

PHYTOCHEMISTRY AND PHARMACOLOGICAL BENEFITS OF CITRUS LIMON- A REVIEW

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Abstract

Citrus limon (C Limon) is reported scientifically to possess antimicrobial, antiinflammatory, anti-parasitic, and anticancer properties have been documented by science. have significant antibacterial, antifungal, sedative, anxiolytic, antidepressant, and anticancer properties. The fruit's abundant phytochemical components and secondary metabolites are responsible for limon. Flavonoids, phenolic acids, coumarins, carboxylic acids, amino acids, vitamins, and more are found in C limon. Citrus limon constitutes a substantial reservoir of bioactive constituents and volatile oils, which significantly contribute to the therapeutic remediation of human health.

Keywords: Citrus limon, phytochemicals, antibacterial, antifungal, antioxidant

Introduction

Ancient India is the source of many beneficial plant products and natural remedies that nature bestows upon humanity. These plants have the pharmacological ability to treat a wide range of illnesses. One such plant is Citrus Lemon, an ellipsoidal yellow citrus fruit that is native to Asia and is always evergreen. It is a member of the Rutaceae family of flowering plants.

It originated in southeast Asia and spread to parts of China, Assam, Burma, and northeastern India. The genus Citrus has about 1300 species and 140 genes. Citrus limon trees are prickly and grow up to 30 feet tall with a canopy that is 25 feet wide (1). The white, fragrant blossom

of the lemon is composed of five petals. The plant's fruits have yellow stripes, and its leaves are bright green with variegated, sharply serrated margins that grow alternately along the stems and branches. (2) This tree bears both fruits and flowers.'(2) Citrus lemons have many therapeutic benefits. Fruit is an ingredient in sherbet, squash, and lemonade. Fresh fruits are also used in a variety of culinary preparations.

Natural products derived from plants have long been used in the prevention and treatment of diseases due to their therapeutic potential, biodegradability, accessibility, affordability, and fewer side effects compared to synthetic drugs. Traditional medicinal systems such as Ayurveda, Siddha, and Unani extensively rely on plant-based remedies. Increased awareness of the adverse effects of synthetic chemicals has further enhanced interest in herbal medicines and natural bioactive compounds (15).

Citrus limon, commonly known as lemon, is an important medicinal plant of the family Rutaceae widely distributed in tropical and subtropical regions, including India. It contains several bioactive compounds such as flavonoids, alkaloids, limonoids, citric acid, essential oils, vitamins, and phenolic compounds, which contribute to its antimicrobial, antioxidant, anti-inflammatory, antifungal, anticancer, and anthelmintic properties (16).

The plant grows in roadsides, wastelands, agricultural fields, and uncultivated areas and is characterized by yellow flowers and a strong odor. Different parts of the plant, including fruits, peels, leaves, seeds, and essential oils, are used for medicinal, culinary, and industrial purposes. Lemon extracts and essential oils have shown significant antibacterial and antioxidant activities, while natural antioxidants such as vitamin C and flavonoids help protect against oxidative stress (17).

Due to its medicinal, nutritional, and economic importance, Citrus limon is widely used in food, cosmetic, pharmaceutical, and aromatherapy industries. Therefore, it remains an important subject for phytochemical and pharmacological research.

Citric acid, pectine, and lemon oil are among the lemonade's byproducts. Pickled fruit is utilized. Its antimicrobial, anti-inflammatory, anti-parasitic, and anticancer properties have been documented by science. have significant antibacterial, antifungal, sedative, anxiolytic, antioxidant, antidepressant, and anticancer properties. Scurvy, high blood pressure, the common cold, fever, cough, sore throat, rheumatism, and menstrual issues have all historically been treated with it. (3). The fruit's abundant phytochemical components and secondary metabolites are responsible for limon. Flavonoids, phenolic acids, coumarins, carboxylic acids, amino acids, vitamins, and more are found in C limon. Monoterpen is the primary component of C limon essential oil. (4,5)

Taxonomical classification (6)

Kingdom - Plantae

Subkingdom - Tracheophyta

Superdivision - Magnoliophyta

Class - Magnoliopsida

Subclass - Rosidae

Order - Sapindales

Family - Rutaceae

Genus – Citrus

Species – Citrus limon

Vernacular names:

Citrus limon is a popular fruit tree commonly used as village folklore medicine. The common names in different languages are listed below

Tamil: Periyaelumichai

English: Lemon

Malayalam: Odichukuthinaregam

Kannada: Bijapura

Hindi: Baranimbu

Bengali: Goranebu

Assamese: Karanebu

Plant Description:

The lemon, a widely consumed citrus fruit originating from a small tree, was brought to European nations by Muslims. This plant features thorny branches and leaves that are serrated and firmly attached to the petiole. The leaf blade is elliptical with a pointed tip, and the tree produces fragrant white flowers, which can be male or bisexual and possess a slight coloration on their edges. The fruits are typically oblong or oval, green when immature, and turn yellow as they ripen. They possess a distinctive aromatic taste and acidic juice. The seeds, which are hard and elliptical, are found within the pulp near the center (7)

Phytoconstituents and bioactive compounds

Phytonutrients illustrate the link between plants and human well-being, representing beneficial bioactive compounds derived from plants for human consumption. Citrus fruits are rich in flavonoids, glycosides, coumarins, and β and γ sitosterol, as well as the significant bioactive compound ascorbic acid, a type of polyphenol. Analysis of the methanolic extract using gas

mass spectrometry identified metabolites such as Maleic anhydride, 6-Oxabicyclo[3.1.0]hexan-3-one, succinic anhydride, and 3-methyl-2,5-Furandione. The presence of these antimicrobial substances positions C limon as a promising ingredient for the pharmaceutical industry in the development of herbal medicines. (8)

Antibacterial activity

Numerous studies have explored the antimicrobial characteristics of citrus plants. Specifically, a concentration of 10mg/ml of C limon essential oil was found to enlarge the zone of inhibition, demonstrating potent antibacterial effects against both gram-positive bacteria such as *Bacillus cereus*, *Streptococcus faecium*, and *Staphylococcus aureus*, and gram-negative bacteria including *Shigella dysentery* and *Salmonella typhi*, as indicated by reference (7). Furthermore, a separate investigation examined the antibacterial potential of leaves from three citrus species: *Citrus grandis*, *Citrus limon*, and *Citrus reticulate*. This research revealed that among these three, the essential oil derived from *Citrus limon* exhibited notable activity with a significant zone of inhibition against gram-positive bacteria. The fundamental way this antibacterial action works is by irreversibly damaging the bacterial membrane, leading to the leakage of cytoplasm, loss of energy substrates, and subsequently cell lysis, ion loss, and ultimately bacterial death. (9)

Antifungal activity

The in vitro antifungal activity of essential oil extracted from *Citrus limon* leaves was investigated against five plant pathogenic fungi, namely *Alternaria alternata*, *Rhizoctonia solani*, *Curvularia lunata*, *Fusarium oxysporum*, and *Helminthosporium oryzae*, using the poisoned food method and a volatile activity assay. The minimum inhibitory concentration (MIC) determined by the poisoned food technique was found to be 0.2 ml/100 ml for *Alternaria alternata*, *Rhizoctonia solani*, and *Curvularia lunata*. For *Fusarium oxysporum* and *Helminthosporium oryzae*, the MIC was greater than 0.2 ml/100 ml. Complete inhibition of fungal spore germination was observed at these concentrations. (10)

Antidepressive effect

Limonene exhibits sedative, anxiolytic, and antidepressant properties. It's a key component in Brazilian Traditional oil, used to treat depression and anxiety disorders. Research indicates that limonene essential oils interact with benzodiazepine receptors, contributing to their antidepressant effects on the central nervous system. Additionally, it impacts noradrenergic and serotonergic activity. (11)

Antioxidant properties

Few studies have explored the antioxidant activity of *Citrus limon* essential oils. One study, conducted with rats, investigated its antioxidant potency and found that *Citrus limon* essential oil treatment significantly reduced lipid peroxidation and nitrite content while increasing glutathione reduced concentration (GSH). Additionally, the phenolic and flavonoid content of lemon fruit and peel were analyzed for antioxidative activity using in vitro methods such as the DPPH assay (2,2-diphenyl-1-picrylhydrazil) and the CUPRAC assay (Cupric ion Reducing Antioxidant Capacity).¹²⁾

Antinociceptive action

Citrus limon leaves demonstrate significant anti-inflammatory and pain-relieving effects, as shown in studies on mice and in vitro. When citrus limon leaf essential oils were administered intraperitoneally, there was a notable reduction in writhes and paw-licking responses, as observed in the abdominal writhing test and formalin-induced paw edema tests. (13)

Anti-cancer activity

The anticancer properties of citrus limonoids were investigated utilizing a murine model, wherein the administration of five distinct limonoid aglycones—specifically limonin, obacunone, nomilin, ichangin, and isoobacunoic acid—resulted in a significant elevation of Glutathione-S-transferase levels in both the intestinal mucosa and hepatic tissues. [14]

CONCLUSION

Citrus limon constitutes a substantial reservoir of bioactive constituents and volatile oils, which significantly contribute to the therapeutic remediation of human health. The present examination of Citrus limon foliage may serve as a supplementary avenue for comprehensive explorations that could lead to the identification of innovative and efficacious compounds, as well as the subsequent inquiry into their biological functionalities. There exists a paucity of literature detailing the detrimental effects associated with its consumption; however, the nutritional and medicinal attributes render Citrus limon a commendable candidate for integration into both the food and pharmaceutical sectors.

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