IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, December 2025
Impact Factor: 7.67

Formulation and Evaluation of Sunscreen Cream Using Butterfly Pea Flower

*[1]Radhika S. Pradhan, [1]Vidhya Ekhande, [1]Sunil S. Jaybhaye, [1]Saurabh M. Bondre
Institute of Pharmacy, Badnapur
Dr. Babasaheb Ambedkar Technological University, Lonere, Raigad MS
Corresponding Author: Radhika S. Pradhan
radhikpradhan825@gmail.com

Abstract: *This study presents the formulation and evaluation of a herbal sunscreen cream enriched with Butterfly Pea Flower extract and other natural constituents. The cream was developed using Aloe Vera gel, Sunflower oil, Coconut oil, Rose water, Beeswax, and Zinc Oxide to achieve an effective and skin-friendly photoprotective product. Comprehensive assessments of the cream's physicochemical parameters—including pH, spreadability, viscosity, and stability—confirmed its suitability for topical application. The inclusion of Zinc Oxide provided broad-spectrum UV protection, while the botanical extracts contributed antioxidant, moisturizing, and soothing properties. Overall, the findings highlight the potential of Butterfly Pea Flower-based formulations as safe, eco-friendly alternatives to conventional sunscreens.*

Keywords: Butterfly Pea,Herbal sunscreen, Zinc Oxide, Topical cream

I. INTRODUCTION

Sunscreens play a crucial role in safeguarding the skin from the harmful effects of ultraviolet (UV) radiation emitted by the sun. By reflecting, absorbing, or scattering UV rays, sunscreen products provide broad-spectrum protection against both UVA and UVB radiation. Consistent application of sunscreens—whether in the form of creams, lotions, or gels—helps prevent sunburn, premature skin aging, and long-term damage that can contribute to the development of skin cancer.Over recent decades, the importance of sunscreen as an effective photoprotective agent has increased substantially. With rising awareness of the risks associated with prolonged sun exposure, including sunburn, early wrinkling, pigmentation, and melanoma, the demand for advanced sunscreen formulations has grown. Modern sunscreens are now being designed not only to prevent sunburn and tanning but also to repair and minimize cellular damage, maintain skin health, and enhance the sun protection factor (SPF) for long-lasting defense.

Understanding UV radiation is essential for classifying and formulating effective sunscreens. UVA rays (320–400 nm), the longest in wavelength, penetrate deeper into the skin and are primarily responsible for immediate tanning and photoaging. UVB rays (290–320 nm) affect the outer skin layers, causing delayed tanning, sunburn, and blistering. UVC rays (100–290 nm), though mostly absorbed by the ozone layer, can cause redness, ulcers, and lesions if exposure occurs.Given these variations in UV wavelengths and their biological impacts, sunscreens are classified based on their protective mechanisms and the type of UV radiation they filter or block. This classification provides a foundation for developing safe, efficient, and broad-spectrum sunscreen products that address the increasing need for effective photoprotection.

Sunscreens are substances designed to protect the skin from the harmful effects of the sun's ultraviolet (UV) radiation. They work by reflecting, absorbing, and scattering both UVA and UVB rays, providing broad-spectrum protection. Regular use of sunscreen in the form of lotions, creams, or gels can help prevent premature aging, sunburn, and skin damage that may lead to skin cancer.

DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 2, December 2025 Impact Factor: 7.67

CLASSIFICATION OF SUNSCREEN

Sunscreens can be classified as follows

1. Based on the mode of action they can be classified as

Physical sunscreen: Reflect harmful rays away from skin.

Eg: zinc oxide and titanium dioxide.

Chemical sunscreen: Absorbs UV rays

Eg: microfine titanium dioxide, avobenzone and oxybenzone.

The combination of both physical and chemicalActive ingredients is considered to be a best sunblock. Physical sun blocks are having scattering affect thereby Results in whitening phenomenon while majority of organic chemicals used in sunscreen formulations have not Been established as safe.

2. Based on application

Topical: They either absorb or reflect radiation to protect from harmful radiation

Oral: These are consumed orally to avoid skin damage. Eg: Carotenoids

Topical sunscreens are divided into two classes based on their mechanism of protection

• Organic sunscreen

• Inorganic sunscreen

• Organic Sunscreen: Organic sunscreen works by absorbing into skin and converting UV rays into heat .it is Thin and ideal for everyday use allow for skincare ingredients to be added easily. Organic sunscreen actives Chemical carbon based compound .it contains non mineral active ingredient.

• Inorganic sunscreen: These are particles that scatter and reflect uv rays back to the environment they act as Physical barrier to indent ultraviolet and uv light. They are considered broad spectrum as they cover entire Ultraviolet spectrum .the Inorganic sunscreen is also referred to as sunblock.

IDEAL PROPERTIES OF SUNSCREEN

- Must absorb a broad range of UV rays causing sunburn
- Must be stable in the presence of sunlight
- Should be able to provide complete protection for skin
- Should be safe effective, chemically inert, at low concentration
- Should not cause irritation, sensitization and toxicity
- Should not stain Filtering
- Activity against UVB and UVA radiation
- Anti-oxidant and reactive oxygen species scavenging property
- Anti-mutagenic property
- Anticancer property
- Booster effect
- Safety stability of active compound.

MERITS OF SUNSCREEN CREAM

- Helps to prevent sunburn and premature aging
- Protects from the sun as soon as it is applied.
- Lasts longer when in direct UV light.
- Better for those with heat-activated skin[redness].
- Offers protection against UVA and UVB rays.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 2, December 2025 Impact Factor: 7.67

DEMERITS OF SUNSCREEN CREAM

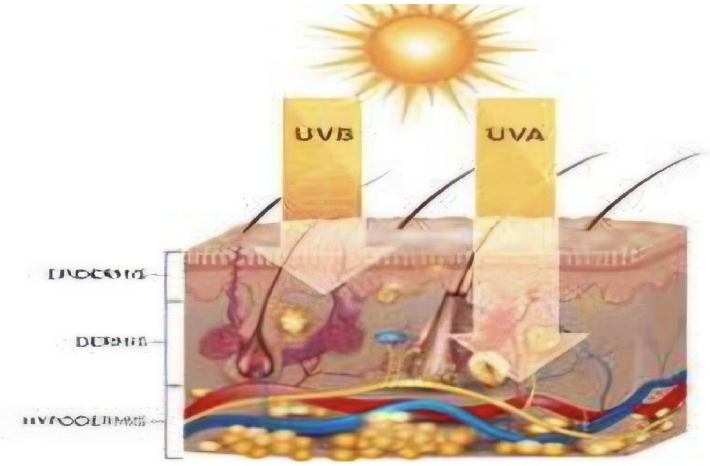
- It is an expensive product.
- Can create an occlusive film which results in perspiration.
- Can be less protective if not applied accurately and generously.
- Can cause white drips to show on the skin when sweating.
- Sunscreen can cause stickiness in some skin types.

IMPORTANCE OF SUNSCREEN

UV radiation is essential to human health such that it helps in the intestinal absorption of calcium, phosphorous and for the production of vitamin D3. On the other hand, these radiations also harm our health by directly interacting with DNA, RNA proteins, lipids and thereby causing potential carcinogenic effects. The most
efficient way to protect skin from harmful UV radiation is the topical application of any active molecule which has UV absorbing or reflecting properties. This is why the sunscreen has gained importance in the currentWearing sunscreen is one of the best and easiest ways to protect your skin's appearance and health at any age. Used regularly, sunscreen helps prevent sunburn, skin cancer and premature aging. To help make sunscreen a part of your daily routine, dermatologist Anna Chien addresses common concerns.

WHY WE USE SUNSCREEN?

• Too much-unprotected sun exposure leads to
• Premature skin ageing
• Sun burn
• Skin cancer



MECHANISM OF ACTION OF SUNSCREENS

Sunscreens function by reducing or preventing the harmful effects caused by ultraviolet (UV) radiation on the skin. UV-mediated photo-oxidative damage can penetrate through the epidermis and dermis, reaching the dermal capillaries. This exposure leads to the depletion of both enzymatic and non-enzymatic antioxidants within the stratum corneum, epidermis, and dermis. Additionally, photo-oxidation of existing melanin and its precursors occurs, resulting in immediate and persistent pigment darkening.To counter these damaging effects, sunscreens enhance the skin's tolerance to UV exposure through two primary mechanisms:

DOI: 10.48175/568

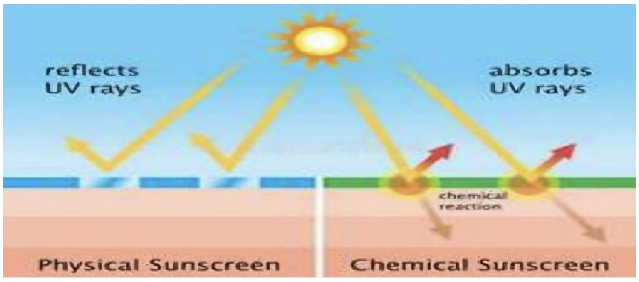
IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, December 2025
Impact Factor: 7.67

Scattering and Reflection of UV Radiation

Mineral-based or inorganic sunscreens, such as those containing Zinc Oxide or Titanium Dioxide, act by forming a protective physical barrier over the skin. This barrier reflects and scatters incoming UVA and UVB rays, preventing them from penetrating the skin layers and causing cellular damage.

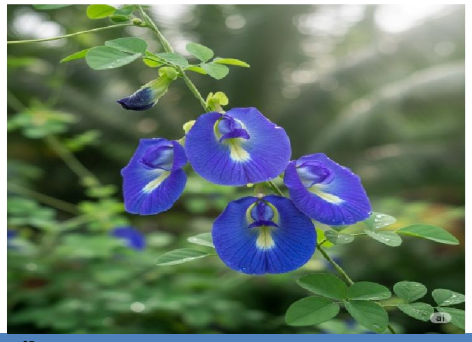
Absorption of UV Radiation

Organic or chemical sunscreen agents absorb UV light and undergo a chemical transformation that dissipates the absorbed energy as heat. This process prevents UV radiation from interacting with skin cells and triggering oxidative or inflammatory responses.



Main role of ingredients used in formulation:

Butterfly Pea Flower :-



Parameter	Details
Botanical Name	*Clitoriaternatea*
Family	Fabaceae (Leguminosae)
Subfamily	Papilionoideae
Common Names	Butterfly Pea, Blue Pea, Asian Pigeonwings, Aparajita (India)
Parts Used	Flowers
Major Bioactive Compounds	Anthocyanins (Ternatins), Flavonoids, Polyphenols, Proanthocyanidins, Triterpenoids, Cyclotides
Coloring Component	Ternatin (responsible for vibrant blue–purple pigment)
Pharmacological Properties	Antioxidant, Anti-inflammatory, Antimicrobial, Neuroprotective, Anti-aging
Skin Benefits	Protects against oxidative stress, Improves elasticity, Promotes collagen production, Soothes irritation, Supports regeneration
Traditional Uses	Cognitive enhancement, Memory improvement, Stress relief, Mood enhancement (Ayurvedicnootropic herb)
Nutritional Components	Essential amino acids, Minerals

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 2, December 2025 Impact Factor: 7.67

MATERIAL AND METHOD

Ingredients	Function	Quantity (100 ml)	Quantity (50 ml)
Butterfly pea flower extract	Antioxidant, soothing	5 ml	2.5 ml
Alovera Gel	Hydrating, soothing	15 ml	7.5 ml
Coconut Oil	Moisturizer, mild SPF	10 ml	5 ml
Sunflower Oil	Emollient, mild SPF	10 ml	5 ml
Rose water	Hydrating, aromatic	20 ml	10 ml
Bees wax	Emulsifier, thickener	10 gm	5 gm
Zinc Oxide	U V protection	20 gm	10 gm
Essential Oils	Fragrance (lavender etc.)	2-3 Drops	1-2 Drops

The butterfly pea flower extraction process begins by gently heating about 50–100 ml of rose water or distilled water until it is warm but not boiling, ideally around 60–70°C. Once the liquid reaches this temperature, add 1–2 tablespoons of dried butterfly pea flowers and stir gently to ensure all the flowers are fully submerged. Cover the mixture and allow it to steep for approximately 15–20 minutes.During this time, the water will absorb the vibrant blue pigments and beneficial antioxidants from the flowers. After steeping, strain the mixture through a fine mesh strainer or cheesecloth to separate the solid petals from the liquid extract. Allow the resulting blue-colored liquid to cool to room temperature before use.

EXPERIMENTAL WORK

START

↓

Weigh Oil Phase Ingredients
• Coconut oil (Cocosnucifera oil)
• Sunflower oil (Helianthus annuus oil) &Beeswax (Ceraalba)

↓

Heat Oil Phase to 70°C (Double Boiler)

↓

Weigh Aqueous Phase Ingredients
• Aloe vera gel (Aloe barbadensis extract)
• Rose water (Rosa damascena hydrosol)

↓

Heat Aqueous Phase to 70°C

↓

Slow Addition of Aqueous Phase into Oil Phase
+ Continuous Stirring (Emulsification)

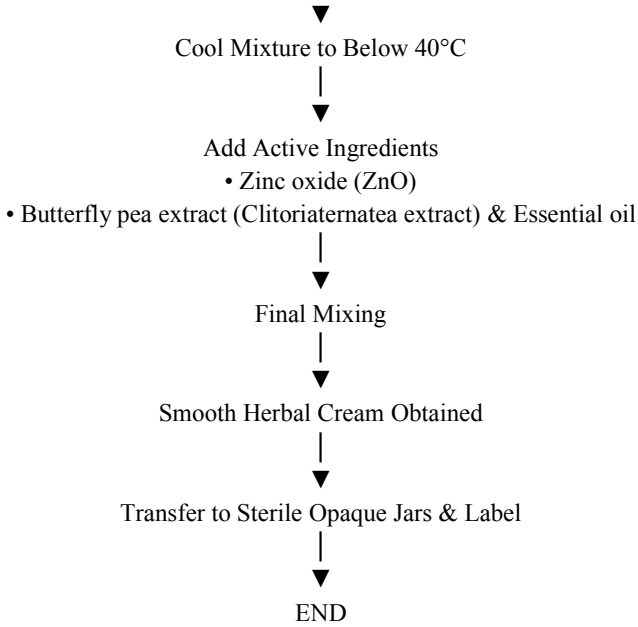
↓

Creamy Emulsion Forms

↓

DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, December 2025
Impact Factor: 7.67



EVALUATION

Sr. No.	Evaluation Parameter	Method Used	Observation / Purpose
1	**Physical Parameters** (Colour, Odour, Appearance)	Checked manually by visual inspection and smelling	To observe colour, fragrance, and overall appearance of the formulation
2	**pH Determination**	Digital pH meter; 1 g sample dissolved in 100 ml distilled water for 2 hrs	Ensures pH is suitable and compatible with skin; readings taken in triplicate
3	**Viscosity**	Brookfield Viscometer with suitable spindle at 5, 10, 20, 50, 100 rpm	Determines thickness and flow behavior of the cream
4	**Spreadability**	Two-slide method; time required for slides to separate under specific load	Indicates ease of application; calculated using formula: **S = M × L / T**
5	**Washability**	Water used to wash off applied sunscreen	Checks if formulation can be removed easily with water
6	**Homogeneity**	Visual inspection and touch	Ensures smooth, uniform texture without lumps
7	**Irritancy Test**	Applied on 1 sq. cm area of dorsal hand and observed for 24 hrs	Confirms absence of irritation, redness, or swelling
8	**Stability Testing**	Stored at room temp & at 45±1°C; evaluated on 0, 5, 10, 15, 20 days	Determines physical and chemical stability of formulation
9	**SPF Determination**	UV-Visible Spectrophotometer (290–320 nm at 5 nm intervals)	Measures sun protection factor using absorbance and standard formula

DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, December 2025
Impact Factor: 7.67

II. RESULT DISCUSSION

The formulated herbal sunscreen cream containing *Clitoriaternatea* (Butterfly Pea Flower) extract was successfully prepared and evaluated for various physicochemical and functional parameters. The results are summarized in the table below:

Table: Evaluation Results of Herbal Sunscreen Cream

Sr. No.	Parameter	Observation
1	Colour	Light Blue
2	Odour	Characteristic Herbal
3	Appearance	Good
4	Washability	Easily Washable
5	Texture	Smooth
6	State	Semi-solid
7	pH	6.5
8	Viscosity	1094 cP
9	Spreadability	Good and Uniform
10	Irritant Effect	Nil
11	Stability Testing	No Phase Separation
12	Homogeneity	Homogeneous
13	SPF	30

The cream exhibited a pleasant appearance, smooth texture, excellent spreadability, and good homogeneity. The pH (6.5) was within the acceptable range for skin application. Stability studies conducted at room temperature and at 45 ± 1°C showed **no separation, no change in colour, and no change in consistency.** The SPF value determined by UV spectrophotometric method was **30,** indicating moderate UVB protection.

The formulated herbal sunscreen cream showed promising results, demonstrating that Butterfly Pea Flower extract can serve as an effective natural photoprotective agent. The cream's light blue colour was attributed to anthocyanins (ternatins) present in *Clitoriaternatea*, which are known for strong antioxidant properties that help neutralize free radicals generated by UV exposure.Sunscreens remain essential for preventing acute and chronic effects of UV radiation, including sunburn, premature aging, and skin cancer. The incorporation of natural ingredients is gaining importance due to the safety concerns and environmental impact associated with some synthetic sunscreen agents.In this study, the addition of herbal components such as Aloe vera, sunflower oil, coconut oil, and rose water contributed moisturizing, soothing, and antioxidant benefits, enhancing the overall therapeutic properties of the formulation. The use of Zinc Oxide, a well-known inorganic sunscreen agent, provided broad-spectrum shielding by scattering and reflecting UVA and UVB rays. Its combination with Butterfly Pea Flower extract enhanced the overall photoprotective potential.The SPF value of **30** indicates adequate protection for daily use and aligns with values reported for many commercial herbal sunscreen formulations. The absence of irritation during the irritancy test confirms its suitability for topical application. Stability studies demonstrated that the product remained physically and chemically stable under both ambient and accelerated conditions.These findings support the increasing scientific evidence that plant-based antioxidants and polyphenols—especially flavonoids and anthocyanins—play a significant role in UV protection by minimizing oxidative stress and preventing DNA damage.

III. CONCLUSION

The present study successfully formulated and evaluated a herbal sunscreen cream incorporating Butterfly Pea Flower (*Clitoriaternatea*) extract. The prepared formulation exhibited desirable physicochemical characteristics, including suitable pH, smooth texture, good spreadability, and excellent stability. The SPF value of 30 indicates effective protection against UVB radiation.The findings demonstrate that *Clitoriaternatea* extract possesses valuable antioxidant and photoprotective properties, making it a suitable natural agent for sunscreen formulations. The cream was non-irritating and maintained stability under different storage conditions, reinforcing its potential as a safe and effective

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 2, December 2025 Impact Factor: 7.67

herbal sunscreen.Overall, the study highlights the potential of Butterfly Pea Flower extract in developing natural, skin-friendly, and eco-friendly sunscreen products. Further investigations, including in-vivo SPF evaluation and extended stability studies, are recommended to validate and enhance its use in commercial cosmetic formulations.

REFERENCES

[1]. Waghmare M.V., Khade P., Hingane L.D. Evaluation of Herbal Sunscreen Lotion. *International Journal of Formulation and Evaluation*. 2021.

[2]. Sahu R.K., Roy A., Jha A.K., Dwivedi J. Inhibitory effect on tyrosinase activity of herbal cream incorporating indigenous medicinal plants. *Pakistan Journal of Biological Sciences*. 2014; 17(1): 146–150.

[3]. Shanbhag S., Nayak A., Narayan R., Nayak U.Y. Anti-aging and Sunscreens: Paradigm Shift in Cosmetics. *Advanced Pharmaceutical Bulletin*. 2019; 9(3): 348–359.

[4]. Roy A., Sahu R.K., Mutlam M., Deshmukh V.K., Dwivedi J., Jha A.K. In vitro Techniques to Assess the Proficiency of Skin Care Cosmetic Formulations. *Pharmacognosy Review*. 2013; 7(14): 97–106.

[5]. Sahu R.K., Roy A., Kushwah P., Sahu A. Formulation and Development of Face Cream Containing Natural Products. *Research Journal of Topical and Cosmetic Science*. 2012; 3(1): 16–19.

[6]. Shahriar M., Akhter S., Hossain M.I., Haque M.A., Bhuiyan M.A. In vitro antioxidant activity of bark extracts of *Terminaliaarjuna*. *Journal of Medicinal Plants Research*. 2012; 6(39): 5286–5298.

[7]. Arunrashid S., Neelufar S., Mohanlakshmi S., Ravichandran V. Formulation, Characterization and In Vitro Evaluation of Herbal Sunscreen Lotion. *Research Article*. 2012.

[8]. VaishaliBambal, Wyawahare N., Turaskar A., Mishra M. Study of Sunscreen Activity of Herbal Cream containing Flower Extract of *NyctanthesArbortristis* and *Tageteserecta*. 2011 (listed here because 2011 < 2012).

[9]. Deep C., Saraf S. Novel Approaches in Herbal Cosmetics. *Journal of Cosmetic Dermatology*. 2008; 7: 89–95.

[10]. Rang V.D.*Pharmacognosy and Phytochemistry, Vol. 1*. 2008; pp. 3–4.

[11]. Baby A.R., Maciel C.P.M., Kaneko T.M., Velasco M.V.R. UV Spectrophotometric Dtermination of Bioflavonoids from Semisolid Dosage Form. *Journal of AOAC International*. 2006; 89: 1532–1537.

[12]. COLIPA. *International Sun Protection Factor (SPF) Test Method Guidelines*. 2006.

[13]. Kullavanijaya P., Lim H.W.Photoprotection. *Journal of the American Academy of Dermatology*. 2005; 52(6): 937–958.

[14]. Dutra E.A., Oliveira D.A.G.C., Kedor-Hackmann E.R.M., Santoro M.I.R.M. Determination of Sun Protection Factor (SPF) of Sunscreens by UV Spectrophotometry. *Brazilian Journal of Pharmaceutical Sciences*. 2004; 40(3): 381–385.

[15]. Boyd A.S., Naylor M., Cameron G.S. Effects of Chronic Sunscreen Use on Dermatoheliosis. *Journal of the American Academy of Dermatology*. 1995; 33(6): 941–946.

[16]. Fotiades J., Soter N.A., Lim H.W. Evaluation of 203 Patients for Photosensitivity. *Journal of the American Academy of Dermatology*. 1995; 33(4): 597–602.

[17]. Levy S.B. How High the SPF? *Archives of Dermatology*. 1995; 131(12): 1463–1464.

[18]. Dromgoole S.H., Maibach H.I.Sunscreening Agent Intolerance. *Journal of the American Academy of Dermatology*. 1990; 22(6): 1068–1078.

[19]. Kaidbey K.H.Photoprotective Potential of Potent Sunscreens. *Journal of the American Academy of Dermatology*. 1990; 22(3): 449–452.

[20]. Mithal B.M., Saha R.N.*Handbook of Cosmetics*. VallabhPrakashan; pp. 122–124.

[21]. PP Sharma.*Cosmetics – Formulation, Manufacturing and Quality Control*. 4th ed. Vandan Publication.

[22]. Kokate C.K., Purohit A.P., Gokhale S.B.*Pharmacognosy*. 54th Edition, NiraliPrakashan.

[23]. Parmacognosy and Phytochemistry, Vol. 1. CBS Publishers.

[24]. Wealth of India. A Dictionary of Raw Materials and Industrial Products. CSIR.

[25]. Chopra R.N., Nayar S.L., Chopra I.C.*Glossary of Indian Medicinal Plants*. CSIR.

[26]. Henry M.D. Analysis of Creams and Lotions. In: *Manual of Cosmetic Analysis*. 1997: 32–33