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Comparative Sun Protection Factor (SPF) Evaluation of Marketed Sunscreen Creams by *In-Vitro* method

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ABSTRACT
UV radiation is still the major cause of skin damage and skin cancer in long term. Depending on the makeup of the sunscreen lotions, which may contain a variety of active substances, the sun's rays may be absorbed, reflected, or scattered. By calculating the UV protection factor, one can assess a sunscreen product's efficacy (SPF). The purpose of this study was to use UV-Visible Spectrophotometry to calculate the sun protection factor (SPF) values of six sunscreen commercial products (creams, lotions, and foundations). SPF ratings for each cosmetic item were determined using the Mansur equation. We found that a few sunscreens are not having the SPF as specified on the label. We can infer from the proposed UV spectrophotometric method that it is quick, uncomplicated, and can be performed using inexpensive reagents for this in vitro determination of SPF values in cosmetic products.
Key words: SPF, in-vitro sun screen evaluation, sun screen cream, Mansur equation.

I. INTRODUCTION

Sunscreen is formerly used by ancient Greeks in a mixture of organic clay and material powder. In 1801 Johann Wilhelm Ritter detected UV light. In 1918 Norman Paul discovered the relation between sun exposure and development of skin cancer. Karl Eilham Hauser and Wilhelm Vahle found that UV rays between 280nm and 315nm causes sunburn[1]. In 1977 Issac Willis detected that UVA exposure causes ultrastructural change of the skin which leads to skin ageing[2].

Sunlight
Sunlight is necessary for skin to make vitamin-D, which is necessary for bone functioning and health. As much sunlight is necessary it's that much harmful even**.** Sunlight travel to earth as combination of visible and invisible rays and waves. Where long rays/waves are harmless to human body ex: - Radio waves. Short rays/waves like UV are harmful to body[3].

UV RAYS ARE ALSO TWO TYPES; -
1. Which are long is known as UVA.
2. Which are short is known as UVB.

UVB ray cause only sun burn. But UVA rays travels more deeply into skin and cause skin problems. Sunlight affects the skin growth, appearance elasticity. It makes skin thick, leathery, wrinkled or thinned like tissue paper. Too much of sun exposure raise risk for skin cancer.

UV radiation and skin cancer
UV radiation is still the major cause of skin damage and skin cancer in long term. Uncontrolled cell division due to UV rays can cause malignant and benign cancer.ESP in Africa people face more skin problems due to uncontrolled UV rays. Sunscreen products gives protection against sunburn, skin ageing, skin cancer[4].

Sunscreen
To protect the skin from harmful UV radiation sunscreen is used. It helps to prevent sunburn and premature aging. Sunscreens helps to lower risk of skin cancer and skin burns. Sunscreen absorbs the suns UV rays, preventing it reaching from deeper layer of skin, by reflating the radiation. Sunscreen does not totally provide protection from UV rays but it lowers risk for some period of time.
Types of sunscreens: -
1. Organic sunscreen.
2. Inorganic sunscreen.

Sun screen products
Sunscreen products are available in the market usually in the form of:
1. Cream.
2. Lotion.
3. Gel.
4. Lip balm[5].

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SPF (Sun Protection Factor)

SPF is a measurement of how much solar energy (UV radiation) is needed to cause sunburn on skin that is shielded from the sun (i.e., when wearing sunscreen) in comparison to how much solar energy is needed to cause sunburn on skin that is not protected from the sun. Sunburn prevention rises with the SPF number. It indicates how much protection a product offers against UVB sunlight.

Types of SPF are

- SPF below 15 = Low protection
- SPF 15-29 = Medium protection (93% of UVB rays for 10x extra time than no sunscreen applied)
- SPF 30-49 = High protection (97% of UVB rays for 30x extra time than no sunscreen applied)
- SPF over 50 = Very high protection (98% of UVB rays for above 30x extra time than no sunscreen applied)

In-vitro evaluation of SPF

Formulators would benefit greatly from having predictive in vitro methods to assess SPFs of sunscreen compositions before clinical testing. Such test protocols should ideally be quick and simple to carry out, requiring just common testing supplies, and should produce repeatable, accurate results that are consistent with in vivo SPF data. Although many in vitro techniques have been created, there is currently no widely used methodology. In the present study we selected five marketed sunscreen creams and performed the in-vitro evaluation of SPF using UV-Visible spectrophotometer. This study intends to determine the Sun Protection Factor (SPF) value in accordance with in order to determine the absorption (ABS) of active ingredients in locally available commercial sunscreens using an Ultraviolet Spectrophotometer in the ultraviolet light UVB band of 290-320 nm.

Mathematically, the SPF is calculated from measured data as follows

$SPF = CF \times {}_{290}\Sigma^{320}\ EE\ (\lambda) \times I(\lambda) \times Abs\ (\lambda)$

Were, EE(ʎ)- erythemal effect spectrum

I - Solar intensity spectrum

CF- Correction factor (=10)

(ʎ)- wavelength

The values of EE x I are constants and are shown in the table 1

The purpose of this study was to use UV-Visible Spectroscopy to calculate the sun protection factor (SPF) values of six sunscreen commercial products (creams, lotions, and foundations). SPF ratings for each cosmetic item were determined using the Mansur equation[6,7].

II. MATERIALS AND METHODS

Five marketed sunscreen products are purchased from local markets of Bengaluru. The products were named as sample A (ALOEVERA, FENGRUEK & HONEY), Sample B (AVOBENZONE, HOMOSALATE), Sample C (METHOXY CINNAMATE), Sample D (CYCLOPENTASILOXANE), Sample E (HELIOPLEX). All the other ingredients used were of analytical grade.

In-vitro SPF determination procedure

1 g of all sample was measured and weighed, transfer to a 100 ml volumetric flask, diluted with 50 ml ethanol followed by ultra sonification for 10 minutes at 28^0C, filtered through cotton, removed 1st 10ml sample and remaining are collected. The absorption spectra of sample in solution were obtained in the range of 290 to 450 nm using 1 cm quartz cell and ethanol as a blank. The absorption data were obtained in the range 290 to 320, every 5 nm and 3 determinations were made at each point, followed by the application of Mansur equation.

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III RESULTS AND DISCUSSION

SPF values of various samples from A to E is given in the table 1

		SUN PROTECTION FACTOR (SPF)				
WAVELENGTH (nm)	**EE*I**	**SAMPLE A (Label SPF30)**	**SAMPLE B (Label SPF 50)**	**SAMPLE C (Label SPF 30)**	**SAMPLE D (Label SPF 30)**	**SAMPLE E (Label SPF 50)**
290	0.015	20.75	30.24	25.28	29.79	42.07
295	0.0817					
300	0.2874					
305	0.3278					
310	0.1864					
315	0.837					
320	0.018					

Table:1 SPF values of marketed sunscreens A to E

The SPF is a quantitative analysis of the measurement sun protection factor for sunscreen formulation. For the effectiveness and preventing of skin from sunburn & skin damage there is different degree of variability.

In this research five different commercially available sunscreen products are evaluated by UV spectrophotometry. Here, after this experiment we found that sample C, sample D & sample E have got the value nearby SPF mentioned on sample label. Sample A & B fails to obtain SPF value mentioned on sample label.

III. CONCLUSION

We can infer from the proposed UV spectrophotometric method that it is quick, uncomplicated, and can be performed using inexpensive reagents for this in vitro determination of SPF values in cosmetic products. Before sending for an in vivo human study, this procedure can be utilised in a laboratory or production business for evaluation.

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