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Research Paper

Formulation And Evaluation of Ash Gourd (*Benincasa Hispida*) Sunburn Recovery Spray

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ABSTRACT

Sunburn is an acute inflammatory skin condition caused by excessive ultraviolet (UV) radiation exposure, characterized by erythema, pain, and skin irritation. The present study aimed to formulate and evaluate a herbal sunburn recovery spray using aqueous extract of Ash Gourd (*Benincasa hispida*) as the primary active ingredient. The spray was prepared with aloe vera juice, rose water, glycerin, propylene glycol, salicylic acid, vitamin E, Tween 20, methylparaben, and propylparaben in a 50 ml formulation. The prepared spray was evaluated for organoleptic properties, pH, film formation quality, and microbial growth. The formulation showed acceptable appearance (pale greenish-white), smooth non-greasy texture, a pleasant herbal odour, and easy uniform film formation. The pH was recorded at 6.8, indicating compatibility with the skin's physiological acid mantle (pH 6.5–7.0). Film formation was rated excellent with an absorption time of 90–120 seconds. No microbial growth was observed on nutrient agar plates at Day 0, 7, 14, or 28, confirming adequate preservation by the paraben system. The study establishes the formulation feasibility and preliminary safety profile of the developed herbal spray as a potential cosmeceutical topical product for first-degree sunburn care. Further studies including ICH stability testing, extract standardization, and clinical efficacy evaluation are recommended before therapeutic claims can be made.

INTRODUCTION

The human skin serves as the primary barrier against environmental insults, including ultraviolet (UV) radiation from the sun. Excessive

exposure to solar UV-B radiation (280–315 nm) triggers a cascade of acute and chronic skin damage collectively termed sunburn (erythema solare), characterized by erythema, oedema, pain, and in severe cases, blistering and systemic

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symptoms. Globally, sunburn is a major public health concern linked to accelerated photoaging, photocarcinogenesis, and immunosuppression. According to the World Health Organization (WHO), unprotected skin exposure to UV radiation is the primary risk factor for basal cell carcinoma, squamous cell carcinoma, and cutaneous melanoma ¹. Post-sunburn skin management is as critical as photoprotection itself. Conventional treatments include topical corticosteroids and NSAIDs; however, prolonged use carries risks of skin atrophy, hypopigmentation, and systemic absorption ². This has fuelled growing research interest in plant-based cosmeceutical formulations. Herbal topical preparations offer a diverse chemical repertoire including polyphenols, flavonoids, vitamins, and mucilaginous compounds conferring anti-inflammatory, antioxidant, and skin-repair properties with a favourable safety profile. Ash gourd (*Benincasa hispida* Thunb.), a member of the family Cucurbitaceae, is extensively used in Ayurvedic and traditional medicine across India and Southeast Asia. The fruit contains over 95% water along with vitamins B and C, minerals, flavonoids (isovitexin, vitexin), beta-sitosterol, ursolic acid, and mucilaginous polysaccharides that collectively impart cooling, anti-inflammatory, antioxidant, and demulcent effects on the skin ³. A spray dosage form was selected over creams or gels because it enables contactless application, which is critical when direct rubbing on erythematous, sensitized skin causes additional pain and irritation. The aqueous base additionally provides an evaporative cooling effect, which is clinically desirable in sunburn management ⁴. The present study aimed to formulate and evaluate a herbal sunburn recovery spray using *Benincasa hispida* aqueous extract and to establish its preliminary physicochemical and microbiological quality profile.

MATERIALS AND METHODS

Plant Material

Fresh, mature Ash gourd (*Benincasa hispida*) fruits were procured from the local vegetable market, Ahilyanagar, Maharashtra. Fruits were selected free from visible damage or fungal contamination and were botanically identified on the basis of established morphological characteristics as described by Singh and Singh ⁵.

Chemicals and Excipients

The following materials were used: Aloe vera juice (commercial grade, preservative-free), Rose water (steam-distilled, pharmaceutical grade), Glycerin IP, Propylene Glycol IP, Salicylic Acid IP, Vitamin E (D-Alpha Tocopherol, cosmetic grade), Tween 20 (Polysorbate 20, cosmetic grade), Methylparaben IP, Propylparaben IP, and Distilled Water.

Preparation of Ash Gourd Aqueous Extract

- The method was standardized based on published protocols.
- Fresh Ash gourd flesh (100 g) was blended with 100 ml distilled water for 5 minutes.
- The slurry was filtered through double-layered muslin cloth followed by Whatman No. 1 filter paper to obtain a clear extract.
- The extract was heated at 60°C for 15 minutes to partially denature proteases and reduce microbial bioburden, then cooled to room temperature and used immediately to minimize degradation of heat-labile Vitamin C.

Formulation Composition

The final formulation composition (per 50 ml batch) is presented in Table 1.



TABLE 1: Final Formulation Composition of Ash Gourd Sunburn Recovery Spray (50 ml Batch)

Sr. No.	Ingredient	Quantity	Category	Rationale
1	Ash Gourd Aqueous Extract	12.5 ml (25% v/v)	Active	Primary active — cooling, anti-inflammatory, antioxidant, wound healing support
2	Aloe Vera Juice	10 ml (20% v/v)	Active	Soothing, moisturizing, promotes epithelial repair via acemannan
3	Rose Water	5 ml (10% v/v)	Vehicle	Mild anti-inflammatory, pleasant aroma, natural pH 5.0–6.5
4	Glycerin	2.5 ml (5% v/v)	Humectant	Moisture retention, prevents post-sunburn dryness
5	Propylene Glycol	2.5 ml (5% v/v)	Co-solvent	Solubilizes parabens, enhances penetration, humectant
6	Salicylic Acid	0.25 g (0.5% w/v)	Keratolytic / Anti-inflammatory	Promotes shedding of UV-damaged cells, anti-inflammatory
7	Vitamin E (Tocopherol)	0.25 ml (0.5% v/v)	Antioxidant	Neutralizes UV-induced ROS, promotes skin repair
8	Tween 20	0.75 ml (1.5% v/v)	Solubilizer	Ensures Vitamin E and Salicylic Acid remain in solution
9	Methylparaben	0.09 g (0.18% w/v)	Preservative	Broad-spectrum antibacterial and antifungal
10	Propylparaben	0.01 g (0.02% w/v)	Preservative	Antifungal synergist; enhances Methylparaben activity
11	Distilled Water	q.s. to 50 ml	Vehicle	Primary dispersion medium

Formulation Procedure

1. (Aqueous Active Phase): Ash gourd extract (12.5 ml) and aloe vera juice (10 ml) were combined and mixed gently.

2. (Preservative Dissolution): Methylparaben (0.09 g) and Propylparaben (0.01 g) were dissolved in warm propylene glycol (2.5 ml) at 60°C.

3. (Vitamin E Solubilization): Vitamin E (0.25 ml) was solubilized in Tween 20 (0.75 ml).

4. (Salicylic Acid Dissolution): Salicylic acid (0.25 g) was dissolved in the Vitamin E-Tween 20 mixture with gentle warming.

5. (Assembly): Rose water (5 ml) and glycerin (2.5 ml) were added to Phase 1, followed by dropwise addition of Phase 2 with continuous stirring.

6. Phase 3+4 mixture was added with vigorous mixing.

7. (Volume Adjustment): Volume made up to 50 ml with distilled water.

8. (pH Adjustment): pH was measured and adjusted to 6.5–7.0 using 0.1N citric acid if necessary.

9. (Filling): The formulation was filled into a sterile amber spray bottle.



Evaluation Parameters

A. Organoleptic Evaluation

The formulation was evaluated for appearance, colour, odour, and texture by visual and tactile assessment by three trained observers.

B. pH Determination

A calibrated digital pH meter (calibrated with pH 4.0 and 7.0 standard buffer solutions) was used. The electrode was immersed in approximately 10 ml of the formulation at room temperature and the reading was allowed to stabilize. Three readings were taken and the mean recorded.

C. Film Formation Quality

A measured volume of 0.5 ml of the spray was applied to a defined 5 cm × 5 cm area on the dorsal surface of the hand. The ease of spreading, uniformity of the resultant film, smoothness, and absorption time were observed and recorded.

D. Microbial Growth Assessment

Nutrient agar plates were prepared and sterilized. One uninoculated plate served as a negative control. A loopful of the formulation was streaked on separate plates and incubated aerobically at 37°C for 48 hours. Plates were examined for visible microbial colonies at Day 0, Day 7, Day 14, and Day 28 post-formulation.

CONCLUSION

The Ash Gourd (*Benincasa hispida*) Sunburn Recovery Spray was successfully formulated and evaluated as an exploratory herbal cosmeceutical preparation. The formulation demonstrated

acceptable organoleptic characteristics, a skin-compatible pH of 6.8, excellent film formation quality, and effective microbiological preservation over a 28-day observation period. The scientific rationale for ingredient selection — including the cooling and anti-inflammatory properties of *Benincasa hispida* aqueous extract, the soothing and moisturizing effects of aloe vera and glycerin, the antioxidant contribution of Vitamin E, and the broad-spectrum preservation of the paraben system — is supported by peer-reviewed pharmacological evidence.

However, this work establishes formulation feasibility only and does not constitute proof of therapeutic or clinical efficacy. Significant further work is required before any product claims can be substantiated, including: ICH Q1A(R2)-compliant accelerated and long-term stability studies; standardized quantitative phytochemical analysis of the ash gourd extract; ISO 11930:2019-compliant antimicrobial effectiveness testing; primary skin irritation and sensitization studies; and controlled clinical trials. This formulation represents a promising starting point for the development of a novel, herbal, consumer-preferred topical product for first-degree sunburn management.

RESULT AND DISCUSSION

Organoleptic Evaluation

The organoleptic characteristics of the formulation are presented in Table 2. The formulation demonstrated acceptable appearance and sensory attributes suitable for a topical product intended for sun-sensitive skin.



TABLE 2: Organoleptic Evaluation Results

Sr. No.	Parameter	Observation
1	Appearance	Clear to slightly opalescent liquid
2	Colour	Pale greenish-white
3	Odour	Mild, characteristic herbal odour
4	Texture	Smooth, non-greasy on application

The pale greenish-white colour is attributable to the combination of ash gourd aqueous extract and aloe vera juice. The mild herbal odour arises primarily from the natural volatile components of rose water and aloe vera. The non-greasy texture is a critical consumer-acceptability attribute for a sunburn spray, particularly given that post-sunburn skin is often hot and hyper-sensitized; any occlusive or greasy feel would compromise patient compliance.

pH Determination

The pH of the formulation was recorded at 6.8 (± 0.1). This value falls within the optimal physiological range for topical skin formulations (6.5–7.0), indicating compatibility with the skin's acid mantle. A pH of 6.8 also favours the undissociated (active) form of salicylic acid (pK_a 2.97) at this concentration, ensuring optimal preservative efficacy of the paraben system, and supports the stability of ascorbic acid present in the ash gourd extract. Singh et al. (2010) established that a pH between 4.5 and 6.5 is acceptable for topical aqueous sprays ⁷; the present formulation, intended for sunburned skin with a mildly disrupted acid mantle (pH commonly rising to 7.0–7.5 post-sunburn), is correctly formulated at the higher end of the acceptable range to minimize additional irritation to compromised skin.

Film Formation Quality

The spray formed a thin, uniform, transparent film over the applied area with minimal effort. Spreading was smooth with no dragging, clumping, or streaking observed. Film formation was complete and even across the test surface area. The absorption time was approximately 90–120 seconds, which is appropriate for a topical spray intended to provide a residual protective and moisturizing layer. The film formation quality was rated excellent. This property is largely attributed to the mucilaginous polysaccharides (pectin) present in the ash gourd aqueous extract, which are known to form thin protective films over epithelial surfaces and promote moist wound environments conducive to epithelial migration ⁸.

Microbial Growth Assessment

No microbial growth was observed on the formulation-streaked nutrient agar plates at any time point — Day 0, Day 7, Day 14, or Day 28. The negative control plate remained sterile throughout. This confirms that the paraben preservative system (Methylparaben 0.18% w/v + Propylparaben 0.02% w/v) effectively inhibited microbial proliferation over the 28-day observation period. Cashman and Warshaw (2005) documented that the methyl–propyl paraben combination provides broad-spectrum antimicrobial efficacy at these concentrations, with methylparaben being more active against bacteria and propylparaben against fungi ⁶. The supplementary antimicrobial activity of Benincasa

hispid extract (demonstrated against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*) likely provides additional preservative support to the system ¹.

It is important to note, however, that the microbial assessment performed in this study (nutrient agar streak method) is a preliminary in-house method and does not constitute a validated antimicrobial effectiveness test (AET) as required by ISO

11930:2019 or USP <51>. A formal AET using challenge organisms at defined inoculation densities (*Staphylococcus aureus* ATCC 6538, *Pseudomonas aeruginosa* ATCC 9027, *Candida albicans* ATCC 10231) would be required to support regulatory submission of this product.

Summary of Evaluation Results

TABLE 3: Summary of Evaluation Results

Evaluation Parameter	Result	Inference
Appearance	Pale greenish-white	Acceptable for herbal topical spray
Odour	Mild herbal odour	Consumer acceptable
Texture	Smooth, non-greasy	Suitable for sunburned skin
pH	6.8 (± 0.1)	Skin-compatible; within physiological range
Film Formation Quality	Thin, uniform, transparent film; absorption 90–120 sec	Excellent — suitable for contactless spray use
Microbial Growth (Day 0–28)	No growth observed	Preservative system effective; microbiologically safe

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