# DETERMINATION OF *IN VITRO* SUN PROTECTOR FACTOR OF NANOEMULSIONS CONTAINING GRAPE SEED OIL AND NATURAL POLYMERS

Severiano, C.C.[1*]; Rangel, A.B. F[2]; Ferraz, C. S[2]; Araújo, E.M [2]; Mourão, S. C.[1,2]

[1]*Universidade Federal Fluminense/Programa de Pós-Graduação em Ciências Aplicadas a Produtos para Saúde, Rua Dr. Mario Viana, 523, Niterói, Rio de Janeiro, Brazil*

[2]*Universidade Federal Fluminense /Faculdade de Farmácia/Departamento de Tecnologia Farmacêutica (MTC) Laboratório de farmacotécnica, Rua Dr. Mario Viana, 523, Niterói, Rio de Janeiro, Brazil*

*castrocintia@id.uff.br

## Introduction

The exposure to solar ultraviolet (UV) radiation is harmful to health and increases the risk of skin cancer, the most frequent type in Brazil. Sunscreens containing UV filters in their composition are used to prevent this type of cancer [1]. However, some UV filters can cause undesirable reactions and be absorbed by the skin, potentially leading to endocrine and hormonal problems, as well as disruptions in organ function, making them not recommended for pregnant and lactating women [2]. Therefore, it is important to develop sunscreens that have not only photoprotective activity but also antioxidant properties and low skin permeation. This way, it would be possible to offer effective protection against damage caused by UV radiation while minimizing potential health risks. Nanoemulsions are systems that stand out for presenting a simple, accessible preparation technique, scaling feasibility, ability to transport complex substances and modulate their skin absorption [3,4]. It has already been proven that the addition of polymers to nanoemulsions reduces skin penetration [5]. The present project aims to determine the *in vitro* Sun Protection Factor (SPF) of a nanoemulsified system designed for photoprotective activity, assessing the effects of vegetable oil and natural polymers.

## Material and Methods

The nanoemulsions were prepared using the Phase Inversion Temperature (PIT) method. The oil phase (OP) consisted of grape seed oil (GSO) (5% w/w), PEG 40 hydrogenated castor oil (6.2% w/w), sorbitan monooleate (3.8% w/w), and the UV filter Octyl methoxycinnamate (10% w/w). The aqueous phase (AP) consisted of water and 2% (w/w) of each polymer: guar gum, pectin and chitosan. The formulations were prepared in triplicate, also three without any polymer.

The determination of the *in vitro* Sun Protector Factor (SPF) of the grape seed oil and nanoemulsions prepared with or without polymers were conducted using the spectrophotometric method developed by Mansur et al. [6,7] using isopropyl alcohol as solvent, and also by transmittance spectrophotometry with an integrating sphere (Labsphere UV-2000S) [8]. Measurements were taken at different time points (T01 and T30 days) in triplicate. The mean and standard deviation of SPF values, UVA/UVB ratio, and critical wavelength were subsequently obtained [8].

## Results and Discussion

The *in vitro* SPF determination by Mansur´s method demonstrated photoprotective capacity of the GSO (10% w/w), but a low SPF value (SPF 0.543 ±0.01). In order to assess potential synergy between the vegetable oils and the UV filter OMC, samples consisted of 10% w/w vegetable oil and 10% w/w UV filter OMC in isopropyl alcohol, and showed SPF 8.202 ± 0.15.

The analyses were conducted using Mansur's method at T01 for formulations containing GSO (5%), UV filter OMC (10%), and polymers (chitosan, pectin and guar gum - 2%). The formulations containing polymers guar gum, pectin and chitosan showed SPF 31.06 ± 2.24, 29.34 ± 2.65 and 32.73 ± 0.47, respectively. Whereas the formulation without polymer showed the lowest value (24.29), being classified as medium protection sunscreen [9]. The differences in SPF among the formulations containing polymers were not statistically significant, and were as medium to high protection.

The SPF of the prepared nanoemulsions were also determined by transmittance spectrophotometry, at T01 and T30. The highest SPF value observed at T01 was in the formulation containing chitosan (SPF=34) followed by the formulation without polymer (SPF=31), pectin (SPF=28), and the formulation containing guar gum (SPF=25), and que UVA/UVB ratio ranged from 0.179 to 0.248. According to the boots star rating classification system [10] these formulations do not provide UVA protection. Also the critical wavelengths were below the threshold of 370 nm, concluding that the formulations has not broader UV protection spectra. Traditional emulsion (F16 to F18) were also evaluated by transmittance spectrophotometry with an integrating sphere. The SPF value obtained was 15.44 ± 1.6.

The formulation without any added polymer did not show a significant difference ($p < 0.05$) between the time points (T01 and T30), showing SPF=26. Meanwhile the formulations containing the polymers guar gum, pectin, and chitosan showed a significant increase in SPF ($p < 0.05$) between the time points (T01 and T30), showing at T30 SPF 33, 38 and 40, respectively. A traditional emulsion were also evaluated by transmittance spectrophotometry with an integrating sphere. The average SPF values obtained were 15.44 ± 1.6

## Conclusion

The nanoemulsions developed demonstrated a significantly higher SPF than conventional formulations. The polymers studied (pectin, chitosan, and guar gum) contributed to the increase in SPF over 30 days, potentially through polymer-induced modifications.

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