WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 5, 144-158. Review Article ISSN 2277–7105

A COMPREHENSIVE LITERATURE REVIEW AND EVALUATION OF ESSENTIAL OIL OF *HIBISCUS ROSA-SINENSIS*

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Article Received on
05 January 2025,

Revised on 25 Jan. 2025,
Accepted on 15 Feb. 2025

DOI: 10.20959/wjpr20255-35616

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1. INTRODUCTION

1.1 General

Nature has always been an integral part of human life, fulfilling our essential needs for survival and growth. Fundamental necessities such as food, clothing, and shelter are derived from natural resources. Additionally, maintaining good health has historically relied heavily on nature, particularly through the use of plants for medicinal purposes. For millennia, plants have served asa cornerstone of traditional healthcare systems, with their medicinal properties recognized and utilized across diverse cultures. Knowledge about herbal remedies has been preserved and passed down through generations, highlighting the enduring role of nature in supporting human health not just for its beauty, but for its ability to help with different health problems. For example, it is used in traditional medicine to treat digestive issues, such as upset stomach, and to soothe skin problems like rashes. The flowers, leaves, and even the roots of the hibiscus plant contain natural compounds that are thought to have health benefits.

People are becoming more interested in herbal remedies like hibiscus because they are considered safer and have fewer side effects than some modern medicines. Hibiscus is particularly popular for its potential benefits in lowering blood pressure, helping to manage weight, and boosting the immunesystem. It is often consumed as a tea, in which the dried flowers are steeped in hot water to make a refreshing and health-boosting drink. In some cultures, the plant is also used to make natural hair andskin treatments.

Therefore, it is important to protect plants like hibiscus and other medicinal herbs. This means not only using them responsibly but also taking steps to conserve their natural habitats. By doing so, we can ensure that future generations can benefit from the healing properties of these plants and continue the traditions that have been part of human culture for thousands of years. The use of hibiscus in traditional medicine is a reminder of how deeply connected we are to nature and how essential it is to preserve it for our well-being.

1.2 Historical Background of Hibiscus

The hibiscus flower (Hibiscus rosa-sinensis) has a rich and fascinating history, tracing its origins to tropical Asia and the Pacific Islands. Over centuries, its cultivation and use spread across diverse regions, including Africa, India, China, and the Americas. Throughout its journey, hibiscus became deeply intertwined with various cultural traditions, medicinal practices, and artistic expressions, highlighting its multifaceted importance.

In ancient times, striking beauty of hibiscus captured human admiration. In Egypt, hibiscus tea was widely consumed for its cooling properties in the harsh desert climate. Additionally, the flower was incorporated into skincare routines, valued for its soothing and rejuvenating effects.

In China, hibiscus carried significant symbolic and medicinal value. It was a longstanding emblem of wealth, fame, and beauty, often appearing in cultural art and literature. Traditional Chinese medicine also utilized hibiscus for its potential health benefits, including enhancing vitality and promoting overall well-being.

In India, hibiscus gained profound spiritual and cultural significance. The flower is closely associated with Hindu rituals, particularly in worshiping the goddess Kali, symbolizing divine

feminine power, energy, and transformation. Its striking red petals are considered an auspicious representation of strength and devotion.

Across the Pacific, hibiscus holds special prominence in Hawaiian and Tahitian traditions. Known as "pua aloalo," hibiscus is the state flower of Hawaii, often worn behind the ear to signify relationship status. Similarly, in Tahiti, hibiscus is an essential component of traditional garlands, or leis, symbolizing beauty, grace, and hospitality.

Beyond its cultural significance, hibiscus has played a notable role in traditional health and beauty practices. Hibiscus oil, derived from its flowers and leaves, has been used for centuries across various regions.

1.2.1 In Indian Ayurvedic Practices

- Hibiscus oil has long been used as a natural remedy for hair care. It is believed to stimulate hair growth, prevent hair loss, and reduce dandruff. Made by infusing hibiscus flowers in a base oil like coconut, it was a popular treatment for promoting healthy and lustrous hair.

- Its cooling properties were also used to calm irritated scalps and soothe sensitive skin.

1.2.2 In African Traditions

- Hibiscus oil was valued for its moisturizing properties, used to nourish the skin and address minor skin concerns, such as sunburn.

- Additionally, it was applied to hair to enhance shine and improve manageability.

1.3 Morphology of Hibiscus

Hibiscus rosa-sinensis, commonly known as the Chinese hibiscus or rose mallow, exhibits distinct morphological characteristics that contribute to its aesthetic appeal and functional utility. This section outlines its key structural features.

1.3.1 Roots

The plant has a fibrous root system, which is adept at providing stability and absorbing water and nutrients efficiently. The roots are typically shallow but spread widely in the soil, supporting the plant's growth and resilience in various conditions.

1.3.2 Stem

The stem of Hibiscus rosa-sinensis is woody at the base and herbaceous toward the top. Young stems are green and cylindrical, gradually becoming woody as they mature. The erect stem provides structural support for the leaves, flowers, and other aerial parts.

1.3.3 Leaves

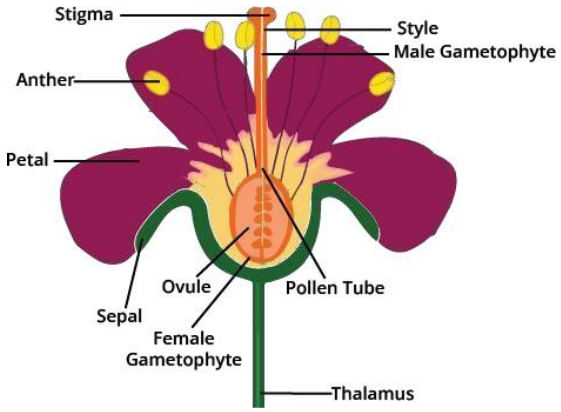
The leaves are simple, alternate, and ovate in shape with serrated (toothed) edges. They are dark green, glossy, and measure approximately 4–8 inches in length. The leaves exhibit a prominent midrib and a clear venation pattern, enhancing their role in photosynthesis.

1.3.4 Flowers

The flowers of Hibiscus rosa-sinensis are its most striking feature, known for their large size and vibrant colours, ranging from red, pink, yellow, and white to orange. They measure about 4–6 inches in diameter and exhibit radial symmetry, making them actinomorphic. The flowers are complete, featuring five petals arranged symmetrically. Hibiscus flowers may be single or double and are characterized by a prominent central column formed by the fusion of stamens and pistils. This central structure enhances the plant's reproductive efficiency.

1.3.5 Fruit

The fruit is a small, five-lobed capsule that splits open upon maturity to release seeds. However, Hibiscus rosa-sinensis rarely produces seeds under normal circumstances, as it is primarily propagated through cuttings, a method favoured for maintaining genetic consistency in cultivated varieties.



1.4 Habitat and Environmental Preferences of *Hibiscus rosa-sinensis*

Hibiscus rosa-sinensis thrives in warm, tropical, and subtropical environments, where its growth is supported by favorable climatic and soil conditions. Its adaptability to these regions

has contributed to its widespread cultivation and ornamental appeal. The following sections outline its specific habitat requirements:

1.4.1 Climate

Hibiscus rosa-sinensis is best suited for tropical to subtropical climates, with ideal temperatures ranging from 15°C to 35°C (60°F to 95°F). The plant is highly sensitive to frost, with freezing temperatures causing significant damage or plant death. It also thrives in moderate to high humidity, conditions that promote optimal growth and flowering.

1.4.2 Sunlight

This species prefers full sun to partial shade. Full sun exposure enhances the vibrancy of its blooms, while partial shade can offer protection in regions with particularly intense heat. Adequate sunlight is crucial for sustained flowering and overall health.

1.4.3 Soil Requirements

Hibiscus rosa-sinensis grows best in well-drained soils that are slightly acidic to neutral, with a pH range of 6.0 to 7.5. Soils rich in organic matter provide essential nutrients, while a sandy loam or loamy texture ensures good drainage and moisture retention. Overly waterlogged conditions should be avoided to prevent root rot.

1.4.4 Watering Needs

While the plant benefits from consistent moisture, especially during warm and dry periods, it is relatively drought-tolerant once established. Regular watering with proper drainage is key to maintaining healthy growth and preventing water stress or root- related issues.

1.4.5 Natural Distribution and Cultivation

Originally native to East Asia, Hibiscus rosa-sinensis has been widely cultivated in tropical and subtropical regions around the world. Its striking appearance and vibrant blooms make it a popular choice in gardens, parks, and landscapes.

1.5 Taxonomical Classification

Kingdom	**Plantae**
Division	Magnoliophyte
Class	Magnoliopsida
Order	Malave's
Family	Malvaceae
Genus	Hibiscus
Species	Hibiscus rosa sinensis

1.6 Phytochemical Constituents of *Hibiscus rosa-sinensis*

Hibiscus rosa-sinensis is a rich source of bioactive compounds, contributing to its traditional use in herbal medicine, cosmetics, and other therapeutic applications. Its diverse phytochemical profile offers a range of health benefits and functional properties. Below are the primary phytochemicals identified in Hibiscus rosa-sinensis.

1.6.1 Flavonoids

- Flavonoids are abundant in hibiscus, with anthocyanins being particularly prominent. These compounds are responsible for the flower's vibrant colors and exhibit strong antioxidant, anti-inflammatory, and antimicrobial properties.
- Specific anthocyanins found in hibiscus include cyanidin, delphinidin, and quercetin, which contribute to its therapeutic effects and potential health benefits.

1.6.2 Polyphenols

Hibiscus contains a variety of polyphenols, known for their potent antioxidant properties.

Key polyphenols include ellagic acid, caffeic acid, and chlorogenic acid, which help neutralize free radicals, reduce oxidative stress, and promote overall health.

1.6.3 Alkaloids

Alkaloids present in hibiscus have shown biological activity, including potential cardiovascular benefits. Their presence adds to the plant's pharmacological relevance.

1.6.4 Saponins

Saponins in hibiscus contribute to its cholesterol-lowering effects and possess immune-boosting and antimicrobial properties. These compounds are also associated with anti-inflammatory and adaptogenic activities.

1.6.5 Tannins

Tannins are polyphenolic compounds known for their astringent and antimicrobial properties. In hibiscus, tannins play a role in promoting skin health and supporting wound healing.

1.6.6 Polysaccharides

Polysaccharides in hibiscus exhibit immunomodulatory and anti-inflammatory effects. These complex carbohydrates are particularly valued for their role in enhancing the immune response and reducing inflammation.

1.6.7 Organic Acids

Hibiscus is rich in organic acids, including citric acid, malic acid, and tartaric acid. These compounds contribute to the plant's characteristic sour taste and provide antioxidant and antimicrobial benefits.

1.6.8 Terpenoids

Terpenoids, such as beta-carotene and various essential oils, add to the antioxidant and therapeutic properties of hibiscus. These compounds are also known for their anti-inflammatory and skin-protective effects.

1.7 Geographical Distribution of *Hibiscus rosa-sinensis*

Hibiscus rosa-sinensis is extensively distributed across tropical and subtropical regions, reflecting its adaptability to warm climates and its popularity as an ornamental and culturally significant plant. The following outlines its geographical spread.

1.7.1 Native Region

- The precise origin of Hibiscus rosa-sinensis remains uncertain, but it is widely believed to be native to East Asia, particularly in areas such as China, India, and the Pacific Islands. Its early domestication in these regions underscores its historical significance in traditional practices and cultural symbolism.

1.7.2 Asia

Hibiscus rosa-sinensis is prevalent throughout tropical and subtropical Asia, with significant presence in countries like China, India, Malaysia, Thailand, and Indonesia. It is a key feature in gardens, cultural rituals, and traditional medicine across these regions.

1.7.3 Pacific Islands

The plant is widely distributed in the Pacific, including in the Philippines, Fiji, and Hawaii. In Hawaii, it holds cultural importance as the state flower and is commonly used in leis and traditional ceremonies, symbolizing beauty and hospitality.

1.7.4 Africa

Hibiscus rosa-sinensis is cultivated across East Africa and in several other African regions, valued both as an ornamental plant and for its use in traditional medicinal practices. Its adaptability has made it a popular choice in diverse environmental conditions.

1.7.5 The Americas

The species has naturalized in parts of Central and South America, particularly in countries such as Brazil and Mexico. It is also widely grown in the Caribbean and in the southern United States, including Florida and Texas, where it thrives in the warm climate.

1.7.6 Australia

In Australia, Hibiscus rosa-sinensis is cultivated across tropical and subtropical regions. Its vibrant flowers and ease of care make it a popular choice for ornamental gardens and public landscapes.

1.8 Modern Pharmacological Uses of Hibiscus rosa-sinensis

Hibiscus rosa-sinensis has gained significant attention in modern pharmacology due to its diverse bioactive constituents and their therapeutic potential. The following are its major pharmacological applications, supported by contemporary research.

1.8.1 Antioxidant Properties

- Hibiscus is a rich source of flavonoids, anthocyanins, and phenolic compounds, which exhibit potent antioxidant activity. These compounds help combat oxidative stress, reduce cellular damage, and potentially lower the risk of chronic conditions such as cardiovascular diseases, cancer, and neurodegenerative disorders.

1.8.2 Antimicrobial and Antifungal Activity

Extracts of hibiscus demonstrate antimicrobial and antifungal properties effective against pathogens like *Escherichia coli*, *Staphylococcus aureus*, and certain fungal strains. These properties support its use in managing infections, wound healing, and skin conditions.

1.8.3 Cardiovascular Health

Hibiscus tea and extracts are widely used for their cardioprotective effects, particularly in managing hypertension and hyperlipidemia. Studies indicate that hibiscus may reduce LDL cholesterol and triglycerides, contributing to heart health. Its diuretic effect further aids in lowering blood pressure and maintaining vascular health.

1.8.4 Anti-inflammatory and Analgesic Effects

The anti-inflammatory properties of hibiscus are effective in alleviating conditions such as arthritis, muscle pain, and other inflammatory disorders. Its analgesic effects provide relief from pain, making it a valuable traditional and modern remedy.

1.8.5 Antidiabetic Potential

Hibiscus has shown promise in regulating blood sugar levels by improving insulin sensitivity and reducing glucose absorption. These effects are beneficial in managing type 2 diabetes and associated metabolic disorders.

1.8.6 Hepatoprotective Properties

The hepatoprotective potential of hibiscus is attributed to its ability to reduce oxidative stress and support detoxification processes. These properties make it a valuable adjunct in managing liver disorders and protecting against liver damage caused by toxins or oxidative stress.

1.8.7 Skin and Hair Health

Skincare: Hibiscus is widely used in skincare formulations for its hydrating, anti-aging, and soothing effects. Its antimicrobial and anti-inflammatory properties make it beneficial for acne-prone skin and inflammatory skin conditions like eczema.

Haircare: Hibiscus oil and extracts promote hair growth, reduce dandruff, and strengthen hair follicles. It is a common ingredient in hair oils and shampoos due to its nourishing and conditioning properties.

1.8.8 Aromatherapy and Stress Relief

Hibiscus oil is occasionally used in aromatherapy, valued for its calming fragrance that may help reduce stress and improve mood.

1.8.9 Skin Moisturization

Hibiscus oil serves as an emollient, providing hydration and enhancing skin elasticity. These properties make it effective in anti-aging formulations aimed at reducing wrinkles and fine lines.

Objectives

1. To explore the methods of extracting essential oil from *Hibiscus rosa-sinensis* and understand its composition and therapeutic potential.
2. To evaluate the antibacterial activity of the essential oil of *Hibiscus rosa-sinensis* and its effectiveness against various microbial strains.
3. To examine the historical origins and evolution of herbal medicine, with a focus on the role of *Hibiscus rosa-sinensis* in traditional healing practices.

4. To investigate the diverse medicinal applications of the hibiscus flower in the treatment of various diseases and its relevance in modern pharmacological research.

3. Literature

General

Among various medicinal plants, *Hibiscus rosa-sinensis* stands out as a valuable species with both aesthetic appeal and therapeutic potential. Known for its large, vibrant flowers, hibiscus has a rich history of use in traditional medicine across diverse cultures. Its flowers, leaves, and roots contain bioactive compounds that are believed to provide a range of health benefits. Traditionally, hibiscus has been used to address digestive issues, soothe skin ailments like rashes, and promote overall wellness The growing interest in herbal remedies like hibiscus reflects a broader trend toward natural healthcare solutions that are considered safer and have fewer side effects compared to some modern pharmaceuticals. This shift highlights the importance of preserving medicinal plants and their natural habitats to ensure that their benefits remain available for future generations.

Younis, A., Riaz, A., Khan, M. A., Khan, A. A., & Pervez, M. A. (2006) They performed experiment on, "Extraction and identification of chemical components of essential oil of Rosa species" and also the extraction of essential oil from the Rona species, was carried out using different extraction methods. They also studied that the chemical composition of the volatile oils isolated from aromatic plants depends strongly on the extraction method, among other variables and explained the importance of rosa essential oil.

Borhan, U., Hossan, T., Paul, S., Ahmed, T., Nahar, T. and Ahmed. S. (2010) studied that, Antibacterial activity of ethanol extracts of Hibiscus rosa sinensis leaves and flowers against clinical isolates of bacteria. They found that the extracts of H. rosa-sinensis flowers shows stronger antibacterial activity than that of leaves. The maximum zone of inhibition was observed against S. aureus, followed by P. vulgaris, P. aeruginosa and Citrobacter sp. and the lowest against S. typhimurium at the highest amount of flower extracts.

Rajesh M., Sreenivas S.A., Sakarkar, D.M., and Avijit C. (2011) studied that, "Radical scavenging and antioxidant activity of Hibiscus rosa sinensis extract". They proved that free radicals induce numerous diseases by lipid peroxidation, protein peroxidation and DNA damage. It has been reported that numerous plant extracts have antioxidant activities to scavenge free radicals. In the present study, the antioxidant properties of crude extract of

Hibiscus rosa sinensis were examined.

Kiruthika, K. A., Jaisheeba, A. A., & Sornaraj. R., (2011). studied on, "Evaluation of the antimicrobial property of selected flower extracts when exposed in a hospital environment", his study was carried out to assess the performance of the flower extracts on the airborne microflora that are prevailed in the dental hospital. The bacterial population was completely vanished in all the study area of the hospital using 15% concentration of all the studied flower extract.

Ruban, P., & Gajalakshmi, K. (2012). performed experiment on, "in vitro antibacterial activity of Hibiscus rosa sinensis flower extract against human pathogens". The antibacterial activity of H. rosa sinensis Bower petals were carried out. Most of the extract shows an antibacterial activity against human pathogen.

Khan. 7. A., Naqvi, S. A., Mukhtar, A., Hussain, Z., Shahzad, S. A., Mansha & Yar, M. (2014). examined the "Antioxidant and Antibacterial Activities of Hibiscus Rosa- sinensis Linn Flower Extracts." Their research demonstrated that extracts derived from H. rosa- sinensis have previously been evaluated for their potential in treating diseases associated with oxidative stress, such as diabetes and tumors. This growing body of evidence suggests that diabetes can lead to a reduction in cellular antioxidants.

Rassem, H. H., Nour. A. II., Ali, G. A., Masood, N., Al-Bagawi, A. H., Alanazi, T. Y. & Assiri, M. A. (2022) explored the production of essential oil from Hibiscus flowers utilizing two different distillation methods: Advanced Microwave-Assisted Hydrodistillation (MAHD) and Conventional Hydrodistillation (HD). They successfully demonstrated the eco-friendly production of essential oil from hibiscus flowers, comparing the properties of the essential oils obtained through the MAHD and HD techniques. It was observed that the yield of flower oil can be influenced by various factors within the extraction process. These variables encompass the solvent ratio, extraction power, and extraction duration.

Riddhi, N. and Nandu, K. (2023) focused on the "Development and Formulation of an Anti-Acne Gel from Hibiscus Rosa-Sinensis." Hibiscus was identified as a source of acids with chemical exfoliating properties, which aid in unclogging skin pores. Additionally, it exhibited antibacterial properties that combat acne-causing bacteria on the skin, consequently serving as a preventive measure against pimple formation. The researchers conducted a

phytochemical screening of fresh flower extracts, followed by the development and evaluation of gel formulations derived from these extracts.

4. Method of Preparation

4.1 Plant Collection

Fresh flowers of *Hibiscus rosa-sinensis* were collected and thoroughly washed with distilled water to remove any impurities or contaminants.

4.2 Extraction Method

4.2.1 Steam Distillation

The essential oil of *Hibiscus rosa-sinensis* was extracted using the steam distillation method. In this process, steam was passed through the petals of hibiscus flowers to extract hibiscus water. A thin layer of oil formed on the surface of the hibiscus water. The oil was separated from the hydrosols using n-hexane, an organic solvent. Following the addition of n-hexane, two layers were formed—an aqueous layer and an organic layer. These layers were separated using a separating funnel. The upper organic layer, containing the oil, was collected for further processing.

To remove n-hexane, the organic solvent was evaporated through distillation at 45°C using a rotary evaporator. Sodium sulphate (2g) was added to the remaining concrete oil to absorb any moisture, and the mixture was then filtered through filter paper to obtain the concrete oil. To obtain the absolute oil, a small volume of absolute alcohol was added to the concrete oil to remove natural waxes. These waxes were filtered out using filter paper. The absolute alcohol was removed from the oil by distillation using a rotary evaporator. Finally, any remaining traces of n-hexane were eliminated by bubbling nitrogen gas through the oil. This process resulted in the extraction of *Hibiscus rosa-sinensis* essential oil.

4.3 Evaluation of Hibiscus Oil

4.3.1 pH Determination

The pH of the hibiscus oil was determined using a pH meter. The pH value of the oil was found to be between 5.5 and 7.0, indicating a mildly acidic to neutral nature of the oil.

4.3.2 Thin Layer Chromatography (TLC) Analysis

The essential oil extract was analysed using thin layer chromatography (TLC). The following procedure was followed

- Aluminium TLC plates coated with silica gel were used for the analysis. The extract was applied 1 cm from the bottom of the plate, spaced 1.5 cm apart.
- The plates were placed inside a TLC chromatography tank containing a mobile phase mixture of ethyl acetate, methanol, and ammonium hydroxide (85:10:5). The mobile phase was allowed to travel up the plate to a distance of 18 cm.
- Afterward, the TLC plates were sprayed with 15 mL of a reagent consisting of ferric chloride and iodine. The reagent was prepared by mixing:

a) 1g of iodine dissolved in 25 mL of acetone

b) 2.5g of ferric chloride and 5g of tartaric acid dissolved in 25 mL of water. The mixture was placed in a hot air oven to dry.

- After drying, the spots on the TLC plate were visualized for analysis.

4.3.3 Antibacterial Activity Evaluation

The antibacterial activity of the hibiscus essential oil was evaluated using the agar diffusion method. The following procedure was employed.

Tryptone soya agar medium was prepared and poured into petri dishes. After the agar solidified, a bacterial suspension was evenly spread over the surface of the agar.

The extracted hibiscus essential oil was applied on the surface of the inoculated agar. The petri dishes were then incubated to allow the oil to interact with the bacteria.

The antibacterial activity was assessed by measuring the zone of inhibition around the oil application, indicating its effectiveness in preventing bacterial growth.

5. CONCLUSION

The research work discussed in the provided text is focused on the extraction and evaluation of the antibacterial properties of different components of *Hibiscus rosa- sinensis*, a flowering plant belonging to the Malvaceae family. Specifically, the study explores the potential use of aqueous extracts and essential oil from *Hibiscus rosa- sinensis* for combating infections caused by human pathogens. The study examines different extraction methods and their effects on antibacterial activity against three pathogens: *Staphylococcus aureus, Bacillus subtilis,* and *Escherichia coli.*

Essential Oil: In contrast, the essential oil extracted from *Hibiscus rosa-sinensis* does not demonstrate significant antibacterial activity against the pathogens tested in this study, as

indicated by the absence of clear zones of inhibition.

The study provides valuable insights into the potential medicinal properties of *Hibiscus rosa-sinensis* and contributes to the growing body of knowledge regarding the health benefits of this plant. However, more research is needed to better understand the active compounds and mechanisms underlying its antibacterial effects.

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