Development of Plant-Based Sunscreen Cream Using *Senna Auriculata* and *Aloe Barbadensis Miller* Extract

G. Gunamathi, M. Pharm[1], P. Pooja[2], D. Pradeepika[3], P. Prasanna Sri [4]
[1] *Assistant professor, Department of Pharmacognosy, Sri Vijay Vidyalaya College of Pharmacy, Nallampalli, Dharmapuri, India.*
[2,3,4] *B. Pharm, Sri Vijay Vidyalaya College of Pharmacy, Nallampalli, Dharmapuri, India.*

***Abstract*—Herbal cosmeceuticals are gaining preference over synthetic sunscreens because plant actives combine ultraviolet (UV) photoprotection with antioxidant, anti-inflammatory and moisturising benefits and a lower likelihood of irritation. In the present work a herbal sunscreen cream was formulated using Avaram (Senna auriculata) flower extract and Aloe barbadensis Miller (Aloe vera) gel as the principal active ingredients, incorporated into an emulsion base of beeswax, shea butter, coconut oil, olive oil, glycerin and vitamin E oil. Senna auriculata flowers were extracted by maceration in 75% ethanol, and fresh Aloe vera gel was collected by cold mechanical separation. Pre-formulation studies (angle of repose, bulk and tapped density, Carr's index, Hausner ratio, moisture content) and phytochemical screening of both extracts were carried out prior to formulation. Three formulations (F1-F3) differing in the ratio of beeswax, shea butter and oils were prepared by the phase-inversion emulsification method and evaluated for physical appearance, homogeneity, spread ability, extrudability, pH, skin-irritation potential, stability and wash ability. Phytochemical screening confirmed the presence of flavonoids, tannins, phenolic compounds, saponins and terpenoids in both extracts, supporting their antioxidant and photoprotective potential. Among the three batches, F3 showed the most favourable overall profile, with easy spread ability, good extrudability, a skin-compatible pH of 5.5, absence of irritation, good physical stability and wash ability, and was selected as the optimised formulation. The study supports Senna auriculata and Aloe barbadensis Miller as safe, effective, plant-derived alternatives to conventional chemical sunscreens.**

***Index Terms*—Aloe barbadensis Miller, herbal cosmeceuticals, phytochemical screening, Senna auriculata, sun protection factor (SPF), UV photoprotection.**

I. INTRODUCTION

Cosmetics are substances or preparations intended for application to the external parts of the human body for cleansing, protecting, perfuming or maintaining good condition, without affecting the body's structure or physiological functions [1]. Within this category, sunscreens occupy a critical protective role: regular use reduces sunburn, photo ageing, hyperpigmentation and the risk of skin cancers arising from prolonged ultraviolet (UV) exposure [2], [3]. Conventional sunscreens rely on chemical (organic) filters such as avobenzone and oxybenzone, or physical (mineral) filters such as zinc oxide and titanium dioxide; both classes are effective but have been associated with skin irritation, photo instability or a cosmetically unacceptable white residue.

Growing consumer preference for natural, biocompatible products has driven interest in herbal sunscreens formulated with plant extracts rich in flavonoids, polyphenols, tannins, carotenoids and vitamins. These phytoconstituents neutralise reactive oxygen species generated by UV exposure, thereby reducing oxidative stress, lipid peroxidation and collagen degradation, while also imparting moisturising, anti-inflammatory and wound-healing benefits [4]. Avaram (Senna auriculata) flower and Aloe vera (Aloe barbadensis Miller) gel are two such ingredients with well-documented antioxidant, anti-inflammatory and skin-protective activity, but their combined use in a topical sunscreen cream has been comparatively little studied.

The present study was therefore undertaken to formulate a herbal sunscreen cream using Senna auriculata flower extract and Aloe barbadensis Miller gel, and to evaluate its physicochemical properties,

stability, spread ability, pH, skin compatibility and general suitability as a natural alternative to conventional sunscreen products.

II. MATERIALS AND METHODS

A. Plant Material and Extract Preparation

Dried Senna auriculata flowers were washed, shade-dried and powdered. About 20 g of powder was extracted with 250 mL of 75% ethanol by maceration for 72 hours. The extract was filtered and concentrated on a water bath at 40-50°C to a semisolid consistency and stored at 4°C in an airtight container until use. Fresh Aloe barbadensis Miller leaves were washed, the outer rind removed, and the inner transparent gel collected, homogenised and filtered through muslin cloth; the gel was stored under refrigeration until formulation.

B. Pre-formulation Studies

The Senna auriculata powder was characterised for angle of repose, bulk density, tapped density, Carr's index, Hausner ratio and moisture content using standard pharmacopoeial procedures, to assess flow and processing behaviour prior to extraction and formulation.

C. Phytochemical Screening

Both the Senna auriculata flower extract and the Aloe barbadensis Miller extract were subjected to qualitative chemical tests for alkaloids (Dragendorff's test), flavonoids (sodium hydroxide test), tannins and phenolic compounds (ferric chloride test), saponins (froth test), glycosides (Keller-Kiliani test) and terpenoids (Salkowski test), using standard phytochemical screening methods.

D. Formulation of Herbal Sunscreen Cream

The oil phase (beeswax, shea butter, coconut oil) and the aqueous phase (purified water, glycerine) were each heated separately to 70-75°C. The hot aqueous phase was added slowly to the hot oil phase with continuous stirring and homogenised for 10-15 minutes to form a smooth cream base. Senna auriculata flower extract and Aloe vera gel extract were incorporated into the base, which was then cooled with continuous stirring to prevent phase separation. Below 40°C, vitamin E oil and rose oil were blended in, and the finished cream was packed into clean, dry containers and stored at room temperature away from direct sunlight. Three formulations (F1-F3) were prepared, varying the proportions of shea butter, beeswax, glycerin and oils, as summarised in Table I.

Fig. 1. Emulsification of the oil and aqueous phases on a magnetic stirrer with hot plate.

TABLE I. FORMULATION CHART OF HERBAL SUNSCREEN CREAM (PER 50 g BATCH)

Ingredient	F1	F2	F3
Avaram flower extract	2 g	2 g	2 g
Aloe vera extract	1.5 g	1.5 g	1.5 g
Shea butter	5 g	6 g	7 g
Beeswax	4 g	5 g	6 g
Glycerin	3 mL	2.5 mL	2 mL
Vitamin E oil	0.5 mL	0.5 mL	0.5 mL
Rose oil	0.2 mL	0.2 mL	0.2 mL
Olive oil	8 mL	7 mL	6 mL
Coconut oil	5 mL	4.5 mL	4 mL
Lavender oil	1 mL	1 mL	1 mL
Purified water q.s.	19.3 mL	22.3 mL	19.3 mL
Total	50 g	50 g	50 g

E. Evaluation Parameters

The formulated creams were evaluated for physical appearance (color, odor, texture), homogeneity, spread ability (S = m.l/t), extrudability from a collapsible tube, pH (1% aqueous solution using a pH meter), skin-irritation potential (patch test on the forearm, 24 hours), stability (storage at 45°C and at room temperature for one month) and wash ability, following standard cosmetic evaluation procedures.

III. RESULTS AND DISCUSSION

A. Pre-formulation Study

TABLE II. PRE-FORMULATION STUDY OF SENNA AURICULATA POWDER

Parameter	Observation	Interpretation
Angle of repose	30.25°	Good flow
Bulk density	0.683 g/mL	Good
Tapped density	0.408 g/mL	Good
Carr's index	40.26%	Poor flow
Hausner ratio	1.674	Poor flow
Moisture content	53.54% w/w	High moisture content

The powder showed a low angle of repose (30.25°), indicating good flowability, whereas the comparatively high Carr's index and Hausner ratio suggest poorer compressibility, consistent with the fibrous, low-density nature of dried flower material. The high moisture content (53.54% w/w) reflects the hygroscopic character of the crude drug and was taken into an account during extraction and storage.

B. Phytochemical Screening

TABLE III. PHYTOCHEMICAL SCREENING OF SENNA AURICULATA EXTRACT

Constituent	Observation
Alkaloids	Present
Flavonoids	Present
Tannins	Present
Saponins	Present
Terpenoids	Present
Glycosides	Slightly present

TABLE IV. PHYTOCHEMICAL SCREENING OF ALOE BARBADENSIS MILLER EXTRACT

Constituent	Observation
Flavonoids	Present
Phenolic compounds	Present
Tannins	Present
Saponins	Slightly present
Terpenoids	Present
Glycosides	Slightly present

Both extracts were positive for flavonoids, tannins and phenolic compounds, the classes most closely associated with free-radical scavenging and UV-absorbing activity, supporting their inclusion as photoprotective, antioxidant actives in the cream. The additional presence of saponins and terpenoids in both extracts, and alkaloids in Senna auriculata, points to supplementary antimicrobial and anti-inflammatory contributions relevant to topical skin application.

C. Physicochemical Evaluation of the Formulated Creams

TABLE V. EVALUATION OF F1, F2 AND F3 CREAM FORMULATIONS

Test	F1	F2	F3
Physical appearance	White, pleasant, smooth	White, pleasant, smooth	White, pleasant, smooth
Homogeneity	Good	Good	Good
Spreadability	Good	Moderate	Easily spread
Extrudability	Good	Moderate	Good
pH	6.9	5.3	5.5
Irritancy test	No irritant	No irritant	No irritant
Stability	Not stable	Stable	Stable
Washability	Washable	Washable	Washable

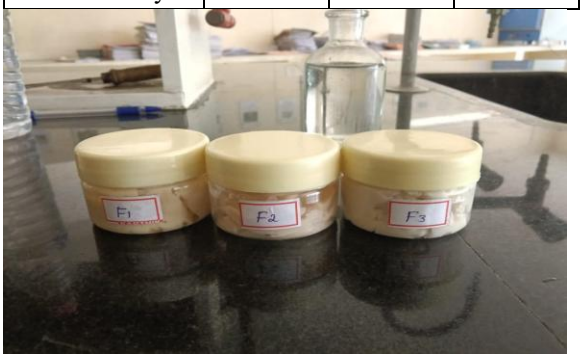

Fig. 2. Formulated herbal sunscreen creams F1, F2 and F3.

TABLE VI. SPREADABILITY AND EXTRUDABILITY OF F1-F3

Formulation	Spread ability	Extrudability
F1	150 g.cm/sec	0.50 g/g
F2	91 g.cm/sec	0.40 g/g
F3	204 g.cm/sec	0.58 g/g

All three formulations were white, smooth and homogeneous with no visible aggregates. Spread ability and extrudability were highest for F3 (204 g.cm/sec; 0.58 g/g), reflecting its optimised ratio of beeswax, shea butter and oils, which allows the cream to be distributed uniformly with minimal effort and dispensed easily from a collapsible tube. The pH of all batches (5.3-6.9) lies within, or close to, the physiological skin pH range, and no signs of redness, itching or swelling were observed in the 24-hour patch test for any formulation, indicating good skin

compatibility. On one-month stability testing at 45°C and at room temperature, F1 showed visible phase separation and was classified as not stable, whereas F2 and F3 remained stable. All formulations were readily washable with water.

Taking spread ability, extrudability, pH, irritancy, stability and wash ability together, F3-containing 7 g shea butter, 6 g beeswax, 2 mL glycerin, 6 mL olive oil and 4 mL coconut oil per 50 g batch-showed the most balanced overall performance and was selected as the optimised formulation.

IV. CONCLUSION

A herbal sunscreen cream formulated with Avaram (Senna auriculata) flower extract and Aloe vera (Aloe barbadensis Miller) gel was successfully prepared and evaluated as a plant-based alternative to conventional sunscreen products. Phytochemical screening confirmed the presence of flavonoids, tannins, phenolic compounds, saponins and terpenoids in both extracts, consistent with their reported antioxidant, anti-inflammatory and photoprotective activity. Of the three batches prepared, F3 demonstrated the most favourable combination of spreadability, extrudability, skin-compatible pH, absence of irritation, physical stability and washability, and is recommended as the optimised formulation. Further work incorporating in-vitro/in-vivo SPF determination and long-term stability studies is warranted to fully establish the photoprotective efficacy of the formulation.

ACKNOWLEDGMENT

The authors thank the Department of Pharmacognosy, [College Name], for providing the laboratory facilities used to carry out this work.

REFERENCES

[1] European Parliament and Council, "Regulation (EC) No. 1223/2009 on cosmetic products," Off. J. Eur. Union, vol. L342, pp. 59-209, 2009.

[2] S. Q. Wang, Y. Balagula, and U. Osterwalder, "Photoprotection: a review of the current and future technologies," Dermatol. Ther., vol. 23, no. 1, pp. 31-47, 2010.

[3] A. R. Young, J. Claveau, and A. B. Rossi, "Ultraviolet radiation and the skin: photobiology and sunscreen photoprotection," J. Am. Acad. Dermatol., vol. 76, no. 3, pp. S100-S109, 2017.

[4] J. A. Nichols and S. K. Katiyar, "Skin photoprotection by natural polyphenols: anti-inflammatory, antioxidant and DNA repair mechanisms," Arch. Dermatol. Res., vol. 302, no. 2, pp. 71-83, 2010.

[5] A. Surjushe, R. Vasani, and D. G. Saple, "Aloe vera: a short review," Indian J. Dermatol., vol. 53, no. 4, pp. 163-166, 2008.

[6] J. H. Hamman, "Composition and applications of Aloe vera leaf gel," Molecules, vol. 13, no. 8, pp. 1599-1616, 2008.

[7] M. Sanchez, E. Gonzalez-Burgos, I. Iglesias, and M. P. Gomez-Serranillos, "Pharmacological update of Aloe vera and its active constituents," Molecules, vol. 25, no. 6, p. 1324, 2020.

[8] P. Puvabanditsin and R. Vongtongsri, "Efficacy of Aloe vera cream in prevention and treatment of sunburn and suntan," J. Med. Assoc. Thai., vol. 88, suppl. 4, pp. S173-S176, 2005.

[9] K. Mohamed Irfan et al., "Formulation of phytosomal nanoparticles containing C. auriculata flower extract for improved topical permeability," 2021.

[10] A. K. Prajapati et al., "Herbal-derived formulations and natural compounds in the treatment of skin ageing," 2022.

[11] H. Gowda H. S. et al., "Phytochemical and pharmacological profile of Cassia auriculata," 2022.

[12] R. Anandan, S. Jeevitha et al., "Phytochemical constituents and therapeutic potential of Cassia auriculata L.," 2023.

[13] S. Rajage, P. Kumbhar et al., "Formulation and evaluation of a herbal peel-off mask using Bael fruit and avaram flower extract," 2024.

[14] A. K. Uchale et al., "Development of a topical sunscreen formulation based on fixed oils and medicinal plants," 2024.

[15] Z. Tietel et al., "Metabolic syndrome-related bioactivities and antidiabetic activity of Cassia auriculata: a review," 2024.

[16] A. M. Agarwal et al., "Formulation and evaluation of a herbal sunscreen cream using aloe vera gel, green tea extract and natural oils," 2025.

[17] P. D. Pokharkar et al., "Formulation and evaluation of herbal sunscreen preparations using natural oils," 2025.
[18] B. Yazhini et al., "Formulation and evaluation of a natural gel-based face wash incorporating Chlorella vulgaris and Senna auriculata extract," 2025.
[19] M. S. Ferreira, M. C. Magalhaes, J. M. Sousa-Lobo, and I. F. Almeida, "Up-to-date overview of the use of natural ingredients in sunscreens," Int. J. Mol. Sci., vol. 23, no. 7, p. 3721, 2022.
[20] D. I. S. P. Resende et al., "Up-to-date overview of the use of natural ingredients in sunscreens," Pharmaceuticals, vol. 15, no. 3, p. 372, 2022.
[21] International Organization for Standardization, ISO 24444:2019 - Cosmetics - Sun protection test methods - In vivo determination of the sun protection factor (SPF), Geneva, Switzerland: ISO, 2019.
[22] U.S. Food and Drug Administration, Sunscreen: How to Help Protect Your Skin from the Sun, Silver Spring, MD, USA: FDA, 2024.