



THERAPEUTIC POTENTIAL OF CINCHONA OFFICINALIS: A COMPREHENSIVE REVIEW

Medicinal Plants

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ABSTRACT

Cinchona officinalis, a medicinal plant native to the Andes Mountains, has been historically renowned for its antimalarial properties. This review delves into the comprehensive therapeutic potential of *Cinchona officinalis*, exploring its bioactive compounds, pharmacological activities, and traditional uses. The plant primary alkaloid, quinine, has been extensively studied for its antimalarial effects. However, recent research has revealed a broader spectrum of pharmacological activities, including antipyretic, anti-inflammatory, and antimicrobial properties. This review aims to provide a comprehensive overview of the therapeutic potential of *Cinchona officinalis*, highlighting its potential as a valuable medicinal resource.

KEYWORDS

Cinchona officinalis, quinine, malaria, antimalarial activity, medicinal plants.

INTRODUCTION

Medicinal plants, the foundation of traditional medicine systems worldwide, have been used for centuries to treat various ailments. Their introduction and cultivation have played a vital role in human health and cultural exchange throughout history. As trade routes expanded, medicinal plants were introduced to new regions. The Silk Road, connecting Asia and Europe, was a significant avenue for the exchange of botanical knowledge and plant materials. Plants like ginseng, rhubarb, and poppy were transported along this route, enriching the pharmacopoeias of different cultures. The introduction of medicinal plants also had a significant impact on agriculture and horticulture. Many plants were cultivated specifically for their medicinal properties, leading to the development of specialized farming techniques and botanical gardens. These gardens served as centers for research, cultivation, and preservation of medicinal plants. Formulations. In the present time, the use of herbal products has increased around the world. World Health Organisation (WHO) also stated that more than 80% of the world's population relies on the herbal medicines [1].

Today, medicinal plants continue to play a vital role in healthcare, both as traditional remedies and as sources of inspiration for modern drug development. A lot of pharmaceutical drugs are derived from natural compounds found in plants. In 2022, the global herbal medicines market was worth USD 170 billion, and the expectation is that this market has the potential to reach USD 600 billion by 2033, with a compound annual growth rate (CAGR) of 15% from 2023 to 2033 [2]. As the world faces new health challenges, the exploration and cultivation of medicinal plants remain essential for addressing the needs of a growing population. When we look over dry herbs, such as oregano, rosemary, sage, savoury, mint, thyme, and bay leaves in the form of the whole plant or powdered material, the global market grew from USD 5.8 billion in 2022 to USD 6.17 billion in 2023 (a CAGR of 6.3%), and there is an expectation it will reach USD 7.93 billion in 2027 [3]. Considering more elaborate forms, such as capsules, tablets, and extracts, the global market forecast is USD 117 billion by 2029, with a CAGR of 7.3% [4].

Cinchona

It is a genus of evergreen trees native to the Andes Mountains of South America, primarily in Peru, Bolivia, and Ecuador. These trees have been revered for centuries due to their medicinal properties, particularly their bark, which contains alkaloids like quinine. The indigenous peoples of the Andes, such as the Incas, were the first to discover the medicinal properties of cinchona bark. They used it to treat fevers, including malaria. The genus name *Cinchona* is believed to be derived from the Countess of Chinchón, the wife of a Spanish viceroy in Peru.

According to legend, she was cured of a fever by drinking a concoction made from cinchona bark. However, the veracity of this story has been debated. Cinchona discovery and cultivation had a profound impact on global health. It helped to control malaria, a disease that had devastated populations in many parts of the world. The availability of quinine allowed for safer travel and colonization of tropical regions.

Cinchona is commonly known as Jesuits bark, Peruvian bark, koina plant etc. Among all other countries Indonesia is largest producer of cinchona [6]. cinchona is an evergreen plant growing 5m to 15m in height. The plant is simple and oppositely arranged (simple panicle) leaves. *Cinchona* flowers are small and are rose or creamy white in colour. Flowers are in terminal clusters, the fruit capsule contain numerous seeds. The stem cutting method or vegetative propagation is the very good method to maintain parent plant [7] Quinine planting period can be done at the beginning of the rainy season to avoid excessive evaporation. Quinine harvesting can be done during the dry season. In modern times, Tissue culture techniques also developed in cinchona plant clone

Chemical Constituents

Bark of *Cinchona* contains about 30 types of alkaloids, which belong to quinoline group. The important alkaloids of cinchona bark is quinidine, quinine, cinchonina and cinchonidine. In the bark are present these chemical constituents and these are stereoisomers of each other. Alkaloids are considerable chemical constituent of cinchona. Other chemicals like quiniarine, hydroquinine, hydrocinchonidine, cinchotine and cinchotannic acid may be present. Methoxy group like quinidine and quinine is present but no methoxy group like cinchonine and cinchonidine is present. In cinchona starch grains and bitter glycosides is present. Crystalline acid and calcium oxalate like quinic acid are also present. The total alkaloids not less than 6.5 percentage in cinchona. The cinchona contains 30 to 60 percentage of quinine alkaloids [8].

Pharmacological Activities

Cinchona officinalis, a South American evergreen tree, is renowned for its medicinal properties, primarily due to its alkaloid content, particularly quinine. Historically, quinine was a breakthrough in combating malaria, a disease that had devastated populations worldwide. However, the pharmacological activities of *Cinchona officinalis* extend beyond malaria treatment.

Beyond its antimalarial effects, *Cinchona officinalis* has been studied for its potential in treating various other conditions. Research suggests that it may possess anti-inflammatory, antipyretic, and analgesic properties. Additionally, certain alkaloids from *Cinchona* have shown promise in combating cancer cells and may have potential applications in anti-diabetic therapies.

It's important to note that while traditional medicine has long recognized the benefits of *Cinchona officinalis*, modern scientific research continues to uncover its full potential. As research progresses, we may see even more diverse applications for this valuable plant.

Cinchona is an official phyto-medicine, which is used in formulation of quinine from the cinchona species, these are used for anti-fever agent. It is very useful in prevention and treatment of malaria. Other alkaloids like cinchonine, cinchonidine and quinidine are extracted from this tree. These also produce analgesic, antipyretic and protoplasmic properties. These are used for bitter stomach and toxic. If the quinidine is producing cardiac depressant property. Rheumatism and neuralgia

are also treated with this. These are also useful in diseases such as abscesses, cavities and ulcers as an antiseptic. These are also used to treatment of cardiac arrhythmia.

Applications

Cinchona officinalis is a species of evergreen tree native to South America, particularly the Andes Mountains. It is renowned for its bark, which contains alkaloids, most notably quinine. This alkaloid has been a cornerstone in the treatment of malaria for centuries. The bark of *Cinchona officinalis* was first used by indigenous peoples of the Andes to treat fever. European colonists learned about its medicinal properties and introduced it to Europe in the 17th century.

Malaria Treatment: Quinine, extracted from the bark, became a vital tool in combating malaria, a disease that had devastated populations worldwide. Its effectiveness was particularly crucial during colonial periods in Africa and Asia. While the advent of synthetic antimalarials has reduced the reliance on quinine, it remains a valuable drug in certain cases: Malaria Treatment: Quinine is still used to treat chloroquine-resistant malaria, a growing concern in some regions.

Other Applications: Beyond malaria, *Cinchona officinalis* has been explored for potential uses in treating other conditions, such as: Muscle cramps: Some studies suggest that quinine may help alleviate muscle cramps. Hemorrhoids: Topical applications of *Cinchona* extract have been used to treat hemorrhoids. Varicose veins: *Cinchona* has been explored for its potential benefits in managing varicose veins.

Many of the studies showed that cinchona plant introduced to europe by the spanish countries in 1638. Famous scientist carl linnaeus named it "cinchona" in 1742 cinchona have many broad spectrum of applications mainly in medicinal, economical, ecological etc. Mainly cinchona alkaloids used in medical and in food industry. Some of the important applications of cinchona medicinal plant are Used in the food industry chemotherapeutic , pharmaceutic products, help in the production of cosmetic items. This functioned as Anti-malarial agent, Anti-microbial agent, Anti-obesity agent. It is Serving as drugs, selectors, chiral catalysts, bitter taste agents (in Tonics) and Widely used in beverage and confectionary industry [9, 10, 11].

CONCLUSION

Cinchona officinalis, a South American evergreen tree, has been a cornerstone in the treatment of malaria for centuries. Its bark contains alkaloids, most notably quinine, which has proven effective against the disease.

While the advent of synthetic antimalarials has reduced the reliance on quinine, it remains a valuable drug for certain malaria strains and is being explored for potential applications in other conditions. However, it's essential to use *Cinchona officinalis* or its derivatives under medical supervision due to potential toxicity.

The historical significance and ongoing relevance of *Cinchona officinalis* underscore its importance in the field of medicine.

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