening properties too.

CONCLUSION: The SPF values of the *Glycyrrhiza glabra* Linn. (Yashtimadhu), *Hemidesmus indicus* R.Br. (Anantmul) and *Santalum album* Linn. (Chandana) aqueous extracts in a cream base were evaluated. It was found that the combined product of these selected herbs showed maximum suncreening activity. Along with their beneficial effects and safety, these

botanicals could become good and economical alternatives to the synthetic sunscreens.

CONFLICT OF INTEREST: The authors have no conflict of interest.

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