

CENTELLA ASIATICA (L.) URBAN AS A NEUROPROTECTIVE AGENT IN HUMAN HEALTH.

Tuwar A. R. Department of Botany and Research Centre, Mula Education Society's, Arts, Commerce, and Science College Sonai, Tal. Newasa, Dist. Ahmednagar.

Arangale K. B. Department of Botany and Research Centre, Mula Education Society's, Arts, Commerce, and Science College Sonai, Tal. Newasa, Dist. Ahmednagar – 414105, Affiliated To Savitribai Phule Pune University, Pune (M.S.) India.

Abstract: *Centella asiatica* (L.) Urban, a popular medicinal plant in Eastern cultures, is progressively gaining popularity across the Asian continent. The active chemicals are pentacyclic triterpenes; the most noteworthy are asiaticoside, madecassoside, Asiatic acid, and madecasic acid. The aerial portions and roots are utilized for medicinal reasons, and the plant's chemical components contain antibacterial, anti-inflammatory, anticancer, neuroprotective, antioxidant, and wound-healing qualities. This article overviews current studies on *C. asiatica's* health advantages. The research focuses on the plant's significance as a neuroprotectant and its phytochemistry and pharmacological qualities.

Keywords: *Centella asiatica* (L.) Urban, Neuroprotectant, Antibacterial, Anticancer, Human Health.

Introduction: In recent years, the world's population has experienced an increase in life expectancy, which has led to a demographic shift from youthful to hyper-aged civilizations, particularly in affluent nations. The World Population Aging by the United Nations in 2020 reported that 9.3% (727 million) of the global human population was more than 65 years old in 2020 [1]. This change can touch social aspirations and economics along with welfare and healthiness. The global healthcare and research industries are very concerned about the rise of chronic and degenerative illnesses and the expenses involved. These universal issues are reflected and supported by current research trends that strongly emphasize the function of nutrition in healthy aging. Demand from consumers concerned about their health is continuously rising for superfoods and functional foods, especially whole foods with outstanding health advantages. In order to ensure the safety of foods like medicinal plants used in traditional meals due to their beneficial properties, which have been scientifically proven over time, researchers are responsible for unlocking the secrets of beneficial characteristics and producing health information that is scientifically supported. Several plants are being researched for possible therapeutic use in age-related medical problems.

Centella asiatica (L.) Urban is a leafy vegetable commonly known as a Mandhukparni due to its well-known health advantages. It is often consumed in traditional communities throughout the world. Since prehistoric times, it has been highly esteemed for its medicinal plant use [2]. It has been employed in Unani, Ayurveda, and traditional Indian and Southeast Asian medicine. Traditional African and Chinese medicine reportedly employ it.[3].

Centella genus under the family Apiaceae (Umbelliferae) has 80 species across the world's tropical and subtropical climates. India, Bangladesh, Sri Lanka, Northern Australia, Indonesia, Africa, Iran, Mexico, South America, Columbia, Malaysia, Venezuela, and other countries in the Asian continent. [4][5][6]. It is found in India's tropical and subtropical regions up to 600m, Sikkim (1550m), and Mount Abu (1200m).

C. asiatica is shown to have multifunctional roles in Indian Ayurveda [7]. The putative "cure-all herb" was utilized for hundreds of years in Ayurvedic practice for treating mild and chronic illnesses [8]. This plant, known as Mandookaparni in Ayurveda, has been cherished since *Charaka* and *Sushruta Samhita* as a *medhya* (memory and intellect enhancing) herb and one that fights to age (*vayahsthaapana*). *C. asiatica* is recognized in China as a "miracle elixir of life" due to its widespread use in traditional Chinese medicine. Due to the general occurrence of phytochemical compounds such as fatty acids, vitamins, polyacetylene, terpenes, phenols, and minerals, *C. asiatica* possesses

medicinal effects. It also contains at least 2% saponins like scelefoleoside, thankuniside, brahminoside, centelloside, asiaticoside, madecassoside, centellose, brahmoside, Centellic acids, Asiatic acids, Brahmic acids, and madecasic acids [9]. According to the European Pharmacopeia, saponins and sapogenins are found in leaves and petioles [10]. Moreover, depending on the location of origin/collection, the percentage might range from 1% to 8%. [11] [12] [13] [14] [15] [16] [17] [18] [19]. Centella is in high demand in the worldwide herbal market due to its tremendous medicinal potential. Indian Medicinal Plant Board reports that it is one of 180 medicinal plant species consumed in quantities of more than 100 Metric tons per year in India. The Indian market average price of fresh herb ranges from 0.45 to 0.53 US dollars/kg under the brand name- '*Brahmi booti*.' [20].

Centella asiatica (L.) Urban (family Apiaceae) and *Bacopa monnieri* L. (Family Plantaginaceae) are sold as "Brahmi." [21] both plants are from taxonomically different families and have different morphologies. Conversely, the existence of saponins such as Bacoside A, Bacopaside II, Bacoside A3, Bacopasaponin C, and its Jujubogenin isomer is thought to contribute to its medicinal potential. [22]. Both plants have similar nootropic, neuroprotective, and free-radical scavenging properties. [22] [23].

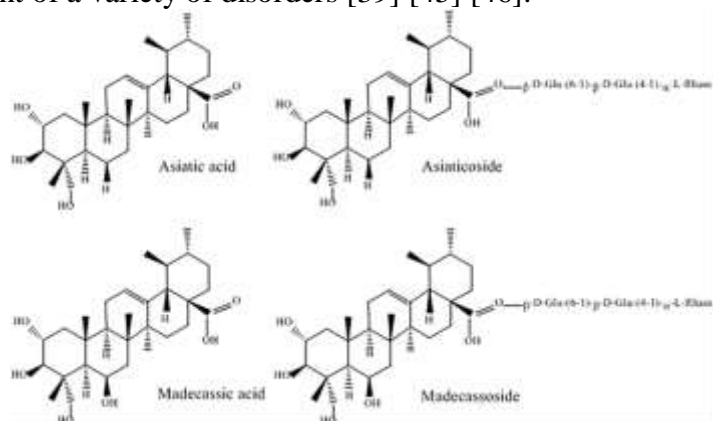
Centella asiatica (L.) Urban is used in Ayurvedic medicine to cure several chronic diseases, including leprosy, varicose veins, duodenal ulcers, certain eczemas, psoriasis, hypertonic keloid scars, and Alzheimer's disease. [2] [8] [24] [25] [26] [27]. It is also anti-inflammatory, anti-asthmatic, anti-oxidative, anticancer, cardioprotective, hepatoprotective, gastroprotective, neuroprotective, nerve regeneration, antimicrobial, immunomodulatory, anti-depressive, memory boosting, radioprotective, wound healing, and anticancer [2] [3] [7] [9] [28] [29] [30] [31] [32] [33]. Limited cultivation and inadequate efforts to replenish natural reserves have depleted its wild supply, causing the IUCN to list it as a Threatened/Endangered species [34]. Due to demand and population depletion [21]. These considerations make it essential to establish an alternative *C. asiatica* production platform [13] [35] [36].

Research Methodology: Searches conducted in scholarly databases such as Google Scholar, SciFinder, ResearchGate, Medline, PubMed, Scopus, and Science Direct were used to compile the essential information and data required for the present investigation. A wide range of reviews, research papers, and book chapters that met the criteria for inclusion and had been previously published in publications and books by publishers such as Taylor and Francis, Springer, Oxford, John Wiley, and Elsevier, amongst others, were also thoroughly examined.

Botanical Description of *C. asiatica*: *Centella asiatica* (L.) Urban, commonly known as a Mandhukparni and their leaf look like rat ears, so known as *Undirkani*, is a prostrate, perennial, stoloniferous creeper weed found in moist places and the average length of 10-15 cm. The stem is glabrous, striated, and has roots at the nodes; stolons vegetatively reproduce the plant with long nodes and internodes. The leaves are simple, medium-sized, clustered, stalked, kidney-shaped, 2–5 cm long, 3–6 cm broad, cordately based, and toothed along the edges. The leaves are gland-studded and fragrant. Petioles are 2 to 6 cm long and 2 to 5 cm wide. They are glabrous, upright, wrinkled above the stipule, short, attached to the petiole, and have a sheathing base. Flowers are irregular, bisexual, sessile, and grouped in threes or fours at the tips of short, pubescent peduncles. May through October is the blossoming season. The fruit is dry, about 0.3 to 0.4 cm long, dull down, ovoid, hard flattened schizocarp with two single-seeded mericarps linked to a thin central axis with indehiscent, severely thickened pericarps. Each mericarp contains a Solitary, single, pendulous, and albuminous seed. [34] [37].

Phytochemistry of *C. asiatica*: Studies on the phytochemistry of *Centella asiatica* have uncovered a diverse array of physiologically active chemicals [4]. These molecules include triterpenoids, flavonoids, and phenolic acids, among others. The triterpenoids known as asiaticoside, madecassoside, Asiatic acid, and madecassic acid are the chemicals with the highest concentrations and the most research done on them [2] [4] [8] [9] [10] [15] [19].

Asiaticoside and madecassoside are glycosides of triterpenoids that have been revealed to contain considerable wound healing and anti-inflammatory activities [27] [30]. These benefits have been shown via scientific research. These substances encourage the creation of collagen, improve blood circulation, and boost the proliferation of fibroblasts, which are the cells responsible for collagen manufacture. It has also been shown that asiaticoside has antioxidant and neuroprotective actions, posing it as a potentially useful option for treating neurodegenerative illnesses [32]. Both Asiatic acid and madecassic acid are examples of the class of chemicals known as triterpenoids [33] [34]. Research has revealed that both of these chemicals contain anti-inflammatory, antioxidant, and anticancer qualities. It has been shown that these chemicals may trigger apoptosis in cancer cells while inhibiting the production of cytokines that contribute to inflammation, such as tumor necrosis factor-alpha and interleukin-6 [41]. Flavonoids, including quercetin, kaempferol, and apigenin, have been extracted from *Centella asiatica* and have been shown to contain antioxidant, anti-inflammatory, and anticancer activities. *Centella asiatica* has also been shown to inhibit the growth of tumors [38] [39] [43]. It has been shown that phenolic acids, such as chlorogenic and caffeic acids, have neuroprotective and antioxidant properties [33] [34]. In general, the phytochemistry of *Centella asiatica* is rather complicated and varied. This plant has various physiologically active chemicals known to have important therapeutic benefits. These compounds have been the focus of a great number of research, and there is reason to be optimistic about their use as prospective therapeutic agents for the treatment of a variety of disorders [39] [45] [46].



Structures of triterpenes molecules in *Centella asiatica* (L.) Urban.

Use as a neuroprotective agent: Memory enhancement is traditionally accomplished by using *Centella asiatica* (L.) Urban. [32] Because of its capacity to heal neurons and brain cells, it was studied by these researchers. This therapeutic use is closely related to its neuroprotective effect, which means that its medicines may be able to treat neurodegenerative diseases such as Parkinson's disease, senile dementia, and Alzheimer's disease, which are prevalent in societies that are getting older, like those in developed countries [34]. A few synthetic medications are currently available for these illnesses' cognitive impairment and memory loss. (Alzheimer's Association, 2021). *C. asiatica* lives at the nexus of traditional and modern scientifically based medicine. Various research has investigated the neuroprotective, anti-depressive, and cognitive-enhancing properties of *C. asiatica* crude extracts and single or mixtures of triterpenic preparations. [38] [39] [40] [41]. The plants are utilized as a nutraceutical in the form of Brahmigritha, medicinal ghee, and syrup by the brand name 'Mentat.' A nervine tonic and memory-enhancing syrup from the whole plant treat various neurological disorders and help young people retain extra information. Its revitalizing and purifying effects on the body and improved memory and cognitive function are among its purported benefits. It is used with milk in some areas of India to enhance memory and prevent dementia and aging. Additionally, it is supposed to benefit youngsters with mental disabilities by improving their overall mental faculties [42] [43].

According to many publications, several clinical research studies have been carried out to establish that *C. asiatica* is involved in both the neuroprotection and the cognitive boosting processes. The

triterpene Asiatic acid and its derivatives may protect cortical neurons from the excitotoxicity caused by glutamate when tested in vitro [44]. The nootropic potential of *C. asiatica* has been studied in pharmacological and behavioral studies in rats. It can serve as a clinical replacement. *C. asiatica* is renowned for its non-toxic nature at appropriate dosages (60-180 mg daily), with few unwanted side effects. Nevertheless, larger doses taken orally can lead to nausea, headache, stomach ache, dizziness, and sleepiness. Larger doses taken topically can cause skin allergies and burning sensations [8]. It is not suggested to consume the herb for longer than six weeks. *C. asiatica* extract is also not recommended for breastfeeding women and may cause complications during pregnancy [45]. Humans who take *C. asiatica* for 20-60 days may suffer hepatotoxicity [46].

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