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The growth patterns, nutritional composition, and medicinal potential of *C. asiatica*

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Abstract
C. asiatica is commonly called Gotukola, Asiatic pennywort, and Indian pennywort. This text comprehensively overviews various pharmacological applications, such as wound healing, mental disorders, atherosclerosis, fungicidal, antibacterial, antioxidant, and anticancer properties. Effective treatment for inflammations, diarrhoea, Asthma, tuberculosis, and various skin conditions like leprosy, lupus, psoriasis, and keloid. Gotukola is renowned for its neuroprotective properties and is often called "brain food." It has been used for various purposes, including anti-inflammatory, antipsoriatic, antiulcer, hepatoprotective, anticonvulsant, sedative, immunostimulant, cardioprotective, and antidiabetic treatment.

Keywords: *Centella asiatica*, Gotukola, growth and distribution, nutrients, traditional medicine

Introduction
Centella asiatica is a versatile herb known for its numerous pharmacological properties. *C. asiatica* has a long history in traditional medicine from different cultures. It is known for its healing properties in treating various diseases, including wound healing, mental disorders, inflammatory conditions, and chronic diseases. The article provides detailed information on the morphological characteristics, distribution, growth patterns, and medicinal activities of *C. asiatica*. Delving into its taxonomy and habitat preferences, the article carefully examines the nuances of its growth dynamics, such as the impact of soil composition, shading levels, and water stress on its development and yield. Moreover, the article illuminates the wide range of pharmacological applications of *C. asiatica*, as found in classical Indian Ayurveda texts and modern scientific studies. *C. asiatica* is a versatile therapeutic resource, with benefits ranging from neuroprotection and anti-inflammatory properties to managing various health conditions like diabetes and cardiovascular diseases and showing potential in fighting tumours and presenting a comprehensive analysis of *C. asiatica's* botanical properties and therapeutic uses by blending scientific data with traditional knowledge. The plant's significance in conventional and modern medicine is emphasised.

Nomenclature
Kingdom: Eukaryota
Division: Spermatophyta
Class: Dicotyledonae
Order: Araliales
Famil: Apiaceae
Genus: *Centella*
Species: Asiatica

Fig 1: *C. asiatica* plant

Fig 2: B Plant leaves

Distribution and morphology of *C. asiatica*

Gotukola is a low-growing herb with a slight aroma, spreading through stolons and typically reaching a height of 15 cm. Certain large varieties can grow as tall as 25 cm. The stem looks smooth, featuring ridges and roots at the nodes. The leaves are clustered at stem nodes and have long petioles. The shape is orbicular-reniform, with crenate edges, and the surface is smooth on both sides. These clusters of flowers are beautifully arranged, with each cluster consisting of three to four flowers in various shades of white, purple, or pink. Flowers blossom between April and June (Seevaratnam *et al*., 2012) [18]. Originating from Southeast Asian countries such as India, Sri Lanka, China, Indonesia, Malaysia, South Africa, and Madagascar, Gotukola is a tropical plant belonging to the *Apiaceae* family (Jamil *et al*., 2007) [10]. This plant flourishes in the warmer regions of both hemispheres. Thriving in natural habitats like marshy and shady areas, this plant can reach altitudes of up to 7000 ft. This plant commonly grows near water sources such as streams, rivers, ponds, and irrigated fields. This plant flourishes on stone walls or rocky areas at an altitude of around 2000 ft in India and Sri Lanka. Advancing in dim, damp areas such as paddy fields and river banks, this plant forms a vibrant green carpet. Thriving in sandy loam habitats over clayey soil is essential for achieving optimal growth and yield, as highlighted by Devkota and Jha (2010) [5].

Characteristics of Gotukola

The growth pattern includes fluctuations in different stages of the plant life cycle. It all comes down to the habitats of the plants. The growth pattern of the plant will change throughout its lifespan. Plants display varying growth patterns depending on the type of soil they are planted in. Plants reproduce through various plant parts, which differ depending on the plant species. Plant growth is affected by a range of biotic and abiotic factors, and finding the right balance is essential for their successful development in their natural habitats.

The influence of soil composition, sunlight, and water stress on *C. asiatica* growth

Plant vegetative traits, like leaf number, petiole length, specific leaf area, primary branch number, and plant biomass growth, show significant differences across various soil types. Opting for sandy loam instead of clayey soil can support the development and productivity of the *C. asiatica* plant (Devkota and Jha 2010) [5]. Plantlets were cultivated in earthen pots filled with soil enriched with manure. The integrated manuring method resulted in significantly higher leaf area, number of leaves per ramet, and number of flowers per ramet compared to the other treatments. In a study by Devkota and Jha 2013 [3], it was discovered that biomass production was significantly higher in integrated manuring compared to the control, incomplete organic manuring, and inorganic manuring with the addition of 100% urea.

C. asiatica flourishes in damp soil, basking in direct sunlight or partial shade. This species might struggle in colder regions of the country. Thrives outdoors in the summer across various areas of the country. Therefore, it can be grown as a summer crop. Plant spacing and nutrient requirements influence crop plants' quantity and quality. Optimal nutrient absorption and enhanced crop yield depend on the timely application of plant nutrients through foliar spray during crucial growth stages.

The measurements for *C. asiatica* are as follows: petiole length of 12.69 cm, leaf length of 3.21 cm, leaf width of 6.13 cm, and dry leaf weight of 0.11g. This text provides details about the leaf area and nitrogen percentage. The morphological traits consist of a rosette diameter of 19.52 cm, a maximum number of leaves at 5.29, a maximum number of primary branches at 3.0, a maximum number of nodes at 5.05, a total length of the internodes at 22.14 cm, a maximum number of flowers per node at 21.0, and moisture content of plants at 74.42% in sandy, loamy soil (Devkota and Jha, 2010) [5].

They explored the growth pattern and yield of the *C. asiatica* plant under different levels of shading: 0% (full sunlight), 30%, 50%, and 70% of solar radiation. The study findings indicated that plants cultivated under 30% shading exhibited greater plant biomass. When the plantlets were grown under full sunlight, their root system significantly increased the dry biomass. There were variations in specific leaf areas, as shown by the treatments. Plants grown in 30% shade have the highest number of leaves. There was a variation in petiole length, with measurements ranging from 2.4 cm under full sunlight to 4.63 cm at 70% shading. The Devkota and Jha 2010 [5] study found that plants grown under 70% shading conditions had a notably longer internodal length.

The study investigated the effects of water stress on the growth and yield of *C. asiatica* in a pot experiment. The plantlets were grown in earthen pots with varying levels of water stress, precisely at 30, 70, 100, and 125% of pot capacity by mass. There was significant variation in growth traits such as leaf area, root length, and the number of flowers per ramet in response to water stress. The results revealed that plants watered to 100% pot water capacity exhibited the most substantial growth and biomass production. The longest petiole length recorded at 100% pot water capacity was 5.67 cm, while the shortest was 2.05 cm (Devkota and Jha 2011) [4]. Prasad *et al*. (2010) [20] outlined the requirements for cultivating C. asiatica, a valuable medicinal herb, through a hydroponic system. During a 70-day

hydroponic growth experiment, the plants showed a significant increase in biomass accumulation, reaching 156.3% more dry matter than the initial inoculum weight around 42 days after cultivation started. This text beautifully highlights the temporary immersion system (TIS) as a leader in large-scale horticulture, combining the benefits of plant tissue culture with superior efficiency in propagating horticultural crops compared to traditional bioreactors. Plant explants undergo cyclic submersion in a nutrient solution, with the immersion duration optimally influencing both nutrient absorption and proliferative capacity.

Medicinal activity of Gotukola

According to classical Indian Ayurveda literature, it is regarded as one of the Rasayana (rejuvenator) drugs (Jayashree *et al*., 2003) [11]. Gotukola offers various pharmacological benefits, including wound healing, mental health support, atherosclerosis prevention, fungicidal and antibacterial properties, and antioxidant and anticancer effects. This treatment has successfully treated various conditions, from inflammations to skin issues like leprosy, lupus, psoriasis, and keloid. *C. asiatica* was called "brain food" due to its neuroprotective properties. The plant has been used for a wide range of purposes including anti-inflammatory, antipsoriatic, hepatoprotective, anticonvulsant, sedative, immunostimulant, cardioprotective, antidiabetic, cytotoxic, antitumor, antiviral, antibacterial, insecticidal, antifungal, antioxidant, and venous deficiency treatment, as supported by various studies (Somchit *et al*., 2004; Sampson *et al*., 2001; Visweswari *et al*., 2010; Wang *et al*., 2003; Gnanapragasam *et al*., 2004; Oyedeji and Afolayan, 2005; Rajkumar and Jebanesan, 2005; Dash *et al*., 2011; Hamid *et al*., 2002; Pointel *et al*., 1987) [19, 17, 20, 21, 7, 13, 16, 2, 8, 14].

Table 1: A list of some of the drugs that *C. asiatica* can be used to treat

	Medicinal claim	Description of treatment
Skin	• Wound healing • Treating skin problems (eczema, psoriasis) • Rejuvenating connective tissue • Treatment for burns and scars • Cleaning up skin diseases • Leprosy	In China, this tropical plant has been used in traditional and ayurveda medicine. Malaysia and Madagascar to help wounds heal and for general health reasons, as well as as an antibacterial and antiviral. The whole plant, including the leaves, can be used as medicine. As part of traditional African medicine, it has been used to treat leprosy. The Asiatic side breaks down the waxy covering of the leprosy bacteria, which lets the immune system kill the bacteria. Extracts of the plant are used to help heal scars from surgery and small burns.
Circulation	Serves as a supportive therapy for venous ulcers	
Arthritis and rheumatism	Oral extracts are commonly used to alleviate symptoms related to the venous and lymphatic vessels.	
Memory improvement and slowing down aging	In India, it has been used to heal wounds, as a light laxative, to boost energy and focus, to make people more aware, and in Ayurvedic medicine to treat long life, stress, and worry.	
Cancer	• This herb is commonly utilized in alternative health to address tumours and anticancer drugs while maintaining the body's immune system and avoiding toxic byproducts. • The crude extract exhibits cytotoxic and anti-tumor properties in primarily purified fractions.	
Health tonic with aphrodisiac properties and immune-boosting benefits	Centella is effective in eliminating toxic buildup in the brain and nerves while also aiding in detoxifying the body from heavy metals and drugs, including recreational substances.	
Cleansing the body	▪ It stimulates lipolysis and blood microcirculation, making it useful in managing local adiposity or cellulite.	
Liver and kidney treatment	• For centuries, it has been utilized to address liver and kidney issues and has gained popularity as an alternative treatment for individuals with hepatitis and alcoholic liver diseases. • Managing Diabetes	

Nutrient Content of Gotukola

Gotukola is a nutrient powerhouse filled with essential minerals such as iron, calcium, potassium, and magnesium, along with vitamins K, C, E, and B. They are loaded with details on phytonutrients like β-carotene, lutein, neoxanthin, and zeaxanthin and their positive impact on human cells, especially in safeguarding eyes from age-related problems.

Table 2: The nutritional profile of Gotukola is presented in percentages

Protein	Carbohydrate	Fiber	Fat	Moisture	Reference
NA	6.7	1.6	0.2	87.7	(Hashim, 2011) [9]
2.4	NA	5.92	NA	84.6	Joshi and Chaturvedi (2013) [12]
9.94	51.92	18.33	NA	84.37	Das (2011) [1]

Table 3: Mineral Content of the Gotukola (mg/100 g)

Na	K	Ca	Mg	P	Fe	Reference
21	NA	NA	NA	32	5.6	(Hashim, 2011) [9]
107.8	345	174	87	17	14.86	Joshi and Chaturvedi (2013) [12]
NA	NA	1.06	NA	370	32	Das (2011) [1]

Gotukola contains a variety of macronutrients, including proteins, carbohydrates, and fibres. In the past decade, three studies discovered that nutrient content mostly had consistent values, although there were some instances of notable differences (Das, 2011; Hashim, 2011; Joshi and Chaturvedi, 2013) [1, 9, 12]. According to a study by Hashim 2011 [9], 100 g of *C. asiatica* contains 37.0 kcal. Gotukola is rich in vitamins, including C, B_1, B_2, niacin, carotene, and vitamin A, as cited by Hashim (2011) [9] and Joshi & Chaturvedi (2013) [12].

Table 4: Vitamin Content of the Gotukola (mg/100g)

Vitamin A	Thiamine (B_1)	Riboflavin (B_2)	Niacin (B_3)	Ascorbic Acid (Vitamin C)	β-Carotene	Reference
0.44	0.09	0.19	0.1	48.5	NA	Hashim (2011) [9]
NA	0.04	NA	NA	11	3.9	Joshi and Chaturvedi (2013) [12]
NA	NA	NA	NA	9.73	1	Das (2011) [1]

Phytonutrients Present in Gotukola

A wide variety of phytonutrients, including volatile oils, fatty acids, alkaloids, carotenoids, glycosides, and flavonoids, are present. A wide variety of phytonutrients have many positive benefits. What follows is a list of the plants' primary chemical components:

1. **Triterpenes:** Major chemical compounds found in *C. asiatica* are triterpenes and their derivative molecules. *C. asiatica* contains various bioactive compounds, mainly triterpenoid saponins, such as Asiatic acid, asiaticoside, madecassic acid, and madecosside. It also includes particular components such as thankuniside, brahmoside, brahminoside, and Brahmic acid, which add to its wide array of potential advantages. As per Das (2011) [1], the plant's leaves contain higher concentrations of asiaticoside and madecassoside than the roots.
2. **Glycosides:** Gotukola contains glycosides in an inactive state. Upon hydrolysis, these glycosides become activated. The plant contains asiaticoside, madecosside, and centelloside as glycosides. Upon hydrolysis, triterpene acids such as Asiatic acid and madegascariacid are released in their free form in the plant (Das, 2011) [1].
3. **Volatiles and Fatty Oils:** This plant has approximately 36% of volatiles and fatty oils. This mixture of glycerides contains various fatty acids, including palmitic, stearic, lignoceric, oleic, linoleic, and linolenic. This oil consists primarily of terpenic acetate, which is an organic compound. β-caryophyllene, farnesene, and other molecules known as sesquiterpenes are crucial ingredients. The compounds are accountable for the oil's distinct properties (Das, 2011; Joshi and Chaturvedi, 2013) [1, 12].
4. **Flavonoids:** These yellow pigments are also collectively referred to as vitamin P and citrin. *C. asiatica* contains flavonoids, 3-glucosyl quercetin, 3-glucosylkaemferol, and 7-glucosylkaemferol. The article effectively highlights the presence of well-known flavonoids such as quercetin, kaempferol, patulin, rutin, apigenin, and myricetin in C. asiatica, along with the recent discovery of two new flavonoids: castilliferol and castillicetin (Das, 2011) [1].

Other Compounds

This composition includes tannins, mineral acids, saccharides, terpenes, and α-amino acids such as L-aspartic acid, glycine, L-glutamic acid, L-alanine, and L-phenylalanine. Tannins function as antioxidants, according to Rahman *et al*. (2013) [15].

Conclusion

Gotukola is a versatile medicinal plant with numerous pharmacological properties. It has been used across various civilizations for treating wounds, skin conditions, mental health, and chronic diseases. Studies indicate that the growth and yield of *C. asiatica* are influenced by soil composition, shade, and water stress. By grasping these components, agricultural yield and farming can be enhanced.

The therapeutic capabilities of *C. asiatica* are attributed to its numerous bioactive components. The botanical, pharmacological, and nutritional studies of *C. asiatica* demonstrate its potential as a natural remedy for various health concerns. This fantastic plant requires more research and advancement to utilize its healing properties fully.

References

1. Das AJ. Review on nutritional, medicinal and pharmacological properties of *C. asiatica* (Indian pennywort). Journal of Biologically Active Products from Nature. 2011;1:216-228.
2. Dash BK, Faruquee HM, Biswas SK, Alam MK, Sisir SM, Prodhan UK. Antibacterial and antifungal activities of several extracts of *C. asiatica* L. against some human pathogenic microbes. Life Sciences and Medicine Research. 2011, 1-5.
3. Devkota A, Jha PK. Effect of integrated manuring on growth and yield of *C. asiatica*(L.) Urb. Tropical ecology. 2013;54:89-95.
4. Devkota A, Jha PK. Influence of water stress on growth and yield of *C. asiatica*. International Agrophysics, 2011.
5. Devkota A, Jha PK. Effects of different light levels on the growth traits and yield of *C. asiatica*. Middle-East Journal of Scientific Research. 2010;5:226-230.
6. Devkota A, Jha PK, n.d. Variation in Growth of *C. asiatica* along Different Soil Composition.
7. Gnanapragasam A, Ebenezar KK, Sathish V, Govindaraju P, Devaki T. Protective effect of *C. asiatica* on antioxidant tissue defense system against adriamycin induced cardiomyopathy in rats. Life Sciences. 2004;76:585-597.
8. Hamid AA, Shah ZM, Muse R, Mohamed S. Characterisation of antioxidative activities of various extracts of *C. asiatica* (L) Urban. Food chemistry. 2002;77:465-469.
9. Hashim P. *C. asiatica* in food and beverage applications and its potential antioxidant and neuroprotective effect. International Food Research Journal. 2011;18:1215.
10. Jamil SS, Nizami Q, Salam M. *C. asiatica* (Linn.) Urban—a review. 2007.
11. Jayashree G, Muraleedhara GK, Sudarslal S, Jacob VB. Anti-oxidant activity of *C. asiatica* on lymphoma-bearing mice. Fitoterapia. 2003;74(5):431-434.
12. Joshi K, Chaturvedi P. Therapeutic efficiency of *C. asiatica* (L.) Urb. An underutilized green leafy vegetable: an overview. International Journal of Pharma and Bio Sciences. 2013;4:135-149.
13. Oyedeji OA, Afolayan AJ. Chemical composition and antibacterial activity of the essential oil of *C. asiatica*. Growing in South Africa. Pharmaceutical biology. 2005;43:249-252.
14. Pointel JP, Boccalon H, Cloarec M, Ledevehat C, Joubert M. Titrated extract of *C. asiatica* (TECA) in the treatment of venous insufficiency of the lower limbs. Angiology 1987;38:46-50.
15. Rahman M, Hossain S, Rahaman A, Fatima N, Nahar T, Uddin B *et al*. Antioxidant activity of *C. asiatica* (Linn.) Urban: Impact of extraction solvent polarity. Journal of Pharmacognosy and Phytochemistry. 2013;1(6):27-32.
16. Rajkumar S, Jebanesan A. Larvicidal and adult emergence inhibition effect of *C. asiatica* Brahmi (Umbelliferae) against mosquito Culex quinquefasciatus Say (Diptera:

Culicidae). African Journal of Biomedical Research. 2005;8:31-33.
17. Sampson JH, Raman A, Karlsen G, Navsaria H, Leigh IM. In vitro keratinocyte antiproliferant effect of *C. asiatica* extract and triterpenoid saponins. Phytomedicine. 2001;8:230-235.
18. Seevaratnam V, Banumathi P, Premalatha MR, Sundaram SP, Arumugam T. Functional properties of *C. asiatica* (L.): a review. Int J Pharm Pharm Sci. 2012;4:8-14.
19. Somchit MN, Sulaiman MR, Zuraini A, Samsuddin L, Somchit N, Israf DA *et al*. Antinociceptive and antiinflammatory effects of *C. asiatica*. Indian Journal of Pharmacology. 2004;36:377.
20. Visweswari G, Prasad KS, Chetan PS, Lokanatha V, Rajendra W. Evaluation of the anticonvulsant effect of *C. asiatica* (Gotukola) in pentylenetetrazol-induced seizures with respect to cholinergic neurotransmission. Epilepsy & Behavior. 2010;17:332-335.
21. Wang W, Vinocur B, Altman A. Plant responses to drought, salinity and extreme temperatures: towards genetic engineering for stress tolerance. Planta. 2003;218:1-14.