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Role of medicinal plants in corona infection with reference to *Cinchona* species

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Abstract

Corona virus diseases 2019 (COVID-19) is a life threatening global health Scenario, WHO (World Health Organization) has declared as their diseases is pandemic and is a global issue. The severity of this diseases has caused highest death rates from December-2019 to October 2020 World wide Medicinal plants and plant based drugs play a major role in preventing the diseases and enhance the immune system. This article reviews diseases the major global issue pandemic corona virus diseases (COVID-19) and Medicinal plants used to treat and prevent the coronavirus with respect to *Cinchona* species which has the medicinal properties to control the disease. The genus *Cinchona* Linn (Rubiaceae) comprises about 40 species of evergreen shrubs or trees growing naturally in South America. Species of the genus are medicinally very important. Their bark yields a variety of useful alkaloids, of which the most important are quinine, quinidine and cinchonidine. Quinine is a very effective drug for the treatment of malaria, and quinidine for the treatment of heart disease. On account of the medicinal value of *Cinchona*, several species have been domesticated in India, and a few grown as plantation crops in the Nilgiris and Anamalai in South India. Some species are also found growing wild around the genus *Cinchona* Linn (Rubiaceae) comprises about 40 species of evergreen shrubs or trees.

Keywords: COVID-19, Medicinal plants, *Cinchona*, treatment

Introduction

The emergence of a new coronavirus known as SARS-COV-2 has initiated a pandemic of COVID-19 (World Health Organization2020b). Since its first reported case in Wuhan, China in December 2019 (World Health Organization) new discovered evidence by both Clinicals and researchers globally have helped shed some light on the disease pathogenesis and the nature of virus itself. The availability of new information subsequently fed the policy on transmission prevention strategies as well as development of preventative vaccines and therapeutic drugs. Enforced physical distancing, hand hygienine and proper usage of personal protective equipments including wearing a Surgical mask remains the most effective way of controlling the spread of disease with most countries which adopted such measures reports to be success in curbing the disease spread (Chu *et al* 2020). However several challenges remain in maintaining these drastic measures of enforced physical distancing for a long period of times. Waves were reported in few countries after relaxation of rules. In addition the economic impact prolonged lock down on social issues such as loss of income and increased poverty especially for low and middle income countries.

As world looks towards Science in search of an effective drug or vaccine, a few countries such as China and India, with long histories of traditional medicine uses (Li *et al.*,2020 Rastogi *et al.*, 2020) have also started in exploring the role of medicinal plants and complementary, alongside conventional treatment. From March to September 2020 Intervention of interest wave received through searches conducted on electronic databases sub as PubMed, Web of Science, Google Scholars, indexing books on medicinal plants available for treatment of corona virus., anxiety.

Taxonomy of *Cinchona*

Cinchona L. (Rubiaceae)

Usually trees or rarely shrubs; bark red or yellow, usually notably bitter. Leaves simple, opposite-decussate, broadly ovate or elliptic-lanceolate or lanceolate, usually with well

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developed domatia; stipules interpetiolar or shortly united around stem, ligulate to obovate, caducous. Inflorescences terminal and often also in axils of uppermost leaves, cymose to penicilliform, many-flowered, pedunculate, bracteate. Flowers bisexual, fragrant, pentamerous and distylous. Calyx with very short tube, 5-lobed and persistent. Corolla salverform or funnelform, yellow, pink, purple, red or occasionally white, pubescent in throat, 5-lobed; each lobe ovate to lanceolate, densely ciliate to villous at margins. Stamens 5, inserted in corolla tube partially exserted; filaments short; anthers dorsifixed. Ovary inferior, 2-loculed; ovules many in each locule, on axile placentae; stigma 2-lobed, capitate. Capsules ovoid to cylindrical or ellipsoid, with persistent calyx, septically dehiscent into 2 valves from base; seeds numerous, ellipsoid to fusiform, somewhat flattened with membranous marginal wing; endosperm fleshy.



Diversity and Distribution

The genus comprises 24 species and its native range is Central America to South America; introduced to Galapagos, Guatemala, Gulf of Guinea Islands, Honduras, Jamaica, Mexico Southeast, Puerto Rico, Society Islands, St. Helena, Sulawesi and Asia.

Cinchona academica Guibourt,
Cinchona chahuarguera Pav,
Cinchona coccinea Pav. ex DC,
Cinchona colorata Lambert, DC,
Cinchona condaminea var. *vera* Wedd,
Cinchona condaminea var. *chahuarguera* Pav. ex
Cinchona crispa Tafalla ex Howard,
Cinchona lancifolia var. *lanceolata* Roem & Schult,
Cinchona legitima Ruiz,
Cinchona macrocalyx var. *uritusinga* Pav. ex DC x Lamb,
Cinchona lucumifolia var. *stuepa* Wedd,
Cinchona macrocalyx var. *obtusifolia* Pavón ex DC,
Cinchona officinalis var. *bonplandiana-colorata* Howard,
Cinchona officinalis var. *condaminea* (Bonpl.) Howard,

Cinchona officinalis var. *crispa* (Tafalla Ex Howard) Howard,
Cinchona officinalis var. *uritusinga* Howard,
Cinchona palton Pav.
Cinchona peruviana Mutis,
Cinchona suberosa Pav. ex Howard,
Cinchona uritusinga Pav. Howard)

Systematic Classification

Domine: Eucaryota

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Clade: Eudicots

Clade: Asterids

Order: Gentianales

Family: Rubiaceae

Subfamily: Cinchoneae

Genus: *Cinchona*

In Asia three species present namely *Cinchona calisaya* Wedd. *Cinchona officinalis* L. and *Cinchona pubescens* Vahl.

1. *Cinchona calisaya* Wedd., Ann. Sci. Nat., Bot. Ser. 3, 10: 6. 1848. Tree, up to 15 m high; bark long, apex obtuse to rounded, caducous. Leaves simple, opposite, oblong-lanceolate, elliptic-oblong or lanceolate, 7–16 × 2.5–6 cm, base acute to cuneate, margins entire, apex obtuse to rounded or rarely acute, sparsely puberulent on both surfaces; veins 7–11 pairs, usually with crypt domatia; petioles greyish brown; young branches sub quadrangular, puberulent to hirtellous; stipules oblong, 1–2 cm up to 3 cm long, pubescent. Inflorescences terminal or axillary, paniced cymose, densely hirtellous to puberulent; peduncles up to 15 cm long, puberulent; bracts triangular, 0.5–3 mm long; pedicels 1–8 mm long. Flowers actinomorphic, bisexual. Calyx with a short tube, 5-lobed; lobes ovate-triangular, less than 2 mm long. Corolla tubular or cylindrical, 5–9 mm long, white, pale yellow or pale pink, 5-lobed; each lobe lanceolate, 3–6 mm long, acute, villous inside. Ovary inferior, ellipsoid, 1.5–2 mm long. Capsules ellipsoid, up to 3 cm long, puberulent, dry dehiscent; seeds numerous, compressed. Flowering & Fruiting: June–February.

Distribution: Native to South America; introduced in tropical regions. India: Kerala and Tamil Nadu.

2. *Cinchona officinalis* L., Sp. Pl. 1: 172. 1753.

Tree, up to 8 m high; bark greyish brown; stipules up to 2 cm long, sparsely pilosulous, caducous. Leaves simple, opposite, oblong-lanceolate or lanceolate, 6–10 × 3–5 cm, base cuneate, margins entire, apex acuminate; veins 6–12 pairs, without cryptdomatia; petioles up to 2 cm long. Inflorescences terminal, paniced cymose; peduncles up to 8 cm long; bracts ovate, up to 2.5 cm long; pedicels ca. 3 mm long, slender. Flowers actinomorphic, bisexual, fragrant. Calyx up to 2.5 mm long, with a very short tube, sparsely to densely pilosulous or hirtellous, 5-lobed; lobes linear-lanceolate, less than 1.5 mm long. Corolla tubular, 8.5–14 mm long, glabrescent to pilosulous, flesh or pale pink, 5-lobed; lobes ovate-lanceolate, 3–5 mm long, acute. Stamens 5, inserted. Capsules ovoid to oblong, up to 2 cm long. Flowering & Fruiting: October–December.

Distribution: Native to Central America and South America; introduced in tropical regions. India: Andhra Pradesh and Tamil Nadu. 3.

3. *Cinchona pubescens*: Vahl, Skr. Naturhist.-Selsk. 1: 19.

1790. Evergreen tree, 12m high; bark greyish brown, sometimes striped with white longitudinally fissured; young branches subterete or angled, densely pilosulous; stipules 1–2.5 cm long, sparsely pilosulous, caducous. Leaves simple, opposite, broadly ovate, ovate-elliptic or elliptic-oblong, 10–25 × 8–18 cm, hirtellous to pilosulous on both surfaces when young, base obtuse to rounded or truncate, margins entire, apex obtuse to rounded; veins 6–11 pairs, with

domatia; petioles up to 4 cm long, pubescent. Inflorescences terminal or axillary, panicle-dymose; peduncles up to 20 cm long, pilosulous to puberulent; bracts triangular, 0.5–3 mm long; pedicels 1–3 mm long, slender. Flowers actinomorphic, bisexual, fragrant. Calyx 1.5–3 mm long, with very short tube, sparsely to densely pilosulous or hirtellous, 5-lobed; lobes triangular, less than 1 mm long. Corolla tubular, 8.5–14 mm long, glabrescent to pilosulous, white or pink, 5-lobed; lobes ovate-lanceolate, 4–6 mm long, acute. Capsules ellipsoid, up to 2 cm long, pilosulous to glabrescent; seeds numerous, compressed. Flowering & Fruiting: June–February.

Distribution: Native to Central America and South America; introduced in tropical regions. India: Tamil Nadu. The *Cinchona* trees are evergreen with bitter bark and scented flowers. They have a two-celled ovary with two short obtuse branches.

4. *Cinchona ledgeriana*

It is a weak tree; grows to a maximum height of 7–8 m. Its bark is yellow, while the bark, powder is Cinnamon brown in colour. The leaves are elliptical, smooth and thick. The flowering takes place between May and August and it bears fruit in autumn.

5. *Cinchona succirubra*

It is a tree with erect trunk growing upto 18–20 m. height. The bark is red in colour and the leaves are large, thin and broad. The flowers are pink, flowering takes place between May to August, and it bears fruit in autumn.

Climate and Soil

Cinchona requires an average temperature of 20°C with a relative humidity of 85%. Annual rainfall should not be less than 1,500 cm. The best elevation is 1000–2000m above MSL without any frost occurrence. *Cinchona* prefers porous, well drained, fertile soils with thick cover of organic matter and high moisture holding capacity. The optimum pH range is 4.5–6.5

Cinchona Producing Countries in the world

The principal *Cinchona* producing countries are Indonesia and Zaire. The other countries where it is produced are India, Peru, Tanzania, Kenya, Rwanda, Sri Lanka, Bolivia, Peru, Colombia, Costa Rica, Ecuador and Guatemala. In India, *Cinchona* Cultivation is being done only in two states viz. West Bengal and Tamil Nadu.

Cinchona Plantation in India

Sir Clements R. Markham, who brought the first consignment of *Cinchona calisaya* from South America to Ootacamund in 1860. It was Mr. W.G. MacIvor who, with broad perspective and energetic cooperation planted *Cinchona* for the first time in the Nilgiri Hills in 1860 on a plantation scale. 1861–1866 following species of *Cinchona* had been introduced to Nilgiris

S. No: Botanical Name commercial names

- *Cinchona succirubra* Red bark
- *C. calisaya* Yellow bark
- *C. officinalis*
- *Cinchona chahurgurea*
- *Cinchona crespilla* Select crown bark
- *C. lancifolia* Fine crown bark

- *C. nitida* Genuin Grey bark
- *C. microthema* Grey bark
- *C. peruviana* Finest grey bark
- *C. oahudiana*

Darjeeling Hills (West Bengal)

Dr. Anderson brought 50 plants of *C. calisaya*, 284 plants of *C. pahudiana* and only 4 plants of *C. lancifolia* and handed them over to Mr. W.G. McIvor at Ootacamund where of him he took 193 plants of *C. succirubra* cultivate in Bengal. Dr. Anderson started his experimental trials in 1862 for cultivation of *Cinchona* in the Darjiling Hills of Bengal. The first planting was made in June 1862 on the Senchal ridge, but this place did not prove to be suitable for the plants. The next spot chosen was at Lebung, at a slightly lower elevation and the stock of plants at Senchal were shifted there in 1863.

Other Parts of India

In 1867, a *Cinchona* Plantation was opened at Nunklow (Assam) on the north western slopes of Khasia hills. The trees thrived well, but because of the scarcity and dearth of labour, the plantation was abandoned. The cultivation of *Cinchona* was attempted also on the Mahabaleswar hills of Bombay Presidency, but there it failed due to the excessive moisture of the climate. A *Cinchona* Plantation was also started by a private company in Sikkim almost simultaneously with that started by the Sikkim Government. Patches of *Cinchona* were also planted in several tea gardens in Sikkim, but the cultivation has not commended itself to private enterprise to the same extent in Sikkim as it has done in the south of India. The cultivation of *Cinchona* also received a very patient trial for several years in the north western provinces of India at various altitudes but all the plants ultimately perished due to frost.

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Conservation improvement strategies and in situ

- Strategies to augment the seed set and germination
- Cultural
- Canopy Management
- Enrichment planting with elite genotype with high quinine content
- Identification and control risk factors.
- In situ multiplication and regeneration protocols.
- In vitro cultivation techniques, seed banks and germplasm.
- Cryopreservation and long-term conservation of genetic material. Ex situ
- Identification superior genotypes in terms of quinine content
- Multiplication and establishment of germplasm
- Standardization of asexual propagation protocols (Macro and Micro)
- Standardization of extraction protocols to augment the recovery of active principle

- Establishment of SSO and CSO towards ensuring quality propagule supply
- Developing Value Chain from production to consumption system. Existing pandemic COVID 19, has made the scientist to revisit the already catalogued species holding antiviral property. The importance of *Cinchona* has been stressed by this article. Incidentally, attempts have not been made since 1951 to preserve.

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