

**FORMULATION AND STANDARDIZATION OF MULTI-HERBAL SKIN SERUM**

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**ABSTRACT**

Herbal face serums offer a natural and effective approach to skincare, utilizing plant-based ingredients with therapeutic benefits. This study focuses on formulating and evaluating a herbal face serum incorporating Hibiscus, Rosemary and Green Tea extracts, known for their antioxidant, anti-aging, and skin-rejuvenating properties. Hibiscus is rich in natural acids and anthocyanins that promote skin exfoliation and elasticity, Rosemary has antimicrobial and anti-inflammatory properties that help in acne prevention, and Green Tea is packed with polyphenols that protect against oxidative stress and improve skin texture. The serum formulation includes natural humectants and essential oils to enhance skin hydration and absorption. Stability, pH, viscosity, and skin compatibility tests were conducted, demonstrating the serum’s effectiveness in improving skin hydration, reducing fine lines, and enhancing overall skin health. The study concludes that this herbal face serum provides a promising, chemical-free alternative for maintaining youthful and radiant skin.

**KEYWORDS:** Face serum, Hibiscus, Rosemary, Green tea extract.

**INTRODUCTION**

Serums, also known as concentrates, are skincare products designed to be more effective and faster-acting than creams. They contain ten times more biologically active ingredients and have the ability to penetrate deeper layers of the skin. Due to their lower viscosity, serums absorb quickly, spread easily, and feel more comfortable on the skin.<sup>[1]</sup>

Facial serum: Many dermatologists and cosmetologists recommend serums for effectively addressing various skin concerns in a short period. Environmental factors can impact facial skin, leading to issues such as poor texture, wrinkles, acne, rosacea, UVinduced dark spots,

dryness, pigmentation disorders (both hypopigmentation and hyperpigmentation), and dullness.<sup>[2-6]</sup> Facial serums are highly concentrated and lightweight, allowing for the rapid and efficient delivery of active ingredients. They are typically packaged in small bottles (15–30 mL) with a dropper for precise application, as only a few drops are needed to treat various skin conditions.<sup>[7-9]</sup>

**MATERIALS AND METHOD**

**COLLECTION OF HERBAL INGREDIENTS**

The plant part required for the study such as *Hibiscus rosa-sinensis L.* (Hibiscus) *Camellia sinensis (L.) Kuntze* (Green tea) *Rosmarinus officinalis L.*(Rosemary) were collected and dried.

**Table 1: Plant sources.**

SI no.	Common name	Botanical name	Family	Part used	Category
1	Hibiscus	<i>HibiscusrosasinensisL.</i>	Malvaceae	Flower	Anti- acne Anti- ageing
2	Green tea	<i>Camellia sinensis L.</i>	Theaceae	Leaves	Anti- oxidant
3	Rosemary	<i>RosmarinusofficinaliL.</i>	Lamiaceae	Leasves	Anti- microbial

**STANDARDIZATION PARAMETERS**

**1. Fourier transform infrared spectroscopy**

Fourier Transform Infrared (FTIR) Spectroscopy is a

widely used analytical technique for identifying and characterizing chemical compounds based on their molecular vibrations. It works by measuring the

absorption of infrared light by a sample, producing a spectrum that represents the functional groups present.<sup>[10]</sup>

## 2. Loss on drying

Loss on drying (LOD) is a test used to determine the amount of moisture and volatile matter present in a sample. The sample is heated under specific conditions to remove water and volatile substances, and the weight loss is measured.

## 3. Total ash value

Ash refers to the residue left behind after a drug is incinerated. The inorganic elements naturally present in the plant contribute to what is known as physiological ash, which can vary within specific limits depending on the soil type. However, external contaminants like dust, sand, mineral impurities, or accidental admixtures with other substances may alter the ash composition.

## FORMULATION OF FACE SERUM

Preparation of individual extract

### • Preparation of hibiscus extract

To extract hibiscus compounds using water, 1.1 grams of dried hibiscus flowers were added to 100 mL of distilled water. The mixture was then heated for 10 minutes while being continuously stirred. After heating, the liquid extract was separated from the solid residues using filter paper to obtain a clear hibiscus extract.<sup>[11]</sup>

### • Preparation of green tea extract

Hot water extraction is a commonly used extraction method. In this method, dried plant material is soaked in boiling water at a temperature of 80–100°C for 10 minutes. After heating, the liquid extract is separated from the plant material by filtering it through filter paper.<sup>[12]</sup>

### • Preparation of rosemary extract

The extraction of rosemary was carried out using a Soxhlet apparatus with ethanol as the solvent. Rosemary

leaves were placed in a thimble-holder within the Soxhlet extractor and subjected to reflux. During the process, the thimble-holder gradually filled with freshly condensed ethanol from the distillation flask. Once the liquid reached the overflow level, a siphon aspirated the contents and returned them to the distillation flask, carrying the extracted analytes in the bulk liquid. This cycle was repeated until complete extraction was achieved. The Soxhlet method, functioning as a hybrid continuous-discontinuous technique, operates in a batch-like manner due to the stepwise action of the solvent while also exhibiting continuous characteristics as the solvent is repeatedly recirculated. Finally, the obtained extract was concentrated to one-third of its original volume.<sup>[13]</sup>

A total of four serum formulations were developed, incorporating hibiscus, green tea and rosemary extracts in varying concentrations. The formulation included Tween 20, glycerin, benzyl alcohol, and an appropriate quantity of rose water to make up 100 ml of serum.

### 1. Pre-Emulsification Step

Tween 20 and glycerin were thoroughly blended in a beaker.

### 2. Preparation of the Aqueous Phase

Hibiscus extract, green tea extract, rosemary extract and rose water were combined and mixed well in a separate beaker.

### 3. Phase Integration

The aqueous phase was gradually introduced into the Tween 20 and glycerine mixture while continuously stirring to achieve uniform dispersion.

### 4. Addition of Preservative

A suitable quantity of benzyl alcohol was incorporated as a preservative.

**Table 2: Formulation of herbal face serum from individual extract.**

Ingredients	F1	F2	F3	F4
Hibiscus	3 ml	4 ml	2 ml	7 ml
Green tea	2 ml	4 ml	6 ml	2.8 ml
Rosemary	5 ml	2 ml	2 ml	1 ml
Glycerine	2 ml	1.5 ml	1.5 ml	1.5 ml
Tween 20	0.5 ml	0.5 ml	0.5 ml	0.6 ml
Benzyl alcohol	0.2 ml	0.2 ml	0.2 ml	0.1 ml
Rose oil	1 drop	1 drop	----	----
Rose water	Upto 15 ml	Upto 15 ml	Upto 15 ml	Upto 15 ml

**Table 3: Standard formula of 100mL herbal face serum.**

Ingredients	Quantity
Hibiscus	46.6%v/v
Green tea	18.6%v/v
Rosemary	6.6%v/v
Glycerine	10%v/v
Tween 20	4%v/v
Benzyl alcohol	0.6%v/v
Rose water	q.s to 100 ml



**Fig 1: Different formulations of herbal face serum.**

**EVALUATION OF HERBAL FACE SERUM**

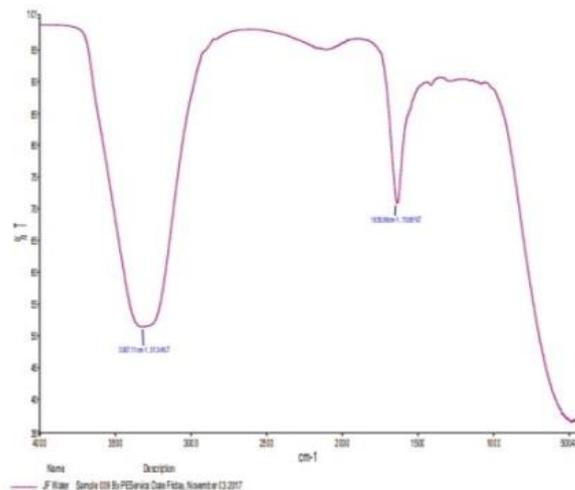
1. Physical evaluation
2. Determination of pH
3. Spreadability
4. Absorbance time
5. Viscosity
6. Homogeneity.
7. Stability studies

**RESULT AND DISCUSSION  
STANDARDIZATION PARAMETER  
FTIR**

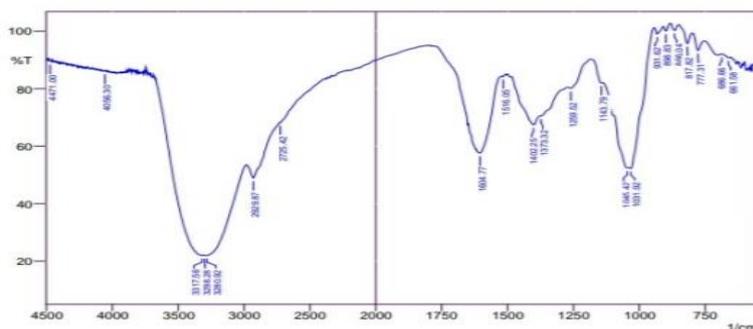
**FTIR of hibiscus extract**

The FTIR analysis of the Hibiscus rosa-sinensis flower water extract (WFE) shows characteristic peaks at

3307.11  $\text{cm}^{-1}$ , corresponding to O-H stretching of alcohol and phenol groups (standard range: 3200–3600  $\text{cm}^{-1}$ ), and at 1635.90  $\text{cm}^{-1}$ , indicating C=O stretching of ketones (standard range: 1600–1700  $\text{cm}^{-1}$ ). These functional groups are key structural components of flavonoids, which are known for their antioxidant, anti-inflammatory, and antimicrobial activities. The presence of both hydroxyl (O-H) and carbonyl (C=O) groups confirms the likelihood of flavonoids in the flower extract, supporting its potential pharmacological applications.<sup>[14]</sup>



**Fig. 2: Std. FTIR of Hibiscus.**



**Fig. 3: FTIR of sample hibiscus extract.**

### FTIR of green tea extract

The FTIR spectrum of green tea reveals characteristic absorption bands that indicate the presence of specific functional groups. A broad peak around  $3354.21\text{ cm}^{-1}$  corresponds to hydroxyl (-OH) stretching, which typically appears in the range of  $3200\text{--}3600\text{ cm}^{-1}$ , suggesting the presence of alcohols or phenolic compounds, commonly found in flavonoids. Additionally, a peak at  $1633.71\text{ cm}^{-1}$  aligns with C=O

stretching, which generally, falls within  $1630\text{--}1750\text{ cm}^{-1}$ , indicating the presence of ketones or conjugated carbonyl compounds, such as those found in flavonoids. Furthermore, additional peaks in the  $1400\text{--}1600\text{ cm}^{-1}$  range, corresponding to C=C stretching in aromatic rings, further confirm the presence of flavonoids. Therefore, based on the FTIR analysis, green tea contains hydroxyl (-OH) and ketone (C=O) groups, strongly suggesting the existence of flavonoids.<sup>[15]</sup>

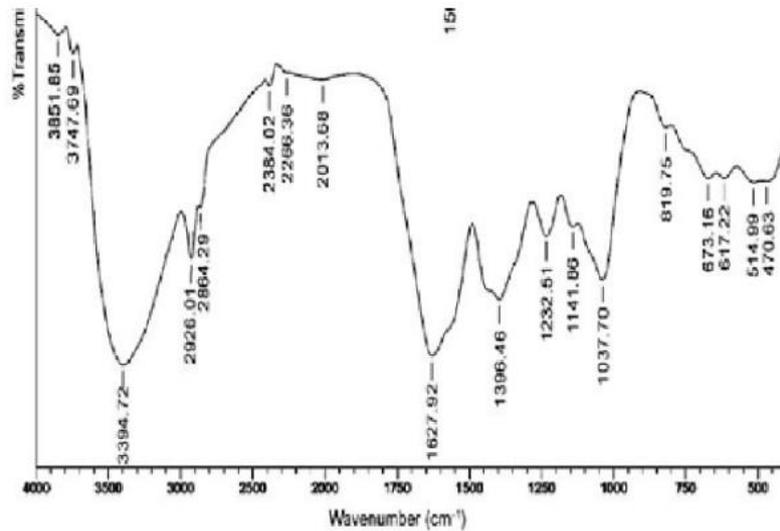


Fig. 4: Std. FTIR of green tea.

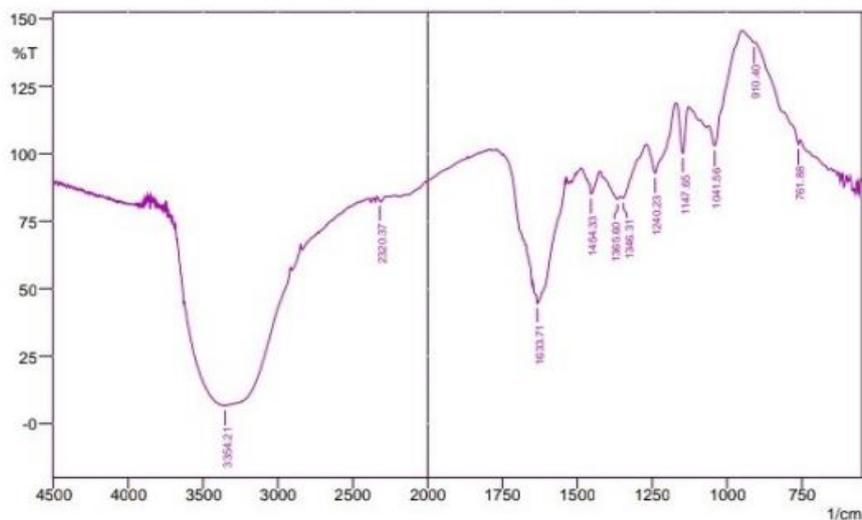


Fig. 5: FTIR of sample green tea extract.

### FTIR of rosemary extract

FTIR (Fourier Transform Infrared) spectroscopy identifies functional groups in a sample by measuring absorbance at specific wavenumbers ( $\text{cm}^{-1}$ ), with each functional group having a characteristic absorption range. The C=O Stretching Carbonyl Group in Flavones and Flavonols ranging from  $1600\text{--}1650\text{ cm}^{-1}$ . And a significant peak near  $1681.93\text{ cm}^{-1}$  is from flavonoids

(conjugated C=O). The broad O-H stretching vibration of alcohols generally, appears between  $3200\text{--}3600\text{ cm}^{-1}$ , and a broad peak around  $3371.57\text{ cm}^{-1}$  indicates the presence of an alcohol (hydroxyl) group, which is expected due to rosemary's phenolic compounds like rosmarinic acid and carnosol that contribute to its antioxidant activity.<sup>[16]</sup>

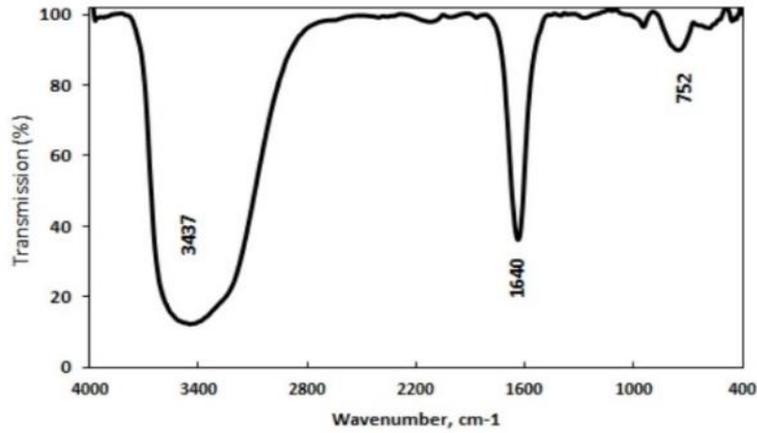


Fig. 6: Std. FTIR of Rosemary.

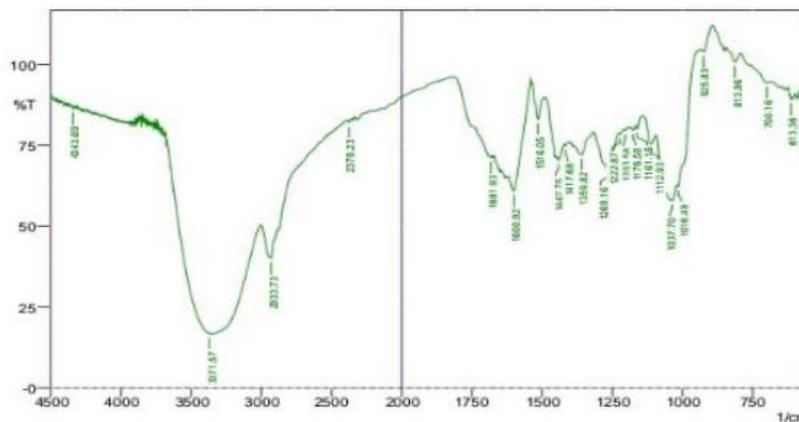


Fig. 7: FTIR of sample rosemary extract.\

**Loss on drying**

**Table 4: Result of loss on drying.**

Ingredients	Loss on drying
Hibiscus	12.4 %
Green tea	6.4 %
Rosemary	9.5 %

Loss on drying (LOD) is essential for determining the moisture and volatile content in plant materials, ensuring stability, potency and preventing microbial contamination.

Maintaining an optimal moisture range preserves bioactive compounds, extends shelf life and ensures product quality in pharmaceuticals and herbal formulations.

**Total ash value**

**Table 5: Result of Total ash value.**

Ingredients	Total Ash value
Hibiscus	5.9 %
Green tea	5.0 %
Rosemary	7.1 %

Ash value is crucial for determining the total inorganic content in plant materials, helping assess purity, quality and the presence of impurities like heavy metals or adulterants. It ensures compliance with standard limits, maintaining the efficacy and safety of herbal and pharmaceutical product.

## EVALUATION OF FACE SERUM PHYSICAL EVALUATION

Physical evaluation ensures the quality, consistency and stability of a product by assessing its appearance, colour, texture, odour and phase separation.

**Table 6: Result of Physical evaluation.**

Property	F1	F2	F3	F4
Colour	Brown	Reddish brown	Pale brown	Reddish
Odour	Sweet	Sweet	Mild	Mild
Texture	Smooth	Smooth	Smooth	Smooth

## DETERMINATION OF pH

**Table 7: Result of PH test.**

Test	F1	F2	F3	F4
pH	7.1	6.6	6.89	6.80

pH plays a crucial role in maintaining the stability, efficacy and safety of skincare and pharmaceutical products. It ensures compatibility with the skin's natural

barrier, prevents irritation and enhances the effectiveness of active ingredients.

## SPREADABILITY

**Table 8: Result of Spreadability.**

Test	F1	F2	F3	F4
Spreadability	17.94%	16.28%	21.53%	24.42%



**Figure 8: Spreadability.**

## ABSORBANCE TIME

**Table 9: Result of Absorbance time.**

Test	F1	F2	F3	F4
Time	60 sec	90 sec	45sec	30 sec

Absorbance time of a face serum determines how quickly active ingredients penetrate the skin, influencing hydration, efficacy and overall user experience. Faster

absorption indicates a well-formulated serum that delivers benefits efficiently without leaving a greasy or sticky residue.

## VISCOSITY

**Table 10: Result of viscosity.**

Test	F1	F2	F3	F4
Viscosity	1.89	1.92	1.81	1.78



**Figure 9: Viscosity.**

Viscosity determines the thickness and flow of a substance, affecting the application, spreadability and absorption of product. Optimal viscosity ensures ease of

use, enhances product stability and influences the overall sensory experience.

**PATCH TEST**

**Table 11: Result of Patch test.**

Formulation	Observation
F1	Irritation
F2	No irritation
F3	No irritation
F4	No irritation

A patch test helps to identify potential allergic reactions or skin sensitivities before using a new product, ensuring safety and compatibility. It prevents adverse effects like

irritation, redness or breakouts, making it essential for skincare and cosmetic formulations.

**HOMOGENEITY**

**Table 12: Result of Homogeneity.**

Formulation	Observation
F1	No lumps or aggregation
F2	No lumps or aggregation
F3	No lumps or aggregation
F4	No lumps or aggregation

Homogeneity ensures uniform distribution of ingredients in a formulation, leading to consistent effectiveness and quality in every application. It prevents separation, enhances stability and ensures a smooth texture for better user experience.

**STABILITY STUDIES****Table 13: Result of stability studies.**

Property	F1	F2	F3	F4
Visual Stability	Translucent	Translucent	Translucent	Translucent
Homogeneity	Good	Good	Good	Good
Phase Separation	Yes	No	No	No

Stability studies are essential to evaluate a product's shelf life, ensuring it maintains its quality, efficacy and safety under various conditions. These studies help to identify potential degradation, optimize formulation and ensure regulatory compliance for longterm reliability.

**SUMMARY AND CONCLUSION**

A herbal serum formulation was developed by incorporating the individual extracts of rosemary, hibiscus and green tea, along with carefully selected excipients such as preservatives, glycerine and other stabilizing agents to enhance the efficacy, consistency and shelf life of the formulation. Each ingredient was chosen based on its specific role in improving the therapeutic and cosmetic benefits of the serum. By carefully combining the individual extracts and excipients, four different serum formulations (F1–F4) were prepared, each varying in composition and concentration to determine the most effective combination for skin application.

After formulation, the herbal serums underwent comprehensive evaluation to assess their stability, effectiveness and overall quality. Several physicochemical tests were conducted, including pH, spreadability testing, homogeneity analysis and stability studies. Among the four formulations, formulation F4 demonstrated superior performance. These findings suggest that formulation F4 is a stable, effective and skin-friendly herbal serum, making it a promising candidate for cosmetic and therapeutic applications aimed at improving skin health, hydration and overall appearance.

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