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In Vitro Evaluation of the Photoprotective Potential of *Matricaria recutita* (L.) Essential Oil

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ABSTRACT

The ultra violet radiation is part of the spectrum of electromagnetic radiation emitted by the sun, which is divided into UVA, UVB and UVC type radiation, according to the wavelength presented. Excessive exposure to these rays triggers severe heatstroke, and can also lead to the development of neoplastic lesions, such as non-melanoma skin cancer. The highest prevalence of these lesions is in light-skinned people. Thus, it is necessary to reinforce the essential care of photoprotection, with the use of appropriate clothing and sunscreens for safe exposure to the sun. The use of natural products rich in flavonoids, such as the species *Matricaria recutita* (L), commonly known as Chamomile, belonging to the Asteraceae family, are responsible for presenting significant therapeutic properties, which can play a photoprotective role of low toxicity in a phytocosmetic. The objective of this work was to determine, from an *in vitro* analysis, the photoprotective activity of Chamomile essential oil. For the experiment, chamomile essential oil was diluted in different concentrations. Producing scans with the aid of a spectrophotometer from 290 to 320 nm with intervals of 5 nm, every 1 minute. According to the results obtained, the concentrations of (50, 100, 500 and 1000) µg/mL-1 showed photoprotection values equal to 16.6, 25.0, 25.0 and 25.0 (SPF), respectively. This proves the effectiveness of the photoprotective activity, *in vitro*, of the essential oil of this species. However, further studies are needed to confirm this biological activity.

INTRODUCTION:

The use of medicinal plants has become a therapeutic option to replace or complement conventional therapies, due to its low cost and easy access [1]. Nowadays, it is still possible to observe an indiscriminate use by the population, without the knowledge of toxicity or effectiveness, which can lead to more serious secondary problems [2, 3].

Brazil has the largest biodiversity of plants with medicinal characteristics, which historically, used by the population, due to easy access and low cost-benefit for therapeutic use. In view of this, since 2006, the country has sought to encourage the use of medicinal plants and herbal medicines in a rational and safe way to the population in health care programs, through the National Policy of Medicinal Plants and Herbal Medicines (PNPMF) and the National Program of Medicinal Plants and Herbal Medicines [4,5,6].

The botanical species *Matricaria recutita* L., Rauschter, synonym *Matricaria chamomilla* L., is a plant belonging to the Asteraceae family, measuring 10 to 30 cm in height. It originated in Europe and North Africa, and currently occurs on all continents [7].

It is characterized by being rich in flavonoids, which are responsible for some of its therapeutic properties [8], among them the antioxidant potential [9, 10] that ensures a control of free radical formation [11] and photoprotection against ultraviolet radiation (UVR) [12].

UVR is part of the spectrum of electromagnetic radiation emitted by the sun, and which presents variable wavelengths [13]. It is subdivided into three categories depending on its wavelength, as presented by the International Commission on Illumination [14]. UV-A has a wavelength between 315 nm and 400 nm; UV-B between 280 nm and 315 nm; and the UV-C wavelength range varies from 100 nm to 280 nm.

The photoprotectors are organic or inorganic substances, capable of filtering, absorbing or reflecting the (UVR) [15]. Some are able to inactivate free radicals produced and therefore, in addition to acting preventing the absorption of UVR by the skin, prevent or repair other damage such as photoaging and oxidative stress [16].

The sun protection factor (SPF) is an index that ensures the effectiveness of a sunscreen, establishing the maximum time of sun exposure when the skin is protected. This variable is

obtained through the ratio between the Minimum Erythematogenous Dose (DEM) of the protected skin and the DEM of the unprotected skin. In short, it means how long a person can be exposed to solar radiation with the use of protection without suffering a heat stroke, compared to the time that would be affected without the use of a filter [17].

Excessive exposure to this UVR triggers several problems to human health, ranging from heat stroke, to skin cancer, and suppression of the immune system [18]. According to the Brazilian Society of Dermatology (2021), the incidence of new cases of skin neoplasms reaches almost 205 thousand records in the last eight years in the country, corresponding to about 30% of all malignant tumors, melanomas and non-melanomas recorded in Brazil [19].

In contrast, it is important to note the importance of UVR for human health. It is responsible for vitamin D synthesis in the body [20], and acts in several other important functions, such as maintaining the immune system and the formation of blood cells [21].

Thus, in view of the information discussed and considering the challenges for the discovery of new photoprotective products from the use of plants with medicinal properties, the present study aims to evaluate *in vitro* the photoprotective potential of the essential oil of Chamomile *Matricaria recutita*. L.

MATERIALS AND METHODS

The present study was performed from an absorption spectrophotometric analysis using chamomile essential oil, obtained from the Quinarí Ponta Grossa-PR industry, consumed in the spectrum of ultraviolet radiation as proposed by Mansur et al. (1986). Thus, scans were made from 290 to 320 nm, adding to this, intervals of 5nm with a duration of 1 minute. At the end of each interval, absorbance was measured.

A digital spectrophotometer (Biospectro®) with a 1 cm quartz cuvette was used for the reading. After measuring the absorbances, the extracted data were submitted to the Mansur et al. equation [22] to verify the Sun Protection Factor (SPF) *in vitro*. This method lists the erythomatogenic effect and the intensity of the radiation (EE x I) (Table 1) that were measured by Sayre *et al*.

Table 1- Relationship erythemogenic effect (EE) versus radiation intensity (I) according to wavelength (ƛ).

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

Source: Sayre et al. (1979).

The formula of Mansur et al. [22] is also composed of the spectrophotometric reading of the absorbance of the solution and a correction factor (= 10). This equation can be seen, below:

$$\text{Spectrophotometric SPF} = \text{FC} \cdot \sum_{290}^{320} EE\,(\lambda) \cdot I\,(\lambda) \cdot \text{Abs}\,(\lambda)$$

In which: SPF = sun protection factor; FC = correction factor, calculated according to two sunscreens of known SPF tested on humans such that a cream containing 8% homosalate would result in SPF 4; EE(λ) = erythemogenic effect of wavelength radiation; I(λ) = the intensity of sunlight at wavelength and Abs (λ) = the absorbance of the formulation at wavelength.

RESULTS AND DISCUSSION

From the present study, it was performed the reading of absorbances between the wavelengths 290 to 320 nm, the range in which the SPF of a sunscreen can act, within the radiation spectrum. Such wavelengths are responsible for inducing the appearance of skin neoplasms, such as squamous cell carcinoma and basal cell carcinoma, besides causing photoaging and increasing the production of free radicals [24].

Thus, the use of sunscreens has become more sought after over the past decades, due to the knowledge about the harmful effects of excessive exposure to solar radiation. In parallel, new substances with photoprotective effects are constantly being increasingly studied in order to

increase the protection in a safe and effective manner [17]. From the *in vitro* experiments it was possible to observe that the essential oil of *Matricaria recutita* presented SPF values of 16.6 for the concentration of 50 µg.mL-1, and from the concentration of 100 µg.mL-1, the values obtained were SPF 25.0.

Put in evidence, the concentration of 100 µg.mL-1 shows maximum SPF values. This may imply an effective phytocosmetic with low toxicity, since it will present an SPF 25 for a small concentration of essential oil.

Table 2 - SPF of the essential oil of *Matricaria recutita* L

Concentrations (µg.mL-1)	50	100	500	1000
SPF	16.6	25.0	25.0	25.0

Source: Survey data, 2022.

In this perspective, chamomile essential oil proved to have an excellent photoprotective activity, showing significant results for SPF. Regarding the results obtained in the spectrophotometric evaluation of the essential oil in the range of UVB radiation (290 to 320 nm), all concentrations showed photoprotection factor above 6 SPF, being in accordance with the RDC No. 30, June 1, 2012, of the National Health Surveillance Agency (ANVISA) [25], which abrogates the MERCOSUR technical regulation in reference to sunscreens in cosmetics, highlights that, the sun protection factor should hold a value of at least SPF 6 (six) [26].

Florencio *et al* [27] evaluated the photoprotective activity from the spectrophometric analysis of the aqueous extract of *Matricaria recutita* L., observing a high absorption of UV radiation due to a wavelength in the range of ultraviolet radiation.

Other studies performed in recent years have demonstrated the effectiveness of extracts of other genera of plants from the Asteraceae family regarding the photorotector activity. According to Sampaio [28], *in vitro* tests performed with the extract of *Tithonia diversifolia*, indicated the effectiveness of the photoprotective activity against UV-A and UV-B radiation, demonstrating a photoprotective potential in irradiated cell culture assay. Concomitant with this study, Rosa et al

[29] working with the aqueous extracts of plants of the genus Achillea and Sonchus revealed data showing a good absorption of this in UV radiation.

Simão and collaborators [30] from tests performed in spectrophotometer with the chloroformic phase of *Praxelis clematidea*, after dilution and acquisition of concentrations of 50, 100, 500 and 1000 µg/mL, determined that the samples, in all concentrations tested, showed a significant photoprotective effect.

In view of this, and in agreement with the results obtained in this work, all concentrations of *Matricaria recutita* L. essential oil could possibly be used as possible photoprotectants in phytocosmetics.

CONCLUSION

Evaluating the sun protection factor, it can be observed that all concentrations tested (50 to 1,000 µg.mL) showed photoprotective potential against ultraviolet radiation. These results suggest that chamomile essential oil has a photoprotective effect. However, it is still necessary to have more studies on the subject, as well as in vivo studies for the development of an efficient phytocosmetic, safe and with a sales value more accessible to the population.

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