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Short Communication

Determination of Sun Protection Factor (SPF) number of some aqueous herbal extracts

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ABSTRACT

The aim of the present study was to determine the ultraviolet (UV) absorption properties of aqueous herbal extracts of some commonly found vegetable sources by determining the sun protection factor (SPF) number. The in vitro SPF number is determined according to the spectrophotometric method described by Mansur et al. Aqueous herbal extracts were prepared and after dilution with alcoholic solutions the absorbance were recorded between 290-320 nm using UV-vis spectrophotometry. It was observed that all of the tested herbals showed some UV protection capabilities with aqueous coconut extract showing the highest SPF number of 7.38 while watermelon showed the lowest SPF number of 0.97.

INTRODUCTION

Solar ultraviolet radiation (UVR) is divided into three categories UV-C (200-280 nm), UV-B (280-320) and UV-A (320-400 nm). UV light has been classified by WHO as carcinogenic and produces several adverse effects including mutagenicity, immune depression of the skin, accelerated skin ageing and photodermatoses (Nohynek and Schaefer, 2001). The most biologically damaging radiation UV-C has been filtered out by the ozone layer and it is mainly UV-B that is responsible for causing the adverse effects of the UV radiation (Kaur and Saraf, 2010; Mishra *et al.,* 2011). Application of sunscreen to the skin changes the way the body reacts to the sun rays (Mishra *et al.,* 2012). Sunscreens and sunblocks are chemicals that absorb or block UV rays and show a variety of immunosuppressive effects of sunlight. There are several agents available from both synthetic and natural sources with UV-filtering properties. Given their potential to produce considerable human local and systemic exposure, UV filters have to be safe (Nohynek *et al.,* 2010). 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 (Chanchal and Saraf, 2009).

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In contrast, herbal botanical sunscreens are safe, widely accepted by consumers and also work in various ways, playing multiple roles in ameliorating the process of carcinogenesis (Guyer *et al.,* 2003). The current research work has been conducted to determine the SPF values of aqueous extracts of some commonly found fruits in the market.

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 (Kaur and Saraf, 2010; Mishra *et al.,* 2012):

$$SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda) \qquad (1)$$

Where CF = correction factor (10), EE (λ) = erythmogenic effect of radiation with wavelength λ, Abs (λ) = spectrophotometric absorbance values at wavelength λ. The values of EE x λ are constants.

Table. 1: Absorbance of aqueous herbal extracts.

Wavelength	EE×I	Absorbance						
		Aloe vera	Carrot	Coconut	Cucumber	Papaya	Strawberry	Watermelon
290	0.015	0.049±0.001	0.001±0.0	1.370±0.095	0.062±0.015	0.146±0.022	0.062±0.021	0.027±0.001
295	0.0817	0.075±0.012	0.047±0.005	1.335±0.056	0.091±0.011	0.149±0.034	0.106±0.055	0.052±0.004
300	0.2874	0.104±0.092	0.103±0.082	0.812±0.150	0.127±0.056	0.161±0.031	0.142±0.039	0.073±0.003
305	0.3278	0.140±0.035	0.152±0.022	0.742±0.185	0.156±0.061	0.172±0.023	0.174±0.041	0.098±0.003
310	0.1864	0.159±0.093	0.176±0.035	0.464±0.092	0.169±0.085	0.202±0.054	0.189±0.056	0.131±0.015
315	0.0837	0.159±0.067	0.180±0.038	0.464±0.059	0.175±0.025	0.205±0.042	0.202±0.033	0.152±0.018
320	0.0180	0.159±0.059	0.176±0.005	0.359±0.025	0.185±0.011	0.205±0.068	0.209±0.057	0.156±0.210

MATERIALS AND METHODS

Materials

Analytical grade ethanol was purchased from Merck (India). Cucumber, coconut, papaya, strawberry, watermelon, carrot and aloe vera were purchased from local market.

Methods

The fruits were grinded separately in a mixer grinder (Super Mixer Grinder MX-AC300, Panasonic) and 20 gm from each were taken separately in a beaker and extracted overnight with 200 ml of distilled water, then filtered with whatman filter paper. The filtered extract was suitably diluted with ethanol and the absorbance was measured between 290-320 nm using 1 cm quartz cell at an interval of every 5 nm using UV-Vis Spectrophotometer (Evolution-201, Thermo Fisher Scientific). The SPF was calculated by applying Mansur equation previously described.

RESULTS AND DISCUSSION

SPF numbers has become a worldwide standard for measuring the effectiveness of sunscreen products. It gives an idea about how long one can stay in the sun without getting burn by the sun rays. The SPF number of aqueous extracts of the herbal sources was calculated by applying Mansur mathematical equation. The absorbance and SPF values of the samples calculated through UV-Spectrophotometric method are shown in Tables 1 and Table 2 respectively.

Table. 2: SPF values of aqueous herbal extracts.

Herbal extracts	SPF values
Aloe Vera	1.28±0.02
Carrot	1.34±0.13
Coconut	7.38±0.22
Cucumber	1.45±0.35
Papaya	1.75±0.26
Strawberry	1.63±0.34
Watermelon	0.97±0.41

The SPF number of the aqueous herbal extracts range between 0.97 in watermelon and 7.38 in coconut. The SPF number for coconut has been found to be the highest among the aqueous extracts studied. Almost all other extracts are having the same or almost similar SPF values as calculated from Mansur equation. Even though several synthetic sunscreens are available, they have limited applications in cosmetics due to their potential toxicity in humans and ability to interfere only in selected pathways of carcinogenesis. Botanical and herbal agents are known to be safe and have been widely accepted by consumers. They also work in various ways by stimulating the immune response, inducing gene suppression, detoxifying carcinogens, blocking oxidative damage to DNA, initiating selected pathways or by other mechanisms (Guyer *et al.*, 2003). Thus, these herbal agents play multiple roles in ameliorating the process of carcinogenesis. Therefore, these herbal formulations at optimum concentrations could produce several beneficial effects to the skin apart from functioning as an UV filters.

CONCLUSION

The SPF values of the aqueous extracts of some commonly found vegetable sources were evaluated. It was found that most of them have the UV protection capabilities. Along with their many beneficial effects and safety, these botanicals could become a good, cheap and easily available formulation ingredients in sunscreen products.

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