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Evaluation of Sun Protection Factor (SPF) of marketed sunscreens by Ultraviolet Spectrophotometry.

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ABSTRACT:
The purpose of this research was to evaluate the SPF of marketed sunscreens by Ultraviolet Spectrophotometry. The different marketed sunscreens contain different active ingredients based on the nature of these sunscreens which affect the sunlight by absorbing, reflecting or scattering. Commercially available six different samples of sunscreen of different manufacturers with values of SPF labelled in the range of 20-35 were evaluated. The result of the research shows that out of six different marketed formulations, 20% of sunscreen formulations are near to their labelled SPF while 80% of sunscreen formulations had minimum value according to their labelled SPF. This research is beneficial in selection with better accuracy and high SPF values of some sunscreen formulations used in cosmetics.

INTRODUCTION:
A healthy tan is a myth! When exposed to UV radiation, the skin produces melanin, a pigment that darkens the skin as a defense mechanism. This darkening does provide some level of protection against sunburn, with a tan on fair skin offering a sun protection factor of 2 to 4. However, this does not shield against the long-term effect of UV damage, including the risk of skin cancer. While a suntan may be seen as aesthetically pleasing, it is actually a clear indication that the skin has suffered damage and is trying to safeguard itself.

The tanning process involves two distinct reactions: immediate pigment darkening and delayed tanning. Immediate pigment darkening occurs when the skin's existing melanin pigment darkens upon exposure to UVA. This initial tan fades within hours after exposure ends. On the other hand, delayed tanning occurs gradually over approximately among the upper layers of the skin. This type of tan can last for several weeks.
Sunscreen product are designed to protect the skin from the harmful effects of the sun. To ensure long term effectiveness of sunscreen products, the UV filters used must be lightfast. Ultraviolet light occurs for approximately 10% of all solar radiation.

UV radiation is divided into three categories: UV-A (320-400nm), UV-B(290-320nm) and UV-C (100-290nm), but only UV-A and UV-B reach the floor. Ultraviolet radiation is thought to be a causative factor in skin cancer. Due to these facts, sunscreen ingredients are now incorporated into everyday products such as moisturizers, creams, lotions, shampoos, mousses, and other hair care and skin preparations. Regular use of these products helps to reduce the risk of the harmful effects of UV radiation. However, very effective sunscreen ingredients must be used in cosmetic formulas.

Typically, the effectiveness of a sunscreen is measured using the sun protection factor (SPF). This value is determined by calculating the amount of UV energy needed to cause a minimal erythemal dose (MED) in skin that has been shielded by the sunscreen, and then dividing it by the amount of UV energy required to produce an MED in unprotected skin. In other words, the SPF is equal to the minimal erythemal dose in skin protected by sunscreen.

The Minimal Erythema Dose in individuals without sunscreen for their skin. The minimal erythemal dose (MED) refers to the smallest amount of UV light exposure necessary to cause a noticeable reddening of the skin when it is not protected. The effectiveness of a sun protection product in preventing sunburn increases as its SPF level rises.

In vitro screening methods are useful because they can represent a rapid and cost-effective tool to reduce the number of in vivo tests and the risks associated with UV exposure in humans. There are two in vitro methods (measurement of the absorption or emission of UV radiation through a sunscreen film on a quartz plate or biomembrane, and the absorption properties of the sunscreen are determined based on the spectrophotometric analysis of dilute solutions).

In vitro SPF was determined according to the desired method. Absorbance values at 5 nm (290-320 nm) were calculated using the formula:
$SPF_{spectrophotometric} = CF \times \sum EE(\lambda) \times I(\lambda) \times Abs(\lambda)$,
where CF = correction factor (10), EE. (λ) = erythropoietic effect of radiation with wavelength λ, Abs(λ) = poor value at wavelength λ. The value of EE(λ) x I is a constant.

Table 1: Values of EE(λ) x I at different wavelength

Wavelength	Value of EE x I
290	0.0150
295	0.0817
300	0.2874
305	0.3278
310	0.1864
315	0.0837
320	0.0180

MATERIALS AND METHODS:

Reagents and samples:

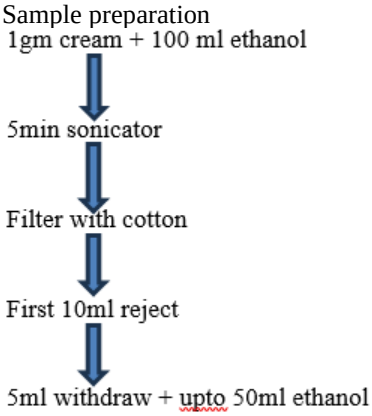
Ethanol analytical grade (Merck®).
Commercially available sunscreen emulsion of various manufactures were purchased from local pharmacies. The sample are shown in table II.

Apparatus:

UV Visible spectrophotometer, equipped with 1 cm quartz call, computer.

Methods:

Sample preparation



Weigh 1.0 g of all samples and transfer to a 100 ml volumetric flask, dilute to volume with ethanol, followed by 5 min of sonication and subsequent filtration. Pass the cotton, discarding the first ten ml. 5.0 mL aliquots transfer to 50ml volumetric flask and dilute Bring to volume with ethanol. The absorption spectrum of the sample in solution is Using 1 cm quartz in the 290 to 450 nm range cells and ethanol as blank values. The absorption data is obtained in the range 290 to 320, all 5 nm and 3 decisions were made at each point and then applications of Mansour's equation.

Table 2 – Labeled SPF and found in the different marketed sunscreen samples.

Sunscreen samples	Sunscreen ingredient	Labeled SPF	Found SPF
Sample 1	Titanium dioxide Benzophenone-3 Ethylhexyl methoxycinnamate	20	13±0.05
Sample 2	Titanium dioxide Benzophenone-3 Octyl methoxycinnamate	20	13±0.03
Sample 3	Titanium dioxide Benzophenone-3 Ethylhexyl methoxycinnamate Ethylhexyl salicylate	30	29±0.02
Sample 4	Titanium dioxide Benzophenone-3	30	24±0.03
Sample 5	Titanium dioxide	35	21±0.05
Sample 6	Titanium dioxide Ethylhexyl salicylate	35	27±0.04

RESULT AND DISCUSSION:

SPF is a quantitative measure of the effectiveness of a sunscreen formula. To effectively prevent sunburn and other skin damage, sunscreen products should have a broad absorption range between 290 and 400 nm. The effectiveness of sunscreen formulas has been evaluated for a long time assessing time through in vivo tests on humans volunteer. In vivo testing is time-consuming and often involves some degree of variability, not to mention the ethical issues involved with human testing. In vitro SPF is suitable for screening testing during product development as a complement to in vivo SPS measurements. In this study six different evaluation of commercially available sunscreen products using UV light spectrophotometry was performed using the mathematical Mansur equation (Mansur et al., 1986). SPF label values range from 20 to 35. The SPF value of these products and samples is determined using UV spectrophotometry.

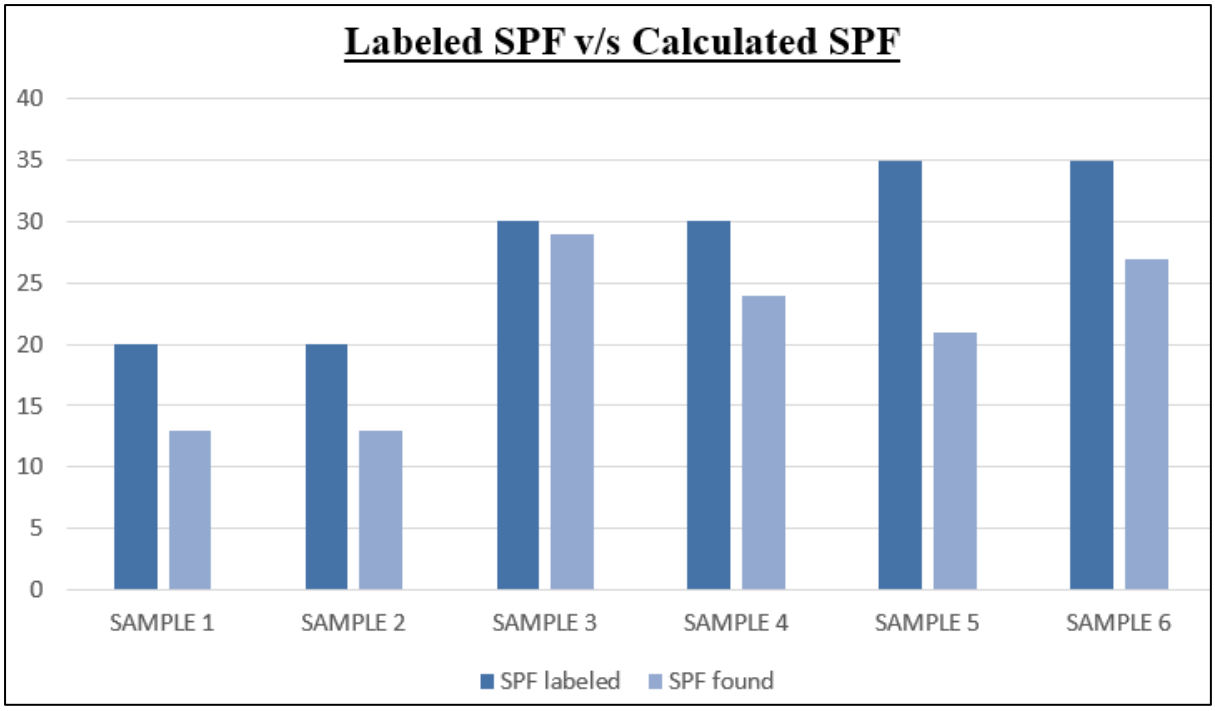


Figure 1 - Graphical representation of labeled SPF and Calculated SPF

The method is listed in Table II. It can be observed that the SPF values of sample 3 and sample 4 are very close to each other consistent with labeled SPF. Sample 1, sample 2, sample 5, sample 6 have SPF values lower than specified. Among the sample analyzed, the maximum absorbance of sample 3 was higher than that of all samples with known amounts of sunscreen, as shown in Table II.

Fluctuations in the data may be due to the use of unvalidated spectrophotometric methods to determine the absorption properties of sunscreens. However, there are many factors that influence this phenomenon determination of SPF value, e.g. using different solvents that dissolve sunscreen; combinations and concentrations sunscreens; types of lotions; effects and interactions of carrier ingredients (such as esters, plasticizers, and emulsifiers) used in the formulation; vehicle interaction with skin; additions by others active Ingredients; pH Systems and Lotions Rheological properties and other factors increase or decrease the UV absorption of each sunscreen .The role of various solvents and plasticizers maximum absorption wavelength and ultraviolet radiation absorption of multiple chemical sunscreens individually or in combination .The combination is known and documented.

Excipients and other active ingredients can also cause UV absorption thereby destroying UVA and UVB bands sun protection. This effect is reflected in the finished formula, Especially lotions with SPF greater than 15.The role of solvents only comes into play at high proportions High SPF often results in there is also greater uncertainty about the final in vivo results because biological differences among volunteers .Therefore, safer sunscreens should be developed and high SPF, formulators must understand physical and chemical principles, not just the UV absorption of the product active ingredients, as well as carrier ingredients such as esters , Plasticizers and emulsifiers used in formulations sunscreen can interact with other ingredients vehicles, these interactions may affect sunscreen effectiveness

CONCLUSIONS:

The proposed UV spectrophotometric method is simple, fast, uses cheap reagents and works determination of SPF value in vitro in many cases cosmetic formulations. The proposed method can be useful as a quick quality control method. Can use during the production process, when analyzing the final product and provide important information in advance continue with in vivo testing.

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