ABSTRACT

Asiatic pennywort (*Centella asiatica* (L.) Urb.) is a plant originating from the Far East that has been used for thousands of years to treat a variety of diseases. Among others, it is characterized by anti-inflammatory, antibacterial, and antioxidant properties, while at the same time, rarely showing allergenic potential.

The aim of this study was to characterize *C. asiatica*, and present its properties and use in cosmetology. Applied externally, as a raw material, *C. asiatica* is characterized by its high cosmetic and therapeutic potential.

Keywords: anti-ageing effect, natural cosmetics, skin, cosmetic ingredients, *Centella asiatica*

INTRODUCTION

Plants have always been present in human life, providing many valuable biologically active substances. The oldest healing methods are plant-based. Nowadays phytocosmetics, cosmetics produced on the basis of plants, are gaining popularity and their caring and healing properties are of interest to consumers [1].

*Centella asiatica* is a species commonly found in Asian areas and is an important part of Indian ayurveda. All parts of the plant exhibit multidirectional therapeutic effects, however, its leaves are the most popular due to their richness in characteristic active substances such as asiaticoside, madecasoside and phenolic compounds [2-15]. The range of beneficial properties guarantees the popularity of *Centella asiatica* and its use in fields of medicine, pharmacy and cosmetology. Its extracts can be found in skin care and cleansing cosmetics, both for the face and body, as well as in pharmaceutical products (e.g. dressings to accelerate wound healing) or dietary supplements.

CHARACTERISTICS OF THE SPECIES

*Centella asiatica*, synonymously *Hydrocotyle asiatica* L., is a species belonging to the celery family *Apioaceae* and the genus *Centella* L. comprising some 50 species, of which *Centella asiatica* is the most widespread. It is found in countries of the intertropical and subtropical zones (Fig. 1), growing in humid, wet, and rather shady areas. It is mainly found in India, China, Japan, Sri Lanka, Madagascar, and Australia or South and Central America [2-6].
**C. asiatica** has a wide range of usages and an equally rich nomenclature, as it goes by more than 60 different names, the most popular are *gotu kola*, *pegagan* or *penny weed*. Other common names are ‘tiger herb’ or ‘tiger grass’, which derive from the legend of the Bengal tiger, whose wounds were healed thanks to asiatic pennywort [2, 7, 12, 15].

*C. asiatica* is a creeping perennial that grows from 5 to 20 or even 45 cm tall. It grows in clusters, forming a dense green carpet (fig. 2) [3, 7, 15]. Asiatic cotton grass is classified as a perennial plant [3, 6, 9]. Its stem is long, naked and limp, and forms sessile stems of various colours, from milky through light green, green-pink to dark pink and even purple [3, 5, 7]. The round or kidney-shaped leaves with a heart-shaped base occur singly or 2-3 at a time in a node. The leaves are naked, with a smooth surface and a notched margin. The petiole is usually 5-10 times longer than the leaf blade. Small flowers up to 3 mm in size form umbels. The flowers range in colour from white through pale pink to reddish-purple. There are up to 5 individual flowers per inflorescence. Fruits are ovoid or round-shaped splits up to 8 mm long, with a strongly thickened pericarp [3-5, 7, 9, 12, 13].

**THE USE OF CENTELLA ASIATICA**

*C. asiatica* is a valuable part of Indian-derived Ayurvedic medicine, which uses plants for medicinal purposes. For thousands of years, all parts of this plant have been used as a remedy for a variety of diseases— including hypertension, tuberculosis, measles, leprosy, asthma, rheumatism, peptic ulcer disease, skin diseases or depression. It is attributed with properties of general strengthening of the body, rejuvenating, improving memory or prolonging life [4, 5, 7, 9, 11, 13-15].

In some countries, *C. asiatica* is used as a raw vegetable and also in the preparation of soups or traditional dishes such as Indian *chutney* or Malaysian *ulam* salad. In China and Thailand, asiatic pennywort is used to prepare a cooling thirst-quenching drink, and in Malaysia it is used to brew tea with anti-diarrhoeal properties and to help urinary tract infections [5, 7, 14]. In India, a powder made from the leaves of *Centella asiatica* is consumed to revitalise nerves and brain cells. Fresh leaves, in turn, are used to make a paste that is applied to ulcers and a syrup that, when spread on the forehead, relieves headaches [14].

*C. asiatica* is highly valued for its anti-inflammatory, antimicrobial and anti-free radical properties, which is why it is so willingly used in traditional medicine as well as in cosmetology [2, 5, 11, 15].

**ACTIVE SUBSTANCES**

In fact, the whole plant is used as a raw material, but the most desirable part of asiatic pennywort is its leaves [4, 15]. The predominant biologically active ingredients found in *Centella asiatica* and determining its therapeutic action are pentacyclic triterpenoids, ursane and olean derivatives. The complex of these compounds is referred as centelloids or asiaticosides. They include triterpene saponins (e.g. asiaticoside, madecasoside, centelloside, brahminoside, tankunoside) and triterpene acids (e.g. asiatic acid, madecasic acid, centellic acid, brahmic acid, tankunic acid). In addition, the plant contains components such as flavonoids (e.g. quercetin, catechin), tannins, carotenoids (lutein, β-carotene), monoterpenes, phytosterols (β-sitosterol, stigmasterol, campesterol), amino acids, vitamins A, D, E, K, C and B group vitamins, as well as micro- and macronutrients (e.g. magnesium, sodium, potassium) [2, 4, 6, 7, 12, 15]. A list of substances present in the herb of *Centella asiatica* is provided in Table 1.

Asiatic pennywort is rich in asiatic acid and madecassic acid and their derivatives such as asiaticoside and madecasoside. However, the level of these components can vary considerably depending on the geographical origin, genetic variations, environmental conditions and growth of the plant. This is due to the fact that the above substances are produced by the plant during its growth as secondary metabolites [4, 12, 13]. According to the requirements of the European Pharmacopoeia and the Polish Pharmacopoeia IX, the pharmaceutical and cosmetic raw material (*Centellae*)
Table 1 List of biologically active substances present in *Centella asiatica* herba

<table>
<thead>
<tr>
<th>CLASS</th>
<th>SUBSTANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triterpene saponins</td>
<td>asiaticoside, asiaticoside A (madecasoside), asiaticoside B, centelloside, indocellloside, madazicoside, brahminoside, tankunoside, isotankunoside, skelleloside, centellasanopesides A, B, C, D</td>
</tr>
<tr>
<td>Triterpenic acids</td>
<td>Asiatic, madecassic, centelic, brahmic, tankunic, isotankunic, madasic, isobramic, brahmic, ursolic, betulinic, terminolic acids</td>
</tr>
<tr>
<td>Flavonoids</td>
<td>quercetin, kemferol, catechin, luteolin</td>
</tr>
<tr>
<td>Essential oil components</td>
<td>p-cymene, α-humulene, β-caryophyllene, germacrene D</td>
</tr>
<tr>
<td>Oily oils</td>
<td>glycerides of palmitic, stearic, linoleic, linolenic, lignoceryl acids</td>
</tr>
<tr>
<td>Vitamins</td>
<td>A, D, E, K, C, PP, group B</td>
</tr>
<tr>
<td>Minerals</td>
<td>sodium, potassium, calcium, magnesium, iron, phosphorus, zinc, copper</td>
</tr>
<tr>
<td>Amino acids</td>
<td>alanine, lysine, serine, phenylalanine, glutamic acid, aspartic acid</td>
</tr>
<tr>
<td>Carotenoids</td>
<td>lutein, β-carotene</td>
</tr>
<tr>
<td>Phytosterols</td>
<td>β-sitosterol, stigmasterol, campesterol</td>
</tr>
<tr>
<td>Sugars</td>
<td>glucose, rhamnose, fructose, sucrose, arabinose</td>
</tr>
<tr>
<td>Other</td>
<td>tannins, phenolic acids and phenols, resins, inorganic acids, polyacetylenes, hydrocotylin (in dried leaves)</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on [2, 4, 6, 7, 12, 15]

*Centella asiatica* (CATTF, *Centella asiatica* Triterpenic Fraction) and the triturated extract of *Centella asiatica* (ETCA, Estratto Titolato di Centella asiatica). According to the literature, all the above acronyms refer to the same extract (containing 40% asiaticoside and 60% asiatic and madecassic acids), which appears under different trade names. TECA is a highly purified extract that has been chemically treated, which disturbs the natural proportion of the extract components in the final product. Based on this information, the Committee on Herbal Medicinal Products (HMPC) in 2010 agreed that TECA could not be classified as a herbal preparation [2, 4, 12, 15].

In cosmetic products, *Centella asiatica* can be found as powdered aqueous or alcoholic extracts and dissolved in water or propylene glycol. Isolated compounds are also used, primarily asiatic acid, asiaticoside, madecassic acid and madecasoside [2].

According to the International Nomenclature of Cosmetic Ingredients (INCI), *Centella asiatica* can be found in cosmetic formulations under the names: *Centella asiatica* leaf extract, *Centella asiatica* leaf water, *Centella asiatica* root extract, *Centella asiatica* flower extract, *Centella asiatica* leaf/stem powder [2, 19].

**PROPERTIES AND USE IN COSMETOLOGY**

Due to the presence of numerous biologically active substances, *C. asiatica* exhibits a number of beneficial features (fig. 3) confirmed by both in vitro and in vivo studies. Asiaticoside and madecasoside are invariably cited as the main compounds with biological activity that have beneficial effects on the human body. The therapeutic effects of these compounds have been successfully exploited in a variety of diseases, but are particularly well effective in diseases related to connective tissue function and the central nervous system. This publication describes studies about the effectiveness of the extracts of *Centella asiatica* in anti-cellulite preparations, against stretch marks or to reduce signs of skin ageing, as well as in the care of dry, vascular and sensitive skin [4, 11, 20].

One of the most important actions of *Centella asiatica* extract is its ability to stimulate skin regeneration and accelerate wound healing. Asiaticoside and madecasoside are particularly involved in these processes, as they influence the synthesis of extracellular matrix elements, primarily type I and III collagen, and stimulate the proliferation of fibroblasts, i.e. dermis cells. Triterpenoids can also stimulate the synthesis of glycosaminoglycans, particularly hyaluronic acid. The above processes contribute to increasing the skin’s elasticity and its resistance to stretching, resulting in a reduction in scars and even stretch marks [2, 5, 9, 20-22].

Biological studies have concluded that the topical application of products such as ointments and extracts of *C. asiatica* herb are efficient in the treatment of ulcers and facilitate the healing of burn wounds. Asiaticoside, which stimulates angiogenesis (the process of capillary formation) and increases the expression of interleukin IL-1β, is largely responsible for the strong healing and healing properties in this type of wounds [4].

The ability to stimulate type I collagen synthesis also determines the anti-ageing properties and applicability of *Centella asiatica* in the prevention from skin photo-ageing. Madecassoside, which is responsible for the activation of the Smad protein signalling pathway that induces collagen expression, plays a major role in skin improvement. Haftek et al. (2008) in the randomised study confirmed the beneficial effect of topically applied madecasoside in combination...
with vitamin C on skin firmness, elasticity and hydration. The study involved 20 female volunteers with signs of photo-aged skin, who were treated with topical 5% vitamin C and 0.1% madecassoside for six months. At the end of the treatment, significant improvements were observed in the clinical assessment of superficial and deep wrinkles, firmness, elasticity, roughness and skin hydration. These results were confirmed by corresponding measurements [20, 23].

The saponins and flavonoids found in *C. asiatica* exhibit anti-inflammatory and antioxidant effects, which significantly improve the skin’s barrier function and associated transepidermal water loss (TEWL). These properties are applicable to dry and sensitive skin, as they determine a soothing and redness-reducing effect, allowing the skin to quickly return to homeostasis after exposure to irritants. In addition, the reduction of TEWL influences the degree of skin hydration, an essential factor regulating skin function [11, 24].

In vivo studies have confirmed the anti-inflammatory effect of *Centella asiatica* extract. This property is due to the ability of saponins, especially asiaticoside, to inhibit nitric oxide synthesis in vascular endothelial cells and inhibit inducible cyclooxygenase (COX-2, *cyclooxygenase-2*) and lipoxygenase (LOX) activity, i.e. enzymes involved in the formation of inflammatory mediators [21, 24].

*C. asiatica* is commonly used in anti-cellulite preparations. Cellulite, or liposclerosis, is a non-inflammatory disease in subcutaneous adipose tissue accompanied by abnormal proliferation of adipocytes (fat cells) and impaired development and function of connective tissue. These changes cause compression of small blood and lymphatic vessels, resulting in metabolic disturbances of the tissue and poorer nutrition. In the action against cellulite, preparations are used to stimulate the skin's microcirculation and have an effect on adipose and connective tissue. *Centella asiatica* improves the elasticity of connective tissue fibres, has an anti-inflammatory, draining and stimulating effect on blood vessels [20]. A number of studies reported significant improvements in skin condition following the use of preparations containing *C. asiatica* extract. A reduction in fat cell volume was observed in volunteers who took dry asiatic pennywort extract for 90 days, and skin elasticity and hydration were improved in participants who applied topical lotions with *C. asiatica* extract [2].

Both in vitro and in vivo studies confirm that asiatic pennywort extracts exhibit strong antioxidant properties, thereby protecting cells from the damaging effects of free radicals. *Centella asiatica* extract inhibits lipid peroxidation and protein oxidation, thereby providing protection to intercellular cement lipids and phospholipids that build cell membranes [2, 25]. There are studies suggesting that extracts are among the most potent antioxidants, comparable or even better than vitamin C, gallic acid or grape seed extract. Asiatic pennywort leaf extract has the highest antioxidant potential, which may be due to the fact that the leaves contain the most phenolic compounds compared to other parts of the plant. Both aqueous and alcoholic extracts of *Centella asiatica* have been shown to neutralise and counteract the formation of reactive oxygen species (ROS) and, in vitro, to effectively neutralise oxygen and superoxide radicals and synthetic radicals: 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2’-azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS). Furthermore, it has been proven that in the ferric reducing antioxidant power (FRAP) assay, the aforementioned extracts show the ability to reduce iron (III) ions to iron (II) ions [2, 5].

Cosmetic products in which *Centella asiatica* is found:
• for facial care with anti-ageing, anti-acne and soothing properties,
• for body care with firming effects, reducing stretch marks and accelerating wound healing,
• for hair care, which has a nourishing and stimulating effect on the scalp.

**CONTRAINDICATIONS AND ALLERGIES**

It has been proven that the extract of *Centella asiatica* is characterised by weak sensitising properties. This is due to the high molecular weight of madecassoside, asiaticoside and asiatic acid and the presence of a hydrophilic fragment in the molecules of the first two compounds, penetration into the stratum corneum of the aforementioned centrioles is hindered. Only a few cases of allergic reactions have been described. However, topical application of higher-than-recommended doses of triterpene compounds derived from *C. asiatica* may cause allergic contact dermatitis (ACD) manifesting as severe itching, redness and blisters initially occurring at the site of contact with the allergen, with time spreading [2, 4, 20]. No significant side effects have been reported from the oral use of asiatic pennywort extracts [4].

### Properties of *Centella asiatica*

<table>
<thead>
<tr>
<th>Antibacterial</th>
<th>Anti-inflammatory</th>
</tr>
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<tbody>
<tr>
<td>Antifungal</td>
<td>Anti-cancer</td>
</tr>
<tr>
<td>Antioxidative</td>
<td>Anti-depressant</td>
</tr>
<tr>
<td>Skin regenerating</td>
<td>Memory-enhancing</td>
</tr>
<tr>
<td>Immunomodulative</td>
<td>Neuroprotective</td>
</tr>
<tr>
<td>Anti-diabetic</td>
<td>Cardioprotective</td>
</tr>
<tr>
<td>Anti-cellulite</td>
<td>Gastroprotective</td>
</tr>
</tbody>
</table>

Fig. 3 Properties of *Centella asiatica* extracts  
**Source:** own elaboration based on [2, 13, 15, 25]
SUMMARY

Centella asiatica is a plant that has been known since ancient times and successfully used in traditional medicine and everyday life, and nowadays is widely used, especially in the cosmetic and pharmaceutical industries. The extracts and isolates extracted from Centella asiatica are characterised by their high cosmetic potential and multidirectional medicinal effects - they exhibit regenerative, anti-inflammatory, antioxidant, generally strengthening or memory-enhancing properties. When applied topically externally, Centella asiatica extracts may only exhibit allergenic potential in extreme cases.

REFERENCES / LITERATURA