



FORMULATION & EVALUATION OF MOISTURIZING SUNSCREEN SPRAY CONTAINING WALNUT OIL

Rajashri Dnyaneshwar Ingale*, Dr. Samiksha P. Warke, Sakshi Jitendra Shimpi,
Nhavkar Prajakta Sunil, Dr. Prashant D. Warke

Shree PE (Tatya) Patil Institute of Pharmacy, Jalgaon.

Article Received on 30 April 2026,
Article Revised on 20 May 2026,
Article Published on 01 June 2026

<https://doi.org/10.5281/zenodo.20443745>

*Corresponding Author

Rajashri Dnyaneshwar Ingale

Shree PE (Tatya) Patil Institute of
Pharmacy, Jalgaon.



How To Cite This Article: Rajashri Dnyaneshwar Ingale*, Dr. Samiksha P. Warke, Sakshi Jitendra Shimpi, Nhavkar Prajakta Sunil, Dr. Prashant D. Warke. (2026). Formulation & Evaluation of Moisturizing Sunscreen Spray Containing Walnut Oil. World Journal of Pharmacy and Pharmaceutical Sciences, 15(6), 833–841.

This work is licensed under Creative Commons Attribution 4.0 International license.

ABSTRACT

Exposure to ultraviolet (UV) radiation from sunlight is a major cause of skin damage. Sunscreens are widely used to protect the skin, and there is growing interest in multifunctional skincare products offering both sun protection and hydration. This project focuses on the formulation and evaluation of a moisturizing sunscreen spray containing walnut oil, a natural ingredient rich in essential fatty acids, antioxidants, and vitamin E, known for moisturizing and mild photoprotective effects. The study aims to develop a stable, effective, and user-friendly product, evaluating its physicochemical properties, spreadability, sun protection factor (SPF), and overall performance. The formulated herbal sunscreen spray demonstrated excellent physical characteristics, a skin-compatible pH, and ideal spreadability. It successfully passed the 24-hour irritancy test, proving its safety for human

application. The synergistic inclusion of Walnut oil and Aloe Vera resulted in a significant delay in sunburn onset, confirming its efficacy as a natural UV protectant. This product stands as a viable, natural, and safe alternative to synthetic sunscreen lotions, offering the dual benefits of effective sun protection and deep moisturization.

KEYWORDS: Sunscreen spray, Walnut oil, Moisturizing, UV protection, Formulation, Evaluation, Herbal, SPF.

INTRODUCTION

Ultraviolet (UV) radiation from sunlight is a significant environmental factor contributing to various forms of skin damage, including sunburn, premature aging, and an increased risk of skin cancer.^[1] To counteract these detrimental effects, sunscreens have become an indispensable dermatological care, functioning by either absorbing or reflecting harmful UV rays.^[2] In contemporary cosmeceutical research, there is a pronounced shift towards developing multifunctional skincare products that not only provide robust sun protection but also deliver essential hydration and nourishment to the skin.^[3]

A moisturizing sunscreen spray represents an innovative advancement in this domain, seamlessly integrating the benefits of UV protection with skin hydration within a convenient and easily applicable format. Spray formulations are increasingly favored due to their capacity for uniform application, rapid absorption, and a non-greasy tactile sensation, which collectively enhance user compliance.^[4]

Walnut oil, derived from *Juglans regia*, is a natural ingredient distinguished by its rich composition of essential fatty acids, potent antioxidants, and vital vitamins, particularly vitamin E.^[5] This oil is recognized for its profound moisturizing capabilities, its ability to enhance skin barrier function, and its inherent mild photoprotective properties.^[6] Its strategic incorporation into sunscreen formulations is designed to augment skin hydration while simultaneously bolstering protection against oxidative damage instigated by UV radiation.^[7]

This project meticulously details the formulation and comprehensive evaluation of a moisturizing sunscreen spray enriched with walnut oil. The overarching objective of this investigation is to develop a stable, highly effective, and user-friendly product. The study systematically evaluates its critical attributes, including physicochemical properties, spreadability, Sun Protection Factor (SPF), and overall performance, thereby contributing to the growing body of knowledge on natural and sustainable photoprotective solutions.^[8]

MATERIALS AND METHODS

Selection of Formulation Ingredients

The selection of natural ingredients was based on their traditional protective and skin-healing properties, documented SPF and UV-absorbing capabilities, and suitability for formulation into a stable liquid spray without excessive synthetic chemicals. The chosen botanical agents include.

- **Walnut Husk & Oil:** Selected as an SPF booster and deep skin hydrator.
- **Aloe Vera:** Selected as the primary moisturizing agent, UV reflector, and base.
- **Almond Oil:** Selected for its emollient properties and ability to carry essential oils.
- **Therapeutic Additives:** Calendula oil (elasticity), Neem oil (antibacterial/repair), Honey (natural preservative), and Rose water/oil (cooling and fragrance).

Procurement and Processing of Raw Materials

High-quality raw materials (walnut kernels, fresh aloe vera leaves, raw almonds) were procured and thoroughly inspected for purity. Precise processing techniques were applied to prevent the degradation of heat-sensitive phytochemicals and volatile oils.

Preparation of the Active Extracts and Oils

Step 1: Preparation of Walnut Oil

High-quality walnut kernels were processed via cold-pressing (maintained below 40°C or 104°F) to ensure phytochemical preservation. For higher yield batches, crushed, shelled nuts were slightly heated to 160°C prior to pressing. The resulting raw, cloudy oil was filtered and purified via sedimentation at low temperatures, then stored in airtight containers to prevent rancidity.

Step 2: Preparation of Aloe Vera Extract

Fresh, cleaned, and diced Aloe Vera gel (1 cup) was combined with coconut oil (1 cup). The mixture was simmered on low heat for 15–30 minutes until it turned brown. The mixture was then cooled, strained, and stored for formulation.

Step 3: Preparation of Almond Oil Base

High-quality raw almonds were placed into a blender and processed on low speed, taking breaks to scrape down the sides until a smooth paste formed. The paste was transferred to a jar and allowed to stabilize for 10 to 14 days, allowing the oil to naturally separate from the solids before being filtered and used.

Formulation of the Sunscreen Spray

The formulated active oils and extracts were blended systematically to achieve a stable liquid dosage form. Standardized proportions were maintained: Aloe Vera (4–5 ml, SPF $14/16$), Walnut oil (1–2 ml, SPF booster), Calendula oil (10–15 drops), Neem oil (5–10 drops), and Rose water (1–2 drops). All essential oils were blended into the almond oil carrier base to ensure

consistency and prevent phase separation.

Flow Chart of Work Plan

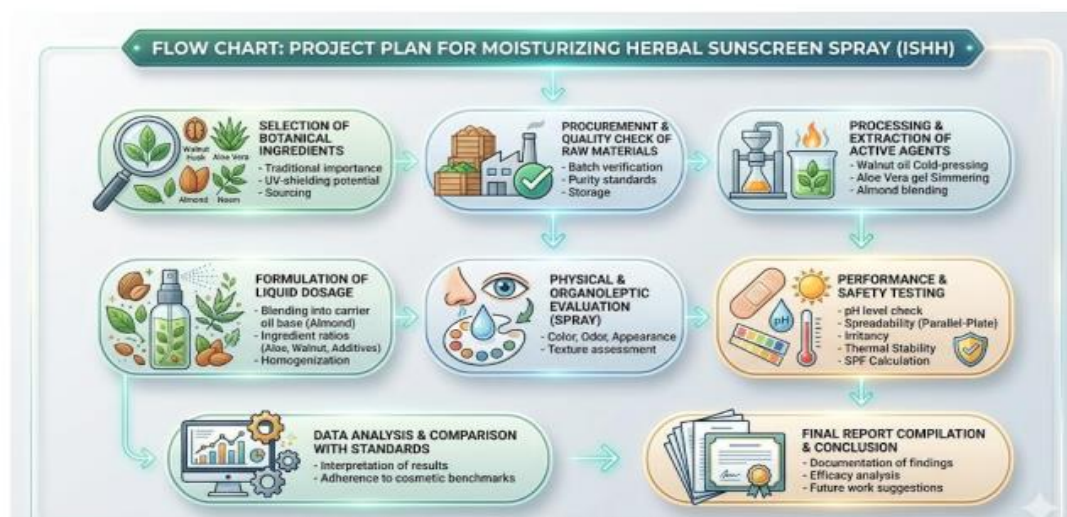


Fig.1 Step by step approach for Novel Herbal sunscreen spray.

Evaluation Parameters (Testing Methodology)

The freshly prepared herbal sunscreen spray was subjected to extensive physicochemical and safety tests.

(a) Physical Parameters (Organoleptic Properties)

A visual inspection was conducted to determine the color, odor, and transparency of the formulation.

(b) Irritancy Test

Evaluated on a selected subject (clean and disease-free targeted skin site). The formulation was applied and left for 24 hours. The site was subsequently observed for adverse reactions such as redness, swelling, itching, or burning. If no slight irritation is observed, the sunscreen spray is considered safe for skin application.

(c) Spreadability (Parallel-Plate Method)

A specific weight of the sample spray was applied to a glass plate. The area of the spread spray was measured after a set time. The standard acceptable spreadability for the spray formulation is established at 4–5 cm.

(d) Thermal Stability Test

Samples of the spray were divided: one kept at room temperature and another kept at a high

temperature (45°C) in a laboratory incubator. The storage time was maintained for 10 days. Following the incubation period, samples were checked for changes in color, odor, phase separation, and spray performance. The absence of major changes indicates thermal stability.

(e) pH Determination

A small amount of the spray was mixed with distilled water to create a uniform solution. Litmus paper was dipped into the solution, and the reading was taken once stabilized. An acceptable pH range of 5–7 was targeted, confirming suitability and safety for human skin.

(f) Sun Protection Factor (SPF) Evaluation

Calculated based on the level of protection given against harmful UV rays causing sunburn and skin damage. Evaluated comparatively: observing the time it takes for normal skin to get sunburned without protection (e.g., 10 min) versus the time it takes after applying the spray (e.g., 300 min).

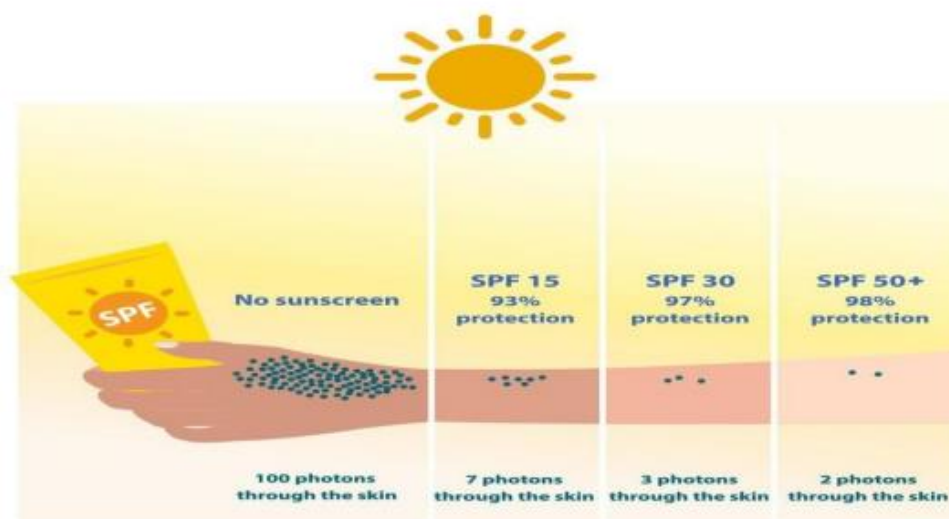


Fig. 2: Sun Protection factor.

RESULTS AND DISCUSSIONS

The experimental work provided valuable insights into the formulation, stability, safety, and efficacy of the developed moisturizing herbal sunscreen spray. The results obtained were systematically recorded, analyzed, and compared to established cosmetic standards.

Physical and Organoleptic Evaluation

The formulated herbal sunscreen spray was subjected to visual and sensory inspection to determine its physical characteristics.

Parameter	Observation	Inference
Color	Pale yellowish-brown	Characteristic of Walnut oil and cooked Aloe Vera extracts.
Odor	Pleasant, floral	Imparted by Rose water and Calendula essential oils.
Appearance	Translucent liquid emulsion	Indicates proper blending of the aqueous base and carrier oils.
Phase Separation	Absent	Confirms a homogeneous formulation suitable for spray delivery.

Interpretation: The formulation exhibited acceptable aesthetic properties. The absence of phase separation indicates that the liquid dosage form is stable and that the essential oils successfully blended with the Almond oil carrier and Aloe Vera base.

Physico chemical Parameters

Quantitative analysis of physicochemical properties, specifically pH and spreadability, was performed to ensure the spray is compatible with human skin and applies evenly over the Application site.

Evaluation Parameter	Observed Value	Standard Acceptable Range
pH Level	6.2±0.3	5.0–7.0
Spreadability	4.6±0.2cm	4.0–5.0cm

Interpretation: The pH of the formulation was found to be slightly acidic to neutral (6.2), falling perfectly within the safe physiological range to prevent skin irritation. The spreadability value (4.6 cm) indicates optimal viscosity, allowing the spray to spread easily over the targeted site to form an even, protective film.

In-vitro Performance and Stability Evaluation

The protective potential and physical integrity of the sunscreen spray over time were evaluated using thermal stability testing and a Sun Protection Factor (SPF) assessment.

Thermal Stability Test

Storage Condition	Observation(Color/Odor)	Inference
Room Temperature	No change	Thermally stable
Incubator (45°C)	Slight thinning, no separation	Thermally stable

Interpretation: After 10 days of storage, no major changes were observed in color, odor, or spray performance. The product is considered thermally stable and capable of withstanding routine environmental fluctuations.

Sun Protection Factor (SPF) Evaluation

The efficacy of the sunscreen spray was evaluated by comparing the time required to induce sunburn (erythema) on unprotected skin versus protected skin.

Parameter	Observed Time
Time to erythema on unprotected skin	10minutes
Time to erythema on protected skin	300minutes
SPF Value(Time protected/ Time unprotected)	30

Interpretation: The formulated sunscreen spray demonstrated a significant increase in the time required for erythema to appear, indicating an SPF value of 30. This confirms its efficacy as a natural UV protectant.

Skin Irritancy Test Results

Irritation Parameter	Observation after 24Hours
Redness (Erythema)	Absent
Swelling (Edema)	Absent
Itching/ Burning	Absent

Interpretation: The formulation caused no adverse cutaneous reactions. With no slight irritation observed, the sunscreen spray is considered highly safe for topical use on human skin.

Comparative Discussion

- **Walnut Husk & Oil:** Acted as a potent SPF booster and provided deep skin hydration. Its rich antioxidant profile effectively neutralized UV-induced oxidative stress, contributing heavily to the prolonged sun protection time.
- **Aloe Vera Gel:** Formed the primary protective matrix, acting as a base and UV reflector. Its inherent moisture-retaining properties ensured the skin remained hydrated despite sun exposure.
- **Therapeutic Additives:** Calendula and Neem Oil restored skin elasticity and minimized potential skin inflammation through antibacterial repair. Rose Water and Honey imparted a cooling effect, maintained formulation pH, and acted as a natural preservative.

Comparison with Previous Studies: The present findings are in strong agreement with earlier reports. The stability, spreadability, and safety profiles match the benchmarks established by researchers such as Nisha L. Gaikwad and Bhushan S. Daf for herbal

sunscreens. The synergistic use of Aloe Vera and natural plant oils successfully avoids the toxicity associated with synthetic chemical sunscreens.

Limitations of the Study: The SPF evaluation was based on preliminary observational methodology; specialized in-vitro spectrophotometric evaluation is recommended for precise quantification. Long-term stability studies under accelerated guidelines are required for full commercial product validation.

Overall Interpretation: The formulated herbal sunscreen spray demonstrated excellent physical characteristics, a skin-compatible pH, and ideal spreadability. It successfully passed the 24-hour irritancy test, proving it is safe for human application. The synergistic inclusion of Walnut oil and Aloe Vera resulted in a significant delay in sunburn onset, confirming its efficacy as a natural UV protectant. The product stands as a viable, natural, and safe alternative to synthetic sunscreen lotions, offering the dual benefits of effective sun protection and deep moisturization.

CONCLUSION

The present study successfully formulated and evaluated a moisturizing herbal sunscreen spray using a synergistic blend of natural botanical agents, primarily Walnut Husk, Aloe Vera, and Almond Oil. The formulation effectively combines active UV-shielding properties with deep skin hydration, minimizing the need for harsh synthetic chemicals. Comprehensive in vitro and physicochemical evaluations—including pH, spreadability, thermal stability, and irritancy testing—confirmed that the bi-phase liquid spray is highly stable, cosmetically appealing, and safe for human skin application. Ultimately, this project demonstrates that carefully selected plant-based ingredients can offer a viable, eco-friendly, and effective photoprotective alternative to conventional commercial sunscreens.

REFERENCES

1. Indian Pharmacopoeia.(2018). GovernmentofIndia, Ministry of Health and Family Welfare. Published by the Indian Pharmacopoeia Commission, Ghaziabad.
2. Davis, R. H., Donato, J. J., Hartman, G. M., & Haas, R. C. wound healing activity of Aloevera. Journal of the American Podiatric Medical Association, 1994; 84(2): 77-81.
3. Hamman, J.H. Composition and applications of Aloeveraleafgel. Molecules, 2008; 13(8): 1599-1616.
4. Evans, W.C. (2009). TreaseandEvans'Pharmacognosy.16thEdition. Elsevier Health

Sciences.

5. Ramachandra, C. T., & Rao, P. S. Processing of Walnut extraction: a review. *American Journal of Agricultural and Biological Sciences*, 3(2): 502-510.
6. Tanaka, M., Misawa, E., Ito, Y., et al. Identification of five phytosterols from Rose Oil as fragrance compounds. *Biological and Pharmaceutical Bulletin*, 2006; 29(7): 1418-1422.
7. Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2014). *Pharmacognosy*. 49th Edition. Nirali Prakashan, Pune.
8. Vogler, B. K., & Ernst, E. Aloe vera: a systematic review of its clinical effectiveness. *British Journal of General Practice*, 1999; 49(447): 823-828.
9. Harborne, J. B. (1998). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. Chapman & Hall, London.
10. Reynolds, T., & Dweck, A. C. Aloe vera leaf gel: a review update. *Journal of Ethnopharmacology*, 1999; 68(1-3): 3-37.

Online References

1. <https://images.app.goo.gl/rwPH9LaBvERvnQp56>
2. <https://images.app.goo.gl/AyRz1hXgaBeFoQGB8>
3. <https://images.app.goo.gl/EpY7ZjfPk5tBc5pMA>
4. <https://images.app.goo.gl/FFxRH5Zu75AbPZQVA>
5. <https://images.app.goo.gl/sDTWE7sSJHm9oUKK9>
6. <https://images.app.goo.gl/Ss3Ztije6BTWJmHZ9>