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ORIGINAL ARTICLE

Pterodon emarginatus Hydroalcoholic Extract: Antioxidant and Photoprotective Activities, Noncytotoxic Effect, and Perspective of Obtaining Formulations with Photochemoprotective Activity

Wannessa Lenyse Rocha de Carvalho, Larissa Ceres Moreira, Marize Campos Valadares, Danielle Guimaraes A. Diniz, Maria Teresa Freitas Bara

School of Pharmacy, Federal University of Goias, Goiania-GO, Brazil

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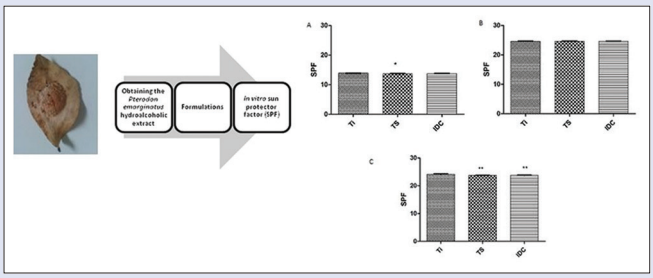
ABSTRACT

Background: *Pterodon emarginatus* fruits have phenolic compounds that may be related to photoprotective and antioxidant activities. **Objective:** This study aims to investigate the antioxidant and photoprotective activities and cytotoxicity effect of hydroalcoholic extract of *P. emarginatus* (HEP) and obtain formulations with photochemoprotective activity containing HEP in Lanette®, Polawax®, or Focus Gel®. **Materials and Methods:** Phenolic compounds, antioxidant activity, cytotoxic effect, and *in vitro* sun protection factor (SPF) were determined in HEP. Lanette®, Polawax®, or Focus Gel® containing HEP or synthetic sunscreen (Eusolex 2292®) or both Eusolex 2292® and HEP were prepared. The *in vitro* SPF of the formulations was determined to investigate the association of protection between HEP and synthetic sunscreen. Preliminary stability of formulations was evaluated. **Results:** Phenolic acids and flavonoids were detected by thin-layer chromatography. HEP showed antioxidant activity by 2,2-diphenyl-1-picrylhydrazyl, with EC_{50} of 19.3 μg/mL, and by ferric reducing antioxidant power methods, in which 1 g of the extract reduces 14,880 μM/L of ferrous sulfate. In cytotoxicity assays, an IC_{50} of 767.3 μg/mL was obtained, suggesting that the HEP is not cytotoxic. The SPF for HEP was 8 ± 0.31 and it was noted an additive effect to SPF for synthetic sunscreen used, in the three formulations, when associated to HEP, resulting in an improvement of about 24% (Focus Gel®), 65% (Lanette®), and 66% (Polawax®). Only on Lanette®-based formulation, no significant changes of the analyzed parameters were observed during the preliminary stability. **Conclusion:** It can be suggested that HEP, due to its antioxidant and photoprotective activities, leads to the photochemoprotective effect on the formulations.

Key words: Additive effect of sun protection, antioxidant activity, natural product, phytocosmetic, sun protection factor

SUMMARY

- The hydroalcoholic extract of *Pterodon emarginatus* (HEP), due to its antioxidant and photoprotective activities, leads to the photochemoprotective effect
- The *in vitro* sun protection factor for synthetic sunscreen used (octyl methoxycinnamate), in the three formulations obtained, resulting in an improvement of about 24% (in Focus Gel®), 65% (Lanette®), and 66% (Polawax®) when associated to HEP
- Only on Lanette®-based formulation, no significant changes of the analyzed parameters were observed during the preliminary stability study.`



Abbreviations used: HEP: Hydroalcoholic extract of *Pterodon emarginatus*; SPF: Sun protection factor; TLC: Thin-layer chromatography; UV: Ultraviolet; ROS: Reactive oxygen species; NP: Natural products; DPPH: 2,2-diphenyl-1-picrylhydrazyl; FRAP: Ferric Reducing Antioxidant Power; DMEM: Dulbecco's Modified Eagle's Medium.

Correspondence:

Prof. Maria Teresa Freitas Bara,
School of Pharmacy, Federal University of Goias,
Postal Code 131, 74605-170, Goiânia-GO, Brazil.
E-mail: mtbara@gmail.com, mbara@ufg.br

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INTRODUCTION

Products for skin protection, such as sunscreens, should be highlighted in the health care because could be able to prevent damages and harmful effects to the skin, including cancers caused by ultraviolet (UV) radiation and by the intracellular imbalance between free radicals. Sunscreens are typically using a synthetic chemical solar filter with high capacity of absorbance sunlight at the UVB and UVA spectrum. The reduction of the chemicals concentration in cosmetic formulations without affecting its properties is a great challenge.[1,2] The search for natural and highly efficient, effective, and safe products has been a target for the industry and research centers, motivated by the relevance of the issue for public policies contemplating the Brazilian potentialities.[2,3]

The association of plant extract with antioxidant activity in sunscreens can help to improve their photoprotective activity. The interest for

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natural products (NPs) as active agents in sunscreens is growing.[2-4] Several botanical agents, mainly vitamins and polyphenols, have shown to influence signal transduction pathways leading to photoprotective effects,[5,6] and some of these molecules could be inactivate reactive oxygen species restoring skin homeostasis, thus preventing erythema and premature aging of the skin.[7,8] Few data are found published in literature on the combined effects of the antioxidants and synthetic sunscreens. Some plant extracts such as tea,[4] propolis,[6] green coffee oil,[9] *Malpighia glabra, Guazuma ulmifolia,*[10] *Stryphnodendron adstringens*, *Trichilia catigua, Maytenus ilicifolia,*[11] and *Bauhinia microstachya* var. massambabensis Vaz extracts[12] have been reported to protect the skin against UV radiation induced.

Pterodon emarginatus Vogel (Fabaceae) popularly known as *Sucupira branca* is a species found in the Brazilian Cerrado, and their fruits have often been used in popular medicine for their analgesic and anti-inflammatory properties mainly due to furanoditerpenes[13-16] and as antioxidant due to phenolics[17] found in these fruits. In this context, hydroalcoholic extract of *P. emarginatus* (HEP) is a potential candidate to be used in association with synthetic chemicals in sunscreens because it is a source of antioxidants and polyphenols.

This study aimed to investigate the antioxidant and photoprotective activities and cytotoxicity effect of the hydroalcoholic extract of the fruits of *P. emarginatus* (HEP) and obtain formulations with photochemoprotective activity containing HEP in Lanette®, Polawax®, or Focus Gel 305®.

MATERIALS AND METHODS

Materials

All reagents were of analytical grade or cosmetic grade and purchased from commercial suppliers.

Obtaining the hydroalcoholic extract of Pterodon emarginatus

The fruits of *P. emarginatus* Vog. Fabaceae were purchased in the market of the city of Goiânia and morphologically identified by Professor Maria Teresa F. Bara of the School of Pharmacy of the Federal University of Goiás, according to Camillo *et al.*[18] Lorenzi and Matos.[19]

The fruits were ground in knife mill Willye (Tecnal®) and after processing were placed in translucent plastic bag in refrigerator (−20°C freezer) in the dark. After that, fruits were submitted to extraction in a water bath at 50°C under reflux for 30 min[17] and were used 50 g of the plant material and ethanol 70% as liquid extractor (70 ml). The extract was filtered, packaged in amber bottle, and kept refrigerated at 40°C. The solids content was determined on the Ohaus MB35 infrared balance. For thin-layer chromatography (TLC) of HEP, 20 µL was applied in silica gel plates with fluorescence indicator (Macherey-Nagel). The compounds were eluted using as mobile phase, ethyl acetate: acetic acid: formic acid: distilled water ratio of 67.6:7.4:7.4:17.6. After elution of the compounds, the plate was revealed with NP reagent (Sigma) 1% in methanol and placed under a 365 nm UV lamp.[20] The total polyphenol content of HEP was determined by the Hagerman and Butler method.[21]

Antioxidant activity of hydroalcoholic extract of *Pterodon emarginatus*

The antioxidant activity of HEP was determined by its capability of scavenger the 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP). The DPPH method was used to determine the radical scavenging activity.[22] Solutions of HEP in ethanol were prepared at concentrations in the range of µl/mL. A 2.5 mL of each one was mixed with 1 mL of 0.004% DPPH in ethanol, at room temperature (RT) and in the dark. The samples were kept in the dark for 30 min (RT), and just after, the absorbance was measured at 515 nm in a Tecnal UV/Vis spectrophotometer. The blank solution was composed by ethanol. The negative control solution was prepared by mixing 1.0 mL of 0.004% DPPH solution with 2.5 mL of absolute ethanol. A curve of free radical inhibition (%) versus concentration was plotted and used to calculate the concentration of extract to inhibit 50% of free radicals in the solutions (IC_{50}). The IC_{50} was calculated by linear regression of the curves obtained by plotting the results of percentage of DPPH inhibition. On these plots, the abscissa represents the concentration of HEP and the ordinate represents the antioxidant activity. The same procedure was used for the data obtained from the solution of gallic acid (µg/mL), which was the standard antioxidant substance used in this study.

The FRAP reagent consists of a mixture of one part of Tripyridyl-triazine (10 mmol/L in HCl 40 mmol/L), one part of $FeCl_3$ (20 mmol/L), and ten parts of sodium acetate buffer 0.3 mol/L (pH 3.6). A 25 µL of solution HEP was mixed with 2.0 ml of the FRAP reagent and left for 10 min in a water bath at 37°C. The absorbance was measured at $\lambda = 595$ nm. An aqueous solution of $FeSO_4 + H_2O$ (0–1200 µmol/L) was used to prepare a standard curve and results expressed as µmols equivalent to Fe^{+2}/L.[23,24]

In vitro cytotoxicity assay of hydroalcoholic extract of *Pterodon emarginatus*

The cytotoxic effect of HEP was assessed by neutral red assay method using basal cells of BALB/c 3T3. The test was performed according to the protocol Puerner and Borenfreund (1984) modified by ICCVAM.[25] 1×10^5 cells/well were distributed into 96-well microplates in Dulbecco's Modified Eagle's Medium (DMEM) supplemented with 10% of fetal bovine serum and antibiotics. After 48 h, cells were exposed to eight concentrations of HEP (0.61–79.7 mg/mL), and these concentrations obtained by serial dilution in DMEM were incubated in a humidified atmosphere of 5% CO_2 in air (Thermo Scientific Revco CO_2 incubator, Waltham, MA, USA) at 37°C for 48 h. Cellular controls were done with DMEM and vehicles, absolute ethanol, and Dimethyl Sulfoxide (DMSO). After exposure, the solutions were removed. In each well were added 250 µL of neutral red solution and incubated for 4 h under the same conditions. The supernatant was removed, and each well was washed with phosphate-buffered saline and added fixative solution of neutral red (1% acetic acid, 49% deionized water, and 50% ethanol). After solubilization, the absorbance was measured by spectrophotometry in a microplate reader at 560 nm. The absorbance obtained from control cells was taken as 100% cell viability. The experiments were performed in triplicate.

Formulations studied

Formulations were developed with Lanette® wax (anionic self-emulsifying wax composed of cetearyl alcohol and sodium cetearyl sulfate), Polawax® wax (nonionic self-emulsifying wax composed of cetearyl alcohol and sorbitan ester [polyethylene glycol-20], and Focus Gel 305® (auto-emulsifiable base for the formulation of oil/water emulsions composed of polyacrylamide and C13–14 isoparaffin and Lauryl 7). The bases were prepared according to the manual of good practices in handling according to Brazil, 2007.[26]

For Lanette® and Polawax® wax, the oil-phase components (Phase A) and the aqueous components (Phase B) were heated separately in a beaker to a temperature of 75°C. When both phases reached the temperature of 75°C, the aqueous phase was slowly poured under the oily phase, remaining under stirring and heating for 5 min. It was then removed from the heating while stirring to a temperature of 40°C.

To prepare the gel cream, distilled water was heated separately at 70°C and Focus Gel® was gradually added under constant stirring. Composition of formulations is described in Table 1 and was used 10% of HEP and 0.1% Eusolex 2292® (octyl methoxycinnamate) in all formulations.

Table 1: Composition of the formulations

Phase	Components	Percent
Lanette		
A	Lanette®	15
A	Nipazol®	0.05
A	Liquid petroleum	5
A	Nipagin®	0.15
B	EDTA	0.2
B	Distilled water	q.s.p 100 ml
Polawax		
A	Polawax®	10
A	Nipazol®	0.05
A	Liquid petroleum	2
A	Nipagin®	0.15
B	EDTA	0.2
B	Distilled water	q.s.p 100 ml
Focus gel		
A	Focus gel 305®	5
A	Nipagin®	0.15
A	EDTA	0.1
A	Distilled water	q.s.p 100 ml

EDTA: Ethylenediamine tetraacetic acid

In vitro sun protection factor

The sun protection factor (SPF) of HEP and formulations was determined according to the method proposed by Mansur *et al.*[27] 1g HEP (88.58mg / ml active) was weighed and the volume was completed to 10mL with absolute ethanol. Subsequently, an aliquot of 1 mL solution was transferred to volumetric flask and completed to volume with absolute ethanol PA for 10 ml. 1g of the formulation was weighed and transferred to volumetric flask, and the volume was completed with absolute ethanol PA to 10 ml. All the samples were prepared in triplicate and were read in Spectrophotometer Cary 50 (Varian®) between 290 and 320 nm in increments of 5 nm.

Preliminary stability

Initially, preliminary stability study of HEP was carried out monitoring the parameters of pH, solids content, and SPF. The periodicity of the sample analysis was done at time 0, soon after extraction, and at time 7, 15, 21, and 30 days.

After this, three semi-solid formulations containing HEP and Eusolex 2292® were prepared®. Three batches of 300 g of each formulation were prepared and stored in an inert plastic bottle. The product was kept at 25°C for 24 h after its preparation (To) and then analyzed with the following parameters: centrifugation, analysis of organoleptic characteristics (appearance, color, and odor), pH, electrical conductivity,[28] and SPF.[27] Then, the thermal stress tests, ice and defrost cycle (IDC), and subsequent evaluation of the defined parameters were performed.

For the centrifugation stability test, aliquots of approximately 10 g of the sample were weighed and packed in graduated Falcon-type tube and centrifugation (centrifuged) at a temperature of 25°C and 3000 rpm.[28] The pH of the formulations was measured in 10% (w/v) aqueous solution on a Tecnal pH meter model TEC-3MP at 25°C in triplicate. The electrical conductivity of the formulations was determined in 10% (w/v) aqueous solution in a Tecnal model TEC-3MP condutivimeter at a temperature of 25°C in triplicate.

To statistical analysis, all experiments with the formulations were done in triplicate. The results are given as mean and standard deviation. Statistical analysis, ANOVA, and Tukey tests were carried out when necessary. The level of significance is 95% ($P < 0.05$).

Obtaining the hydroalcoholic extract of *Pterodon emarginatus*

The HEP was obtained from fruits crushed by the water bath at 50°C under reflux for 30 min, and the efficiency (w/v) of the extraction was of 8%. It is known that according to the solvent used, for the same medicinal plant, it is possible to obtain different extracts in terms of polarity, selectivity, and consequently, presence of different chemical classes.[29] In this context and based on the study of Dutra *et al.*[17] with adaptations, which investigated different conditions for extracting phenolic compounds from the sucupira fruits, we chose to prepare an extract with 70% ethanol, from *P. emarginatus* fruits, in order to extract polyphenols and not the diterpenes present in this plant, which are nonpolar compounds. In addition, the extraction of compounds with photoprotective activity would be favored. The hydroalcoholic extract of the fruit of *P. emarginatus* yielded a total solids content of 9.73 g/100 ± 0.04 (m/m) of extract.

In TLC analysis, four bands were found, probably related to the presence of flavonoids (yellow and green bands) and another two bands were found that seem related to phenolic acids (bluish-white band). Phenolic acids and flavonoids are important secondary metabolites that act as UV blockers. These compounds can prevent the penetration of radiation into the skin, resulting in the reduction of inflammation, oxidative stress, and DNA damaging effects.[3] Thus, the presence of these compounds could enhance the final protection of the product and/or neutralize the free radicals produced in the skin after sun exposure.[2]

Antioxidant activity of hydroalcoholic extract of *Pterodon emarginatus*

In the DPPH method, the analytical curve (y = -0.0494x + 0.7432) presented a linear correlation coefficient of (r): 0.9933 and therefore the EC_{50} found was 19.3 ± 1.5 µl/ml. Souza *et al.*[30] pointed out that antioxidants of natural origin deserve attention, since plants represent a great capacity of capture free radicals and also have the ability to synthesize secondary metabolites with this activity. Silva *et al.*[31] reported that some plants belonging to the Fabaceae family have a high content of total polyphenols, and phenolic core substances are especially prominent as antioxidants. Andrade *et al.*[32] determined the phenolic content and evaluated the antioxidant activity of *Acacia podalyriifolia*, Fabaceae, using the DPPH method and showed that, depending on the polarity of the solvent used in the extraction, a higher antioxidant capacity is explained.

Niki[33] emphasized that the antioxidant capacity must be investigated by different methodologies, since a substance that often does not present significant antioxidant potential. Thus, we followed the investigation of the antioxidant activity of the HEP by the FRAP method, constructing an analytical curve (y = 0.0016 x + 0.1221) of the ferrous sulfate presenting a linear correlation coefficient of (r): 0.9999. This curve was used to calculate HEP antioxidant activity considering its equivalence per mL to 14880 µMol/L of ferrous sulfate.

Antioxidants are commonly used in cosmetic formulations to prevent skin aging. Most of these formulations currently contain at least one substance with antioxidant properties.[34,35] Recently published studies have reported the beneficial effects of plant-derived antioxidant compounds, especially carotenoids and flavonoids, in sunscreens because of their protection against sun damage. Compounds with aromatic rings can absorb UV rays, especially UVA and UVB at a wavelength range of 200–400 nm. Therefore, phenolic compounds such as flavonoids may be used as sun filters.[2]

In vitro cytotoxicity assay of hydroalcoholic extract of *Pterodon emarginatus*

The exposure of BALB/c 3T3 to different concentrations of HEP, for 48 h, induced low cytotoxicity in these cells with IC_{50} value of 767.3 µg/ml (0.7673 mg/ml) [Figure 1]. According to Martínez *et al.*,[36] plant extracts with IC_{50} values below 5 mg/mL are considered with no cytotoxic relevant effects.

It has been demonstrated the cytotoxic activity of *P. emarginatus* against different cell lines. This cytotoxic activity has been associated with the active compounds vouacapane diterpenoids present in the nonpolar fraction of this plant.[16] In our study, the HEP extract obtaining was from the extraction of polar compounds.

In vitro sun protection factor

In the present work, the SPF of HEP was 8 ± 0.31 and it was noted in addition to the SPF for synthetic chemical sunscreen used, in the three formulations obtained, resulting in an improvement of about 24% (to Focus Gel® formulation), 65% (to Lanette® formulation) and 66% (to Polawax® formulation), when associated to HEP [Table 2].

According to the Agencia Nacional de Vigilancia Sanitaria guidelines,[37] a sunscreen should have a SPF ≥6. According to the US Food and Drug Administration recommendations,[38] sunscreen formulations should have an SPF value higher than 2. Therefore, a large number of natural compounds are currently being studied to determine whether they fulfill this requirement and can be classified as green sunscreens.[37,38]

Souza *et al.*[39] showed that the emulsion containing extracts of acerola showed absorption in the UVB region, with maximum absorbance at 290 nm. At the concentration used, the acerola did not exhibit SPF ≥2 and thus cannot be considered with photoprotective potential, but antioxidant activity was confirmed in the formulation. The combined emulsion of acerola extract and chemical filters performed well in the stability tests and showed associative action in protecting the skin from UV irradiation damage.

Mansur *et al.*[12] demonstrated that the leaves extract of *Bauhinia microstachya* var. massambabensis increased the SPF, verified by the *in vivo* SPF determination, in which the results showed higher values for the formulations containing the extracts, suggesting that the free radical scavenging activity occurred in the human skin due to the presence of the antioxidant substances contained in the extract.

Jarzycka *et al.*[40] investigated the *in vitro* photoprotective activity and photostability of sunscreen formulations containing *Helichrysum arenarium, Sambucus nigra,* and *Crataegus monogyna* extracts. These plants are rich in phenolic compounds including flavonoids. The results showed *in vitro* SPF values in the range of 6.00–9.88 for the individual plant extracts. However, the emulsions containing a mixture of plant extracts showed SPF and PF-UVA values that were higher for *H. arenarium* and *C. monogyna*, with values of 19.51 and 16.58; for *C. monogyna* and *S. nigra*, 18.21 and 7.54; and for *S. nigra* and *H. arenarium*, 16.94 and 11.57, respectively. Therefore, the photoprotective activity of the formulations against UVA and UVB was significantly enhanced with the association of extracts.

Açai (*Euterpe oleracea*), a native palm of the Amazon region, is rich in anthocyanins, a class of polyphenols with demonstrated antioxidant properties, so may be used for skin protection against damage induced by UV radiation. However, when açai glycolic extract was added to an emulsion sunscreen, no significant increase in the *in vivo* SPF value was observed. The sunscreen emulsion containing this extract showed a PF-UVA = 14.97, 1.69 of the SPF/PF-UVA ratio, and a critical wavelength value of 378 nm and may, therefore, be considered a sunscreen with UVA and UVB protection, according to Brazilian legislation (2012).[41] According to Velasco *et al.*,[10] bioactive compounds interact with UV filters and their photoprotective efficacy may be dependent on the nature of the bioactive compound and UV filter concentrations.

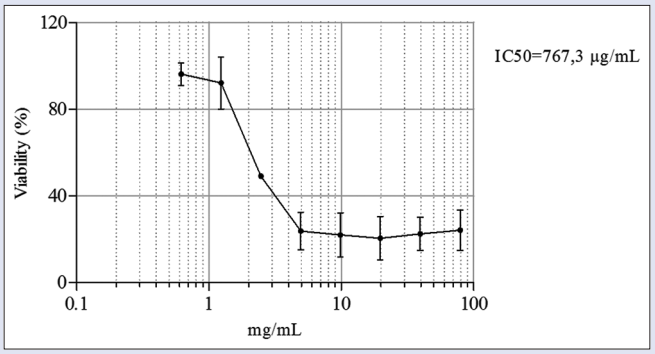


Figure 1: Cell viability of the hydroalcoholic extract of *Pterodon emarginatus* (0.61 to 79.7 mg/ml) against the 3T3 cells, for 48 h

Preliminary stability

It was possible to observe that the HEP maintained its initial characteristics for the parameters of pH, solids content, and SPF. The results are described in Figure 2, and it can be observed that there were no statistical differences in the applied tests.

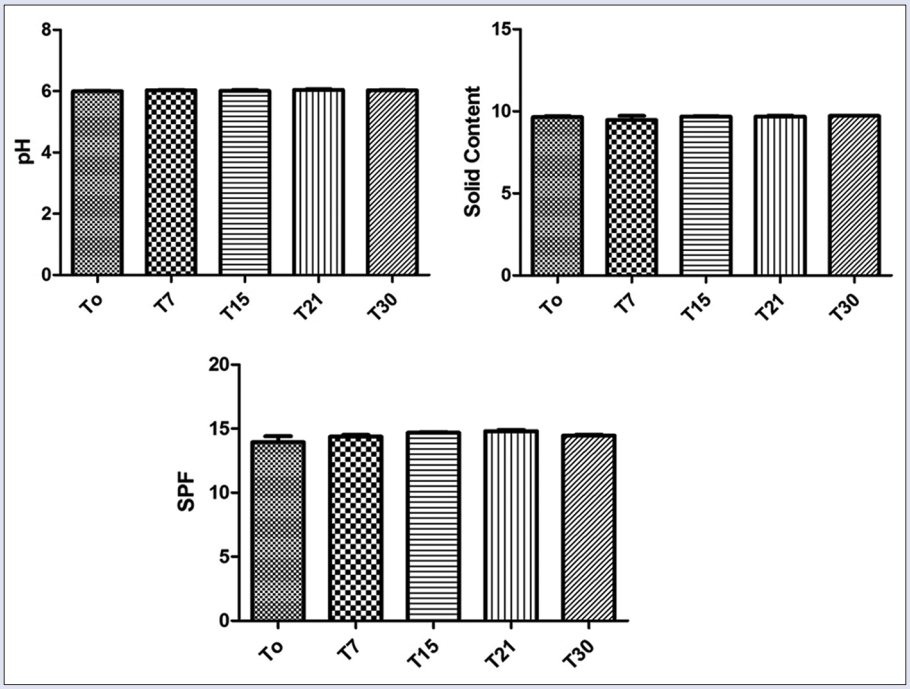
Regarding the organoleptic characteristics, formulations with Lanette®, Polawax®, and Focus Gel® showed no difference in appearance, color, and odor. However, only the Lanette®-based formulation demonstrated no significant difference in the analyzed parameters evaluated during the preliminary stability [Figures 3-5]. In the results of preliminary stability for Polawax® formulations, comparing the initial time (Ti) of the assay with formulations subjected to extreme exposure conditions, significant differences in pH and conductivity were observed after the freeze-thaw cycle (IDC). This behavior was also observed in the SPF value, after the thermal stress (TS) and the IDC [Figures 3-5]. These data allow us to suggest that this cosmetic base is not suitable for maintaining the original characteristics under stress conditions. For the Focus Gel® formulations, comparing the initial time (Ti) of the assay with formulations submitted to extreme exposure conditions, a significant difference was observed in SPF parameter after TS [Figure 5]. For the other analyzed parameters, no significant differences were observed [Figures 3 and 4]. These data allow us to suggest that also this cosmetic base is not suitable for the maintenance of the original characteristics under TS condition.

In the literature consulted, this was the first time that the additive effect of sun protection (SPF) was described in semi-solid formulations containing HEP fruits.

Table 2: *In vitro* sun protection factor obtained

Formulations	SPF ± SD
HEP 10%	8±0.31
Focus Gel® + HEP 10%	9.44±0.50
Focus Gel® + Eusolex 2292® 0.1%	10.52±0.74
Focus Gel® + Eusolex 2292® 0.1% + HEP 10%	13.87±0.75
Lanette® + HEP 10%	14.72±0.40
Lanette® +Eusolex 2292® 0.1%	8.75±0.50
Lanette® + Eusolex 2292® 0.1% + HEP 10%	24.77±0.27
Polawax® + HEP 10%	14.22±0.50
Polawax® + Eusolex 2292® 0.1%	8.18±0.17
Polawax® + Eusolex 2292® 0.1%+ HEP 10%	23.87±0.29

SD: Standard deviation; SPF: Sun protection factor; HEP: Hydroalcoholic extract of *Pterodon emarginatus*



Time (days)	pH	Solids content	SPF
T0	5.99±0.021	9.65±0.055	13.95±0.454
T7	6.03±0.008	9.47±0.247	14.38±0.124
T15	6.01±0.020	9.68±0.021	14.67±0.079
T21	6.04±0.014	9.68±0.055	14.82±0.068
T30	6.03±0.011	9.71±0.008	14.46±0.060

SPF: Sun protection factor

Figure 2: Study of the stability of the hydroalcoholic extract of *Pterodon emarginatus*: Evaluation of the physicochemical parameters of pH, solids content, and sun protection factor in 0, 7, 15, 21, and 30 days ($P < 0.05$)

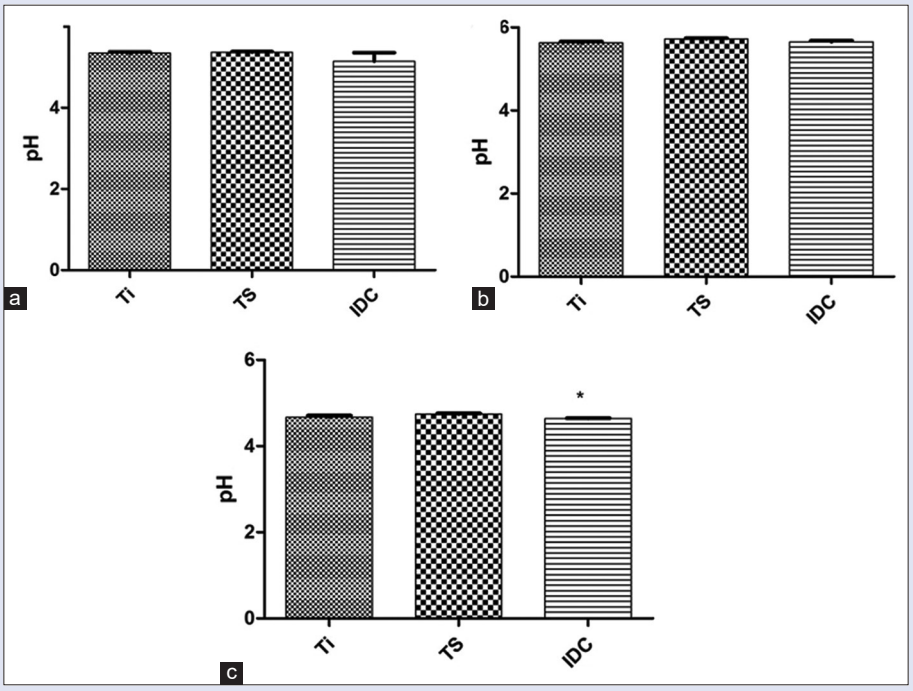


Figure 3: pH parameters of Focus Gel® (a), Lanette® (b), and Polawax® (c) formulations containing hydroalcoholic extract of *Pterodon emarginatus* in initial time (Ti), after thermal stress (TS) and the ice and defrost cycle (IDC) ($P < 0.05$)

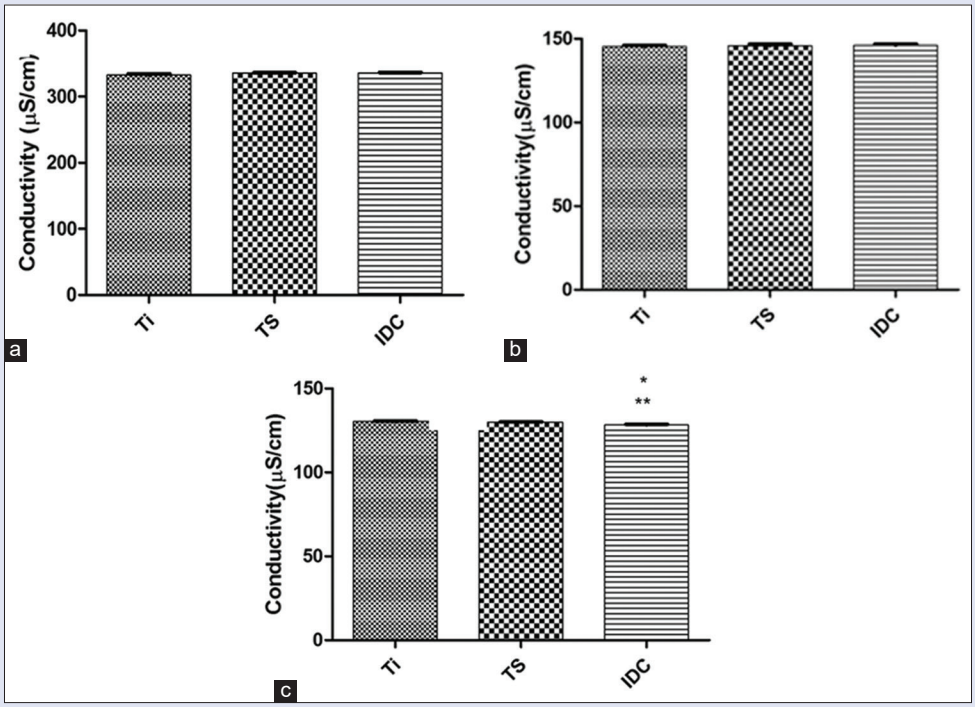


Figure 4: Conductivity parameters of Focus Gel® (a), Lanette® (b), and Polawax® (c) formulations containing hydroalcoholic extract of *Pterodon emarginatus* in initial time (Ti), after thermal stress (TS) and the ice and defrost cycle (IDC) ($P < 0.05$)

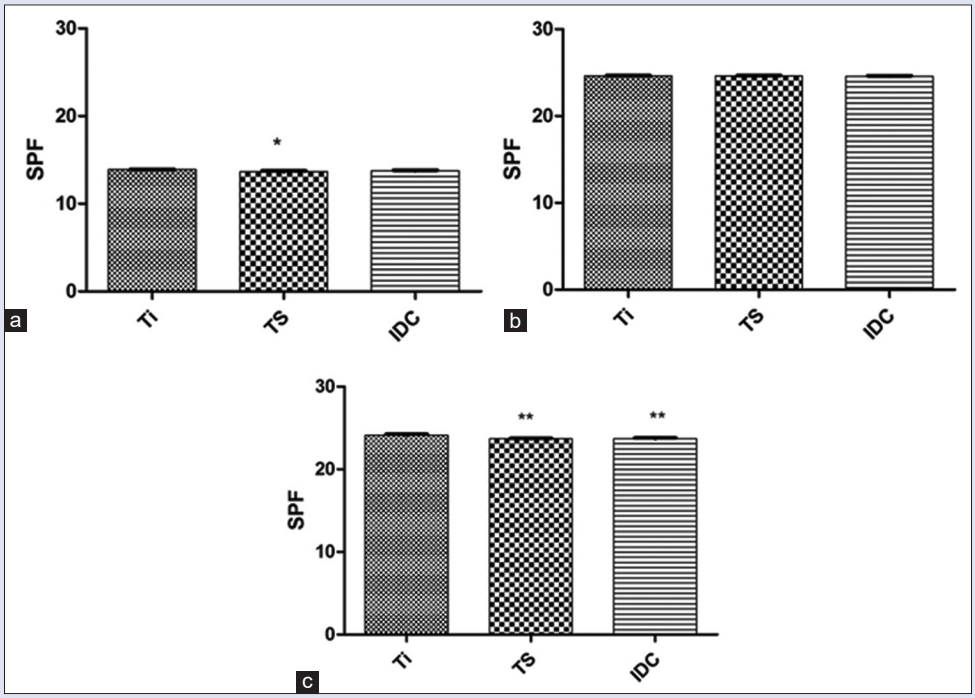


Figure 5: Sun protection factor parameters of Focus Gel® (a), Lanette® (b) and Polawax® (c) formulations containing hydroalcoholic extract of *Pterodon emarginatus* in initial time (Ti), after thermal stress (TS) and the ice and defrost cycle (IDC) ($P < 0.05$)

CONCLUSION

The HEP is a highly promising constituent in the development of photoprotective and antioxidant cosmetic formulations, thus showing a tendency to photochemoprotective activity. We emphasize that HEP showed no cytotoxicity. Another interesting characteristic to be highlighted is its ability to add the SPF for octyl methoxycinnamate (Eusolex 2292®) in formulations, with emphasis on the Lanette® base which was the one that remained unchanged during the preliminary stability tests.

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Conflicts of interest

There are no conflicts of interest.

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