

**DEVELOPMENT AND EVALUATION OF HERBAL COSMECEUTICAL
FORMULATIONS: SUNSCREEN, ANTI-ACNE FACEWASH, AND ANTI-DARK CIRCLE
NIGHT GEL USING THUJA OCCIDENTALIS****Gunjal Shubham Shantaram*¹, Dr. Ramteke Kuldeep Hemraj², Raundhal Trisha Shankar¹**¹Samarth Institute of Pharmacy, Affiliated to Dr. Babasaheb Ambedkar Technological University (DBATU), Lonere, Maharashtra, India.²Professor, Department of Pharmaceutics, Samarth Institute of Pharmacy, Affiliated to Dr. Babasaheb Ambedkar Technological University (DBATU), Lonere, Maharashtra, India.***Corresponding Author: Gunjal Shubham Shantaram**Samarth Institute of Pharmacy, Affiliated to Dr. Babasaheb Ambedkar Technological University (DBATU), Lonere, Maharashtra, India. DOI: <https://doi.org/10.5281/zenodo.20444790>**How to cite this Article:** Gunjal Shubham Shantaram*¹, Dr. Ramteke Kuldeep Hemraj², Raundhal Trisha Shankar¹. (2026). Development And Evaluation of Herbal Cosmeceutical Formulations: Sunscreen, Anti-Acne Facewash, and Anti-Dark Circle Night Gel Using Thuja Occidentalis. European Journal of Pharmaceutical and Medical Research, 13(6), 173-181. This work is licensed under Creative Commons Attribution 4.0 International license.

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ABSTRACT

Herbal cosmetic formulations have gained considerable importance in recent years due to increasing consumer preference for natural, safe, and effective skincare products. Unlike synthetic cosmetics, herbal formulations are associated with fewer side effects, better biocompatibility, and additional therapeutic benefits derived from plant-based bioactive compounds. Medicinal plants rich in flavonoids, phenolics, tannins, and essential oils exhibit antioxidant, antimicrobial, anti-inflammatory, and skin-protective properties, making them valuable ingredients in modern cosmeceuticals. *Thuja occidentalis*, commonly known as Arborvitae, is an important medicinal plant widely recognized for its antibacterial, antiviral, antifungal, antioxidant, and anti-inflammatory activities. The presence of phytoconstituents such as thujone, flavonoids, tannins, and essential oils contributes to its effectiveness in managing various skin conditions including acne, pigmentation, irritation, and oxidative skin damage. These properties make *Thuja occidentalis* a promising herbal ingredient for skincare formulations. The aim of this review is to highlight the role of *Thuja occidentalis* in the formulation and evaluation of herbal skincare products such as sunscreen lotion, anti-acne face wash, and anti-dark circle night gel. The review summarizes different herbal ingredients, formulation methods, evaluation parameters, and therapeutic applications reported in the literature. Herbal sunscreen formulations containing natural UV-protective agents were found to provide antioxidant and anti-tanning effects. Herbal face washes exhibited significant antimicrobial activity against acne-causing microorganisms, while herbal night gels demonstrated moisturizing, skin-lightening, and anti-aging benefits. Literature findings suggest that herbal cosmeceuticals formulated with *Thuja occidentalis* offer effective skincare benefits with improved safety and minimal adverse effects compared to synthetic products. The study concludes that the incorporation of herbal bioactive compounds in cosmetic formulations has strong potential for the development of safe, economical, and therapeutically effective skincare products.

KEYWORDS: *Thuja occidentalis*, herbal cosmeceuticals, sunscreen, anti-acne face wash, night gel, antioxidants, skincare formulations, herbal cosmetics.**INTRODUCTION**

The herbal cosmetics industry has witnessed rapid growth worldwide due to increasing awareness regarding the harmful effects of synthetic chemicals and the growing preference for natural skincare products. Herbal cosmetics, also referred to as cosmeceuticals, are products that combine cosmetic benefits with therapeutic

effects derived from medicinal plants and natural ingredients. These formulations are considered safer, environmentally friendly, biocompatible, and more suitable for long-term use compared to conventional synthetic cosmetics. The global demand for herbal skincare products has increased significantly because consumers are becoming more conscious about skin

health, sustainability, and the use of naturally derived ingredients.

Plant-based skincare products have gained immense popularity because of their ability to provide nourishment and protection to the skin with minimal side effects. Herbal ingredients contain bioactive compounds such as flavonoids, tannins, alkaloids, terpenoids, vitamins, and essential oils that exhibit antioxidant, antimicrobial, anti-inflammatory, and moisturizing properties. Unlike synthetic chemicals that may cause irritation, dryness, or allergic reactions, herbal formulations help maintain the natural balance of the skin. As a result, herbal face washes, creams, gels, lotions, and sunscreens are increasingly used in daily skincare regimens.

The skin is the largest organ of the human body and acts as the primary protective barrier against environmental pollutants, microorganisms, chemicals, and ultraviolet (UV) radiation. Structurally, the skin consists of three major layers: epidermis, dermis, and hypodermis. The epidermis provides protection, the dermis contains connective tissues and blood vessels, while the hypodermis supports insulation and cushioning. Various environmental and physiological factors can disturb normal skin function and lead to common skin problems such as acne, pigmentation, premature aging, wrinkles, dryness, and UV-induced damage. Acne vulgaris occurs due to bacterial infection, increased sebum production, and inflammation of sebaceous glands. Pigmentation and dark circles are associated with melanin accumulation, stress, poor blood circulation, and oxidative stress. Excessive exposure to UV radiation leads to tanning, oxidative damage, collagen degradation, and premature aging of the skin.

In modern cosmetology, multifunctional herbal formulations have gained considerable importance because they provide both cosmetic enhancement and therapeutic benefits. Herbal skincare products can simultaneously perform multiple actions such as cleansing, moisturizing, photoprotection, anti-aging, antimicrobial activity, and skin rejuvenation. The incorporation of herbal ingredients with antioxidant and anti-inflammatory properties enhances the efficacy of skincare formulations while reducing adverse effects associated with synthetic agents. Therefore, the development of herbal sunscreen lotions, anti-acne face washes, and nourishing night gels has become a major focus in pharmaceutical and cosmetic research.

Thuja occidentalis, commonly known as Arborvitae or White Cedar, belongs to the family Cupressaceae. It is an evergreen coniferous tree native to North America and widely cultivated in various regions for ornamental and medicinal purposes. The plant contains several important phytoconstituents such as thujone, flavonoids, tannins, polysaccharides, glycosides, and essential oils, which contribute to its pharmacological activities. Traditionally,

Thuja occidentalis has been used in folk medicine and homeopathy for the treatment of skin infections, warts, respiratory disorders, inflammation, and microbial diseases. Scientific studies have demonstrated that the plant possesses antibacterial, antifungal, antiviral, antioxidant, anti-inflammatory, and immunomodulatory properties.

The selection of *Thuja occidentalis* for the present study is based on its significant medicinal and dermatological potential. Its antimicrobial activity makes it effective against acne-causing microorganisms, while its antioxidant properties help protect the skin from oxidative stress and UV-induced damage. In addition, the anti-inflammatory and soothing effects of the plant support skin healing, improve hydration, and reduce pigmentation and irritation. These multifunctional properties make *Thuja occidentalis* a promising natural ingredient for the formulation of herbal sunscreen lotion, anti-acne face wash, and anti-dark circle night gel. The use of this medicinal plant in herbal cosmeceuticals may provide safe, effective, and economical skincare solutions with minimal side effects.

Plant Profile: *Thuja occidentalis*

Scientific Classification

- **Botanical Name:** *Thuja occidentalis*
- **Common Names:** Northern White Cedar, Arborvitae, White Cedar
- **Family:** Cupressaceae
- **Kingdom:** Plantae
- **Genus:** *Thuja*
- **Species:** *occidentalis*

Description

Thuja occidentalis is an evergreen coniferous tree widely distributed in North America. The plant possesses flattened branchlets with scale-like aromatic leaves and small cones. It is commonly cultivated as an ornamental plant and has also been used traditionally in herbal medicine for various therapeutic purposes.

Geographical Distribution

The plant is native to eastern regions of North America, especially Canada and the northeastern United States. It grows well in moist soils, swampy areas, and temperate climatic conditions.

Morphological Characteristics

- Medium-sized evergreen tree reaching approximately 10–20 meters in height
- Leaves are green, flattened, soft, and scale-like
- Bark is reddish-brown to gray and fibrous
- Produces small yellowish-green flowers and seed cones
- Characteristic pleasant aromatic odor due to volatile oils

Chemical Constituents

The major phytoconstituents present in *Thuja occidentalis* include:

- Essential oils (thujone, fenchone, borneol)
- Flavonoids
- Tannins
- Polysaccharides
- Coumarins
- Terpenoids

These compounds contribute to its antimicrobial, antioxidant, anti-inflammatory, and skin-protective properties.

Medicinal and Cosmetic Uses

Traditionally, *Thuja occidentalis* has been used in herbal medicine for:

- Skin infections and warts
- Antimicrobial applications
- Anti-inflammatory activity
- Antioxidant effects
- Herbal cosmetic formulations such as creams, gels, and face washes

In cosmetic preparations, extracts of *Thuja occidentalis* are incorporated for their soothing, cleansing, and protective effects on the skin.

Pharmacological Activities

Reported pharmacological properties include:

- Antimicrobial activity
- Antioxidant activity
- Anti-inflammatory action
- Antiviral effects
- Immunomodulatory activity

Safety and Precautions

Although *Thuja occidentalis* possesses medicinal value, excessive use may cause skin irritation or toxicity due to the presence of thujone. Therefore, proper formulation concentration and safety evaluation are essential before topical application.

CONCLUSION

Thuja occidentalis is an important medicinal plant with significant potential in herbal cosmetic and dermatological formulations owing to its bioactive constituents and multiple pharmacological properties.

Skin Structure and Physiology

Structure of Skin

The skin is the largest organ of the human body and acts as a protective barrier between the internal body organs and the external environment. It is mainly divided into three layers:

1. Epidermis

The epidermis is the outermost layer of the skin and provides the first line of defense against environmental damage. It is composed mainly of keratinized epithelial

cells and contains melanocytes, which produce melanin pigment responsible for skin color and UV protection.

Functions of the epidermis include

- Protection against microorganisms and chemicals
- Prevention of water loss
- Formation of skin tone through melanin production
- Continuous regeneration of skin cells

2. Dermis

The dermis lies beneath the epidermis and consists of connective tissue rich in collagen and elastin fibers. It contains:

- Blood vessels
- Hair follicles
- Sweat glands
- Sebaceous glands
- Nerve endings

The dermis provides strength, elasticity, nourishment, and sensory functions to the skin.

3. Hypodermis (Subcutaneous Layer)

The hypodermis is the deepest layer composed mainly of adipose (fat) tissue and connective tissue. It functions as:

- Thermal insulation
- Energy storage
- Cushioning and shock absorption
- Support for overlying skin structures

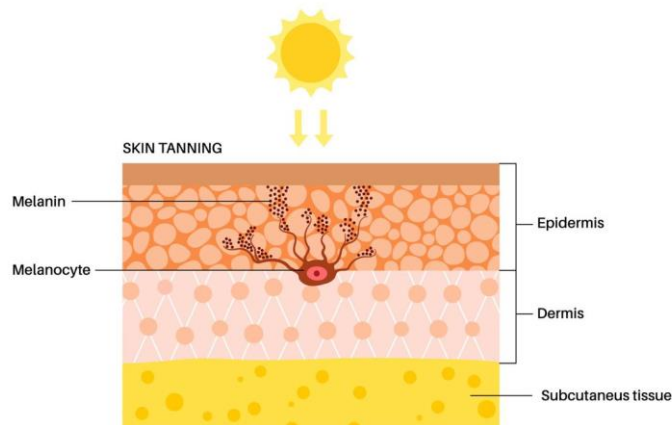
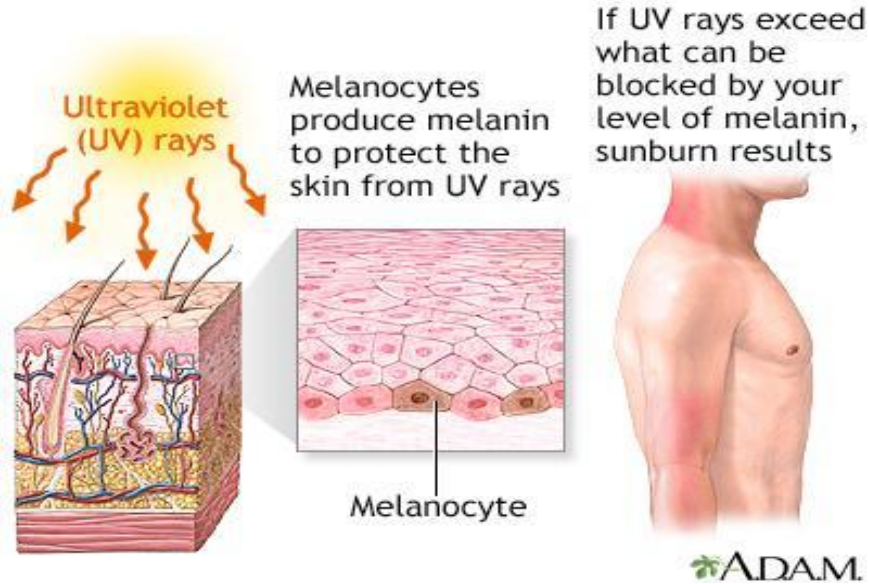
Role of the Skin Barrier

The skin barrier, primarily formed by the stratum corneum of the epidermis, plays a vital role in maintaining skin health. It:

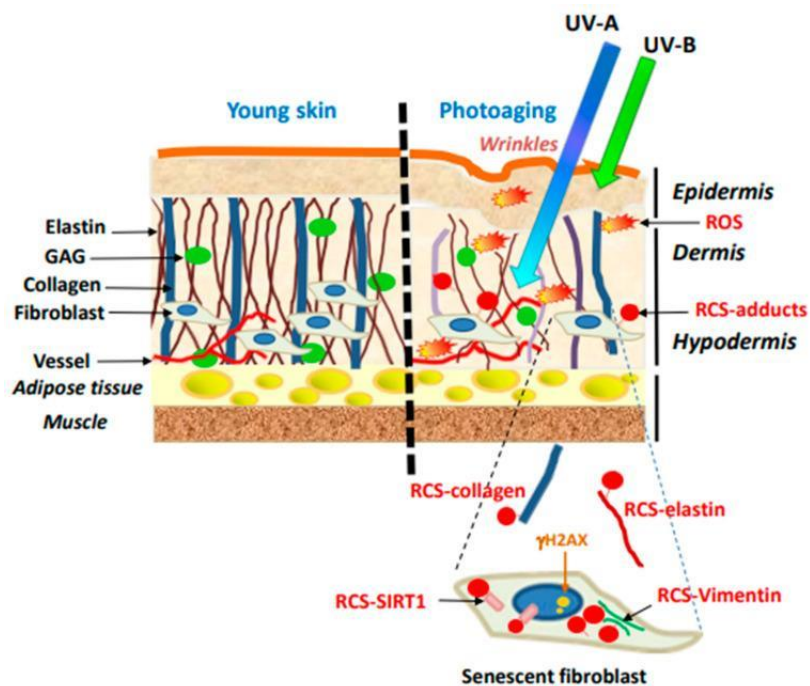
- Prevents excessive water loss
- Protects against pathogens, toxins, and pollutants
- Maintains skin hydration and pH balance
- Reduces penetration of harmful substances

Damage to the skin barrier may lead to dryness, irritation, infection, and increased sensitivity.

Mechanism of UV Damage



MELANIN IS RESPONSIBLE FOR SKIN COLOR



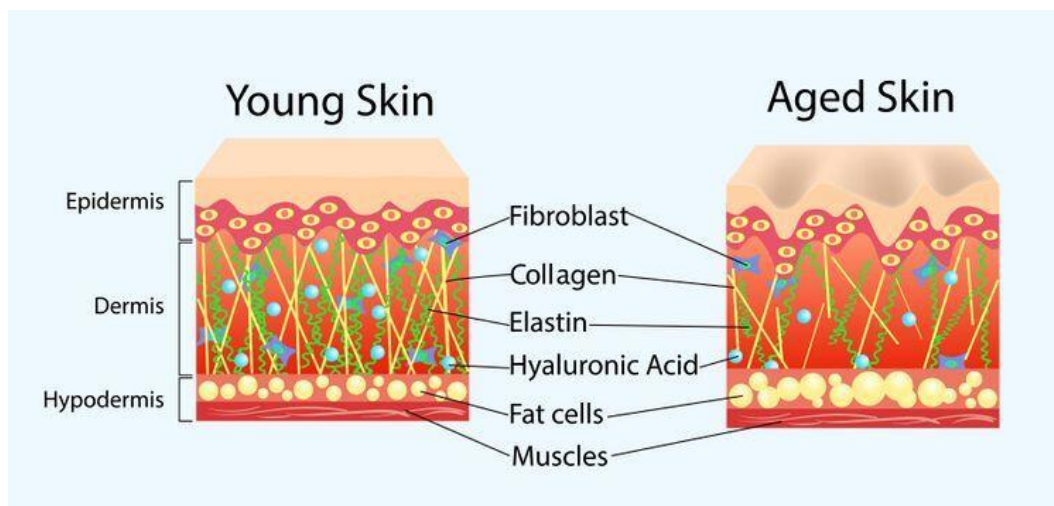
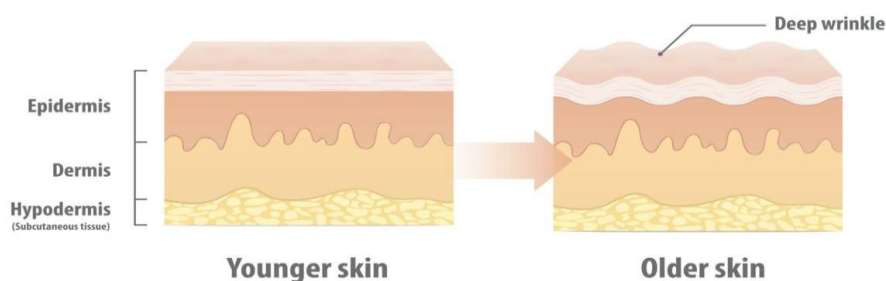
Ultraviolet (UV) radiation from sunlight is one of the major causes of skin damage. UV radiation is mainly classified into:

- **UVA (320–400 nm):** Penetrates deeply into the dermis and causes premature aging
- **UVB (290–320 nm):** Primarily affects the epidermis and causes sunburn and DNA damage

UV exposure can

- Generate reactive oxygen species (ROS)
- Damage cellular DNA
- Cause inflammation and pigmentation
- Break down collagen and elastin fibers
- Increase the risk of skin cancer

AGING CHANGES IN SKIN



Antioxidants and sunscreen agents help reduce UV-induced oxidative stress and skin damage.

Skin aging is a gradual biological process influenced by intrinsic and extrinsic factors.

Intrinsic Aging

Also called **chronological aging**, it occurs naturally with age due to

- Reduced collagen production
- Decreased cell turnover
- Loss of skin elasticity
- Reduced moisture retention
- Extrinsic Aging

Caused by environmental and lifestyle factors such as

- Sun exposure (photoaging)
- Pollution

- Smoking
- Poor nutrition
- Stress

Common signs of aging include

- Wrinkles and fine lines
- Dryness
- Sagging skin
- Pigmentation changes
- Loss of firmness and elasticity

Proper skin care, antioxidants, moisturizers, and photoprotective herbal formulations may help delay the aging process and maintain healthy skin.

UV Radiation and Its Effects on Skin

Ultraviolet radiation is an invisible component of sunlight responsible for various biological effects on

human skin. UV radiation is mainly divided into three categories:

1. UVA Radiation (320–400 nm)

- Penetrates deeply into the dermis
- Responsible for premature aging and wrinkle formation
- Generates reactive oxygen species (ROS)
- Causes collagen degradation and pigmentation
- Contributes to photoaging

2. UVB Radiation (290–320 nm)

- Primarily affects the epidermis
- Causes sunburn and erythema
- Damages cellular DNA
- Increases risk of skin cancer
- Produces inflammation and tanning

3. UVC Radiation (100–290 nm)

- Highly harmful but absorbed by the ozone layer
- Normally does not reach the earth's surface

Harmful Effects of UV Radiation

- Sunburn
- Hyperpigmentation
- Skin dryness
- Premature aging
- Wrinkles and fine lines
- DNA mutations
- Oxidative stress
- Loss of skin elasticity
- Skin cancer

Need for Herbal Sunscreen

Synthetic sunscreens may sometimes produce adverse effects such as:

- Skin irritation
- Allergic reactions
- Photosensitivity
- Hormonal disturbances
- Environmental toxicity

Therefore, herbal sunscreen formulations are increasingly preferred due to their

- Natural origin
- Better skin compatibility
- Antioxidant properties
- Reduced toxicity
- Biodegradability
- Nutritional and therapeutic benefits
- Eco-friendly characteristics

Herbal constituents rich in flavonoids, polyphenols, tannins, and terpenoids can absorb UV radiation and neutralize free radicals generated during UV exposure.

Thuja occidentalis in Sunscreen Formulation

Botanical Profile

Botanical Name: *Thuja occidentalis*

Family: Cupressaceae

Common Names: Northern White Cedar, Arborvitae

Important Phytoconstituents

Thuja occidentalis contains several bioactive compounds including:

- Thujone
- Fenchone
- Borneol
- Flavonoids
- Tannins
- Coumarins
- Terpenoids
- Essential oils

Skin Benefits of *Thuja occidentalis*

The plant extract exhibits several beneficial activities useful in sunscreen formulations:

1. Antioxidant Activity

Neutralizes reactive oxygen species generated by UV radiation and prevents oxidative damage.

2. Anti-inflammatory Activity

Reduces redness, irritation, and inflammatory responses caused by sunlight exposure.

3. Antimicrobial Property

Protects skin from microbial contamination and infection.

4. Skin-Protective Action

Helps maintain healthy skin barrier function and minimizes photodamage.

5. Soothing Effect

Provides calming and refreshing action on irritated skin.

Ingredients Used in Herbal Sunscreen Formulation

1. Active Herbal Ingredient

Thuja occidentalis Extract

The extract may be prepared using solvents such as ethanol, methanol, or water. It is incorporated into the sunscreen base to provide antioxidant and skin-protective benefits.

Functions

- Antioxidant effect
- Anti-inflammatory action
- UV protective support
- Skin conditioning

2. Physical Sunscreen Agents

Zinc Oxide

Zinc oxide is a mineral sunscreen agent that provides broad-spectrum UV protection.

Functions

- Reflects UVA and UVB radiation
- Prevents UV penetration
- Non-irritating and safe

- Suitable for sensitive skin

Titanium Dioxide

Titanium dioxide is another physical UV filter widely used in sunscreen formulations.

Functions

- Scatters UV radiation
- Provides UVB protection
- Improves SPF value
- Enhances photostability

3. Emulsifiers

Emulsifiers stabilize oil and water phases in cream or lotion formulations.

Examples

- Tween 80
- Span 60
- Stearic acid
- Cetyl alcohol
- Glyceryl monostearate

Functions

- Maintain emulsion stability
- Improve texture
- Prevent phase separation
- Enhance consistency

4. Oils and Bases

Various oils and bases are used to improve moisturizing property, texture, spreadability, and skin feel.

Common Oils

- Coconut oil
- Almond oil
- Olive oil
- Jojoba oil

Bases and Gelling Agents

- Aloe vera gel
- Carbopol
- Beeswax
- Liquid paraffin
- Petroleum jelly

Functions

- Moisturization
- Emollient action
- Improved consistency
- Better skin application

5. Preservatives

Preservatives prevent microbial contamination and improve shelf life.

Examples

- Methyl paraben

- Propyl paraben
- Phenoxyethanol

6. Humectants

Humectants retain skin moisture and prevent dryness.

Examples

- Glycerin
- Propylene glycol
- Sorbitol

7. Fragrance and Color

Natural fragrances and approved colorants may be added to improve aesthetic acceptability.

- **Method of Preparation of Herbal Sunscreen**

General Procedure

Step 1: Preparation of Oil Phase

Oil-soluble ingredients such as oils, waxes, emulsifiers, zinc oxide, and titanium dioxide are weighed and heated.

Step 2: Preparation of Aqueous Phase

Water-soluble ingredients including herbal extract, glycerin, preservatives, and water are dissolved separately.

Step 3: Emulsification

The aqueous phase is slowly added to the oil phase with continuous stirring.

Step 4: Cooling

The mixture is cooled while stirring continuously until a uniform cream or lotion is formed.

Step 5: Addition of Heat-Sensitive Ingredients

Fragrance and other sensitive ingredients are added after cooling.

Step 6: Packaging

The final formulation is filled into suitable airtight containers.

Mechanism of Action of Herbal Sunscreen

1. UV Absorption

Certain herbal constituents absorb harmful UV rays and prevent their penetration into deeper skin layers.

2. Reflection and Scattering

Mineral sunscreen agents such as zinc oxide and titanium dioxide reflect and scatter UV radiation.

3. Antioxidant Protection

Antioxidants present in *Thuja occidentalis* neutralize free radicals generated by UV exposure.

4. Prevention of Photoaging

Protection from oxidative stress helps prevent collagen degradation and premature aging.

5. Maintenance of Skin Barrier

Herbal ingredients support hydration and maintain the integrity of the skin barrier.

Evaluation Parameters of Sunscreen Formulation

1. Organoleptic Evaluation

Physical appearance of the formulation is examined.

Parameters

- Color
- Odor
- Texture
- Consistency
- Homogeneity

2. pH Determination

The pH of sunscreen formulation should be compatible with skin pH to avoid irritation.

Ideal pH range:

- 5.5 to 7

3. Spreadability

Spreadability determines ease of application and uniform distribution.

Importance

- Uniform protection
- Better patient compliance
- Smooth application

Formula

$$S = M \times L / T$$

Where:

- S = Spreadability
- M = Weight tied to upper slide
- L = Length moved by slide
- T = Time taken

4. Viscosity

Viscosity measures the consistency and flow behavior of the formulation.

Importance

- Stability assessment
- Ease of application
- Product elegance

Measured using

- Brookfield viscometer

5. SPF Determination

SPF (Sun Protection Factor) indicates the effectiveness of sunscreen against UVB radiation.

Formula:

$$\text{SPF} = \frac{\text{Minimal erythema dose on protected skin}}{\text{Minimal erythema dose on unprotected skin}}$$

Importance

- Determines photoprotective efficacy

- Higher SPF indicates better protection

6. Stability Studies

Stability studies evaluate the ability of formulation to remain stable under different conditions.

Parameters observed:

- Color changes
- Odor changes
- Phase separation
- pH variation
- Viscosity changes
- Microbial growth

Conditions

- Room temperature
- Refrigerated conditions
- Elevated temperature

7. Irritation Test

Performed to determine safety of topical application.

Observations

- Redness
- Itching
- Burning sensation
- Swelling
- Allergic reaction

Patch testing may be performed on human volunteers or animal skin.

8. Washability Test

Determines ease of removal from skin surface using water.

9. Homogeneity Test

Checks uniform distribution of ingredients and absence of lumps.

10. Extrudability Test

Measures ease of extrusion from collapsible tubes or containers.

Advantages of Herbal Sunscreen

- Natural and safe
- Less toxic
- Antioxidant-rich
- Skin nourishing
- Eco-friendly
- Reduced irritation
- Multifunctional activity
- Better consumer acceptance

Limitations of Herbal Sunscreen

- Lower SPF compared to synthetic agents in some cases
- Possible instability of herbal constituents
- Shorter shelf life
- Variability in plant extract composition

- Need for proper standardization

Applications of Herbal Sunscreen

- Daily skin protection
- Prevention of photoaging
- Cosmetic formulations
- Dermatological preparations
- Moisturizing sunscreens
- Anti-aging products
- Sensitive skin formulations

CONCLUSION

Herbal cosmeceuticals have emerged as an important area in modern skincare research due to increasing consumer demand for natural, safe, and effective cosmetic products. The use of medicinal plants in cosmetic formulations offers multiple therapeutic advantages including antioxidant, antimicrobial, anti-inflammatory, moisturizing, and photoprotective activities with comparatively fewer side effects than synthetic agents. Among various medicinal plants, *Thuja occidentalis* has shown significant potential in herbal skincare formulations because of the presence of bioactive phytoconstituents such as flavonoids, tannins, terpenoids, thujone, and essential oils.

The present review highlighted the role of *Thuja occidentalis* in the development of herbal sunscreen lotion, anti-acne face wash, and anti-dark circle night gel. Herbal sunscreen formulations containing *Thuja occidentalis* and mineral UV filters such as zinc oxide and titanium dioxide provide effective photoprotection and antioxidant defense against UV-induced oxidative stress and photoaging. Herbal anti-acne face wash formulations exhibit cleansing, antimicrobial, and anti-inflammatory properties useful in controlling acne-causing microorganisms and reducing skin irritation. Similarly, herbal night gel formulations help improve skin hydration, reduce pigmentation and dark circles, and promote skin rejuvenation through antioxidant and soothing effects.

Evaluation parameters such as pH, spreadability, viscosity, stability studies, SPF determination, foamability, washability, and irritation testing are essential for ensuring the quality, safety, and effectiveness of herbal cosmetic formulations. Literature findings indicate that herbal formulations possess good consumer acceptability, improved skin compatibility, and promising therapeutic efficacy.

Overall, the incorporation of *Thuja occidentalis* into herbal cosmeceutical formulations represents a promising approach for the development of multifunctional skincare products that are economical, environmentally friendly, and therapeutically beneficial. Further scientific studies, standardization, and clinical evaluations may help establish the commercial and pharmaceutical potential of herbal cosmetic formulations on a larger scale.

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