

FORMULATION AND EVALUATION OF BEETROOT AND ROSE HYDROSOL TINTED GEL

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ABSTRACT

This study focuses on the formulation and evaluation of a beetroot and rose hydrosol tinted gel, combining the natural benefits of these botanical extracts. Rose (*Rosa rugosa*) is known for its traditional medicinal uses and rich vitamin content, particularly vitamin C. It offers antioxidant and antimicrobial properties, making it beneficial for skin health. Beetroot (*Beta vulgaris*) is a rich source of betalains, polyphenols, and vitamins B and C. It acts as a natural detoxifier and can enhance skin complexion and hydration. The gel formulation utilized Carbopol as a thickener, Triethanolamine as an emulsifier, Vitamin E for its antioxidant properties, and Methylparaben as a preservative. The procedure involved mixing rose, beetroot, and hibiscus extracts, heating the mixture, and incorporating the thickening and stabilizing agents.

The formulated hydrosol gel underwent a series of quality control tests to assess its characteristics and ensure its quality. It including Fourier Transform Infrared Spectroscopy (FTIR) to assess physical appearance, pH, spreadability, washability, and viscosity. SEM analysis at the 1st and 2nd week post-formulation revealed smooth surface characteristics and well-dispersed particles, indicating good bonding and no deterioration over time. The gel maintained its stability and compatibility, proving to be a robust and effective formulation. The objective of tinted rose and beetroot gel is to provide natural color enhancement to the skin, imparting a subtle rosy hue. Infused with the botanical benefits of rose and beetroot extracts, this gel aims to hydrate, nourish, and revitalize the skin, promoting a healthy and radiant complexion with a touch of natural tint.

The combination of beetroot and rose hydrosol provides synergistic skincare benefits, offering antioxidants, hydration, and a natural tint. This innovative formulation caters to the growing demand for natural, multifunctional skincare products, setting it apart from traditional gels. The tinted aspect, derived from natural beetroot pigment, enhances the gel's visual appeal and functional benefits, making it suitable for consumers seeking organic skincare solutions.

Keywords : Beetroot extract , Rose hydrosol, Tinted gel, Antioxidants, Carbopol, Skin hydration, Natural colorant, Herbal formulation, evaluation parameters.

INTRODUCTION

According to the US Food and Drug Administration (FDA), a cosmetic is defined as a product (excluding pure soap) intended to be applied to the human body for cleansing, beautifying, promoting attractiveness, or altering the appearance [1]. The origin of the term "cosmetic" from the Greek word "Kosmetikos" indeed reflects its meaning related to arrangement, decoration, order, and harmony [2]. Colored cosmetics play a vital role in dermatology. They can conceal contour and pigment irregularities, offer moisturization, improve oil control, provide sun protection, deliver barrier-enhancing agents, aid in acne treatment, and foster a sense of personal well-being.

It highlights the historical connection between cosmetics and the concept of enhancing appearance. Indeed, cosmetics have been used for millennia for various purposes, including enhancing beauty and maintaining youthful appearances. In ancient Egypt, bathing in sour milk was one method believed to contribute to skincare and beauty maintenance. The lactic acid in sour milk was thought to have exfoliating and

moisturizing properties, helping to keep the skin soft and supple. Regulations surrounding cosmetics play a crucial role in ensuring consumer safety and product quality. In recent years, India has implemented various regulations aimed at enhancing the legal framework, technical standards, and inspection systems related to cosmetics production and distribution. These measures aim to raise the entry threshold for the cosmetics industry, promote better quality control, and enhance supervision and management practices. As a result, the industry may experience increased concentration and adherence to stricter standards. The increasing desire among baby boomers and others to maintain a youthful appearance has indeed spurred significant market demand and opportunities in the cosmetics industry. Furthermore, the influence of social media and the internet has heightened awareness regarding the potential risks associated with certain chemicals in cosmetics, leading to a growing preference for natural products derived from plants and other natural resources. Consequently, the cosmetic industry is shifting its focus towards developing and promoting natural products to meet consumer preferences and health concerns. The increasing demand for non-invasive skincare solutions with fewer adverse effects has led to rapid advancements in dermocosmetics development. Natural compounds derived from plants and herbal formulations have gained popularity due to their perceived safety and diverse active properties. Our research primarily centers on herbal-derived skin products, with evaluations conducted through in vitro studies. The shift towards non-invasive, natural-based skincare products reflects consumers' growing interest in holistic health and sustainability. While biotechnologies offer innovative possibilities, there's still a strong demand for bioactive compounds sourced from nature. This emphasizes the importance of balancing technological advancements with traditional knowledge of natural remedies in the skincare industry [3].

The rose, derived from the Latin word *Rosa* and belonging to the Rosaceae family, is classified as a flowering shrub. *Rosa rugosa*, has traditionally been used as an herbal medicine for ailments such as dermatological treatment, stomach aches, diarrhea, menoxenia, diabetes mellitus, pain, and chronic inflammatory diseases [4]. *Rosa damascene*, known as the king of flowers, symbolizes love, purity, faith, and beauty. *Rosa rugosa* thrives in various temperate regions of eastern Asia. Rose hips are abundant in vitamins, particularly vitamin C, along with phenolic compounds, carotenoids, tocopherol, bioflavonoids, tannins, volatile oils, and pectins. Freeze-dried extracts of *Rosa rugosa* fruits demonstrate antioxidant and antimicrobial properties, investigated for their effect on bacterial survival in protein-based fluids [5].

Beetroot (*Beta vulgaris*), a flowering plant in the Chenopodiaceae family, is a well-known root vegetable cultivated in all temperate climates. It is consumed raw in salads and soups or juiced. Additionally, beetroots are utilized in the food industry as a colorant due to their richness in betalains, a group of chromoalkaloids comprising betacyanins (red-violet pigments) and betaxanthins (yellow pigments) [6]. Beetroots are also a source of polyphenols, vitamins B, and C [7]. Beetroot acts as a natural detoxifier, eliminating impurities from deeper skin layers. Beetroot can also nourish, hydrate, and brighten lips, helping to alleviate darker tones and add a pinkish hue [8]. Rose and beetroot gel offer multiple benefits for the skin, including detoxification, healing sun damage, and enhancing complexion. The combination of rose and beetroot powder in skincare products provides antioxidants, vitamins, and minerals, promoting healthier skin. Additionally, their anti-inflammatory properties soothe irritation and reduce redness. Overall, the combination of rose and beetroot provides natural radiance and a healthy complexion, while their hydrating and antioxidant-rich properties contribute to skin health. Natural products derived from plants of the Malvaceae family are utilized worldwide, with particular emphasis on the genus *Hibiscus* due to its numerous pharmacological activities and high phenolic content [9,10,11]. *Hibiscus* spp. comprises approximately 240 species of annual or perennial flowering herbs, shrubs, or trees found in various regions globally. Traditionally, *Hibiscus* extracts have been employed in folk medicine as emollients for treating various skin disorders and burns. Based on literature findings, extracts from *Hibiscus* sp. plants present compelling potential as active ingredients in skin cosmetic formulations. They offer protection against oxidative stress, collagen degradation, and the harmful effects of UV radiation, safeguarding skin cells and promoting skin health [12].

Our formulation utilizes Carbopol as a thickener, Triethanolamine as an emulsifier and stabilizer, Vitamin E for its antioxidant properties to protect the skin and formula, and Methylparaben as a preservative to prevent microbial growth, ensuring product safety and longevity in cosmetics like lotions, creams, and gels. Gels are semisolids ranging from transparent to opaque, characterized by a high ratio of solvent to gelling agent. When dispersed in a suitable solvent, gelling agents combine or entangle to create a three-dimensional colloidal

network structure. This network restricts fluid flow by trapping and immobilizing solvent molecules. Furthermore, the network structure is accountable for the gel's resistance to deformation, thus determining its viscoelastic properties. Facial blushes, or rouges, are formulated to enhance the natural rosy color of the cheeks. Often, rosy cheeks are a sign of vasomotor instability or fine telangiectatic mats caused by actinic damage, but the look remains stylish. Blushes come in a range of colors, including red, pink, orange, and brown, catering to consumer preferences. They also offer various finishes, such as matte, frosted shine, and metallic glow, to align with current trends.

The objective of tinted rose and beetroot gel is to provide natural color enhancement to the skin, imparting a subtle rosy hue. Infused with the botanical benefits of rose and beetroot extracts, this gel aims to hydrate, nourish, and revitalize the skin, promoting a healthy and radiant complexion with a touch of natural tint.

MATERIALS AND METHODOLOGY

1. Preparation of ingredients

a) Beetroot extract

To prepare beetroot extract, start by washing the beet roots thoroughly. Once clean, peel the beet roots and chop them into small pieces. Next, blend the chopped beet roots thoroughly until they form a smooth mixture. To separate the liquid extract, filter the blended mixture through a piece of muslin cloth. The resulting filtrate will be the red beet color extract [14].

b) Rose extract

Preferably, the rose extract is prepared by sequentially extracting, filtering and concentrating fresh rose petals. To extract rose essence, begin by selecting fresh rose flowers and carefully removing the petals. Wash the petals thoroughly with water to remove any impurities. After washing, place the rose petals in a mortar and crush them using a pestle. Add a small amount of rose water to the mortar to facilitate the crushing process and enhance the extraction of the essence. Continue to crush the petals until they are thoroughly macerated and the essence is released [14].

c) Hibiscus extract

Fresh Hibiscus flowers were collected from the market for their rich color. The extraction process was carefully conducted to obtain vibrant pigments. Initially, the flowers were immersed in distilled water to release their natural pigments. After thorough maceration, involving gentle crushing and soaking, the resultant solution was a vividly pigmented extract. This pigmented water, rich in Hibiscus essence, was filtered and collected for further use. The meticulous process preserved the flower's natural color and properties, making it ideal for various applications [15].

d) Rose powder

To prepare rose petal powder, start by collecting fresh rose petals and thoroughly washing them to remove any dirt or impurities. Spread the washed petals out on a clean surface or tray and allow them to air dry completely, which may take several days. Once the petals are fully dried and crisp, place them in a blender or food processor and grind them into a fine powder. Sift the ground petals through a fine mesh sieve to ensure a uniform consistency. Store the rose petal powder in an airtight container, away from moisture and direct sunlight, to maintain its quality.

e) Aloe extract

To extract aloe vera gel, select healthy leaves, wash and trim their thorny edges. Cut the leaves into sections and carefully remove the skin to expose the gel. Scoop out the gel with a spoon and, if desired, blend it for a smoother consistency. Transfer the gel to a clean glass jar and store it in the refrigerator. The gel can be used directly for skin and hair care.

f) Other synthetic chemicals

All other ingredients were taken from the institutional chemical store. Each ingredient was carefully selected and sourced to ensure the highest quality and consistency for the preparation process. The chemical store provided a reliable supply of these components, supporting the integrity of the overall formulation [15].

2. Method to prepare tinted gel:

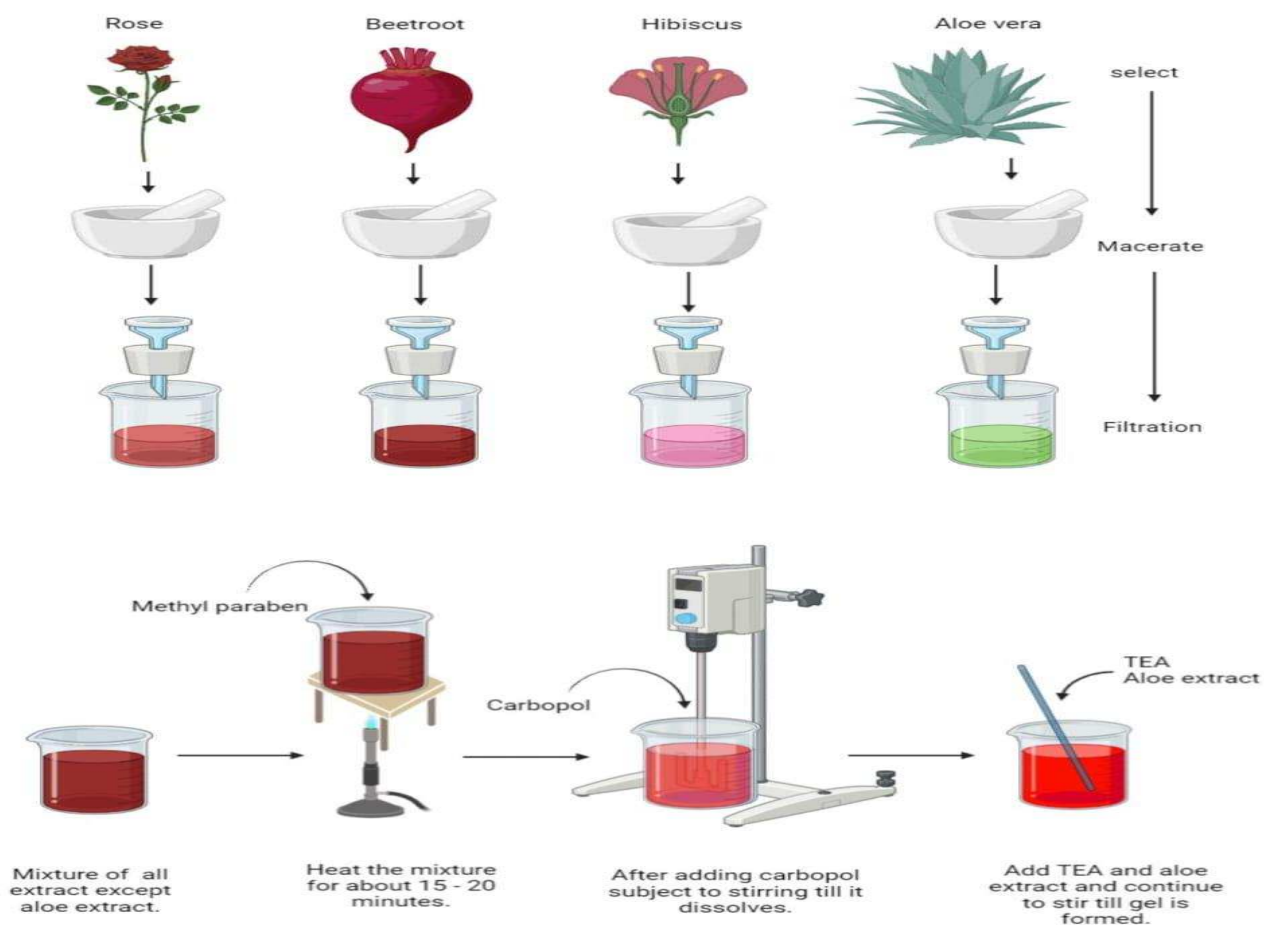
a. Formulation table:

Ingredients	Formulations						
	F1	F2	F3	F4	F5	F6	F7
Rose extract	12ml	5ml	10ml	2ml	15ml	13ml	20ml
Beetroot	6ml	19ml	5ml	16ml	10ml	6ml	1ml
Hibiscus	2ml	1ml	5ml	2ml	5ml	1ml	9ml
Carbopol [0.5%]	0.10gm	0.10gm	0.10gm	0.10gm	0.10gm	0.10gm	0.10gm
TEA	0.2ml	0.2ml	0.2ml	0.2ml	0.2ml	0.2ml	0.2ml
Vitamin E	1capsule	1capsule	1capsule	1capsule	1capsule	1capsule	1capsule
Methyl paraben	0.05gm	0.05gm	0.05gm	0.05gm	0.05gm	0.05gm	0.05gm
Rose water	q.s	q.s	q.s	q.s	q.s	q.s	q.s
Aloe extract	nil	5ml	3ml	nil	nil	2ml	2ml

b. Procedure:

Take a sufficient quantity of rose extract or rose powder and mix it with an adequate amount of beetroot and hibiscus extract. Measure the total quantity of the mixture and heat it to 70°C for about 15 minutes. While heating, add methylparaben. Once the mixture reaches a lukewarm temperature, add 0.5% carbopol powder and mix well until fully dissolved. After dissolving, add 2 to 3 drops of triethanolamine to the gel, followed by the

contents of one vitamin E capsule. Finally, incorporate the aloe vera gel extract into the mixture, blending thoroughly to achieve a smooth consistency.



3. Evaluation

The formulated hydrosol gel underwent a series of quality control tests to assess its characteristics and ensure its quality.

Fourier transform infrared spectroscopy (FTIR): Fourier Transform Infrared Spectroscopy, also known as FTIR Analysis or FTIR Spectroscopy, is an analytical technique used to identify chemical bonds and functional groups through the absorption of infrared radiation. This technique is essential in fields like polymer science, materials science, and pharmaceuticals for understanding the composition, structure, and changes in gels over time.

Factorial design: A factorial design for optimization has been implemented, using Beetroot, rose, and Carbopol as independent variables, while the temperature, viscosity and gelation were chosen as dependent variables. All batches (F1 to F7) were statistically evaluated using Analysis of Variance (ANOVA), and the results obtained from factor design for optimization are provided below.

Physical appearance:

Colour -The colour of formulated hydrosol gel was checked against white background.
Consistency - The consistency was checked by applying on skin.

Grittiness- The greasiness was assessed by the application on to the skin.

Odour- The odour of the gels was checked by mixing the gel in water and taking the smell [16].

pH parameter: The pH of the formulated hydrosol gel was determined by using digital pH meter and the following procedure was followed where the gel was diluted with distilled water and stirred thoroughly. Calibrate the pH meter with standard buffer solutions (pH 4, 7, and 10), rinsing the electrode between calibrations. Immerse the electrode in the gel sample, let the reading stabilize, and record it. Rinse the electrode after measurement. Repeat for accuracy and average the results [15,16].

Spreadability: Spreadability refers to how easily a gel spreads when applied to the skin. It is measured by the time in seconds it takes for two slides to slip apart when the gel is placed between them under a specified load. This is calculated using a specific formula, reflecting the gel's spreading value.

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

Where M = weight tied to upper slide, L = length of glass slides, T = time taken to separate the slides [16].

Washability: Washability refers to how easily and thoroughly a formulation can be washed off the skin with water. This is assessed by applying the product to the skin and then manually evaluating the ease and extent of its removal with water [16].

Stability studies: The prepared hydrosol gel was subjected to accelerated stability studies at three different temperatures: room temperature ($25.0 \pm 3.0^\circ\text{C}$), refrigeration ($4 \pm 2.0^\circ\text{C}$), and elevated oven temperature ($40.0 \pm 2.0^\circ\text{C}$) for a duration of 30 days. Following this period, the gel underwent reevaluation for its organoleptic properties, pH level, spreadability and other pertinent characteristics [17].

Viscosity study: For the viscosity study, the prepared gel underwent viscosity measurement using a Brookfield digital Viscometer with spindle no. 4 at a speed of 10 RPM. Prior to measurement, the gel was deaerated and transferred into an appropriate wide-mouth container. Samples were allowed to settle for 30 minutes at the assay temperature of $25 \pm 1^\circ\text{C}$ before measurements were taken. The relationship between RPM and viscosity was analyzed: typically, an increase in RPM accompanied by an increase in viscosity indicates shear-thinning behavior, where viscosity decreases as shear rate increases. Conversely, if viscosity increases with increasing RPM, it suggests non-Newtonian behavior, which is uncommon in most fluids [16,17].

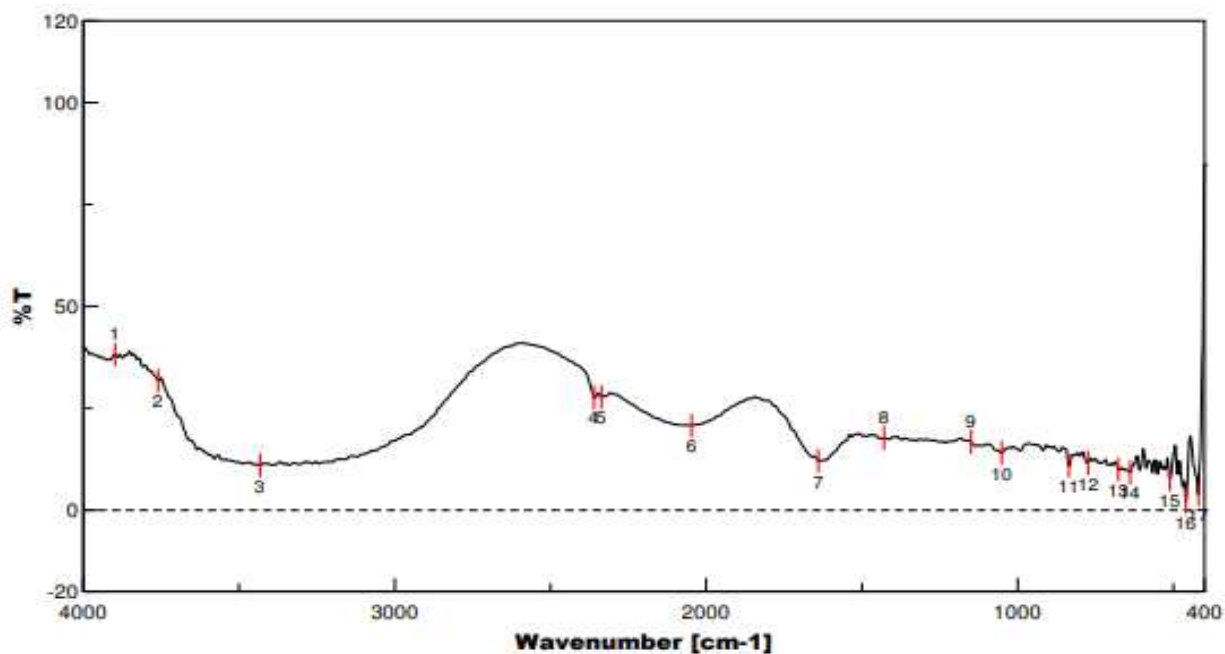
Microscopic analyses: It was conducted by utilizing an optical microscope with a magnification of 100x. To ensure accurate observations, samples underwent careful dilution with purified water in a 1:1 ratio whenever necessary. This meticulous approach allowed for comprehensive examination of the samples, enabling detailed insights into their microstructural characteristics and properties [17].

Scanning Electron Microscopy (SEM): It is a powerful analytical technique widely employed to examine the surface morphology and microstructure of materials at high magnification. Chromatogen Analytical Solution Pvt. Ltd. conducted the SEM analysis of tinted rose gel. The results were provided online, and the images have been uploaded below.

RESULTS

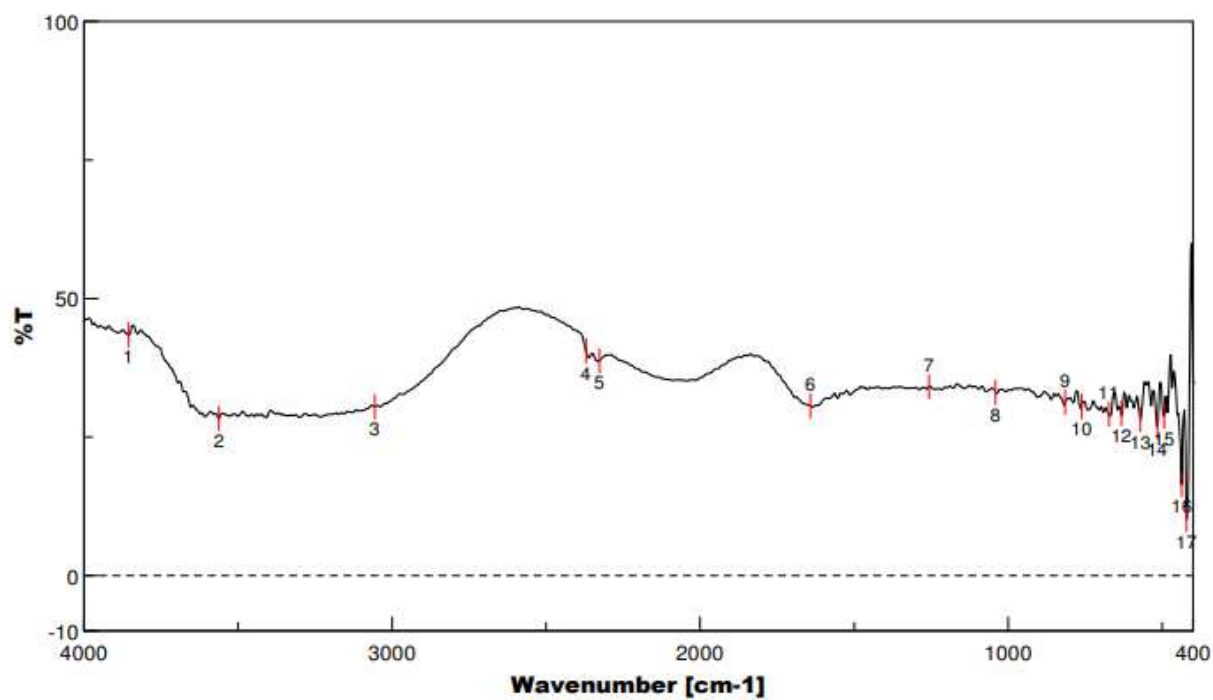
FT-IR spectrum

a) Beetroot

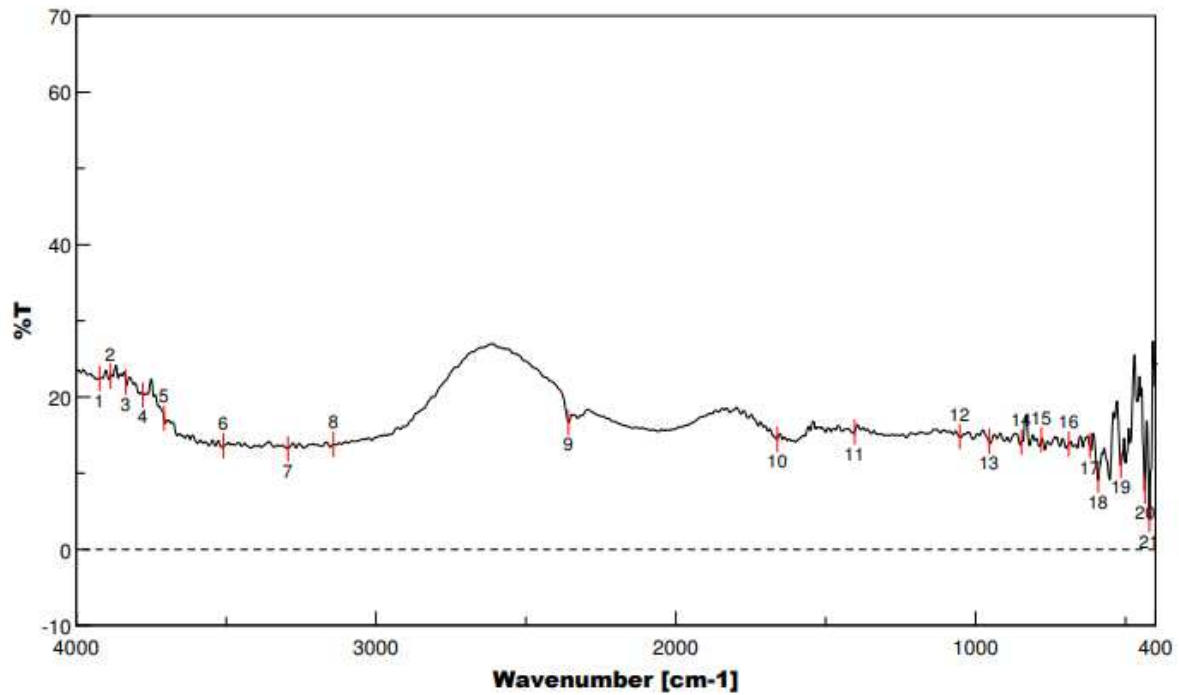


b) Rose

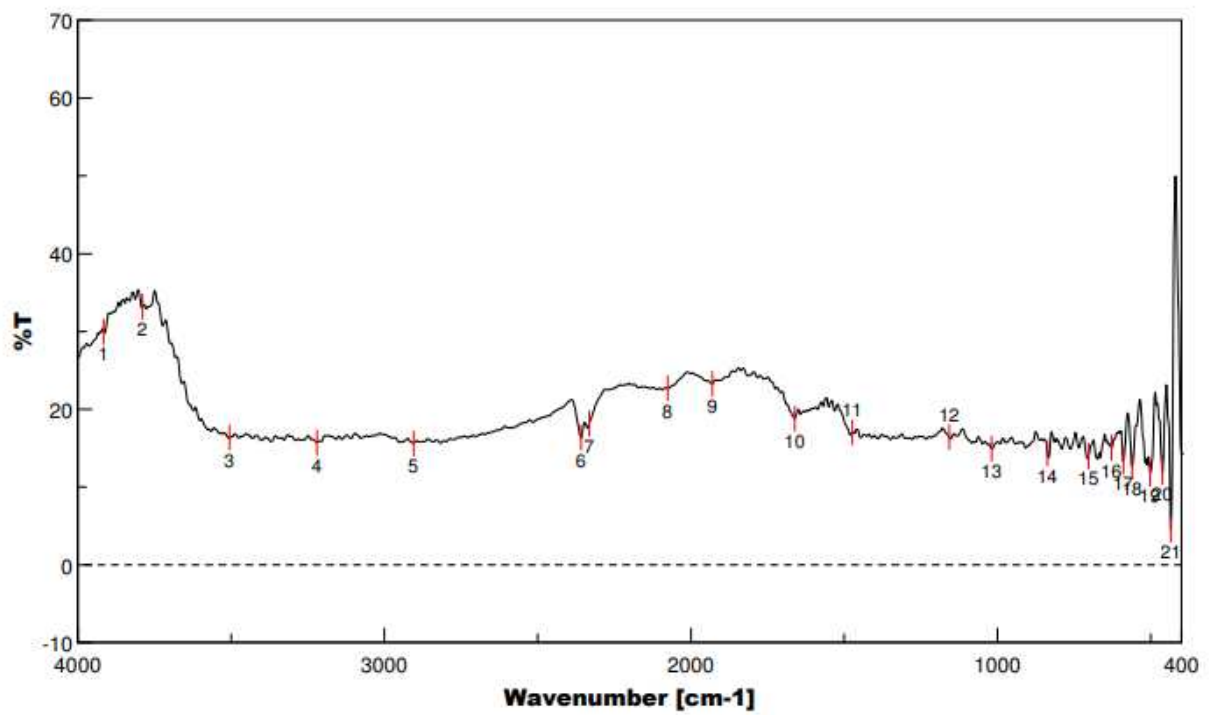
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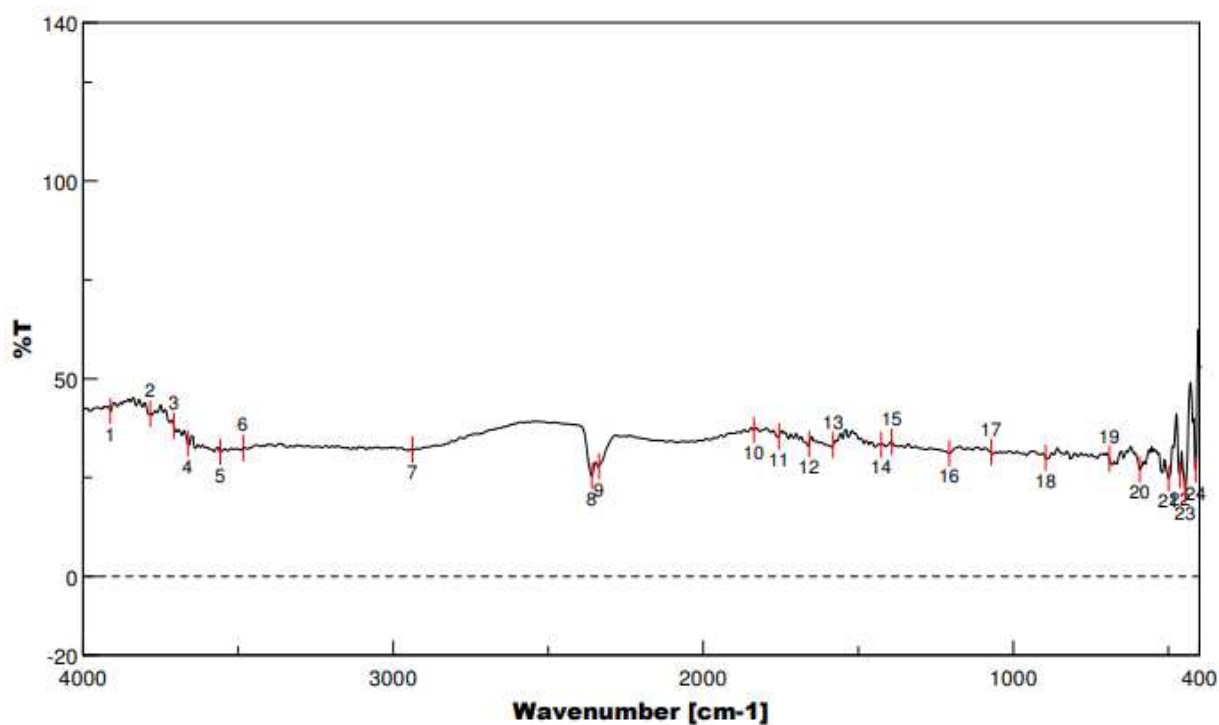
c) Carbapol



d) TEA

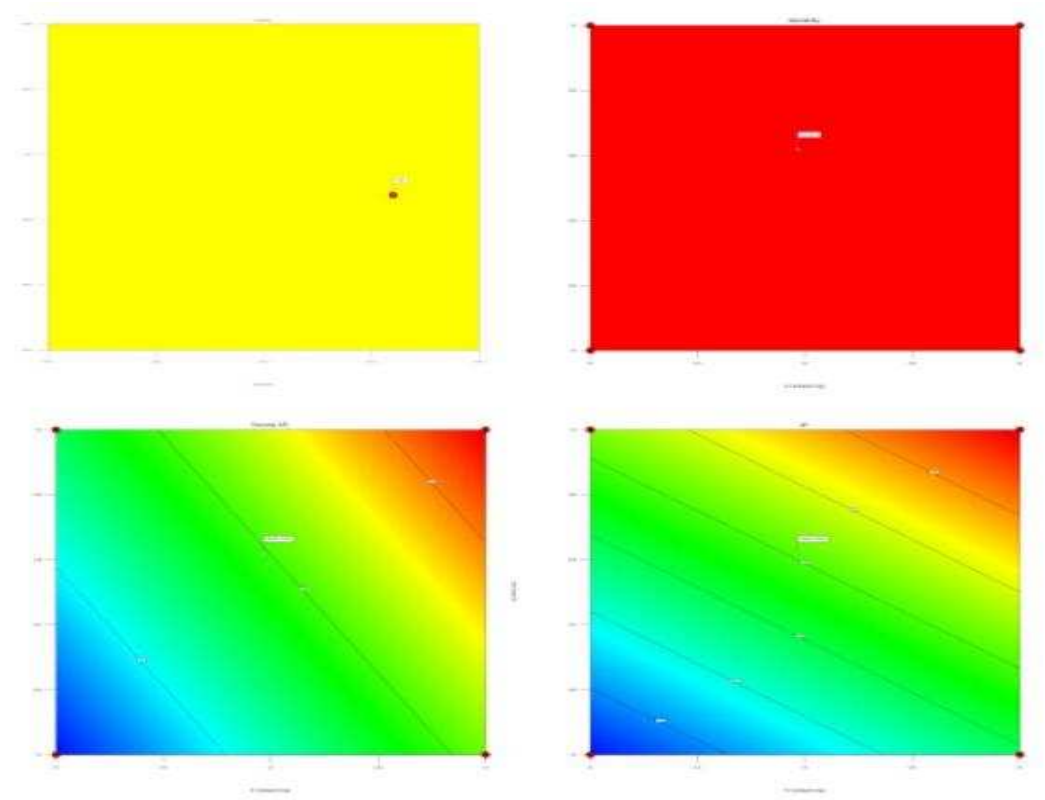


e) Formulation



The FTIR spectroscopic analysis of beetroot and rose hydrosol gel demonstrated peaks that indicate no interaction between the ingredients. This result confirms the stability and compatibility of the formulation, ensuring its suitability for use.

Drug design:



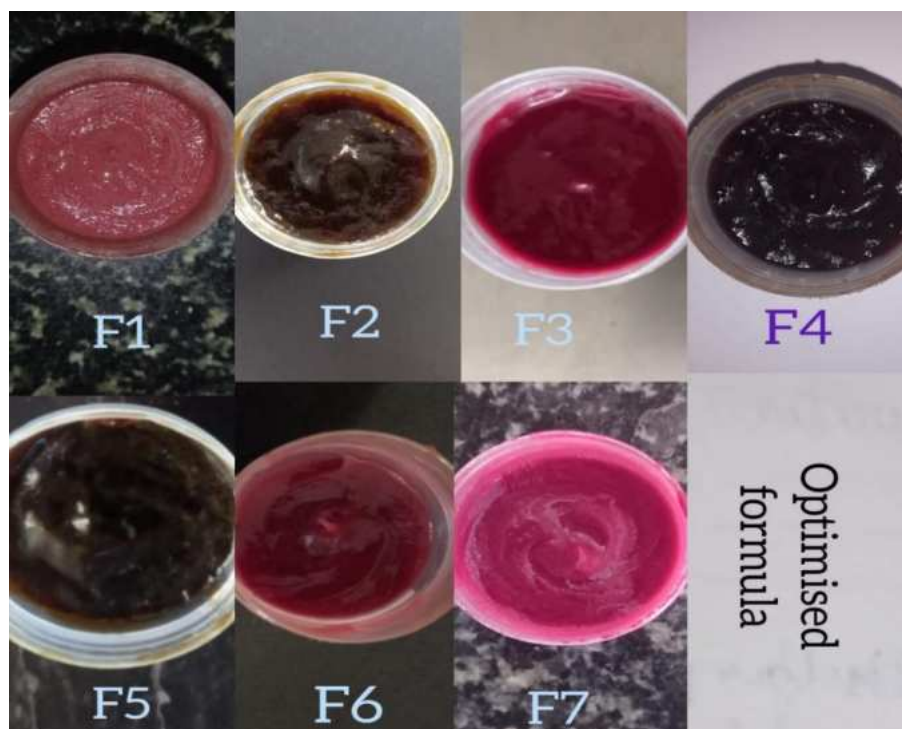
Physical appearance:

Table:01: Results of the organoleptic evaluation of emulgel formulations F1–F7 are presented in Table1.

Control	Formulations						
	F1	F2	F3	F4	F5	F6	F7
Colour	RB	B	R	B	R	PR	P
Consistency	++	++	+	++	++	+++	+++
Grittiness	++	+	++	+	+	+	0
Odour	+	++	+	++	++	+++	+++
Homogeneity	+	+	0	+	++	+++	+++

a. 0 (unavailable), + (moderate), ++ (good), +++ (best)

b. P – Pink, R – Red, RB – Reddish Brown, B – Brown and PR – Pinkish red



Formulation of beetroot and rose hydrosol tinted gel

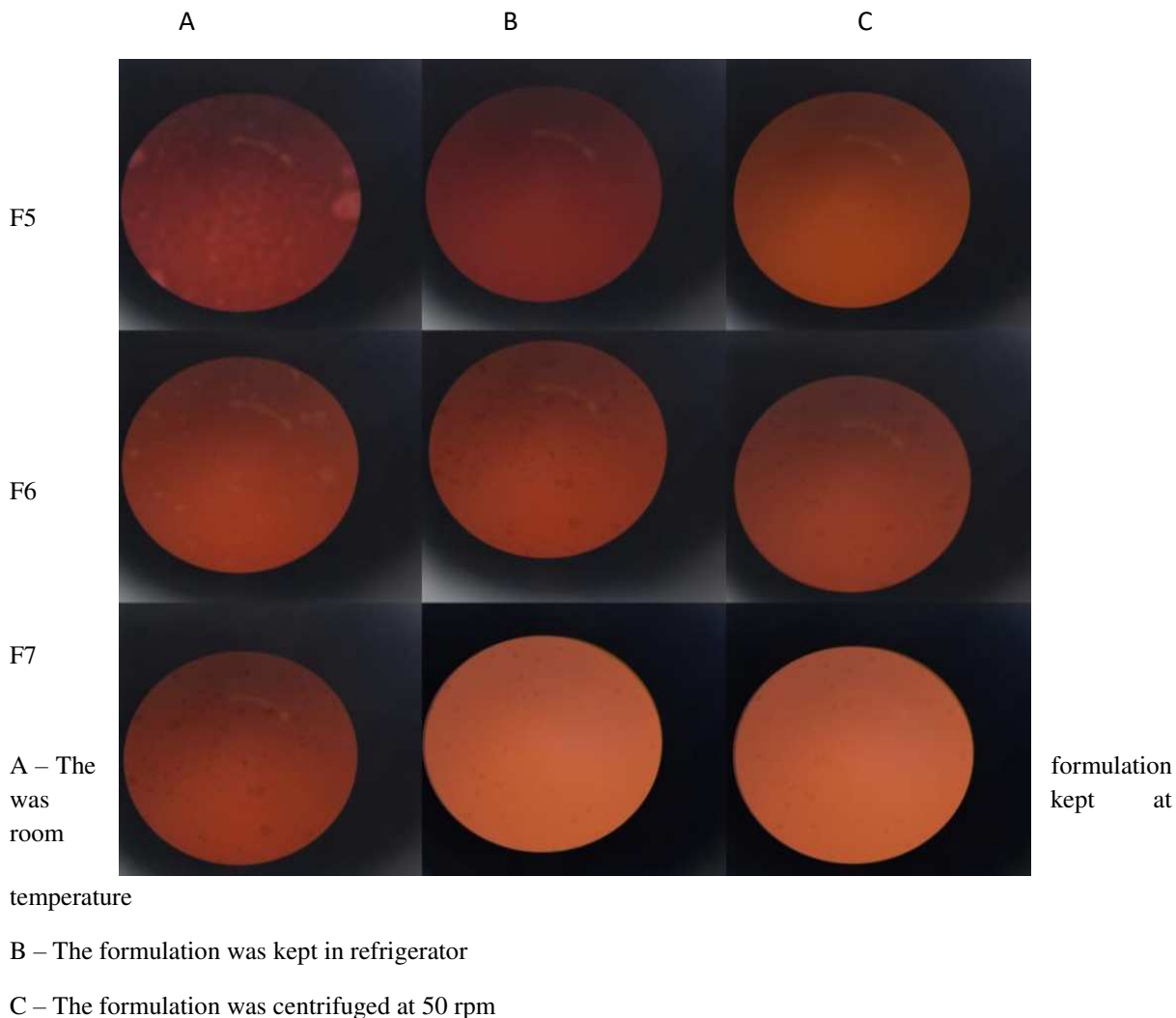
pH, spreadability, washability, and viscosity studies: The results were tabulated. Each parameter showcased variations among formulations, providing crucial insights into their characteristics and potential performance enhancements which is presented in the table 2 shown below.

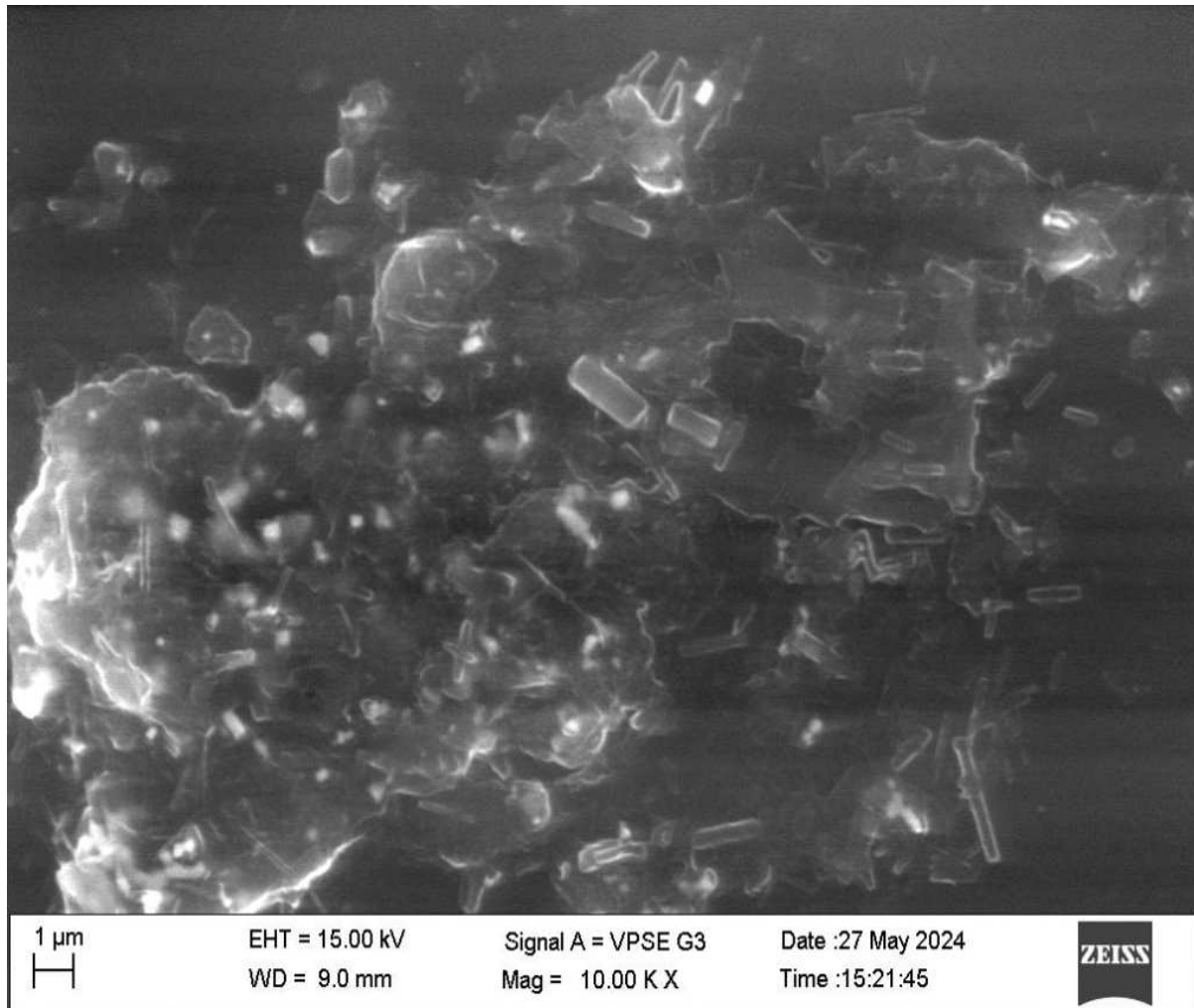
Table 02:

Parameter	Formulations						
	F1	F2	F3	F4	F5	F6	F7
Spread ability	6.8cm	6.4cm	6.6cm	6cm	7cm	6.8cm	6cm
Viscosity	26.7cP	27.5cP	30.4cP	35.6cP	37.1cP	38.9cP	28.1cP
Wash ability	Moderately	Easily	Extremely	Moderately	Easily	Moderately	Easily
pH	6.4	6.8	6.8	6.3	5	6.8	6.8

Microscopic analyses:

Microscopic analysis was conducted to evaluate the effect of different temperatures on beetroot rose hydrosol gel formulations F5, F6, and F7 before and after stability testing. The results indicated no drastic changes in the gel's structure at varying temperatures, confirming the stability and compatibility of the gel. Therefore, it proves to be a stable, good-quality formulation suitable for use.



Scanning Electron Microscopy (SEM):

SEM observations revealed that the beetroot and rose hydrosol gel exhibited smooth surface characteristics. The lattice network of carbopol and TEA was tightly packed, ensuring structural integrity. Particle size analysis indicated that over 90% of the formulation was within a 1 μm diameter range. SEM analysis, conducted at the 1st and 2nd week post-formulation, showed that the gel particles were well-dispersed and bonded effectively. Throughout the 14-day period, the gel's morphological changes remained consistent and harmonious, with no signs of deterioration or damage. This analysis highlighted that the gel's components were well-integrated, maintaining their stability and compatibility over time. Consequently, the SEM observations confirmed that the beetroot and rose hydrosol gel formulation was robust, with components bonding well and exhibiting favorable surface characteristics. This stability ensures the gel's efficacy and reliability, making it a suitable formulation for its intended use.

DISCUSSION

Our research studies "Formulation and Evaluation of Beetroot and Rose Hydrosol Tinted Gel" stands out due to its use of natural colorants and beneficial botanical extracts. The combination of beetroot and rose hydrosol is innovative, with beetroot providing antioxidants and natural pigmentation, and rose hydrosol offering hydration and soothing properties. This unique blend not only enhances the visual and sensory appeal of the gel but also provides synergistic skincare benefits. Furthermore, the tinted aspect, derived from natural beetroot pigment, adds a subtle, natural-looking tint, appealing to consumers seeking multifunctional and natural skincare products. In contrast, the other study on a gel with flax seed extract, carbopol, and carboxymethyl cellulose focuses on traditional gelling agents, which do not offer the same level of novelty or appeal to the

natural product market. Our work effectively caters to the growing demand for organic and multifunctional skincare solutions. [18]

Our study on the represents a significant leap forward in skincare innovation. By integrating the exquisite botanical essences of Rose, beetroot, hibiscus and aloe into our formula, we have crafted a luxurious and efficacious product that transcends traditional skincare boundaries. This harmonious blend not only enhances the visual allure of the gel but also imbues it with potent skincare properties, such as soothing hydration and rejuvenating antioxidants. Our meticulous attention to natural ingredients and commitment to excellence exemplify a new standard of skincare product development, offering consumers a delightful fusion of beauty and wellness.

The formulation and evaluation of beetroot and rose hydrosol tinted gel were aimed at harnessing the natural benefits of these botanical extracts for skincare applications. The FTIR spectroscopic analysis of the gel demonstrated that there were no interactions between the ingredients, confirming the stability and compatibility of the formulation. This ensures the gel's suitability for use in cosmetic applications. Organoleptic evaluation revealed that the formulations varied in color, consistency, grittiness, odor, and homogeneity, with formulation F6 exhibiting the best overall characteristics. This variation in physical appearance and texture highlights the importance of selecting the appropriate ratios of ingredients to achieve the desired product qualities. The pH, spreadability, washability, and viscosity studies provided crucial insights into the performance characteristics of the formulations. Most formulations had a pH range suitable for skin application, with F5 showing a slightly lower pH of 5. The spreadability results indicated that formulation F5 had the highest spreadability, making it easier to apply. The viscosity results varied, with F6 and F7 exhibiting the highest viscosity, indicating a thicker consistency. The washability results showed that formulations F2, F4, and F7 were easily washable, making them more convenient for users.

Microscopic analysis was conducted to assess the effect of different temperatures on the stability of the formulations. The results indicated that there were no drastic changes in the gel's structure at varying temperatures, confirming its stability and compatibility. This demonstrates the robustness of the formulation under different storage conditions. SEM observations further supported these findings by revealing smooth surface characteristics and tightly packed lattice networks of carbopol and TEA, ensuring structural integrity. Particle size analysis showed that over 90% of the formulation was within a 1 μm diameter range, which is ideal for achieving a smooth texture. SEM analysis at the 1st and 2nd week post-formulation indicated that the gel particles were well-dispersed and bonded effectively, with no signs of deterioration or damage over the 14-day period. This consistent and harmonious morphological change over time confirmed the stability and compatibility of the gel components.

In conclusion, the beetroot and rose hydrosol tinted gel formulation demonstrated excellent stability, compatibility, and performance characteristics, making it a promising natural skincare product. The combination of antioxidant-rich beetroot and hydrating rose hydrosol, along with the structural integrity provided by carbopol and TEA, resulted in a robust and effective formulation suitable for cosmetic use.

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