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Formulation And Evaluation Of Herbal Blue Light Protection Face Serum

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ABSTRACT

In recent years, prolonged exposure to digital devices like smartphones, laptops, and LED screens has increased the risk of blue light–induced skin damage, including oxidative stress, premature aging, pigmentation, and loss of elasticity.

To address this, the study focuses on formulating and evaluating a herbal blue light protective face serum using Butterfly Pea Flower, Moringa leaf powder, Green Tea, and Rose Hip in a rose-water base with sodium hyaluronate for hydration.

The serum was evaluated for appearance, colour, clarity, fragrance, pH, viscosity, spreadability, homogeneity, and stability, showing good cosmetic elegance, smooth texture, and stable characteristics.

It also demonstrated significant antioxidant activity, confirming its ability to neutralize reactive oxygen species caused by blue light.

Overall, the herbal serum shows strong potential as a safe and effective formulation for protecting skin from blue light damage in daily skincare.

Keywords: Blue light; Herbal serum; Antioxidant; Oxidative stress; Photoaging; Natural skincare.

INTRODUCTION

Increased dependence on digital devices has led to continuous exposure of the skin to high- energy visible (HEV) blue light (400–500 nm), which has been associated with oxidative stress, collagen degradation, hyperpigmentation, and premature aging. Unlike UV radiation, blue light penetrates deeper into the skin and contributes to the generation of reactive oxygen species (ROS), resulting in cellular damage and acceleration of photoaging. This has created a rising demand for safe, natural, and effective topical formulations capable of protecting the skin against blue light–induced damage.

Herbal-based cosmetic formulations are gaining prominence due to their safety, minimal side effects, biodegradability, and consumer preference for natural skincare. Plant extracts rich in antioxidants, polyphenols, flavonoids, and vitamins can effectively neutralize ROS and maintain skin health. Ingredients such as Butterfly Pea Flower, Moringa, Green Tea, and Rose Hip possess strong antioxidant and photoprotective properties, making them suitable candidates for blue light defense formulations

The present study focuses on the formulation and evaluation of a herbal blue light protection face serum using these botanical extracts. The formulation is assessed for physicochemical properties, stability, antioxidant activity, and blue light protective efficiency to establish its potential as a safe and effective natural skincare product.

BLUE LIGHT PROTECTION HERBAL FACE SERUM

The blue light protection herbal face serum is a modern skincare formulation developed to protect the skin from the harmful effects of prolonged exposure to digital devices such as smartphones, laptops, and LED screens. Blue light, also known as high-energy visible (HEV) light, penetrates deeper into the skin compared to UV rays and leads to various skin issues such as oxidative stress, premature aging, hyperpigmentation, and loss of elasticity. This herbal serum is designed using natural ingredients rich in antioxidants and skin-nourishing properties, making it a safe and effective alternative to synthetic formulations.

The mechanism of action of the serum mainly involves antioxidant defences, hydration, and barrier protection. The antioxidants present in herbal extracts neutralize free radicals generated by blue light exposure, thereby preventing cellular damage. The serum forms a thin protective layer on the skin, reducing the penetration of harmful radiation. Additionally, it enhances skin hydration and supports repair processes, improving overall skin texture and appearance.

The herbal blue light protection face serum is an effective skincare solution that combines the benefits of natural antioxidants and hydrating agents to protect the skin from digital pollution. It not only prevents

damage caused by blue light but also improves skin health by providing hydration, nourishment, and a natural glow. This formulation represents a promising approach in the field of cosmetic science, especially in today's digital era where exposure to blue light is unavoidable.

METHOD OF PREAPARATION: -

1.Procedure for Powder Preparation:

The collection of dried Butterfly Pea flower, Moringa leaf, Green tea leaf, and Rose hip was carried out by procuring them from an online source. The collected ingredients were then checked and directly crushed into smaller pieces for size reduction. Subsequently, all the materials were ground into a fine powder using a grinder and passed through a sieve (sieve no. 60) to obtain a uniform particle size. Finally, the prepared powders were stored in airtight containers for further extraction.

2.Preparation of extracts and gel base:

Aqueous extracts were prepared by the infusion method using the powdered samples of Butterfly Pea flower (2 g), Moringa leaf (1 g), Green tea leaf (1 g), and Rose hip (1 g) were accurately weighed and transferred separately into clean beakers. To each beaker, 50 mL of distilled water was added. The mixtures were heated on a water bath at 60–70°C for about 15–20 minutes with occasional stirring to facilitate extraction of active constituents. After heating, the mixtures were allowed to cool to room temperature. The extracts were first filtered through muslin cloth to remove coarse particles, followed by filtration using Whatman filter paper to obtain clear aqueous extracts, The filtrates were collected in clean, closed containers for further use, from which 8 mL each of Butterfly Pea, Moringa, and Green Tea extracts, and 4 mL of Rose hip extract were measured as per formulation requirement .Separately, xanthan gum (0.3 g) was dispersed in rose water (25 ml) and a small quantity of distilled water with continuous stirring and allowed to hydrate to form a smooth gel base.

3.Mixing of ingredients:

Glycerine (1 ml) was added to the prepared gel base and mixed properly. Then, all the herbal extracts (butterfly pea 8 ml, moringa 8 ml, green tea 8 ml, and rose hip 4 ml)

were added slowly into the gel with continuous stirring to ensure uniform mixing. After that, sodium benzoate (0.4 g), previously dissolved in a small amount of distilled water, was added to the mixture and mixed well.

4.Final adjustment and storage:

Citric acid (0.1 g) was added to adjust the pH of the serum to around 5–6, which is suitable for skin. The final volume was made up to 100 ml using distilled water. The mixture was stirred well to obtain a smooth and uniform serum. The prepared serum was then stored in airtight containers for further evaluation.

COLLECTION OF INGERDIENTS, IT'S ROLE AND QUANTITY IN 100 ML FACE SERUM:

INGREDIENTS	ROLES	PLACE
Butter fly pea flower	1. Rich in anthocyanin (antioxidants) 2. Protects skin from blue light damage 3. Improves skin tone & gives natural blue colour	Bought from an online shopping site
Moringa leaf	1. Strong antioxidant & anti-pollution agent. 2.Nourishes skin (vitamins A, C, E) 3. Helps in skin repair and anti-aging	Bought from an online shopping site
Green tea	1. Contains polyphenols (EGCG) 2. Anti-inflammatory & anti-acne 3. Protects from UV and oxidative stress	Bought from an online shopping site
Rose hip	1. Rich in Vitamin C & essential fatty acids 2. Promotes collagen formation 3. Helps in skin brightening and repair	Bought from an online shopping site
Rose water	1. Natural toner and soothing agent 2. Maintains skin pH 3. Provides fragrance and refreshing effect	Bought from an online shopping site
Xanthum Gum powder	1. Thickening agent 2. Provides gel-like consistency 3. Stabilizes the formulation (prevents separation)	Used from college laboratory
Glycerine	1. Humectant (attracts moisture to skin) 2. Keeps skin hydrated and soft 3. Improves spread ability	Used from college laboratory

SR N0	Ingredients	Formulation 1	Formulation 2	Formulation 3	Formulation 4	Formulation 5
1	Butter fly pea flower (aqueous extract)	10 ml	12 ml	**8ml**	10 ml	7 ml
2	Moringa leaf (aqueous extract)	10 ml	12 ml	**8 ml**	10 ml	7 ml
3	Green tea (aqueous extract)	10 ml	12 ml	**8 ml**	10 ml	7 ml
4	Rose hip (aqueous extract)	5 ml	8 ml	**4 ml**	5 ml	4 ml
5	Rose water	20 ml	15 ml	**25 ml**	18 ml	20 ml
6	Xanthum Gum (powder)	0.5 g	0.6 g	**0.3 g**	0.7 g	0.3 g
7	Glycerin (liquid)	2 ml	2ml	**1 ml**	4 ml	1.5 ml
8	Sodium benzoate (powder)	0.5 g	0.5 g	**0.4 g**	0.5 g	0.4 g
9	Citric acid (powder)	0.2 g	0.25 g	**0.15 g**	0.2 g	0.15 g
10	Distilled water	QS to 100 ml	QS to 100 ml	**QS to 100 ml**	QS to 100 ml	QS to 100 ml

Sodium benzoate	1. Preservative 2. Prevents growth of bacteria, yeast, fungi 3. Increases shelf life of product	Used from college laboratory
Citric acid	1. PH adjuster 2. Maintains slightly acidic pH (~5–6) 3. Enhances preservative effectiveness	Used from college laboratory
Distilled water	1. Solvent/vehicle 2. Helps dissolve all ingredients 3. Makes up final volume of formulation	Used from college laboratory

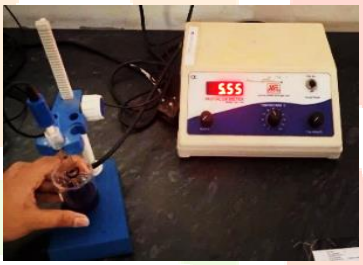
BATCH 3 WAS SUCCESSFUL

EVALUATION OF SERUM

1.Physical Evaluation

The colour and overall appearance of the formulation were evaluated through direct visual inspection. Additionally, the texture and feel were assessed by touch to confirm its physical characteristics.

2.pH value



The pH meter was first standardized using an appropriate buffer solution. Approximately 50 ml of was accurately measured. The pH of this solution was then determined. Since human skin is slightly acidic, the pH of the serum should be ideally fall within the range of 5.5 to 6.0.

3.Skin Irritancy

The serum was gently applied to the back (dorsal surface) of the hands of three volunteers. The treated area was then monitored over a period of 24 hours to detect any signs of irritation or undesirable skin reaction.

4. Determination of Viscosity

The viscosity of the formulation was measured using an **Ostwald Viscometer.** The instrument was thoroughly cleaned and dried before use. The sample was placed in the viscometer and allowed to reach a constant temperature. It was then drawn above the upper mark and permitted to flow downward under gravity. The time required for the liquid to pass between the marked points was noted, and the average of repeated readings was used to calculate the viscosity.

5.SPF Determination:

In this study, the in vitro sun protection factor (SPF) of the polyherbal face serum was evaluated using a spectrophotometric method adapted from the procedure reported by Mansur equation. Formulation 3 was diluted to 1% v/v with distilled water, and its absorbance was measured in the UV range of 290–320 nm at 5 nm intervals using a UV–visible spectrophotometer. The SPF value was then calculated using the following equation:

$$\boxed{\mathbf{SPF} = \mathbf{CF} \times \sum[\boldsymbol{EE}(\boldsymbol{\lambda}) \times \boldsymbol{I}(\boldsymbol{\lambda}) \times \boldsymbol{Abs}(\boldsymbol{\lambda})]}$$

Where:

- **CF** = Correction factor (usually 10)
- **EE(λ)** = Erythemal effect spectrum
- **I(λ)** = Solar intensity spectrum
- **A(λ)** = Absorbance of the sample at wavelength λ

This method provides an estimation of SPF based on UV absorbance characteristics.

6.Microbial Test:

Cosmetic products are not sterile but require proper preservation to avoid microbial contamination. Therefore, microbial testing of the serum was conducted to ensure its safety and stability against microbial growth.

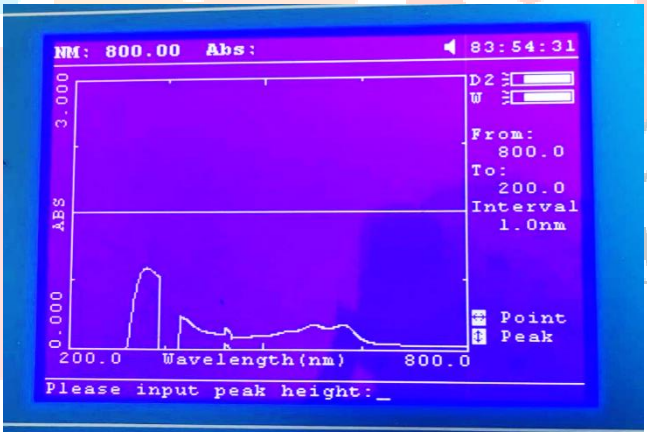
7.Absorbance Time:

The serum was applied to the skin, and a stopwatch was used to measure the time required for its absorption.

RESULT

Sr No.	Test	Result
1.	**Physical Evaluation**	Colour: Bluish Colour, Odour: Pleasant, Appearance and Texture: Smooth and Non-Greasy
2.	**pH value**	5.55
3.	**Skin Irritancy**	No
4.	**Viscosity determination**	2.79cP
5.	**SPF**	

DETEMINATION



SPF was calculated using the Mansur equation by measuring absorbance of the serum in the UV range (290–320 nm) using a UV spectrophotometer.

OBSERVATION AND CALCULATION

Wavelength (λ)	Absorbance	EE (λ)×I (λ)	EE (λ)× I (λ) ×Abs (λ)
290	0.28	0.0150	0.0042
295	0.42	0.0817	0.0343
300	0.58	0.2874	0.1667
305	0.65	0.3278	0.2131
310	0.50	0.1864	0.0932
315	0.34	0.0839	0.0285
320	0.20	0.0180	0.0036

Mansur Equation

$$SPF = CF \times \sum [EE(\lambda) \times I(\lambda) \times Abs(\lambda)]$$

$$= 10 \times (0.0042 + 0.0343 + 0.1667 + 0.2131 + 0.932 + 0.0285 + 0.0036)$$

$$= 10 \times 0.5436$$

$$= 5.44$$

SPF = Sun Protection Factor (SPF) is a measure that indicates how effectively a sunscreen protects the skin from UVB rays, which cause sunburn. It represents how much longer a person can stay in the sun without developing redness compared to unprotected skin. For example, using an SPF 5.4 product correctly means it would take 5.4 times longer for the skin to show signs of sunburn. SPF is widely accepted as a key indicator of sunscreen performance.

6. Absorption:

The serum begins penetrating the skin immediately after application and is completely absorbed within 1–2 minutes.

7. Microbial Test:

The formulation exhibited microbial counts within the permissible range, confirming that the serum is safe for topical use from a microbiological perspective.

APPLICATION

The serum should be applied to clean, dry skin for best results. After washing the face with a mild cleanser and gently patting it dry, take a few drops of the serum onto the fingertips. Apply it evenly over the face and neck, and massage gently in circular motions until it is fully absorbed into the skin. It is recommended to use the serum before exposure to digital screens such as mobile phones and laptops. For optimal benefits, it can be used once or twice daily, preferably in the morning and evening.

The serum should be stored in refrigerated.

CONCLUSION

The herbal blue light protection serum was successfully formulated using antioxidant-rich plant extracts with proven photoprotective properties. The formulation demonstrated significant protection against blue-light–induced oxidative stress, indicating its strong potential in preventing blue light–related skin damage. Physicochemical evaluation revealed that the serum possessed desirable stability characteristics with acceptable pH, viscosity, and spreadability. It also exhibited good cosmetic elegance, favorable sensory properties, and high consumer acceptability. Safety assessments confirmed that the formulation was non-irritant and suitable for topical application. Overall, the developed serum can be considered a safe, natural,

and effective alternative to conventional synthetic blue light protective products, supporting its potential application in modern skincare formulations.

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