International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 365-372 www.ijprajournal.com ISSN: 2456-4494

Formulation and Evaluation of SPF Lip Balm: Incorporating Karanja Seed Oil and Tomato Seed Oil

Aditi Hirlekar, Tanaya Chandekar, Khushbu Choudhary, Arti Ingole, Dr.P.N.Sable

[1]*Student , Siddhi College of Pharmacy, Chikhali ,Pune*
[2]*Student, Siddhi College of Pharmacy, Chikhali ,Pune*
[3]*Student, Siddhi College of Pharmacy, Chikhali ,Pune*
[4]*Assistant Professor, Siddhi College of Pharmacy, Chikhali ,Pune*
[5]*Principal, Siddhi College of Pharmacy, Chikhali ,Pune*

Date of Submission: 10-11-2025 Date of Acceptance: 20-11-2025

ABSTRACT:
The present study focuses on the formulation and evaluation of a natural SPF lip balm designed to protect the sensitive skin of the lips from harmful ultraviolet (UV) radiation. Three distinct formulations were developed incorporating beeswax, zinc oxide, almond oil, castor oil, vitamin E, and lavender essential oil, while leveraging the photoprotective and antioxidant properties of karanja and tomato seed oils. Evaluation parameters included organoleptic properties, pH, spreadability, melting point, and skin irritation potential. All formulations demonstrated smooth texture, pleasant sensory characteristics, near-neutral pH, excellent spreadability, stable melting point, and no skin irritation. These results affirm the efficacy of natural oils such as karanja and tomato seed oil in enhancing both the photoprotective performance and lip-care benefits of the lip balm. The study supports the potential of plant-based ingredients to provide an effective, safe, and nourishing alternative to synthetic sunscreen agents in lip care products.

Keywords: SPF lip balm, karanja seed oil, tomato seed oil, photoprotection, zinc oxide, herbal formulation, antioxidant activity, natural ingredients, lip care.

I. INTRODUCTION:

The lips are one of the most delicate and exposed parts of the human body, yet they often receive minimal protection compared to other areas of the skin. Due to the absence of sebaceous glands and melanin, the lips are highly susceptible to environmental damage, particularly from ultraviolet (UV) radiation. Prolonged exposure to UV rays can lead to dryness, pigmentation, premature aging, and in severe cases, actinic cheilitis or skin cancer. To address these concerns, the formulation of lip balms containing Sun Protection Factor (SPF) has gained significant importance in the cosmetic and dermatological industries.**[1]**

Anatomy of Lips:

The lips, referred to as the labia oris, are a prominent and expressive feature of the human face. Here is a detailed examination of their structure:

1. Skin: The outer layer of the lips consists of skin that is relatively thin and does not possess the stratum corneum, the outermost layer present in other body regions. This absence of a stratum corneum contributes to the typical reddish or pink hue of the lips.

2.Vermilion Zone: This area is the pinkish-red part of the lips, situated between the facial skin and the mouth's mucous membrane. It has a high concentration of blood vessels, which gives it its unique color.

3. Vermilion Border:Also referred to as the vermilion margin, this is the clear line separating the lips' vermilion zone from the face's flesh. Some people have it more prominently, and makeup like lip liner is frequently used to highlight it.

4.Philtrum: This is the upper lip's vertical furrow or groove that runs from the nasal septum to the vermilion border of the upper lip. It is a noticeable aspect of facial anatomy that varies in depth from person to person.

5. Cupid's Bow:The double curve or indentation in the center of the upper lip that mimics the Roman deity of love Cupid's bow. It differs in prominence from person to person and is a defining trait of the upper lip's shape.

6. Mucous Membrane: Compared to the outer skin, the inner surface of the lips changes into a moist, more sensitive mucous membrane. The oral

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 365-372 www.ijprajournal.com ISSN: 2456-4494

mucosa, which lines the inside of the mouth, is continuous with this mucous membrane.

7. Labial Frenulum:This is a little tissue fold that joins the oral mucosa or gums to the inner surface of the lips. It limits excessive movement and aids in stabilizing the lips' posture.

8. Muscles:The orbicularis oris muscle is a ring of muscles that controls the lips. These muscles enable the lips to move in a variety of ways, such as speaking, frowning, smiling, and puckering.

9. Nerve Endings: Because the lips have so many nerve endings, they are extremely sensitive. The lips are vital for activities because of their sensitivity, which allows them to sense touch, pressure, warmth, and pain.

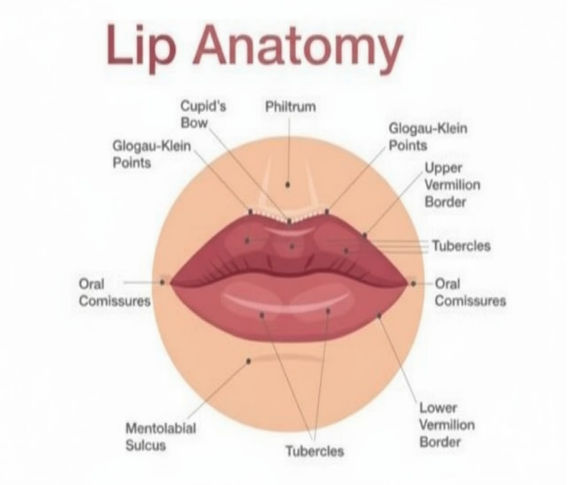

Fig. 1

The development of SPF lip balms utilizing natural oils such as karanja seed and tomato seed oils aims to protect the delicate skin of the lips from the damaging impact of ultraviolet (UV) rays and oxidative stress.**[3][4]** Lip skin, being particularly thin, is highly prone to sunburn, aging, and potential malignancy, which makes effective UV shielding essential**.[4][5]**

Karanja seed oil (from Pongamiapinnata) contains diverse fatty acids—oleic, linoleic, palmitic, and stearic acids—together with valuable components like flavonoids and karanjin that act as natural UV filters and moisturizers.[6][5][7] Research has consistently demonstrated karanja oil's effectiveness for topical sun protection and overall skin wellness, substantiating its use in photoprotective products**[5][8]**

Tomato seed oil, derived from Solanumlycopersicum, is rich in lycopene—a powerful antioxidant with proven efficacy in absorbing UV radiation and providing photoprotection. **[9][10]**Studies examining tomato-based sunscreen formulations report significant SPF values, highlighting its utility in preventing UV-related damage when included in cosmetic applications**.[10][11][9]**

The combination of these two oils in an SPF lip balm has the potential to deliver broad-spectrum sun defence while simultaneously nourishing, soothing, and repairing lip tissue. Such natural formulations not only offer safe alternatives to synthetic sunscreens but also align with current trends in plant-based skincare innovation.

Advantages of Lip balm:

1. Sun Protection: SPF lip balm's main advantage is its capacity to shield your lips from the damaging effects of UV radiation, lowering the chance of sunburn, dryness, and irritation brought on by exposure to the sun.
2. Stops Untimely Aging: similar to the skin on our lips are more prone to fine lines and wrinkles from UV damage than the rest of your face. By protecting the lips from UV rays, SPF lip balm helps prevent these aging symptoms.
3. Lowers the chance of Skin Cancer: Extended exposure to UV radiation raises the chance of developing skin cancer, particularly lip cancer. Applying a layer of protection with SPF lip balm reduces this risk.
4. Hydrates and soothes: Shea butter and coconut oil, two hydrating ingredients included in many SPF lip balms, assist to keep lips hydrated while shielding them from the sun.
5. Prevents Chapping: Dry, cracked lips can result from exposure to the sun. SPF lip balm moisturizes and creates a barrier of protection to keep your lips healthy and smooth.
6. Convenient Protection: Because lip balms are portable and easy to use, reapplying is a breeze.**[12]**

MATERIALS:

1. Karanja seed oil2. Tomato seed oil

Fig. 2

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 365-372 www.ijprajournal.com ISSN: 2456-4494

Biological Source	Solanumlycopersicum
Family	Solanaceae
Species	S.lycopersicum
Parts used	Seeds
Properties	Photoprotection

Fig. 3

Biological Source	Pongamiapinnata
Family	Fabaceae
Species	P.pinnata
Parts used	Seeds
Properties	Natural UV filter,

3. Castor oil

Fig. 4

Biological Source	Ricinus communis
Family	Euphorbiaceae
Species	R.communis

The antimicrobial and anti-inflammatory characteristics of castor oil can support the recovery of minor cuts or irritations on the lips. This is advantageous for keeping lips healthy and avoiding infections. Being a natural oil, castor oil is typically safe for topical application and is appropriate for various skin types. It is a favoured component in natural and organic lip balm recipes because of its non-toxic and eco-friendly characteristics.**[2]**

4. Bees wax

Fig.5

Biological source	Apis mellifera Linn
Family	Apidae
Species	Apis

Beeswax functions as an emollient, forming a barrier on the skin's outer layer that assists in retaining moisture. This barrier keeps lips moisturized and guards them agai nst harsh environmental elements like wind and cold temperatures. It functions as a thickener, providing lip balm with its solid consistency. Beeswax guarantees that the lip balm stays solid and consistent at room temperature, which is crucial for effortless use and convenience.**[2]**

5. Almond oil

Fig. 6

Biological source	Prunusamygdalus Rosaceae
Family	Rosaceae
Species	P.amygdalus

Almond oil is rich in vitamins and antioxidants that nourish and protect the lips. It has

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 365-372 www.ijprajournal.com ISSN: 2456-4494

anti-inflammatory properties that soothe irritation, helps reverse sun damage, provides deep moisturization, and rejuvenates the skin to maintain healthy, soft lips.**[12]**

6. Vitamin E capsule;

Fig. 7

Biological source	Synthetic or natural Vitamin E (usually derived from vegetable oils or wheat germ)
Family	None (vitamin)

[2]Vitamin E is a strong antioxidant that safeguards the lips from harm caused by free radicals and external elements like UV rays and pollution.
This safeguard assists in avoiding early aging of the skin on the lips. Vitamin E possesses remarkable moisturizing qualities, aidi ng in the hydration of the lips. It functions by trapping moisture and stopping the lipsfrom drying out and cracking, whichis particula rly advantageous in difficult weather conditions.

7. Zinc oxide

Fig. 8

It forms a natural barrier against harmful UV rays, protecting the lips from sun damage and keeping them healthy. Commonly used in lip balms with SPF, it offers natural sun defense, prevents sunburn, and helps avoid pigmentation.**[16]**

8. Lavender essential oil

Fig. 9

Biological source	Lavandula angustifolia
Family	Labiatae
Species	Lavandula

It provides antioxidant, anti-inflammatory, moisturizing, skin-rejuvenating, and soothing benefits. In formulations, it provides a pleasant fragrance, moisturizes, and promotes skin healing and soothing, improving the appearance of lips.**[17]**

FORMULATION TABLE:

INGREDIENTS	**FORMULATION**		
	F1	**F2**	**F3**
1. Karanja Oil	1.5 ml	1.5 ml	1 ml
2. Tomato Seed Oil	1 ml	1.5 ml	1 ml
3. Beeswax	1.0 g	1.20 g	1.50 g
4. Zinc Oxide	0.15 g	0.20 g	0.25 g
5. Almond Oil	4.3 ml	2.55 ml	4.2 ml
6. Castor Oil	1 ml	2 ml	1 ml
7. Vitamin E	1 ml	1 ml	1 ml
8. Fragrance (lavender essential oil)	0.05 ml	0.05 ml	0.05 ml
Total	**10 g**	**10 g**	**10 g**

❖ **METHOD OFPREPARATION :**

1. Weigh all the ingredients accurately.
2. Melt beeswax in a water bath at approximately 62-64°C until fully liquefied.
3. Add the carrier oils : Karanja seed oil, tomato seed oil, castor oil, and almond oil—and stir well to blend.
4. Add zinc oxide by stirring thoroughly to form uniform dispersion.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 365-372 www.ijprajournal.com ISSN: 2456-4494

5. Remove from water bath and add vitamin E capsule and fragrance and mix well.
6. Pour the mixture into small clean containers.
7. Allow the balm to cool and solidify at room temperature.
8. Store in a cool, dry place and use as needed.**[18]**

Fig. 10

EVALUATION:[16][18][19]

1. Organoleptic Properties: Visual and sensory characteristics such as colour, odour, taste, and appearance are examined to ensure the product is appealing and acceptable to consumers.

Sr.No	Parameters	F1	F2	F3
1.	Colour	White	White	White
2.	Odour	Pleasant	Pleasant	Pleasant
3.	Appearance	Smooth	Smooth	Smooth
4.	Taste	Tasteless	Tasteless	Tasteless

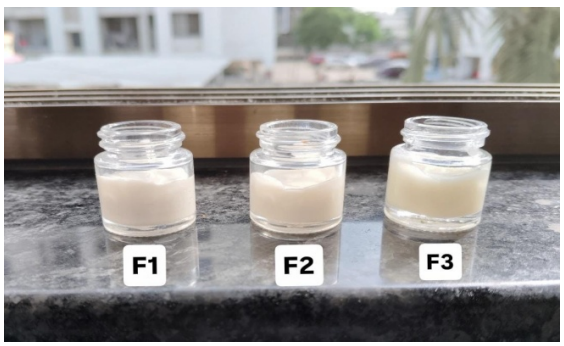

Fig. 11

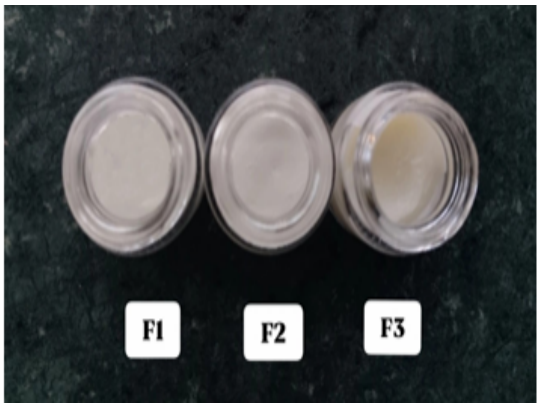

Fig. 12

Discussion:

All three formulations appeared smooth, uniform, and pleasant in fragrance. F1 showed an off-white shade while F2 and F3 were white. The texture was soft and consistent, indicating proper blending of ingredients and good consumer acceptability.

2. pH Measurement: The pH of the lip balm is measured by dissolving a sample in distilled water and using a pH meter or pH paper. A near-neutral pH (around 5.5 to 6.5) is preferred to avoid irritation and maintain compatibility with the skin of the lips.

Sr.No	Parameter	F1	F2	F3
1.	pH	6.12	5.60	5.71

Fig. 13
F1

Fig. 14
F2

Fig. 15
F3

Discussion:

The pH values (6.12, 5.60, and 5.71) were within the ideal range of 5.5–6.5, confirming that all formulations are compatible with lip skin and safe for regular use.

3. Spreadability Test: This test evaluates the ease with which the lip balm can be applied evenly on the lips. It is quantified by measuring the time or force required to spread a fixed amount of the product uniformly, indicating user-friendliness and texture. The spreadability of

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 365-372 www.ijprajournal.com ISSN: 2456-4494

the lip balm is assessed by uniformly applying a specific amount onto a glass slide and observing the ease of spreading, including the smoothness and absence of fragmentation or deformation during application.

Sr. No	Parameter	F1	F2	F3
1.	Spreadibility	Easily Spreadable	Easily Spreadable	Easily Spreadable

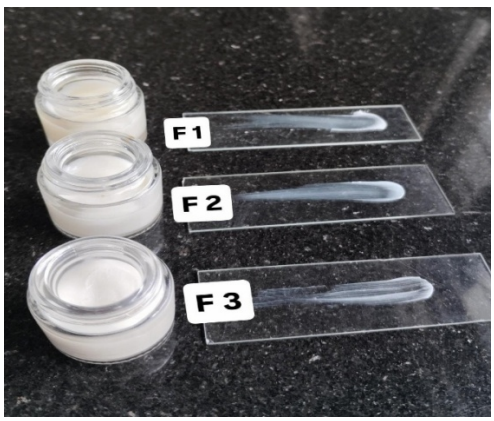

Fig. 16

Discussion:

Each formulation was easily spreadable, ensuring smooth application without stickiness. This reflects a well-balanced ratio of wax and oils, providing a soft and uniform texture.

4. Melting Point: The melting point determines the thermal stability and suitability of the lip balm under various storage conditions. The melting point is determined by sealing a lip balm sample in a glass capillary, immersing it in a melting point apparatus, and visually noting the temperature at which the product transitions from solid to liquid.

Sr.No	Parameter	F1	F2	F3
1.	Melting point	55^{0}C	57^{0}C	60^{0}C

Discussion:

Melting points ranged between 55°C and 60°C, indicating good firmness and stability under normal storage conditions. F1, with the highest melting point, showed slightly better thermal stability.

5. Skin Irritation Test: The product is applied to a small skin area to check for any adverse reactions, confirming dermal safety.

Sr.No	Parameter	F1	F2	F3
1.	Skin irritation	No Irritation	No Irritation	No Irritation

Fig. 17 **F1** **Fig. 18** **F2** **Fig. 19** **F3**

Discussion:

No irritation, redness, or itching was observed, confirming that all formulations are safe and suitable for topical application.

II. DISCUSSION:

The formulated SPF lip balms, incorporating natural ingredients such as karanja seed oil, tomato seed oil, beeswax, zinc oxide, and almond oil, demonstrated strong performance across all evaluated parameters. The organoleptic assessment revealed that all three formulations provided a smooth, consistent texture and pleasant fragrance, supporting good consumer acceptability. Notably, the pH values for all formulations (6.12, 5.60, and 5.71) were within the optimal range (5.5–6.5), confirming the suitability of these balms for lip application and minimizing irritation risk. Spreadability was excellent for all samples, ensuring ease of use and even distribution with little resistance or stickiness, reflecting an appropriate balance between wax and oil phases.

The melting point measurements (55°C to 60°C) indicated robust thermal stability, ensuring that the product remains solid under typical storage and usage conditions. No skin irritation was observed during dermal testing, underscoring the safety of the formulations for sensitive lip skin. These results collectively highlight the effectiveness of natural oils (particularly karanja and tomato seed) both as photoprotective agents and for maintaining lip skin health, thanks to their antioxidant content and fatty acid profiles. The use

of zinc oxide further amplified the UV protection without compromising cosmetic qualities. Overall, the results align with previous studies on herbal lip care and natural sunscreens, supporting the shift toward safer, plant-based alternatives in personal care products.

III. CONCLUSION:

This research confirms that lip balms formulated with karanja seed oil, tomato seed oil, and zinc oxide can provide effective sun protection, hydration, and nourishment for the lips. All three tested formulations exhibited stable physical properties, user-friendly textures, optimal pH, favorable sensory profiles, and no adverse skin reactions. The combination of natural photoprotective and antioxidant ingredients resulted in a lip balm suitable for daily use, offering a safe alternative to synthetic SPF products and supporting broader trends in natural, sustainable personal care. This study reinforces the potential for innovative, plant-based ingredients to enhance both function and appeal in lip care products, benefiting consumer skin health and aligning with the demand for eco-friendly cosmetic solutions.

REFERENCES:

[1]. Wright TI, et al. Prevention of Environmental Damage—Daily use of lip balms with SPF prevents sunburn and lip cancer. Comprehensive Review of Lip Balms. International Journal of Research Publication and Reviews. 2025;6(3):1148-1154.

[2]. Sable Santosh Barikrao, Lad Snehal D., Garje S. Y., Sayyed G.A. (2024). Development and Evaluation of a Herbal Lip Balm Enriched with Beetroot Extract. International Journal of Research Publication and Reviews, Vol. 5, Issue 6, June 2024, pp. 6858-6864. ISSN 2582-7421.

[3]. Alam R. Studies on the Properties of Karanja Oil for Probable Industrial Application [Internet]. MSc Dissertation, National Institute of Technology Rourkela; 2011.

[4]. Mansuri R, Nagori BP, Kumar S, Pant AB, Chauhan B. Potential of Natural Compounds as Sunscreen Agents. Pharmacogn Rev [Internet]. 2021;15(29):47-57.

[5]. Sopyan I, Lestari SD, Yuliati A, Wahju K, Widowati S. Formulation of Tomato Extracts (Solanumlycopersicum L.) as a Sunscreen Lotion. Natl J Physiol Pharm Pharmacol [Internet]. 2018;8:1086–1090.

[6]. Sjahjadi FR, Widowati S, Sopyan I, Wahju K, Lestari S. Formula Optimization of a Sunscreen Cream of Tomato's Purified Extract. In: Proceedings of ICCSCP-21 [Internet]. Atlantis Press; 2021.

[7]. Syamsidi A, Muntini MS, Rudianto N, Dewi K. Development and Evaluation of Microemulsion-Based Sunscreen Containing Tomato Lycopene. [Internet]. 2023.

[8]. Patel S, Shinde P. Formulation and Evaluation of Karanja-Based Herbal Sunscreen. World J Pharm Res [Internet]. 2024;13(2).

[9]. Goswami PK. Natural Sunscreen Agents: A Review. SchAcad J Pharm [Internet]. 2019;2(6):458-463.

[10]. Mahajan SG, Gajbhiye KT. Analytical Analysis of Karanj Seed Oil. World J Pharm Med Res [Internet]. 2022;8(3):140-143.

[11]. Sagwan S, Chauhan S, Kaushik P. Comparative Physical Properties of Karanja Seed Oil. Int J Appl Biol Pharm Technol [Internet]. 2016;7(2):23-29.

[12]. Athira G R, KhadeejathLuhluh K K, Nandana K Ramesh, Nida Moidu, Sreelakshmi M V, VenkideshRajagopal. "Formulation and Evaluation of Lipbalm." International Journal of Pharmaceutical Sciences, 2025, Vol 3, Issue 6, pages 3400-3408. Published June 23, 2025. DOI: 10.5281/zenodo.15718295.

[13]. Planet Ayurveda. Karanj / Indian Beech (PongamiaPinnata) [Internet]. 2022 Oct 16 [cited 2025 Nov 8]. Available from: www.planetayurveda.comWikipedia contributors.

[14]. Tomato seed oil [Internet]. Wikipedia, The Free Encyclopedia; 2011 Oct 18 [cited 2025 Nov 8]. Available from: en.wikipedia.org/wiki/Tomato_seed_oil

[15]. Mishrsa I, Jyoti, Sonia, Singh RK, Tanniru R, Rao CMM. Formulation and Evaluation of a Polyherbal Lip Balm. J Clin Case Rep Med Images Health Sci. 2025;11(2):1-12.

[16]. Sarukh VS, Mehetar YR, Kunde NV. Design & Characterization of Sun

Protective Lip Balm Formulation. Int J Res Public Rev. 2025;6(4):1361-1366.

[17]. Pokajewicz K, Białoń M, Ciesielski W, Krzemińska J, Wieczorek PP, Stochmal A. Chemical composition of the essential oil of the new cultivars of Lavandula angustifolia Mill. bred in Ukraine. Molecules. 2021 Sep 17;26(18):5681. doi: 10.3390/molecules26185681. PMID: 34579494; PMCID: PMC8509468.

[18]. Chate AP, Ansari RA, Jain S. Formulation and evaluation of herbal lip balm. Int J Novel Res Dev. 2024;9(6):385-392.

[19]. Paithankar S, Pansare K, Jadhav D, Pawar A. Formulation of Natural Lip Balm. Int Res J Eng Technol. 2023;10(1):1009-1014.

[20]. Vikram, Shadab MD, Lakshmi CSR, Kavitha PN. Formulation and evaluation of herbal lip balm. Int J Novel Res Dev. 2023;8(9):288-298.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 6 Nov - Dec 2025, pp: 365-372 www.ijprajournal.com ISSN: 2456-4494