ISSN: 2456-4508

JPRE

Review Article

SGVU Journal of Pharmaceutical Research & Education

Journal homepage: http://www.gyanvihar.org/researchjournals/

Phytochemical and Biological Properties of *Cordia subcordata* Lam- A review

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ABSTRACT:

Cordia subcordata Lam is a member of the Boraginaceae (Borage Family). is a small to medium-sized tropical tree, recognized for its attractive blooms, substantial leaves, and use in traditional medicine, lumber, and cultural customs. The tree is recognized for its visual appeal and versatility in coastal settings. Glycosides, flavonoids, sterols, saponins, terpenoids, alkaloids, phenolic acids, tannins were found by preliminary phytochemical screening of *Cordia subcordata* Lam extract. Pharmacological studies revealed that *Cordia subcordata* Lam address wounds, respiratory ailments, and digestive disorders. The plant is said to possess anti-inflammatory and antibacterial properties; however, further scientific research is required to validate this traditional use. This review focused on phytochemical and pharmacological properties conducted on different parts of *Cordia subcordata* Lam. plant.

Keywords: *Cordia subcordata*, Saponins, hepatoprotective, antibacterial, wound healing, anti-oxidant.

INTRODUCTION:

Cordia subcordata Lam, belonging to the Boraginaceae family, generally referred to as Raktarag, is a small to medium-sized tropical tree noted for its appealing flowers, large leaves, and several uses in traditional medicine, timber production, and cultural practices. This plant is indigenous to the tropical and subtropical zones of the Indian and Pacific Oceans, flourishing in coastal environments and exhibiting adaptability to several soil types. Medicinal plants have been a natural boon to humanity, facilitating the quest for a disease-free and healthy existence for millennia. The collective experience of previous generations has fostered a comprehensive understanding of herbal medicine among global civilizations. The importance of plant-derived substances in contemporary medicine has been more evident. Annually, two-thirds of newly recognized compounds are derived from higher plants, and 75% of the global population depends on plants for therapeutic and preventive purposes. In the United States, despite the predominance of chemical synthesis in the pharmaceutical sector, 25% of medications are produced from plant-based compounds (1). The significance of plants as a source of useful secondary metabolites is paramount. These compounds fulfill several functions, including applications as medicines, agrochemicals, flavorings, perfumes, colorants, biopesticides, and food additives (2). *Cordia subcordata* Lam exemplifies this tendency, since initial phytochemical analysis of its extract has shown a diverse array of bioactive components, such as glycosides, flavonoids, sterols, saponins, terpenoids, alkaloids, phenolic acids, and tannins. The pharmacological potential of *Cordia subcordata* Lam has attracted considerable attention among the scientific community. Conventional use and contemporary studies indicate its effectiveness in treating wounds, respiratory conditions, and gastrointestinal issues. The plant's components, including as leaves, bark, and fruits, have been used in traditional medicine across its indigenous territory,

underscoring its cultural and therapeutic significance. As worldwide interest in natural treatments and phytomedicines increases, comprehending the chemical contents and pharmacological effects of species such as *Cordia subcordata* Lam becomes more essential. This study seeks to provide a thorough examination of the phytochemical composition and therapeutic potential of this extraordinary plant, enhancing the overall understanding of medicinal plants and their roles in contemporary healthcare (3).

PLANT PROFILE:

Cordia subcordata Lam., commonly known as Sea Trumpet, Island Walnut, Kerosene Wood, Kou (in Hawaiian), or Tou (in Fijian), is a flowering plant species belonging to the family Boraginaceae, also known as the Borage family. It is sometimes referred to by its botanical synonym *Cordia sebestena* variety subcordata (Lam.) DC. This species is widely recognized for its ecological, ornamental, and ethnobotanical importance, particularly in coastal tropical regions. Taxonomically, *Cordia subcordata* is classified within the Kingdom Plantae, indicating that it is a member of the plant kingdom. It falls under the Subkingdom Tracheobionta, denoting that it is a vascular plant with a specialized conducting system. The plant is part of the Superdivision Spermatophyta, which includes all seed-producing plants, and is further categorized within the Division Magnoliophyta, indicating it is a flowering plant. It belongs to the Class Magnoliopsida, comprising dicotyledonous plants, and the Subclass Asteridae. Within the taxonomic hierarchy, it is placed in the Order Lamiales, Family Boraginaceae, Genus Cordia, and specifically identified as the species *Cordia subcordata* Lam., commonly known as Kou. This plant is notable not only for its taxonomic placement and distinctive common names across different cultures but also for its adaptability to coastal environments and traditional uses in indigenous medicine and crafts.

Botany:

The evergreen shrub or small tree may grow to a height of 15–20 meters; it has a trunk that is up to 8 meters long, sometimes twisted, and can be up to 60–100 centimeters in diameter; it does not have buttresses. The bark, which is initially smooth in young plants, becomes fissured and scaly as it matures, and its color ranges from brown to dark brown. The inner bark, which is also brown, turns greenish brown when exposed to light. The crown of the plant is rounded to irregular, with spreading branches, and its twigs are slightly ridged, nearly hairless, and pale grey in color. The alternately oriented, thickly clustered leaves are simple and entire, without stipules short grass. The length of the blade ranges from 1.5 to 11 centimeters, and its shape may be either nearly circular or widely elliptical or ovate. Its dimensions are 4-34 centimeters by 3-17 centimeters, and it is usually rounded at the base and acute or short-acuminate at the tip. The texture is almost hairless, with a papery yet meaty feel, and it is pinnately veined with around six pairs of lateral veins. In its juvenile form, an inflorescence may display tiny hairs and contain up to twenty blooms; it is an axillary or terminal cyme that can reach a length of fourteen centimeters. The bisexual, regular, heterostylous flowers may have a pedicel that is up to half a centimeter to a full centimeter long. With 3–5 lobes, the calyx is cylindrical to funnel-shaped, 1–2 cm long. A funnel-shaped tube adorns the 2–5 mm long corolla, which may be any shade of orange, red, or even white. Two to three centimeters long, with five to seven billowy projections. The dimensions of the flower are 1.5-2.5 cm in length, with 3-8 mm stamens positioned just below the corolla tube's midway; the ovary is superior, conical, approximately 3 mm long, hairless, and styled. Measures 2-3 cm in length, has two stigmas, and is bisexual. Ovoid to almost spherical drupes are fruit. Encased totally by the persistent calyx, this 1.5-4 cm, 2-3 cm, glabrous, yellowish-red to blackish fruit has a corky flesh and an angular, ridged stone with one

or two seeds. There are white seeds that are 10–13 mm long. Rapid tree growth is possible on soils that are both quite productive and well-drained. The average height and diameter of seedlings in Indonesia was 7 meters after 4 years, with a range of 1-1.5 meters at 10 months, 4-5 meters at 2 years, and 6.5 cm at the end of the first year. A large and spreading canopy is the consequence of substantial branches that arise from the stem at a low level.

The root system of *Cordia subcordata* is wide and shallow. Bees and other insects probably nourish the flowers. Some trees may begin bearing fruit as early as three years of age. The buoyant fruits are carried by the ocean currents as they float on the sea. With approximately 250 species, *Cordia* is a large pantropical genus. Most of these species are endemic to the Americas, however around 35 are found in tropical Africa. Some have argued that it should be split into many genera due to its diversity.

Coastal forests, scrub vegetation on dunes, inner woods, and forest borders are the most common habitats for *Cordia;* however it may also be found in southern Mozambique and eastern South Africa. Its position in southern Madagascar is same. It may grow to be 7–20 meters tall and is either a shrub or a small tree. The regionally cherished wood is light brown in color and somewhat thick, making it ideal for construction, furnishings, and fences. Toys, curios, veneer, plywood, interior trim, crates, vats, and boats are all good places to use it. Charcoal and firewood are made from it. You may eat the citrus fruits. The *cordia* tree is a beautiful decorative tree.

Ecology:

Coastal vegetation and secondary woods along to the seashore are rich with *Cordia subcordata*. Strong, salty winds are ideal for it. Though it may be found in places with 1000-1200 mm of yearly precipitation with a noticeable dry season, it is more common in regions that get more

than 1500 mm of rainfall per year without a clear dry season. Temperatures ranging from 24 to 28 degrees Celsius are typical on an annual basis. Deep sandy soils, sand dunes, and coralline sands over limestone are common habitats for Cordia subcordata. It thrives on soils that are neutral to slightly acidic. Mild salt levels may be present in the soil. Above the high tide level in sheltered locations, Cordia subcordata is most often found on East African shorelines.

Management

There are 560 to 700 fruits per kilogram. The difficulty in removing the criteria from the fruits without damaging them is a common reason why they are not removed. In Malaysia, the germination time for seeds ranges from 19 to 62 days, and around 25% of those seeds end up being viable. According to research conducted in Indonesia, the germination rate of ground-gathered seed was as low as 50%, whereas the viability of fresh seed might be as high as 100%. To hasten the germination process, you may either cut the ends of the fruits or soak them in water for a few of nights. Energy loss occurs at a rate of 60% after 7 months of ambient storage, although there is no loss of viability when dried fruits are kept in cold, dry conditions for up to a year.

In seed beds, it's best to cover the fruits with earth 1.5-2 cm deep. Little irrigation is required for seedlings. Germination boxes made of sand and, sometimes, humus are used to grow seeds in eastern Polynesia. To keep the seedlings free of fungal diseases, make sure they are grown in areas with good air circulation. Once they reach a height of 40-50 cm, which typically occurs at 6-8 months of age, they may be transferred to the field. In Indonesia, 2.5 m × 1 m and 2.5 m × 3 m have been used as spacing.

Open spaces and direct sunshine are ideal for the pioneer species *Cordia subcordata*. However, to ensure that your young trees are well-suited for wood production, it is best to plant them in

partial shade under existing trees. Light levels more than 30% relative intensity may be optimal for them, yet they have a low tolerance for shadow. Weeding, thinning, and pruning should be done regularly. It is recommended that the manufacture of lumber be done in 60 to 70 year cycles. Heart rot is a common condition in the trunks of older trees. Defoliation is a major damage that the larvae of the Ethmia nigroapicella moth may cause to trees.

Properties:

The sapwood is a pale yellowish brown color, while the heartwood may be anywhere from light brown to dark brown. The heartwood can also have purple streaks and dark brown to almost black hues. The texture is delicate, and the grain is often interwoven. You can see the wood's sheen. With a density ranging from 470 to 650 kg/m³ at 15% moisture content, it has a somewhat lightweight feature. It has been observed that wood from French Polynesia is heavier, with a density ranging from 740 to 850 kg/m³ at 12% moisture content. Careful handling is required throughout the drying process to avoid distortion as it dries slowly in air. Mild shrinkage rates (radially 3.1-4.5% and tangentially 4.9-8.9%) characterize the transition from green to oven dry. As soon as it dries, the wood is ready for use. When the moisture content is 12%, the following mechanical properties are observed: modulus of rupture: 88–128 N/mm², modulus of elasticity: 12,300–18,100 N/mm², compression parallel to grain: 45–81 N/mm², shear: 3.5 N/mm², cleavage: 18 N/mm and Chalais–Meudon side hardness: 3.1–5.9. You can easily cut through the wood and work it with both your hands and a power tool. Using filler may give your project a more polished look and feel. Although it is durable when used inside, its lack of durability makes it vulnerable to powder-post and longhorn beetles, termites, and decay fungi when exposed to the elements. Even when subjected to pressure treatment, the heartwood still

shows a resistance to preservative absorption. Because of its high combustibility, wood may be easily ignited by rubbing two pieces of wood together.

Uses:

Although there is a lack of documented applications in Africa, tropical Asian nations extensively utilize this wood for a diverse array of purposes, including but not limited to canoes, paddles, sliced veneer, musical instruments, furniture, cabinets, tools, utensils, boxes, carvings, and lightweight construction. Its property of not altering the taste of food renders it suitable for use as a food container or utensil. Additionally, it serves as firewood. The genus *Cordia* comprises approximately 250 species, which are distributed across tropical to warm temperate climates globally, with the greatest species diversity observed in the Neotropics. *Cordia subcordata* is reportedly native to Malaysia but has spread throughout the Pacific and along the coastlines of the Indian Ocean. This species inhabits coastal regions and adjacent lowlands from East Africa to Polynesia. *Cordia subcordata* bears a notable resemblance to *C. sebestena* L., a more widely recognized species frequently cultivated as an ornamental along tropical and subtropical coastlines. *Cordia subcordata* is a relatively fast-growing, small evergreen tree characterized by a broad, dense canopy. It attains a height of approximately 8 to 10 meters and may reach a diameter at breast height of 60 centimeters. The plant thrives in a variety of soil types, ranging from coastal sands to clays, exhibits tolerance to brackish water, and demonstrates resilience to drought conditions. It commonly occurs at low elevations in dry to moderately moist environments (annual rainfall below 2000 mm). The tree readily generates branches from its extensive, superficial root system and may form thickets. The wood possesses a specific gravity of approximately 0.45 and often displays an attractive grain characterized by undulating dark and light lines and bands. It is malleable, easily worked, and durable. The wood's lack of taste

transfer makes it ideal for cups, bowls, calabashes, and cutlery. It is further employed in artisanal crafts and small furniture pieces. *Cordia subcordata* is frequently cultivated as an ornamental and shade tree. In Hawaii, where the tree was once more prevalent, the flowers were often used for leis. The showy blooms are arranged in open cymes or panicles, with a light green calyx and an orange corolla. *Cordia subcordata* flowers throughout the year, with peak blooming occurring in April. Blooming may commence between 3 to 5 years of age. The fruit is drupaceous, nearly spherical, and green when immature, and brown and firm upon maturation. The capsules measure approximately 2.5 cm in length and contain up to four white seeds, each measuring between 10 and 13 mm. Fruits may be collected from the ground or harvested directly from the trees using manual methods or a pruning pole. There are no specific guidelines for the storage of *C. subcordata* seeds. Seeds from different *Cordia* species may retain viability for up to one year when stored in sealed containers; however, the planting of fresh seeds is recommended. Due to the difficulty of extracting seeds without causing damage, whole capsules are typically sown. Germination starts in around 3 to 4 weeks; the majority of seeds will germinate within 6 weeks, while some may need as long as 3 to 4 months. If many seedlings sprout from a capsule, trimming may be required. Once the capsule has adequately decayed, the seedlings must be meticulously removed and planted separately. Seedling development in the first season is gradual, with seedlings generally reaching a height of around 10 to 15 cm. Seedlings may be out planted at this height or maintained in the nursery for an another season, potentially attaining a height of 1.5 m thereafter. More substantial seedlings may undergo top-pruning or the removal of lower branches before to out planting. Transplanted seedlings thrive in mild shade. Seedlings may require supplemental irrigation in drought-prone areas, particularly when situated in direct sunshine (4, 5).

DESCRIPTION AND MORPHOLOGY:

Cordia subcordata is a small to medium-sized tropical tree, noted for its appealing flowers, large leaves, and use in traditional medicine, timber, and cultural practices. The tree is esteemed for its aesthetic allure and adaptability in coastal environments (6).

Size and structure:

Cordia subcordata reaches elevations of 8-15 meters (26-50 feet) and has an expansive canopy with robust foliage. The tree often has a gnarled and contorted trunk due to the challenging environments in which it flourishes, especially in coastal areas (6).

Leaves:

The leaves (figure 1) of *Cordia subcordata* are large, oval to cordate in shape, and have a dark green coloration. Their measurements typically range from 10 to 25 cm in length and 7 to 20 cm in width. The leaves have a gritty texture and may have a tactile resemblance to leather upon contact (6).

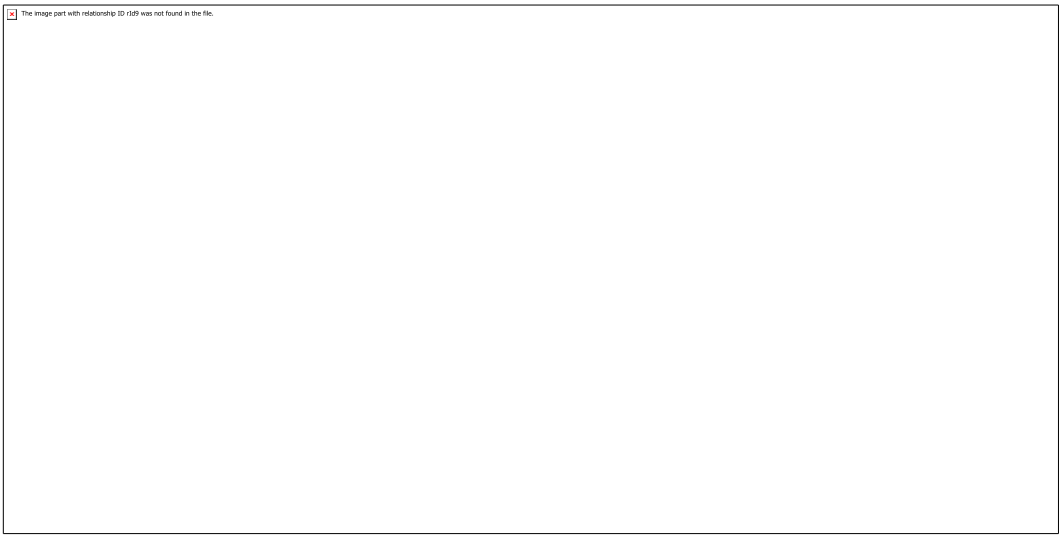

Figure 1. Leaves of *Cordia subcordata*

Flowers:

The tree has vivid orange to reddish-orange, bell-shaped, trumpet-like blossoms. Each flower (figure 2) has 5-7 lobes and blooms continuously in tropical regions. The blooms are vivid and fragrant, making the tree an attractive ornamental specimen. Each flower endures for around one day, however new blossoms continuously appear.

Figure 2. Flower of *Cordia subcordata*

Fruits and Seeds:

The fruit (figure 3) is a solid, spherical drupe of around 2.5 to 4 cm in diameter, which becomes brown during maturity. The fruit has a fibrous husk that protects the seeds. The seeds demonstrate buoyancy and can withstand extended periods in seawater, enabling the plant's widespread distribution in coastal areas (6).

Figure 3. Fruit and seeds of *Cordia subcordata*

DISTRIBUTION AND HABITAT

Cordia subcordata is indigenous to a wide expanse of the Indo-Pacific region, including coastal regions from East Africa and Madagascar to Southeast Asian islands, and reaching over the Pacific to French Polynesia and Hawaii. It is particularly common in coastal areas, where it often flourishes in circumstances that are too severe for several other plant species owing to elevated salt and constant coastal breezes. Generally located from sea level to altitudes of 30 meters (100 feet), it may also be detected at heights of 150 meters (500 feet) above sea level in some instances. The plant favors areas with yearly precipitation between 1,000 and 4,000 mm (40–160 inches), underscoring its adaptability to many coastal climates.

This rapidly growing tree often attains a height of 7 to 15 meters (23–49 feet), while it is most frequently seen at a somewhat reduced height of 5 to 7 meters (16–23 feet). It is linked to coastal forest flora and is compatible with many coastal species, given enough exposure to full sunshine. The tree thrives in several soil types, including sandy, clayey, rocky limestone foundations, and lava headlands. It favors neutral to alkaline soils and has quick initial growth, surpassing 1 meter (3.3 ft) annually under optimal circumstances.

Cordia subcordata has substantial ecological and economic importance in agro forestry. It is often used for coastal defense, wind barriers, and residential gardening systems. The wood is esteemed for fabrication, decorative applications, and ritualistic functions. Despite the tree's ability to propagate via seeds, it seldom becomes invasive, perhaps owing to its indigenous position in Pacific island environments. Its tolerance to dry circumstances and saline spray further underscores its significance in maintaining coastal environments when other plants may falter.

Ecological Role

Coastal Protection: *Cordia subcordata*, being a coastal species, plays a crucial role in protecting shorelines from erosion. The root system stabilizes sandy soils, while the thick canopy provides shade that helps maintain cooler temperatures for neighboring plant species.

Wildlife Habitat: The tree's flowers attract many pollinators, including bees and butterflies. Avifauna and small mammals use the tree for shelter and nourishment, particularly by ingesting its seeds and fruit.

TRADITIONAL AND CULTURAL APPLICATIONS:

Cordia subcordata is of considerable significance in several Pacific and coastal cultures owing to its practical use and incorporation into traditional activities.

Timber and Woodworking: The timber of *Cordia subcordata* is lightweight, sturdy, and termite-resistant, making it suitable for carving, boat construction, and furniture fabrication. In Hawaiian culture, Kou wood was historically used to craft bowls, dishes, and tools. Its capacity to achieve a refined shine made it preferred for ornamental objects (7).

Medicinal Uses:

The bark, leaves, and fruit of *Cordia subcordata* are used in traditional medicine. In some civilizations, extracts from the bark and foliage are used to address wounds, respiratory ailments, and digestive disorders. Cook Islanders use the leaves in remedies for abdominal swellings and urinary tract infections (8-10). The plant is said to possess anti-inflammatory and antibacterial properties; however, further scientific research is required to validate this traditional use.

Cultural Significance: The vibrant orange blossoms of *Cordia subcordata* are often used in leis and garlands within Hawaiian and other Pacific Islander traditions. The tree is regarded as holy in many faiths owing to its historical significance in rituals and traditional healing methods (7).

STATUS OF CONSERVATION

The International Union for Conservation of Nature (IUCN) now categorizes *Cordia subcordata* as "Least Concern." Despite its extensive distribution, its natural environment faces challenges from coastal development, deforestation, and climate change. Initiatives are underway in some areas to cultivate *Cordia subcordata* along damaged beaches to rehabilitate ecosystems and save biodiversity.

CULTIVATION AND PROPAGATION

Propagation: *Cordia subcordata* may be grown by seeds or cuttings. The seeds are often disseminated by ocean currents because to their buoyancy, however they may also be gathered and seeded manually. Seed germination may take many weeks; nevertheless, once established, the plant exhibits fast growth (11).

Growth Conditions: The tree favors full sunlight and flourishes in well-drained, sandy soil. It has significant tolerance to sea spray, making it an exceptional option for coastal gardens and

landscapes. It is drought-resistant but benefits from intermittent irrigation during extended dry spells.

Maintenance: *Cordia subcordata* takes little upkeep once established. Pruning may be essential to preserve its form and encourage vigorous growth, especially in decorative plantings.

Environmental preference and tolerances

Tropical kou trees are most common in coastal forests and stands, although they also flourish in mangrove habitats and mixed coconut and breadfruit farms. Although it may often be found in sparse thickets or tiny stands, Kou shows remarkable adaptation to its environment. Although it is more often found in lowlands, this species may also thrive at higher altitudes. From sea level to an elevation of about 30 meters (100 feet) is its typical range of height, yet specimens have been found growing as high as 150 meters (500 feet). It doesn't matter whether it rains all summer, all winter, or evenly distributed throughout the year; what matters is that the average annual rainfall be between 1,000 and 4,000 mm (40-160 inches) for kou to flourish. During a dry season that lasts for three to four months straight, with monthly rainfall of less than 40 mm (1.6 inches), it may survive.

In terms of temperature preferences, Kou grows best in warm climates, with a mean annual temperature between 24°C and 28°C (75°F to 82°F). The mean maximum temperature during the hottest month ranges from 28°C to 30°C (82°F to 97°F), while the mean minimum temperature of the coldest month remains relatively high, between 28°C and 36°C (82°F to 97°F), indicating its strong preference for consistently warm conditions. The minimum temperature tolerated by Kou is around 12°C (54°F), making it unsuitable for cooler or frost-prone regions.

Kou demonstrates a broad soil adaptability and grows in sandy, clay, and rocky limestone soils, as well as on lava headlands. It prefers neutral to alkaline soils, with an optimal pH range of 6.1

to 7.4. Experience from cultivation in Hawaii, I suggest Kou may not perform well in acidic soils, particularly on former sugarcane lands. The tree tolerates a wide range of soil textures, from light sands to heavy clays, including sandy loams, loams, sandy clay loams, sandy clays, clay loams, and clays, provided they are well-drained. While Kou requires freely draining soils for healthy growth, it also shows a special tolerance to saline soils and occasional water logging, particularly in its native coastal and mangrove-edge habitats.

In terms of environmental stress tolerances, Kou is moderately drought-tolerant and thrives in full sunlight, although it can manage in slightly shaded conditions. However, it is not frost-tolerant. The tree is well-adapted to coastal environments, showing strong resistance to salt spray and wind. Nonetheless, persistent strong winds can lead to the development of leaning or misshapen trees a phenomenon known as flagging. Kou also exhibits excellent regenerative ability, being a prolific seeder capable of natural regeneration from seed, which enhances its ecological resilience and usefulness in reforestation and landscape restoration projects.

Growth and development

Kou has modest growth rates throughout its youth, if it is situated in an optimal location with full sunlight, proximity to the shore, protection from wind, and access to neutral loamy or sandy soil with enough moisture. Upon attaining adult dimensions of 7-10 meters (23-33 feet) in height, development becomes sluggish.

Growth rate

In optimal conditions, trees may attain heights of 1-1.5m (3-5ft) one-year post-planting, 4-5m (13-16ft) after two years, and 7m (23ft) after four years. Growth is markedly diminished in arid or more exposed locations, or when trees are infested by the leaf worm.

Flowerings and fruiting's

When the trees are three to five years old, they may begin to blooming. During the blossoming season, you may find both green and ripe kou fruits on trees, so you can enjoy these fruits at any time of year.

Rooting habit

Kou have a broad, superficial root-system. It's suited for shallow, sandy soils and arid conditions.

Reaction to competition

Kou exhibits suboptimal growth in thick, tall grass stands.

Propagation

Kou is propagated only by seeds. Mature trees may provide many fruits containing seeds that are useful, which can be collected directly off the tree. Whole fruit can be directly sown either planting areas or pots, or they may be soaked nightly. Pruning the extremities of the fruits may accelerate germination. Fresh seeds are frequently utilized; nonetheless, they may be stored for duration of up to one year.

Seed collection

Kou seeds are dispersed year-round, with maximum prevalence in spring, and ripe fruits can be gathered at any time. Seedlings may be found beneath parent trees and may be repositioned if desired.

Seed characteristics

There are 560 to 700 fruits per kilogram (250 to 320 fruits per pound), each bearing one to four seeds.

Seed storage

Kou seeds are categorized as traditional, signifying its ability to be dried and stored for prolonged durations. Whole fruits may be dried and stored in cold, dry conditions for up to one year, although their viability decreases over time. Seeds obtained directly from trees may demonstrate 100% germination, however seeds gathered from the ground may indicate less survivability.

Pre-planting treatments

Pre-planting treatments for woody fruits are essential to enhance germination rates and ensure successful propagation. One common method involves soaking the ripe seed capsules (fruits) in water overnight or for up to two days. This process helps to soften the outer layers and stimulate germination. To further accelerate the process, the end of the capsule may be clipped off prior to soaking, allowing water to penetrate more easily and reach the seeds within. It is generally not recommended to remove the seeds from the capsules, as they are delicate and can be easily damaged during extraction. As a result, the entire fruit is typically sown directly, with one fruit placed per pot. In cases where multiple seedlings sprout from a single fruit, the extra seedlings must be either transplanted to separate pots or carefully removed (rogued) to prevent overcrowding. Visual observations during this treatment process include the soaked capsule softening overnight, exposure of a delicate seed after clipping the capsule end, and loosening of the outer capsule layers as germination begins. These steps play a crucial role in improving the success rate of seedling establishment for species with hard or woody seed coverings.

Growing area

Seedlings can be grown in light shade, and some rooftop shade is advantageous to safeguard them from intense rains; nevertheless, if shaded, seedlings must be adjusted to full sunlight for 4-6 weeks. Germination seeds require safeguarding from rodents.

Germination

Seeds require 3 to 4 weeks to initiate development, with the bulk emerging within 6 weeks. Whole fruits can be placed on a germination bed, and the newly sprouting seedlings may be relocated to pots. Seedlings can be transplanted at the cotyledon stage.

Media

An optimal substrate is one that is well-drained. A soilless blend of peat moss, perlite, and vermiculite offers superior drainage and is less likely to harbor diseases compared to a potting mix that includes garden soil. Potting medium must be supplemented with slow-release fertilizers and compost.

Time to out planting

Kou seedlings may remain in the nursery for 6 to 8 months. Seedlings often exhibit modest growth during the first 6-10 weeks, followed by a period of accelerated growth. The accelerated development period in the nursery may extend for 4-6 months, including acclimatization in full sunlight during the last 4-6 weeks before to transplantation.

Approximate size at time of out planting

Seedlings ready for out planting are approximately 40-50 cm (16-20 in) in height.

Disadvantages

Kou is a resilient tree in coastal ecosystems but inappropriate for highland and acidic soils. It is periodically assaulted and at times exterminated by the kou leaf worm. The heartwood is prized;

however, the tree exhibits slow growth. Boles are little and often contorted. Kou trees produce seeds abundantly, and the spherical, hard fruits might pose a risk to pedestrians when situated in urban environments.

Uses and products:

The Kou tree (often referred to in botanical contexts as *Cordia subcordata*) offers a variety of practical and cultural uses across different regions. Its seeds, carefully extracted from the hard, woody fruit, have historically served as an emergency food source during times of famine, demonstrating the plant's importance in subsistence strategies. The leaves are not only functional as a component of traditional medicine where they have been reported to possess therapeutic properties but also serve as a valuable source of fodder for livestock, particularly pigs, in regions such as Kiribati and other Pacific islands. In addition, the tree's vivid orange flowers, though short-lived, are celebrated for their aesthetic and cultural significance; they are traditionally woven into leis, reflecting their role in ceremonial and ornamental practices. This multipurpose utility underscores the Kou tree's enduring ecological, medicinal, and cultural relevance.

Fuel wood

Kou ignites easily, and the remaining wood after the finest pieces have been used for carving or other applications may serve as fuel wood. The wood's flammability has resulted in its designation as "kerosene wood" in Papua New Guinea.

Craft wood/tools

Kou wood exhibits a structure ranging from light to moderately dense, with a specific gravity between 0.45 and 0.65. The sapwood is characterized by a light tan hue, occasionally displaying pinkish tones, while the heartwood is brown with dark brown to black streaks, sometimes showing purple undertones and often featuring attractive grain patterns. The wood has a fine

texture, moderate durability, minimal shrinkage, and can achieve a high gloss finish. Historically, kou wood was employed in the production of cups, bowls, and calabashes. Smaller fragments were fashioned into storage boxes, containers, and lids for calabashes. Kou wood was favored for its workability and its lack of taste transfer to food. The ancient Hawaiians crafted large calabashes, known as 'umeke la'au, from kou wood for the storage and fermentation of poi, with capacities ranging from 8 to 16 liters (2 to 4 gallons). Currently, the wood is used for ornamental carving, turning, storage containers, small furniture, and sculptural figures. In the Cook Islands, the timber is utilized for traditional sculptures and the creation of musical instruments. The term "Kou" is occasionally used in reference to the construction of canoes or paddles, provided that sufficiently large trees are available.

Body ornamentation/garlands

The vibrant orange blossoms are traditionally utilized in the creation of leis. These flowers feature an elongated floral tube, facilitating their stringing with materials available to ancient peoples, such as the fiber from the beach hibiscus (Hibiscus tiliaceus, hau). The construction of this lei in ancient times, without the use of metal lei needles, is evident.

Tannin/dye

In ancient Hawaii, the leaves were used to tint kapa (bark) fabric tan and to paint fishing lines for enhanced invisibility.

Ceremonial/religious importance

The tree has cultural and traditional religious significance throughout the Pacific. Kou trees were often cultivated near holy sites, and kou is significant in Pacific Island folklore.

PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITIES:

Phytochemicals: Initial investigations of *Cordia subcordata* have shown many physiologically active substances, such as flavonoids, alkaloids, and phenolic compounds, recognized for their prospective therapeutic advantages. These substances are accountable for the plant's alleged antioxidant, anti-inflammatory, and antibacterial properties (12-13).

PHARMACOLOGICAL ACTIVITIES:

Antioxidant: Research indicates that extracts of *Cordia subcordata* have considerable antioxidant properties, aiding in the neutralization of free radicals and safeguarding cells from oxidative stress (14).

Antimicrobial: The plant has shown efficacy against several bacterial and fungal strains, positioning it as a viable option for natural antimicrobial therapies (7).

Hepatoprotective activity: Traditional medicine makes use of Cordia subcordata Lam. to heal lymphadenitis, cirrhosis of the liver and hepatic infections. In order to support its traditional usage for liver disorders, this research set out to assess the hepatoprotective effects of a Cordia subcordata leaf extract (90% ethanol) in rats that had been subjected to carbon tetrachloride, a hepatotoxin. Researchers often use in vivo and in vitro methods to study the hepatoprotective effects of pharmaceuticals or medicinal plant extracts utilizing carbon tetrachloride-induced liver injury as an experimental strategy (15-18). Centrilobular liver necrosis may be caused by the potent hepatotoxin carbon tetrachloride (CCl4). It is converted to CCl3 in the liver by cytochrome P450-dependent monooxygenases (19). Hepatic parenchymal cells store it. Histological examination and the measurement of levels of circulating hepatic enzymes ALT, AST, and ALP are common ways to assess the extent of liver damage (20, 21).

Anti-inflammatory: Extracts from the bark and leaves have been historically used to mitigate inflammation, and current research has corroborated these applications by demonstrating that *Cordia subcordata* obstructs essential inflammatory pathways (22-24).

CONCLUSION:

This review has highlighted the significant phytochemical and pharmacological properties of *Cordia subcordata* Lam. Preliminary phytochemical screening has revealed the presence of important bioactive compounds including glycosides, flavonoids, sterols, saponins, terpenoids, alkaloids, phenolic acids, and tannins in various parts of the plant. These phytochemicals likely contribute to the plant's reported medicinal properties. Pharmacological studies have demonstrated several promising activities of *Cordia subcordata* extracts, including antioxidant, antimicrobial, and hepatoprotective effects. The plant shows potential for addressing wounds, respiratory ailments, and digestive disorders based on its traditional uses. However, further rigorous scientific research is needed to fully elucidate and validate these pharmacological properties. The tree also has ecological and cultural significance, being valued for coastal protection, timber, and traditional medicine across its native range in the Pacific and Indian Ocean regions. However, its natural habitats face threats from coastal development and climate change. Overall, *Cordia subcordata* represents a valuable medicinal plant species with diverse applications. Additional research into its phytochemistry, biological activities, and sustainable cultivation could help realize its full therapeutic and economic potential while supporting conservation efforts. Standardization of extracts and clinical studies are recommended as next steps to develop evidence-based herbal formulations from this promising plant.

CONFLICTS OF INTEREST:

The authors declare no conflicts of interest.

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