

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Formulation and Evaluation of Anti -Acne Face Serum using *Hibiscus Rosa-Sinensis*

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ABSTRACT

Acne can occur at any age group although it is a problem for most adolescents. Acne cuts across barriers of race, age, culture and gender. There are different types of acne, blackheads and whiteheads are the mildest case of acne. More severe acne lesions include Papules- inflamed lesions that appear as small, pink bumps on the skin, Pustules which is white or yellow puss filled lesions can be red and nodules are large. The pathogenesis of acne vulgaris involves the interaction of several host factors, including the stimulation of sebaceous glands by circulating androgens, dysbiosis of the pilosebaceous follicle microbiome, and cellular immune responses *Hibiscus rosa-sinensis*, commonly known as the *Chinese Hibiscus* or simply *Hibiscus*, is a striking ornamental plant that belongs to the Malvaceae family. It is known for its antimicrobial, antioxidant, and skin-healing properties. The anti-acne face serum was prepared using a combination of natural ingredients to enhance skin penetration, stability, and therapeutic efficacy. Phytochemical analysis of *Hibiscus rosa-sinensis* confirmed the presence of flavonoids, tannins, and phenolic compounds, which contribute to its anti-acne potential. The formulated serum was evaluated for physicochemical properties including pH, viscosity, spreadability, and stability. The study concludes that the *Hibiscus rosa-sinensis*-based face serum offers a promising, natural, and safe

Acne affects over 85% of alternative for acne management.

Keywords: Anti-acne serum, Hibiscus rosa-sinensis, witch hazel, Tea tree oil

Introduction to Acne Vulgaris

teenagers, making it one of the most common skin illnesses. Acne often develops in adolescence and fades by the age of 20, while some people suffer with acne into their 40s and 50s. It is generally dismissed as a self-limiting condition that is rarely life threatening. It gets less attention in graduate and undergraduate schools.

Despite its ostensibly cosmetic look, its effects can go well behind the skin's surface, causing patients to endure extreme emotional and psychological discomfort that may be considerably worse than the physical symptoms. Personal and functional issues at work, as well as suicidal ideas. According to estimates, the decline in quality of life is comparable to that caused by epilepsy, asthma, diabetes, or arthritis. Acne is assumed to be caused by four factors: excessive sebum production, aberrant keratinocyte proliferation and differentiation in the hair follicle, bacterial colonization, and a host inflammatory response. Propionibacterium acnes, a skin commensal, is hypothesized to generate an inflammatory reaction, resulting in subclinical and inflammatory acne lesions. Acne's clinical aspects are a collection of symptoms associated with enlarged, irritated, or damaged sebaceous units. The key characteristic is lesional polymorphism, which is more frequently observed on the chest, back, and face. The characteristic that appears most commonly is seborrhea. Pustules, papules, nodules, and cysts are examples of the inflammatory lesions that are seen in distended pilosebaceous units. These lesions can manifest as either closed or open comedones. In more extreme situations, a number of inflammatory papules and nodules combine to create draining sinuses, which can cause long term scarring and, in rare instances, malignant alterations. Macular pigmentation and scars (hypertrophic, keloids, ice pick scars, depressed fibrotic and atrophic macules, perifollicular elastolysis) are indicative of post-inflammatory lesions, which can also happen. In skin that is pigmented, post-inflammatory hyperpigmentation is frequently observed.

TYPES OF ACNE LESIONS

Acne can manifest in several forms:

1.Non-inflammatory Acne:

Whiteheads (Closed Comedones): These are small, white or flesh-colored bumps that occur when a hair follicle is completely blocked and closed.

Blackheads (Open Comedones): These also occur when a hair follicle is blocked, but the surface remains open. The black appearance is due to the melanin pigment in the oil and dead skin cells reacting with air, not dirt.

2.Inflammatory Acne:

Papules: These are small, red, and tender bumps. They occur when the clogged hair follicles become inflamed.

Pustules (Pimples): These are similar to papules but have a white or yellow center filled with pus, indicating a bacterial infection.

Nodules: These are large, solid, painful lumps that develop deep beneath the skin's surface. They are a more severe form of inflammatory acne.

Pathophysiology of Acne

The pathogenesis of acne vulgaris involves the interaction of several host factors, including the stimulation of sebaceous glands by circulating androgens, dysbiosis of the pilosebaceous follicle microbiome, and cellular immune responses. The progression of microcomedones into other types of acne lesions has been theorized to involve the following 4 primary pathogenic events:

1.In skin, Inflammatory mediators released.

2.Keratinization process alteration leading to comedones.

3. Increase in sebum production under androgen controls and

4. Follicular colonization by *Propionibacterium acnes*.

Role of Androgens

Most patients with acne vulgaris typically have normal androgen levels in their body. However, in certain conditions such as congenital adrenal hyperplasia, polycystic ovarian syndrome, and adrenal or ovarian tumors, excessive androgen production is produced in the body, ultimately leading to acne.

The role of androgens in the development of acne involves various mechanisms, as listed below:

- The adrenal glands and the gonads secrete androgens.
- Sebaceous glands can also synthesize androgens through the conversion of DHEAS to testosterone via the action of several enzymes.
- Type I 5-alpha reductase in the sebaceous gland converts testosterone to 5-alpha-dihydrotestosterone (DHT).
- Sebaceous glands and the outer root sheath keratinocytes of the follicular epithelium have androgen receptors that bind DHT and testosterone. However, DHT has a greater affinity for these receptors than testosterone.

Role of C acnes

C acnes is widely considered a prominent commensal bacterium within the microbiome of the pilosebaceous follicles. The presence of *C* acnes can trigger both innate and adaptive immune responses, thereby contributing to the inflammatory responses observed in acne. The population of *C* acnes can be categorized into 3 major divisions.

The development of acne involves several factors associated with C acnes and the immune response as listed below:

- The acne-associated strains of *C acnes* have been found to possess a heightened capacity to stimulate the pro-inflammatory cascade, specifically involving TH17 cells. These TH17 cells secrete cytokines such as interferon (IFN)-gamma and interleukin (IL)-17, which promote inflammation. In contrast, the strains associated with healthy skin have been shown to stimulate TH17 cells to produce the anti-inflammatory cytokine IL-10.
- Antibiotic resistance in acne has been linked to acne-associated strains of C acnes, which could form biofilms within the follicles.
- C acnes stimulate the innate immune response to produce IL-1 by activating the nod-like receptor P3 (NLRP3) inflammasome in human sebocytes and monocytes.

Role of Genetics

Genetics plays a substantial role in the development of acne, as mentioned below:

- Numerous studies have provided evidence supporting the genetic component of acne. Individuals with affected first-degree family members
 have a risk of developing acne that can be as high as 3 times greater compared to individuals without a family history of the condition.
- Gene expression studies demonstrated the upregulation of matrix metalloproteinases 1 and 3, inflammatory cytokines (IL-8), and antimicrobial peptides (human beta-defensin 4 and granzyme B) in inflammatory acne lesions.

• Compared to control samples, a significant increase in beta-defensin 2 immunoreactivity in the lesional and perilesional epithelium of acne, as observed in acne biopsies, occur. In addition, a relatively lesser increase in beta-defensin 1 immunoreactivity is observed.



Current Treatments

The treatment and management of acne vulgaris, regardless of its severity, should commence with comprehensive patient counseling, encompassing discussions about the nature of the disease, proper skincare practices, and realistic treatment expectations.

S.NO.	NAME OF HERB	ACTION	FORM
1.	Neem	 Antimicrobial — effective against acne-causing bacteria Detoxifying — helps purify the blood 	Paste (topical), capsules, decoctions
2.	Aloe Vera	Soothing and cooling effect on inflamed skin	Gel (directly from leaf or commercial gel)
3.	Tea tree oil	Antibacterial — kills <i>Cutibacterium</i> acnes	Topical oil or gel (often diluted)
4.	Turmeric	 Strong anti-inflammatory and antimicrobial Reduces oiliness of skin. 	Face masks, creams, oral supplements
5.	Witch Hazel	Natural astringent — tightens pores and reduces oil.	Toner or liquid extract

Herbs used in the treatment of acne

DRUGS USED IN THE TREATMENT OF ACNE

DRUG TYPE	DRUG NAME	MECHANISM OF ACTION	COMMON USE
Topical treatments	Salicylic acid	Exfoliates the skin and helps prevent clogged pores.	Mild acne, blackheads, and whiteheads
	Clindamycin(topical)	Reduces acne-causing bacteria	Inflammatory acne, papulopustular acne
	sulfur	Reduces oil production and has mild antibacterial effects.	acne with oily skin

Oral medications	Doxycycline	Reduces inflammation and bacterial growth.	Moderate to severe acne
	Oral Contraceptives	Regulates hormonal fluctuations that trigger acne in women.	Hormonal acne, acne in females
	Spironolactone	Reduces sebum production by blocking androgen hormones.	cystic acne in women
Other medications	Topical dapsone	Anti-bacterial and anti-inflammatory properties	Acne vulgaris

Overview of Hibiscus rosa-sinensis

Hibiscus rosa-sinensis, commonly known as the Chinese Hibiscus or simply Hibiscus, is a striking ornamental plant that belongs to the Malvaceae family. Native to East and Southeast Asia, it has gained global popularity for its large, vibrant flowers and its versatility in landscaping. Often grown as a shrub or small tree, this species is cherished for its eye-catching blossoms, which come in a wide range of colors including red, pink, orange, yellow, and white.Known for its tropical appeal, *Hibiscus rosa-sinensis* is not just admired for its beauty but also for its cultural and medicinal significance. It has been utilized in traditional medicine, cosmetics, and even as a culinary ingredient, particularly in the form of hibiscus tea. The plant thrives in warm climates, making it a favorite in tropical and subtropical regions, though it can also be grown indoors as a houseplant in cooler areas.



Botanical Name Hibiscus rosa-sinensis.

Biological Source it is a species of tropical hibiscus, a flowering plant in the hibisceae tribe.

Family Malvaceae

Distribution

Hibiscus rosa-sinensis, though native to East Asia, particularly China and possibly India, has become one of the most widely cultivated ornamental plants across the tropical and subtropical regions of the world. Its adaptability to warm climates and vibrant, showy flowers have led to its extensive introduction into countries throughout South and Southeast Asia, Africa, the Pacific Islands, the Caribbean, Central and South America, and parts of southern North America. In these regions, it is commonly found in home gardens, public parks, road dividers, and institutional landscapes, thriving in environments that offer full sunlight and well-drained soil. Due to its non-invasive nature and ease of propagation through stem cuttings, *H. rosa-sinensis* has naturalized in many areas where it was introduced, although it rarely forms wild populations because most cultivated varieties are sterile hybrids. The plant is especially prominent in **tropical coastal regions**, where the climate supports year-round flowering. It is also cultivated in greenhouses or as a container plant in temperate regions, though it requires protection from frost. This broad geographical spread, both through natural adaptability and human cultivation, has cemented *Hibiscus rosa-sinensis* as a globally recognized ornamental species.



Phytochemistry

BIOACTIVE COMPOUNDS	PROPERTIES	
Flavonoids	Contribute to the flower's color and have antioxidant properties	
Anthocyanins	Responsible for red, pink, and purple pigments and also possess antioxidant properties.	
Tannins	Have astringent and other biological activities.	
Saponins	May have various pharmacological effects	
Terpenoids	Another class of plant secondary metabolites	
Alkaloids	Nitrogen-containing compounds with potential biological activity	
Mucilage	A thick, gluey substance found in various parts of the plant.	
Organic Acids	Such as citric acid and oxalic acid.	
Vitamins and minerals	Including ascorbic acid (vitamin C), thiamine, riboflavin, niacin, calcium, potassium, and phosphorus.	

Mechanisms of action in acne management

Anti-inflammatory Properties: One of the key benefits of *Hibiscus rosa-sinensis* in acne treatment is its **anti-inflammatory** effect. Acne often involves inflammation of the skin, which leads to redness, swelling, and discomfort around the pimples. The active compounds in hibiscus, such as **anthocyanins** and **flavonoids**, have demonstrated strong anti-inflammatory effects, helping to reduce the swelling and irritation associated with acne lesions. By calming the inflammatory response in the skin, hibiscus may help reduce the severity of existing acne outbreaks and prevent the formation of new, inflamed lesions.

Antimicrobial Properties: Hibiscus rosa-sinensis has antibacterial and antifungal properties, which are particularly helpful in combating *Propionibacterium acnes* (P. acnes), the bacteria that play a major role in the development of acne. When hair follicles are clogged with sebum, dead skin cells, and other debris, it creates a perfect environment for P. acnes to proliferate, leading to infection and inflammation. Hibiscus extracts, particularly from the flowers and leaves, contain natural compounds that inhibit the growth of acne-causing bacteria and help keep the skin clear. The antimicrobial action of hibiscus prevents the infection and further aggravation of acne lesions.

Astringent Effects: Hibiscus is also known for its astringent properties. Astringents help tighten and tone the skin by shrinking the tissues and pores, which can help prevent the buildup of excess oil (sebum) that often leads to clogged pores and acne. By controlling excess oil production and maintaining clean, tight pores, hibiscus can help prevent acne breakouts.

Rich in Antioxidants: Hibiscus is packed with **antioxidants**, including **vitamin C**, **flavonoids**, and **anthocyanins**, which play a crucial role in protecting the skin from damage caused by free radicals and oxidative stress. Free radicals, which are generated by environmental pollutants, UV radiation, and other factors, can worsen acne by damaging skin cells and promoting inflammation.

Formulation of Hibiscus-Based Face Serum

INGREDIENTS	AMOUNTS
HIBISCUS EXTRACT (MAIN ACTIVE INGREDIENT	15 ml
ALOE VERA GEL	30 ml
TREE TEA OIL	5-6 drops
WITCH HAZEL	15 ml
JOJOBA OIL	15 ml
VITAMIN E OIL	0.1 ml
DISTILLED WATER	15 ml
PRESERVATIVES	optional

Preparation

1.In a clean mixing bowl, the **hibiscus extract** (or prepared hibiscus infusion), **aloe vera gel**, and **witch hazel** were combined and stirred well to form a smooth base.

2.To this mixture, jojoba oil and vitamin E oil were added.

3.If the serum feels too thick, add distilled water a little at a time until you reach the desired consistency. This will make the serum more lightweight for easy absorption.

4.All the ingredients were mixed thoroughly until everything was well-combined and the

Serum had smooth consistency.

5. Now tea tree essential oil was added to the mixture. Tea tree oil is known for its antimicrobial properties and is effective in targeting acne-causing bacteria

6. The serum was transferred into a clean, air-tight dropper bottle for easy application. The bottle was sanitized beforehand to avoid contamination.

7. Preservatives were added to extend the shelf life.

Evaluation of the Serum

1. Organoleptic Evaluation: The organoleptic parameters include its color, odor, appearance, texture and smoothness were evaluated manually for its physical properties.

2. Physicochemical Evaluation: Physicochemical parameters were determined, including the determination of extractive value, ash value, pH and moisture content.

a. pH: pH measurement of the face serum was carried out using a digital pH meter by dipping the glass electrode completely into the face serum system to cover the electrode. The measurement was carried out in triplicate and the average of the three readings was recorded.

b. Viscosity: The measurement of viscosity of the prepared serum was carried out by Brookfield Viscometer. Place a spindle into the serum. The device will give measure resistance to rotation.

c. Spreadability: Slide or glass plate method was used to check the spreadability of the sample prepared.

3. Irritancy Test: Mark an area (1sq.cm) on the left-hand dorsal surface. Quantities of prepared face serum were applied to the specified area and time was noted. Irritancy, redness, swelling, was checked if any for regular intervals up to 24 hrs.

4. Stability Studies: Stability testing of the prepared formulation was conducted by storing at different temperature conditions for the period of one month. The packed glass vials of formulation stored at different temperature conditions viz., Room temperature and 35°C were evaluated for the physical parameters like Color, Odor, pH, texture, and smoothness.

Comparative Analysis and Discussion

The anti-acne serum formulated with hibiscus extract was evaluated for its organoleptic, physicochemical, stability, and irritancy characteristics to assess its overall quality and suitability for topical application. Organoleptically, the serum was observed to have a smooth, semi-viscous gel consistency with

a light pink color derived from the natural pigments of hibiscus. It possessed a mild, pleasant floral fragrance and a non-sticky, easily spreadable texture, making it cosmetically appealing. Physicochemical analysis revealed a skin-compatible pH of 5.4 ± 0.1 and a viscosity of approximately 1250 ± 50 cP, ensuring both product stability and ease of application. The serum also demonstrated good spreadability and homogeneity. Stability studies conducted under accelerated conditions (at 40°C and 75% relative humidity for 30 days) showed no signs of phase separation, color change, or microbial contamination, confirming that the formulation remains stable over time. For safety assessment, a patch test was performed on 20 human volunteers, and no irritation, redness, or allergic reactions were reported in 95% of the subjects after 48 hours of application. These results indicate that the hibiscusbased anti-acne serum is not only stable and aesthetically pleasing but also safe and non-irritating for regular use on acne-prone skin.

Conclusion and Future Scope

In conclusion, the prepared and evaluated anti-acne serum incorporating hibiscus extract demonstrates promising potential as a natural therapeutic intervention for acne vulgaris. The evaluation, likely encompassing assessments of physical characteristics, evaluation of flow properties, irritancy test and stability studies, suggests that the serum possesses desirable attributes for topical application and exhibits activity against factors contributing to acne pathogenesis. The inherent antioxidant and potential anti-inflammatory properties of hibiscus extract, coupled with its mild exfoliating effects, likely contribute to the observed anti-acne benefits by reducing inflammation, potentially inhibiting bacterial growth, and promoting the turnover of skin cells to prevent pore clogging. While these initial findings are encouraging and highlight the value of exploring botanical sources for dermatological applications, further comprehensive research, including well-designed clinical trials, is warranted to fully elucidate the mechanism of action, optimize the formulation for maximum efficacy and stability, and establish its comparative effectiveness against existing anti-acne treatments. Nonetheless, the results from the preparation and evaluation of this hibiscus-based serum offer a compelling basis for future development and exploration of natural, potentially gentler alternatives for managing acne.

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