

A REVIEW ON FORMULATION AND EVALUATION OF ANTI SUNBURN PREPARATION WITH SILVER NANO PARTICLES

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ABSTRACT

Sunburn is a common skin condition caused by excessive exposure to ultraviolet (UV) radiation, leading to inflammation, redness, and long-term skin damage. The present study focuses on the formulation and evaluation of an anti-sunburn preparation incorporated with silver nanoparticles, aiming to enhance protective and therapeutic efficacy. Silver nanoparticles (AgNPs) have gained significant attention in pharmaceutics due to their antimicrobial, anti-inflammatory, and antioxidant properties. The anti-sunburn efficacy of the formulation is assessed by determining its ability to protect against UV-induced damage and soothe inflamed skin. The presence of silver nanoparticles enhances skin protection by reducing microbial growth, minimizing oxidative stress, and promoting faster healing.

KEYWORDS: AgNPs: Silver nanoparticles, UV: Ultraviolet.

INTRODUCTION

Skin is the largest organ of the human body and acts as a protective barrier against environmental pollutants, microorganisms, and harmful ultraviolet (UV) radiation from sunlight. Continuous exposure to UV radiation can lead to various skin problems such as sunburn, premature aging, pigmentation, wrinkles, and even skin cancer. Therefore, protection of the skin against harmful solar radiation has become an important aspect in pharmaceutical and cosmetic research. Sunlight contains different types of ultraviolet rays, mainly UVA and UVB rays. UVA rays penetrate deeply into the skin and are responsible for skin aging and wrinkles, whereas UVB rays mainly affect the outer layer of the skin causing redness, irritation, and sunburn. Prolonged exposure to these radiations damages skin cells and produces oxidative stress due to the generation of free radicals. To overcome these harmful effects, anti-sunburn preparations such as lotions, creams, gels, and sprays are widely used. These preparations contain active

ingredients capable of absorbing, reflecting, or scattering ultraviolet radiation before it penetrates into the skin. Among different topical dosage forms, lotions are widely preferred because they are non-greasy, easily spreadable, soothing to the skin, and suitable for large surface application.^[1]

Silver nanoparticles (AgNPs) are particles of silver having a size range between 1–100 nanometers. Due to their nano-size, they exhibit enhanced reactivity and improved surface activity. These nanoparticles can provide better interaction with skin surfaces and improve the effectiveness of topical formulations. Incorporation of silver nanoparticles into anti-sunburn preparations enhances the stability, spreadability, and therapeutic efficacy of the formulation. Silver nanoparticles also exhibit anti-inflammatory properties that help in reducing redness, irritation, and inflammation associated with sunburn. In addition, they possess excellent antimicrobial activity against various bacteria and fungi,

thereby preventing microbial contamination and skin infections. These properties make silver nanoparticles highly suitable for incorporation into topical sunscreen formulations.

Conventional sunscreens mainly contain chemical or physical UV filters for protection against sunlight. However, incorporation of silver nanoparticles into sunscreen formulations provides additional benefits such as improved UV-scattering properties, enhanced antioxidant activity, and better skin protection. Nanoparticles form a thin protective layer on the skin surface and provide uniform distribution, thereby increasing the efficiency of the preparation.

The formulation of anti-sunburn lotion containing silver nanoparticles represents an innovative and promising approach in the development of modern skincare products. Such formulations provide effective protection against UV radiation while maintaining skin hydration, smoothness, and cosmetic elegance. The small particle size of silver nanoparticles improves penetration and enhances the overall performance of the formulation. Nowadays, increasing environmental pollution and depletion of the ozone layer have increased human exposure to harmful ultraviolet radiations. This has resulted in increased awareness among people regarding the importance of sunscreen products.

1. Antioxidant Activity

Silver nanoparticles (AgNPs) exhibit strong antioxidant properties by neutralizing free radicals generated due to

ultraviolet (UV) radiation exposure. UV rays induce oxidative stress in skin cells leading to cellular damage, premature aging, and skin irritation. AgNPs help in scavenging these free radicals, thereby protecting skin cells from oxidative damage and maintaining healthy skin structure.^[2]

2. Anti-inflammatory Effects

Exposure to excessive sunlight often causes redness, swelling, irritation, and inflammation of the skin. Silver nanoparticles possess anti-inflammatory properties that help in reducing inflammatory responses caused by UV radiation. They soothe the affected skin and minimize skin irritation and burning sensation associated with sunburn.^[3]

3. Antimicrobial Protection

Silver nanoparticles are well known for their broad-spectrum antimicrobial activity against bacteria, fungi, and other microorganisms. Incorporation of AgNPs into anti-sunburn preparations helps in preventing microbial contamination of the formulation and protects damaged skin from infections.

4. UV-Scattering Properties

Silver nanoparticles possess the ability to scatter and reflect ultraviolet radiation, thereby reducing UV penetration into the skin. This enhances the sun protection efficiency of the formulation and improves overall skin protection against harmful solar radiation.

Formulation of anti-sun burn lotion

Ingredients	Quantity(%)	Category
Silver nanoparticles	0.5%	Active ingredient
Stearic acid	5%	Emulsifier
Cetyl alcohol	3%	Thickening agent
Liquid paraffin	8%	Emollient
Coconut oil	5%	moisturizer
glycerin	4%	Humectant
Propylene glycol	3%	Moisturizer
Tween 80	2%	Emulsifying agent
Span 80	1%	Emulsifying agent
Methyl paraben	0.2%	Preservative
Propyl paraben	0.1%	Preservative
Aloe vera extract	2%	Soothing agent
fragrance	Q.s	Perfuming agent
Distilled water	Q.s to 100ml	Vehicle

Preparation of Anti-Sunburn Lotion with Silver Nanoparticles

The anti-sunburn lotion containing silver nanoparticles was prepared by emulsification method. The formulation was designed to provide protection against harmful ultraviolet radiation while maintaining skin hydration and smoothness. Initially, all required ingredients were collected and accurately weighed according to the formulation table. The preparation process was divided

into oil phase preparation and aqueous phase preparation.^[4]

In the oil phase, stearic acid, cetyl alcohol, liquid paraffin, coconut oil, and Span 80 were taken in a clean beaker and heated at about 70°C until completely melted. Simultaneously, in another beaker, distilled water, glycerin, propylene glycol, Tween 80, and preservatives were dissolved and heated to the same temperature. After

complete heating, the aqueous phase was slowly added to the oil phase with continuous stirring using a mechanical stirrer. Stirring was continued until a uniform emulsion was formed.^[5]

Procedure

Step 1: Collection of Materials

All ingredients required for formulation of anti-sunburn lotion were collected and accurately weighed.

Step 2: Preparation of Oil Phase

Stearic acid, cetyl alcohol, liquid paraffin, coconut oil, and Span 80 were mixed together and heated at 70°C until completely melted.

Step 3: Preparation of Aqueous Phase

Distilled water, glycerin, propylene glycol, Tween 80, methyl paraben, and propyl paraben were dissolved in another beaker and heated to the same temperature.

Step 4: Emulsification Process

The aqueous phase was added slowly into the oil phase with continuous stirring. Stirring was continued until a smooth and uniform lotion was obtained.

Step 5: Addition of Silver Nanoparticles

After cooling the lotion slightly, silver nanoparticles were added slowly with continuous stirring to ensure proper distribution.

Step 6: Addition of Additives

Aloe vera extract and fragrance were added to improve soothing effect and acceptability of the lotion.

Step 7: Packaging and Storage.^[6]

EVALUATION

Evaluation of topical formulations is an important step in pharmaceutical and cosmetic formulation development. Evaluation studies help determine the quality, stability, safety, effectiveness, and acceptability of the prepared formulation. Anti-sunburn preparations containing silver nanoparticles require various physical, chemical, and biological evaluation tests to ensure that the formulation provides effective protection against harmful ultraviolet radiation without causing skin irritation or instability.^[7]

1. Organoleptic Evaluation: Organoleptic evaluation is performed to determine the physical characteristics of the formulation using sensory organs.

2. Homogeneity Test: Homogeneity refers to the uniform distribution of ingredients throughout the formulation.

Procedure: A small quantity of formulation is pressed between the thumb and index finger to detect the presence of lumps or coarse particles.

Importance: Homogeneous formulations ensure uniform drug distribution and proper therapeutic activity.

3. pH Determination

The pH of topical formulations is an important parameter because formulations with unsuitable pH may cause skin irritation.^[8]

Procedure: 1 g of formulation is dispersed in distilled water and measured using a digital pH meter.

Importance: The pH of skin normally ranges between 5 and 7. The formulation should maintain skin compatibility.

4. Viscosity Study: Viscosity determines the resistance to flow and spreadability of the formulation.

Procedure: Viscosity is measured using a Brookfield viscometer at room temperature.

Importance: Proper viscosity ensures easy application and uniform spreading over the skin.^[9]

5. Spreadability Test: Spreadability determines the ease with which the formulation spreads on the skin surface.

Procedure: The formulation is placed between two glass slides and compressed using a specific weight. The time required for spreading is measured.^[10]

Formula;

$$\text{Where: } S = \frac{M \times L}{T}$$

S = Spreadability, L = Length moved by glass slide

M = Weight tied to upper slide, T = Time taken

Importance: Good spreadability improves patient compliance and ensures uniform application.

6. Washability Test: Washability determines the ease of removal of the formulation from the skin surface.

Procedure: The applied formulation is washed using water and observed for ease of removal.

Importance: Good washability improves user convenience.^[11,12]

7. Extrudability Test: Extrudability measures the ease with which the formulation can be removed from the container or tube.

Procedure; The formulation is filled into a collapsible tube and pressure is applied to extrude the product.

Importance: This test ensures convenient handling and application.

8. Irritancy Test: The irritancy test evaluates the safety of the formulation on skin

Procedure: The formulation is applied to a small area of skin and observed for redness, itching, or irritation.^[13,14]

Importance: Topical preparations should be non-irritant and safe for skin application.

9. Drug Content Determination: Drug content determination measures the amount of active ingredient present in the formulation.

Procedure: A known quantity of formulation is dissolved in suitable solvent and analyzed using UV-visible spectrophotometer.^[15]

Importance: Uniform drug content ensures proper therapeutic efficacy.

10. In Vitro Diffusion Study: This study evaluates the release of active ingredients from the formulation.

Procedure: The formulation is placed in a diffusion cell separated by membrane and drug diffusion is measured over time.^[13]

Importance: Controlled drug release improves therapeutic effectiveness.

CONCLUSION

Anti-sunburn preparations containing silver nanoparticles provide effective UV protection, antimicrobial action, improved stability, and enhanced therapeutic efficiency. Their multifunctional properties make them highly beneficial in modern skincare and pharmaceutical formulations. However, issues such as toxicity risk, environmental concerns, high production cost, and limited long-term safety data must be carefully considered. Proper formulation design, safety evaluation, and regulatory control are essential for the successful development of silver nanoparticle-based anti-sunburn preparations.

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