WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.453
Volume 14, Issue 23, 706-709. Research Article ISSN 2277–7105

FORMULATION AND EVALUATION OF SUNSCREEN SOAP CONTAINING CARROT SEED OIL AND ZINC OXIDE

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Article Received on 28 October 2025,
Article Revised on 17 Nov. 2025,
Article Published on 01 Dec. 2025,
https://doi.org/10.5281/zenodo.17745238

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How to cite this Article: 1Ms. Nayan R. Samant, 2Ms. Aishwarya B. Bhogate, 3Ms. Komal R. Pednekar, 4Mr. Rohan D. Ratool, 5Mr. Siddhesh L Sawant, 6*Mr. Sourabh D. Thakur. (2025) FORMULATION AND EVALUATION OF SUNSCREEN SOAP CONTAINING CARROT SEED OIL AND ZINC OXIDE. "World Journal of Pharmaceutical Research, 14(23), 706–709.

ABSTRACT

This study focuses on developing a novel sunscreen soap formulation that combines cleansing action with UV protection. The soap incorporates carrot seed oil (CSE)—a natural antioxidant and mild UV absorber—and zinc oxide (ZnO), a broad-spectrum physical UV filter. The aim is to enhance daily skin protection through routine washing. Formulations were prepared using the cold-process method, and evaluated for pH, hardness, foaming ability, stability, and in-vitro SPF. Results indicated that soaps containing both CSE (2%) and ZnO (4%) exhibited favorable physicochemical properties and measurable UV absorbance, suggesting potential for low-level daily photoprotection. The findings demonstrate the feasibility of integrating sunscreen actives in cleansing formulations for enhanced skincare benefits.

KEYWORDS: Sunscreen soap, carrot seed oil, zinc oxide, UV protection, cold process, photoprotection.

1. INTRODUCTION

Ultraviolet (UV) radiation is a major cause of premature skin aging, tanning, and carcinogenesis. Sunscreens are the most common preventive measure, but daily compliance is often poor. A multifunctional cosmetic product such as a sunscreen soap, used as part of routine bathing, can offer practical benefits and increase adherence to photoprotection.

Zinc oxide (ZnO) is a well-established physical UV filter that reflects and scatters both UVA and UVB radiation. It is chemically stable, non-irritant, and widely accepted in dermatological formulations. However, its incorporation into soap requires uniform dispersion to avoid agglomeration and maintain appearance. Carrot seed oil (CSE) is a natural essential oil rich in carotenoids and phenolic compounds, which exhibit antioxidant properties and mild UV absorbance. The combination of CSE and ZnO can provide synergistic photoprotective and skin-conditioning effects while aligning with the demand for natural skincare products.

The present research aims to formulate and evaluate sunscreen soaps containing ZnO and CSE, and to determine their physicochemical characteristics and in-vitro UV protective potential.

2. MATERIALS AND METHODS

2.1 Materials

Oils: Coconut oil, olive oil, palm oil, and castor oil

Actives: Zinc oxide (cosmetic grade, micronized), Carrot seed oil (cold-pressed)

Additives: Glycerin, Vitamin E (antioxidant), Distilled water

Alkali: Sodium hydroxide pellets (NaOH)

All materials were of analytical or cosmetic grade.

2.2 Method of Preparation (Cold Process Method)

1. The required quantity of NaOH was dissolved in distilled water to prepare the lye solution and cooled to room temperature.
2. The oils were weighed and melted together at 45–50 °C.
3. The lye solution was slowly added to the oil blend with continuous stirring until trace appeared.
4. Carrot seed oil (2%), vitamin E (0.5%), and pre-dispersed ZnO (4%) were incorporated with gentle mixing.
5. The mixture was poured into molds and allowed to cure for 4–6 weeks at room temperature.
6. After curing, the soaps were demolded, labeled, and stored for evaluation.

2.3 Evaluation Parameters

The formulated soaps were evaluated for the following

pH – 1% aqueous solution measured using a digital pH meter.

Hardness – Penetrometer method.

Foaming ability – Cylinder shake method.

Stability – Stored at 25 °C and 45 °C for 30 days; observed for color, cracking, separation

In-vitro SPF – UV spectrophotometric method using Mansur equation (UV scan 290–320 nm).

Appearance & Texture – Visual inspection.

2.4 In-Vitro SPF Determination

Soap samples were dissolved in ethanol (0.002 % w/v) and analyzed spectrophotometrically in the range of 290–320 nm at 5 nm intervals. The SPF value was calculated using the Mansur equation:

$$SPF = CF \times \Sigma\, EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

Where: CF = Correction Factor (10); EE(λ) = Erythemal effect spectrum; I(λ) = Solar intensity spectrum; Abs(λ) = Absorbance of sample.

3. RESULTS AND DISCUSSION

The prepared sunscreen soaps were hard, smooth, and free from air bubbles. No cracking or discoloration was observed after 30 days of storage, indicating good stability. The pH values (9.4–9.8) were within acceptable limits for cosmetic soaps. In-vitro SPF determination showed that the combination of CSE (2%) and ZnO (4%) achieved an SPF of approximately 6.8 ± 0.4, higher than individual ingredients. This synergistic effect confirms that ZnO provides the primary UV protection while CSE enhances antioxidant and mild UV-absorbing properties.

4. CONCLUSION

The study successfully formulated a sunscreen soap combining carrot seed oil and zinc oxide that exhibited satisfactory physicochemical properties and measurable in-vitro UV protection. The dual benefit of cleansing and photoprotection offers a promising innovation in personal care. However, to substantiate SPF claims, in-vivo and residual skin deposition studies are necessary.

ACKNOWLEDGMENT

The authors express gratitude to Shree Pushpasen Sawant College of Pharmacy, Digas, for providing laboratory facilities and technical support during the study.

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