

**CENTELLA ASIATICA: THE ELIXIR OF LIFE**

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**ABSTRACT**

*Centella asiatica* is a perennial herb that has been used since times immemorial as Medhya, Rasayana. According to the ancient literature of Charaka Chikitsa I, the juice of mandookaparni promotes longevity and cures all diseases. It also improves strength, digestive power, complexion, voice and intellect. It is rejuvenating and used as a nervine tonic. Innumerable pharmacological and clinical studies conducted by prominent scientists have validated these claims, yet there are some properties that need further investigation. There is great demand for this elixir in Indian as well as International market. It is used in numerous pharmaceuticals and cosmetic products. But today this plant has been marked as endangered species. This review aims to present a comprehensive report on the plant *Centella asiatica*, its pharmacology, and market prospects and to cite examples that justify its use as a panacea drug.

**KEYWORDS:** *Centella asiatica*, nervine tonic, rasayana, wound healing.

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**INTRODUCTION**

Herba Centellae consists of the dried, fragmented aerial parts, preferably leaves of *Centella asiatica* (L.) Urban, belonging to family Apiaceae (Umbelliferae)<sup>1,2</sup> sub-family Mackinlaya, (previously included in Hydrocotyle). It contains not less than 2.0 per cent of total triterpenoid derivatives, expressed as asiaticoside calculated with reference to the dried drug.<sup>4</sup> The generic name has been derived from the Latin word "CENTUM =HUNDRED" referring to profusely branched prostrate herb. *Centella* comprises some 33 species.<sup>5</sup> The drug occurs as a compressed mass of grey-green leaves, flattened stems and umbels of schizocarpic fruits.<sup>3</sup>

Since ancient times *C. asiatica* has been used in traditional Indian medicine for various pathological disorders and in particular for healing wounds and for leprosy. In the Ayurvedic system of medicine it is also recommended in chronic diseases and as a "brain tonic" in various mental disorders. The wound healing applications have also been known in the folk medicine of Malay Peninsula, Java and Madagascar, whereas the psychotropic application of *C. asiatica* has been known in China. It is listed officially in the Chinese & European Pharmacopoeia and used as an antipyretic and diuretic, and in the treatment of icterus, heat stroke, diarrhea, ulcerations, eczema and traumatic diseases. It is also mentioned in the British Herbal Pharmacopoeia (1983),

for use as a mild diuretic and antirheumatic.<sup>3</sup> As mentioned in Ayurvedic Pharmacopoeia of India, the dried plant is used in raktapitta (Haemorrhagic diseases), kustha (Leprosy), meha (Polyurea), jvara (Fever), svasa (Dyspnoea), kasa (Cough), aruchi (Anorexia), pandu (Itching), sotha (Oedema/ Inflammation) and raktadosa (Vitiated blood).<sup>6</sup> The plant has high medicinal value which makes it socially desirable. It is economically affordable and sustainable. But, the unrestricted exploitation of the drug has markedly depleted the wild stocks of the plant. It has been listed as Threatened plant species by International Union for Conservation of Nature and Natural Resources (IUCN) and an endangered species.<sup>7</sup> Despite this; it has not been included in prioritized medicinal plants list for cultivation by the National Medicinal Plant Board (NMPB), India.<sup>8</sup>

**Geographical Source**

*Centella* is indigenous to tropical and subtropical regions of the world. It is found in Africa, Australia, Cambodia, Central America, Madagascar, Thailand, Vietnam, South America, the Pacific islands.<sup>4</sup> In India it is commonly found in moist areas and in crop fields and other waste places upto an altitude of 600m.<sup>9</sup>

**Ethnopharmacological Uses**

It is used as whole plant or aerial parts. The drug is used internally as well as externally. As a paste it is applied on

boils. Cold poultice of fresh herb is used for external application in rheumatism, elephantiasis. Leaf juice is rubbed on forehead to treat severe headache. To treat leprosy and other skin disorders it is used as ointment or dusting powder. Mixed with bath water, it is used in eczema.

Internally it is used as tonic, to treat bronchitis, asthma, gastric catarrh, leucorrhoea, kidney troubles, urethritis and dropsy. It is considered to be an aphrodisiac and used in venereal diseases. Mixture of leaf syrup with ginger and black pepper treats cough. Leaf juice when mixed with palm jaggery is used as tonic for women, postpartum. Leaf extract is used in medicated oils for bone fracture. It is given in the form of decoction to treat hemorrhoids.<sup>9</sup>

In Malligainatham village (Tamil Nadu) cooked leaf is eaten to increase memory power.<sup>10</sup> The powdered leaf is used in Uttarakhand, to give body strength and increase brain power.<sup>11</sup> In Brazil the leaves are used to treat obesity.<sup>12</sup>

### Chemical Constituents

*C. asiatica* has been reported to contain the following type of compounds.

**Triterpene acids:** The plant contains the following triterpene acids- asiatic acid [fig-6], madecassic acid [fig-5], terminolic acid, centic acid, centoic acid, centelloic acid, indocentoic acid, brahmnic acid, isobrahmic acid, betulic acid and madasiatic acid.<sup>9,13,14</sup>

Three triterpene acids belonging to  $\alpha$ -amyrine group namely centic, centellic and centoic acid were isolated from Ceylonese variety whereas the Indian variety contains indo-centoic acid which is an isomeric form of centoic acid<sup>9</sup>

**Glycosides:** Asiaticoside A, Asiaticoside B, madecassoside and Centelloside. On hydrolysis these glycosides yield triterpene acids- Asiatic acid, madecassic acid and centellic acid. Indian variety also contains indocentelloside, brahminoside, brahmoside, thankuniside and isothankuniside. These upon hydrolysis yield indocentoic, asiatic, brahmnic, thankunic & isothankunic acid respectively.<sup>15</sup> Brahmoside and brahminoside are tri-glycosides and tetra-glycosides of the aglycone - brahmnic acid. The glycone component has been identified to contain rhamnose, glucose and arabinose.<sup>9,16</sup>

**Volatile & Fatty oils:** The alcoholic extract of the plant yields oleic, linoleic, linolenic, palmitic, stearic and lignoceric acids.<sup>9</sup>

**Alkaloids:** An alkaloid, hydrocotylin has been isolated from hot ethanolic extract of the plant.<sup>16</sup>

**Flavanoids:** Two new flavanoids namely castiliferol and castilicetin have been isolated from *Centella asiatica*.<sup>17</sup>

The leaves contain 3-glucosylquercetin, 3-glucosylkaempferol and 7-glucosylkaempferol.

**Others:** The various extracts of the plant showed presence of sterols, tannins, sugars and inorganic salts.<sup>14</sup> They also showed presence of amino acids viz., aspartic acid, glycine, glutamic acid,  $\alpha$ -alanine and phenylalanine. The total ash contained chloride, sulphate, phosphate, iron, calcium, magnesium, sodium and potassium. A phytosterol was isolated from unsaponifiable portion of petroleum ether extract and identified as  $\beta$ -sitosterol. Presence of other components which include minerals, enzyme, hormones, waxes, proteins, quinones and ascorbic acid has also been indicated.<sup>9,16</sup>

### Pharmacological and Clinical Activity

#### Antiepileptic activity

In an experiment conducted at IIT Hyderabad, aqueous extract of *C. asiatica* (25mg/kg) i.p. decreased spontaneous motor activity and delayed PTZ – convulsions in mice.<sup>18</sup>

In another study conducted on young male Wistar rats showed conspicuous inhibition of  $\text{Na}^+/\text{K}^+$ ,  $\text{Mg}^{2+}$  and  $\text{Ca}^{2+}$ -ATPases in rat brain during PTZ-induced epilepsy in all the brain regions when compared to the saline control.<sup>19</sup>

The alcoholic extract of the plant in a dose of 100mg/100g for 15 days produced anticonvulsant activity against electrically induced convulsions. The 10% suspension of 50% ethanolic extract of the plant, when given orally to rats, protected them from maximal electroshock convulsions.<sup>9</sup>

The anticonvulsant effect of different extracts of *C. asiatica* and *Bacopa monnieri* were studied and compared. The crude extract of drug in dose of 500mg/kg showed mild-moderate anticonvulsant activity while the methanolic extract showed higher activity than crude drug at 3-6hrs but there was no anticonvulsant activity at 1 hr. Quantitatively *C. asiatica* had less activity than *B. monnieri* but it had a longer duration of action.<sup>9</sup>

#### Neuro-protective

*C. asiatica* improved cognition in male Wistar rats, decreased malondialdehyde and nitrite levels, restored level of growth stimulating hormone, increased activity of Glutathione-S-Transferase, catalase and superoxide dismutase.<sup>20</sup>

In another study, it was reported that the constituents present in *C. asiatica* fresh leaf extract have a neuronal dendritic growth stimulating property. Hence, the extract can be used for enhancing neuronal dendrite in stress and neurogenerative & memory disorder. Since active brain

growth occurs during the spurt period thereby this study was carried out on neonatal rats.<sup>21</sup>

CNS activity of the plant can be attributed to its action on the levels of three amines namely norepinephrine, dopamine and 5-HT and their metabolites in the brain.

#### **Anti-anxiety and anti-depressant activity**

*Centella asiatica* possesses anti-anxiety effect comparable to diazepam but does not affect the behavioral despair.

Triterpenes have been found to reduce the levels of corticosterone in serum and increase monoamines, thereby exerting an antidepressant effect.<sup>9</sup>

#### **Anti-ulcer action**

A study conducted by Ullah *et al* revealed that rats pretreated with *C. asiatica* extract exhibited protection of gastric mucosa and inhibition of leucocytes infiltration in gastric wall.<sup>22</sup>

Extract of *Centella* effectively treats stress-induced stomach and duodenal ulcers in humans. Oral administration of *C. asiatica* extract to rats produced a dose-dependent reduction in stress-induced gastric ulceration, and the antiulcer activity was similar to that of Famotidine.<sup>23</sup> The mechanism of action appears to be associated with a central nervous system-depressant activity of *C. asiatica*, owing to an increase in the concentration of GABA ( $\gamma$ -amino butyric acid) in the brain.<sup>4</sup> A study by Sarma *et al* reported that the ethanolic extract of roots of *C. asiatica* and *Tinospora cordifolia* induce a protective action comparable to diazepam against stress induced ulceration.<sup>24</sup>

#### **Wound healing**

The pharmacological activity of *Centella asiatica* is thought to be due to several saponin constituents, including asiaticoside, asiatic acid, and madecassic acid. *In vitro*, each of these compounds stimulated the production of human collagen I, a protein involved in wound healing. Stimulation of collagen synthesis in foreskin fibroblast monolayer cultures by an extract from *Centella* has also been reported. Asiaticoside accelerated the healing of superficial postsurgical wounds and ulcers by accelerating cicatricial action. Asiaticoside stimulates the epidermis by activating the cells of the Malpighian layer in porcine skin, and by keratinization *in vitro*. Topical application of asiaticoside promoted wound healing in rats and significantly increased the tensile strength of newly formed skin. Extracts of *C. asiatica*, and in particular its major triterpene ester glycoside, asiaticoside, are valuable in the treatment of hypertrophic scars and keloids. Asiaticoside has been reported to decrease fibrosis in wounds, thus preventing new scar formation. The mechanism of action appears to be two fold by increasing the synthesis of collagen and acidic

muco-polysaccharides and by inhibiting the inflammatory phase of hypertrophic scars and keloids.<sup>4</sup> It has further been proposed that asiaticoside interferes with scar formation by increasing the activity of myofibroblasts and immature collagen.

#### **Immuno-modulation**

In an extensive study conducted by Coldren *et al*, triterpenes present in *C. asiatica* have shown to modulate gene expression when applied to human fibroblast in cultures. Titrated extract of *C. asiatica* drives changes in hyaladherin and cytokine expression which may be expected to lower the rate of proteolysis in the extracellular matrix. Thereby supporting the accumulation of collagen and fibronectin. No changes in expression levels of genes encoding fibronectin and collagen were noted indicating its indirect action.<sup>25</sup> Study by Mali *et al* reported that with increase in concentration of *C. asiatica* extract i.e. from 25mg/ml to 100mg/ml, not only increase in neutrophil locomotion and chemotaxis was observed but also increase in ingestion of *Candida albicans* by neutrophils.<sup>26</sup>

#### **Antioxidant action**

Both tender as well as mature leaves exhibit varying levels of enzymatic antioxidant properties. A study suggested that the consumption of leaves would render self protection against oxidative damage.<sup>9</sup>

#### **Antimicrobial activity**

In a comparative study it has been reported that the chloroform extract of the drug was found to be active against gram positive bacteria (*B. cereus*, *B. megaterium*, *B. subtilis*, *S. aureus*, *Sarcina lutea*), gram negative bacteria (*E. coli*, *P. aeruginosa*, *S. paratyphi*, *S. typhi*, *Shigella boydii*, *Vibrio mimicus*, *Shigella dysenteriae*, *Vibrio parahemolyticus*) and fungi (*Candida albicans*, *Aspergillus niger*, *Saccharomyces cerevaceae*) as compared to Kanamycin. This supports its use in various infectious diseases.<sup>27</sup>

#### **Cytotoxic and Tumoricidal activity**

Gotu-kola has been reported to possess weak-moderate tumoricidal activity and LC<sub>50</sub> was reported to be between 2.528-4.939 mg/ml. Neuro-2a-cells were used in this study to screen tumoricidal effects.<sup>28</sup> The oncogenic activity has been attributed to the triterpene glycosides present in *C. asiatica*.<sup>29</sup> In a brine shrimp lethality test conducted by Ullah *et al*, aqueous soluble fraction of methanolic extract of *Centella asiatica* exhibited cytotoxic activity using vincristine sulphate as a positive control.<sup>22</sup>

#### **Antiallergic, Antipruritic and Anti-inflammatory action**

George *et al* investigated anti-allergic effect *in vitro* using sheep (*Capra hircus*) serum method with respect to

standard ketotofen fumarate; anti-pruritic and anti-inflammatory in rats using chlorpheniramine maleate and ibuprofen as standard. Results exhibited significant anti-allergic, anti-pruritic and anti-inflammatory activity.<sup>30</sup>

#### **Radioprotective effect**

*C. asiatica* protects against radiation- induced lethality, lipid peroxidation and DNA damage. It does so by scavenging of free radicals and increasing anti-oxidant status.<sup>31</sup>

#### **Periodontal activity**

Combined extract of *C. asiatica* and *Punica granatum* significantly reduced clinical signs of chronic periodontitis. Herbal medicament was formulated in the form of biodegradable chips for subgingival application. 20 patients with initial pocket depth 5-8mm were enrolled into the study. After baseline examination, scaling and root planning of non-target teeth, the target teeth received scaling and root planning followed by subgingival delivery of medicated chips in the test group and unmedicated chips in placebo group. Probing pocket depth, attachment level, bleeding on probing, gingival index and plaque index were recorded at baseline, 3 and 6 months.<sup>32</sup>

#### **Effect on CVS- Venous insufficiency**

In a clinical study conducted on 94 patients, suffering from venous insufficiency of lower limbs, it was observed that Titrated extract of *Centella asiatica* (TECA) improved venous distensibility in patients receiving 60mg/day and 120 mg/day TECA over a period of 2 months.<sup>33</sup>

#### **Anti diabetic effect**

Ethanollic and Methanollic extracts of *Centella asiatica* show significant anti-diabetic activity comparable to glibenclamide. It also lowers elevated blood glucose levels to normal in rats subjected to glucose tolerance test. In alloxan induced diabetic male Wistar rats (180-200gm), maximum reduction in blood glucose occurs after 3 hrs at a dose level of 250 mg/kg. It also lowers total cholesterol, triglycerides and urea levels in blood.<sup>34</sup> The result of this study contradicts the claims by Newall *et al*, which suggests that *Centella asiatica* has hyperglycemic and hypercholesteremic effect.<sup>35</sup> Hence, this topic needs further investigation.

#### **Anti-fertility action**

Crude extract of the plant and glycoside isothankuniside and its derivative exhibit anti-fertility activity in female mice.<sup>36</sup>

#### **DOSAGE**

- 0.5 g of the powdered drug is given orally three times daily for the treatment of leprosy.<sup>37</sup>

- In liver diseases 90-150 mg of standardized extract may be given each day.<sup>38</sup>
- For external treatment of skin diseases *C. asiatica* can be applied as a salve with 0.5% asiaticoside, or as a powder with 2% asiaticoside, once or twice daily.<sup>39</sup>
- The WHO mentions an oral dose of 0.33-0.68g or by an oral infusion of a similar amount three times daily.<sup>4</sup>

#### **CONTRAINDICATIONS**

- It is not used in patients allergic to plants of the Apiaceae family.<sup>4</sup>
- It is contraindicated with the concurrent use of barbiturate, benzodiazepine and anti-epileptics since it inhibits hepatic enzymes responsible for barbiturate metabolism and has GABA-nergic activity.<sup>7</sup> It has been found to cause relaxation of rat uterus; hence its use during pregnancy is avoided. Caution should be exercised with the concomitant use of hypolipidemic and hypoglycemic therapies. The drug can cause Contact dermatitis, headache, and unconsciousness and may also aggravate pruritis.<sup>35</sup>
- Asiaticoside can act as a possible carcinogen on repeated use.<sup>40</sup>

#### **TRADE PROSPECTS**

Over the centuries ayurveda has developed into a time tested science of life. It has flourished in India because of its floral diversity. *Centella asiatica* enjoys the status of medhya, rasayna (group of plants that act on nervous system and improve mental ability) in ayurveda. India is the largest exporter of H13O2 type of drug form which includes vegetable saps, extracts, mucilage and thickeners constituting 36% of the total world exports. Mandukaparanii has been reported to be one among the best selling herbal drugs in Europe and USA, exported from India.<sup>5</sup> *C. asiatica* (kudangal) is used for preparing over the counter products, available in the market as memory booster and nervine tonic. Increasing demand of the user industry has created a deficit in supply of sufficient quantities of genuine drugs. In India, it grows in non forest areas of Jammu, Uttar Pradesh (Lucknow), Andhra Pradesh (Hyderabad), Uttarakhand (Dehradun) Tamil Nadu and West Bengal.<sup>9</sup> It is collected from the Nedumangal city in Tamil Nadu. Two varieties namely Kayakriti and Majja poshak are registered for commercial cultivation by Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow. Kayakriti contains 1.1% of asiaticosides. The plant is rich in triterpene glycosides mainly asiaticoside and madecassoside. The average collection charges are Rs 10.<sup>8</sup> An average selling price by wholesalers in Coimbatore is 50-65 Rs/kg.<sup>41</sup> Thus has a large profit margin. In 1990, the annual requirement of *Centella asiatica* was estimated to be 12,700 tonnes of dry

biomass, valued at Rs.1.6 billion<sup>7</sup>. Despite this, collectors from non forest areas report scarcity of the plant growing naturally in the wet land. The reason cited for this is the obliteration of rural lands.<sup>8</sup> This has resulted in controversial substitution with other plants. It is adulterated with *Bacopa monnieri* (Neer brahmi) and other herbs and plants with semi-lunar or orbicular leaves such as *Merremia emarginata* (Hallier), *Hydrocotyle javanica* (Thumb.) and *Hydrocotyle rofundifolia* (Roxb.) Recently large scale adulteration with *Malva rofundifolia* (Linn.) has been observed.<sup>13</sup> *Centella asiatica* Linn. and *Bacopa monnieri* Welst. often get substituted for each other in the market as both are commonly sold under the same vernacular name "Brahmi". Table 2 mentions vernacular and foreign names of *C. asiatica*. But in Ayurvedic texts and related literature the name Brahmi (Aindri)<sup>42</sup> refers to *Bacopa monnieri* and *Centella asiatica* has been referred to as "Mandukaparni". Comparative anatomical features can differentiate the two species. Chemically both the species are rich in saponins. Madecassoside and Asiaticoside are the important triterpenoid saponins of *Centella asiatica* whereas *B.monnieri* contains Bacosides A and B. **Table 1** mentions a comparison between *C.asiatica* and *B. monneiri*.

#### PATENTS

- Bomballi *et al* have patented a process for the preparation of complex of saponins and their aglycones with phospholipids and pharmaceuticals and cosmetic compositions containing them. These complexes are more effective than free *Centella asiatica* selected triterpenes (CAST) and used in the formulation for wound healing and anti-inflammatory effects.<sup>43</sup>
- Singh-Verma has patented cosmetic formulation containing extracts from *Phyllanthus embelica* and *Centella asiatica* and/or *Bacopa monnieri*. This formulation is used for accelerating epidermic proliferation and to treat non-genetic hair loss.<sup>44</sup>
- Se -Kyung Oh *et al* claim that pure Asiatic acid shows dose dependant cytotoxicity on human foreskin fibroblast cells in culture.<sup>45</sup>
- Soumyanath *et al* have patented methods for development of *Centella asiatica* extracts, containing Asiatic acid, Madecassic acid and Asiaticoside. These extracts promoted nerve regeneration and increased rate of neurite elongation.<sup>46</sup>
- Loiseau *et al* have patented method of preparation of *Centella asiatica* extract rich in madecassoside and in terminoloid. This extract can be used for regulating inflammation. The anti-inflammatory effect is in the following order: terminoloid  $\geq$  heterosides  $\geq$  madecassoside.<sup>47</sup>

- Tomer *et al* patented herbal compositions and their use as anti-inflammatory agents for alleviation of arthritis and gout. The herbal composition of the invention is safe and is efficacious in alleviating the conditions of gout as well as arthritis.<sup>48</sup>

#### DISCUSSION

History of man disease confrontation is as old as human civilization and *Centella asiatica* also known as Gotu kola has been used by man to combat various diseases. Preparations of *C. asiatica* are used in traditional and alternative medicine due to the wide spectrum of pharmacological activities. It is among the top 10 herbs in category of anti-ageing and CNS drugs used worldwide. *C.asiatica* leaves constitute the active principle of pharmaceutical and cosmetic products for the treatment of venous and skin disorders. *Centella asiatica* acts as medhya rasayana through the circulatory, digestive, respiratory, urinary, and reproductive and nervous system. It exerts its action on all the vital organs of the body. The pharmacological effect is a balanced complex of interaction possibly due to the synergisms of all constituents. The herb produces significant intellectual improvement. Triterpenoid fraction improves the conditions in patients with venous hypertension and post phlebotic syndrome. *C.asiatica* and its constituents, chiefly asiaticosides are beneficial in the treatment of wounds and skin abnormalities. Experimental studies have demonstrated its anti-ulcer and wound healing activity, neuroprotective, and cardioprotective, anti-epileptic and anti-anxiety action. It is an all healing drug of mighty potency and is capable of rejuvenating the system thus gifting us with long life. It is a panacea drug. *Centella asiatica* has been subjected to quite extensive experimental & clinical investigations. However, the true potential of this drug is yet to be exploited. *C. asiatica* may be helpful in the treatment of varicose veins, cancer, chronic liver disorders, asthma, obesity and hair loss.<sup>44</sup> It should be noted that contradictory results have been reported by various scientists for the use of *C.asiatica* in the treatment of diabetes, liver disorder and pruritis. Since it is an endangered species, steps should be taken for its conservation. Plant tissue culture techniques can be helpful for the propagation and also for the conservation of the germplasm of this plant.<sup>7</sup>

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**Table 1: Differentiating *Centella asiatica* and *Bacopa monnieri***

Characters	<i>Centella asiatica</i> <sup>49</sup>	<i>Bacopa monnieri</i> <sup>6</sup>
<b>Family</b>	Apiaceae	Scrophulariaceae
<b>Taste</b>	Umami <sup>50</sup> , kasaya rasa (astringent).	tikta rasa (bitter)
<b>Macroscopy</b>		
a) Root	Brownish grey Rooting at nodes, thin 2.5-6cm long	Colour is creamish-yellow, small branched, wiry, thin
b) stem	Green and shows long internodes [fig.2]	Thin, green to purplish green, 1-2mm thick, nodes and internodes prominent, glabrous
c) leaf	Orbicular-reniform shape, rotund apex, crenate margin, cordate base, petioles channeled with adnate stipules, 1-3 leaves arise at node, leaf diameter-1.5-6.5cm. [fig. 3]	Simple, green, Oblong-obovate, entire, opposite, decussate, sessile, 1-2cm long, 3-8mm broad, dotted at lower surface [fig. 1]
d) flower	Fascicle umbels, each carrying 3-4 flowers, blue or white with purple veins, short stalked, pink	Small, axillary, pedicels-(6-30) mm long, bracteoles shorter than pedicels.
e) fruit	Ovoid, cremocarp, laterally compressed seeds. [fig. 4]	Capsule, upto 5mm long, ovoid, glabrous
<b>Chemical Constituents</b>	Glycosides-namely Asiaticoside, Madecassoside, upon hydrolysis yield diterpene acid Asiatic acid and madecassic acid. [fig. 5,6] Also contains thankuniside, isothankuniside and indocentelloside. <sup>14</sup>	Saponins-namely Bacosides A and B. Alkaloids-Brahmine, herpestine and mixture of 3 other alkaloids. Others-Betulinic acid, stigmastrol, hersaponine <sup>14</sup>
<b>Dose</b>	3-6gm <sup>15</sup>	Powder: 1-3gm Infusion: 8-16 ml. <sup>15</sup>
<b>Therapeutic uses</b>	Kaphapittahara, Hradya, Dipana, Varnya, Visaghna, Balya, Sritipada <sup>15</sup>	Vatahara, Kaphahara, Prajasthapana, Visahara, Matipada <sup>15</sup>
<b>At Large Doses</b>	Contact Dermatitis <sup>31</sup> , Headache <sup>35</sup> , Unconsciousness <sup>35</sup>	Sedation

**Table 2: Vernacular Names<sup>9</sup>**

LANGUAGE/PLACE	VERNACULAR NAMES
Assamese	Manimuni
Bengali	Thalkuri, Jholkhuri, Tholkuri, Tholkhuri, Thankuni, Brahma Manduki
Gujarati	Khadbrahmi, Khodabrahmi, Khad-bhrammi, Barmi, Moti brahmi
Hindi	Brahmibhed, Bengsag, Brahmi, Brahmamanduki, Mandukparni, Mandookaparni, Khulakhudi, Kulakudi
Kannada	Ondelaga, Brahmi-soppu, Urage, Vondelaga, Brahmisoppu, Vandelaga-illikiwigidda
Malayalam	Kodangal, Muyalchevi
Marathi	Karivana, Karmga, Brahmi
Oriya	Thalkudi
Punjabi	Brahmi
Tamil	Babassa, Vallarai, Ballau, Vallari
Telegu	Saraswati aku, Vauari, Saraswataku, Manduk brahmi

**Table 3: Foreign names for *Centella asiatica*<sup>7</sup>**

LANGUAGE/PLACE	NAME
English	Centella, Indian Pennywort, Thick-leaved Pennywort, Marsh Pennywort
Chinese	Fo-te-tieng, Chi-hsueuh-ts'ao
Hawai	Pohe Kula
Cook islands	Kapukapu
Samoa, Tonga	Tono
Fiji	Totodro
Nepalese	Ghod tapre



Fig.1 *Bacopa monneiri*



Fig.2 *Centella asiatica*-stem



Fig.3 *Centella asiatica* - Leaf



Fig.4 *Centella asiatica* -Fruit

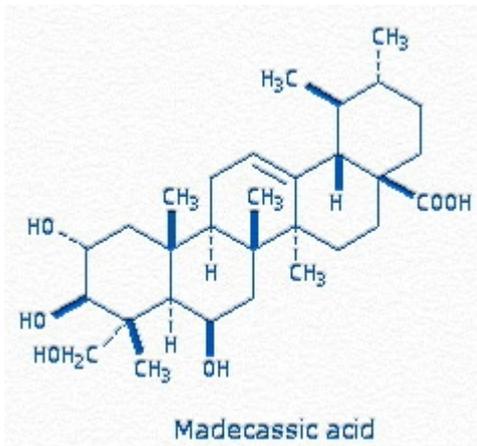


Fig.5 Madecassic acid

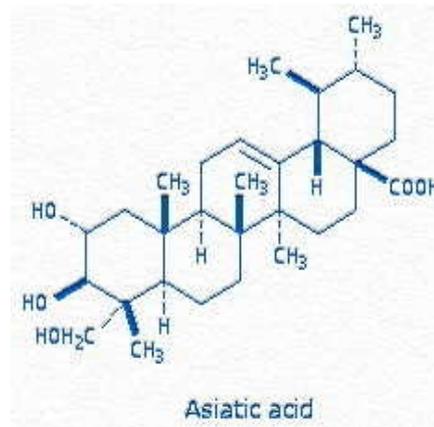


Fig.6 Asiatic acid