

A COMPREHENSIVE REVIEW OF *Apium graveolens* (CELERY) PLANT: PHARMACOTHERAPY AND HEALTH PERSPECTIVES

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ABSTRACT

Apium plants belong to the Apiaceae family and have been integral to traditional medicine across the Mediterranean, tropical, and subtropical regions of Asia and Africa for millennia. They are valued for their medicinal benefits, particularly in preventing coronary and vascular disorders. Apium plants are rich in phytochemicals such as bergapten, flavonoids, glycosides, furanocoumarins, furocoumarin, limonene, psoralen, xanthotoxin, and selinene. These plants exhibit diverse pharmacological properties including anticancer, antioxidant, antimicrobial, antifungal, nematocidal, anti-rheumatic, antiasthmatic, anti-bronchitic, hepatoprotective, appetizer, anticonvulsant, antispasmodic, lactation-inducing, anti-jaundice, antihypertensive, anti-dysmenorrheal effects, as well as promoting cardiovascular health and spermatogenesis. This review synthesizes information on the ecology, botany, cultivation practices, natural habitat, medicinal properties, phytochemical composition, and pharmacological efficacy of Apium plants, aiming to optimize their therapeutic potential for human health.

KEYWORDS: *Apium graveolens*, phytochemistry, medicinal use, phytochemicals; pharmacological properties.

INTRODUCTION

Celery, scientifically classified as *Apium graveolens*, is a plant that typically grows in marshy areas and belongs to the Apiaceae family. It has a long history of cultivation as a vegetable dating back to ancient times. The genus *Apium* comprises approximately 20 species of flowering plants distributed worldwide. These plants are medium to tall in stature, biennial or perennial, and can reach heights of up to one meter. They thrive in marshy habitats found in subtropical and temperate regions. The leaves of *Apium* plants are typically pinnate or bipinnate, adorned with small white flowers arranged in compound umbels. *Apium* species are cultivated globally for their edible green leaves, bulbous roots, seeds, and petioles (see Figure 1). Among the notable varieties within the *Apium graveolens* genus are *Apium graveolens* var. dulce (Mill.) Pers, known simply as celery; *Apium graveolens* var. rapaceum (Mill.) DC., also called celeriac or root celery; and *Apium graveolens* var. secalinum Alef, recognized as leaf [1].



Figure 1. Celery plant (A), seeds (B) and roots (C)

HABITAT

The genus *Apium*, belonging to the Apiaceae family, encompasses edible plants characterized by green blanched leaf stalks. With 18 confirmed species, *Apium* plants are predominantly distributed across temperate regions globally, as documented by The Plant List. They are found extensively in South and North America, Southern Europe, Asia, and Africa. Among these species, *A. graveolens* stands out commercially for its leaves (celery, smallage), roots (celeriac), seeds, and essential oil, owing to its distinct aroma and health benefits. The evolution of *Apium* species through centuries of selective breeding illustrates human intervention in enhancing wild species. While most *Apium* species enjoy a global presence, some, like *Apium repens* and *Apiumbermejoi*, face extinction risks and are listed on the IUCN Red List. The genus exhibits significant ecological diversity, thriving in saltmarshes, wetlands, coastal regions, and aquatic environments [2].

BOTANY OF APIUM GRAVEOLENS

A. graveolens is classified as a scapose hemicryptophyte with slender roots and thin, hollow stems. It typically grows as a deciduous, upright, herbaceous annual or biennial herb, reaching heights ranging from 0.5 m to 1 m. The plant features celery-like compound leaves arranged in rosettes, with rhombic leaflets and hollow stems. Its root system comprises a superficial taproot and a branching, fleshy stem characterized by ridges. The leaflets are oblong to suborbicular, often with three lobes, measuring between 2–4.5 cm. The plant produces small, creamy white flowers with distinct calyx teeth and broad, ovoid to globose seeds measuring 1.5–2 mm in length and width [3].

CULTIVATION

Apium graveolens, commonly known as celery, is the most widely cultivated species within the *Apium* genus. It is cultivated in three primary varieties: *A. graveolens* var. *dulce* (stalk celery), grown for its edible stalks, leaves, dried fruits, and seeds; *A. graveolens* var. *rapaceum* (root celery or celeriac), valued for its edible fleshy taproots; and *A. graveolens* var. *secalinum* (leafy celery or smallage), prevalent in Asian countries for its aromatic leaves. Originating from the eastern Mediterranean region, *A. graveolens* has various wild ecotypes, complicating efforts to pinpoint its precise origin [4]. It is typically grown as a biennial plant cultivated annually, though specific annual cultivars are tailored for dry fruit and seed production [5].

PHYTOCHEMISTRY

The initial phytochemical study of celery seeds revealed that their methanol extract contains flavonoids, glycosides, steroids, alkaloids, and carbohydrates. Celery is rich in phenolic compounds and furocoumarins, including apigravrin, celereoside, bergapten, ostheno, apiumoside, isoimperatorin, celerin, isopimpinellin, apiumetin, 5-hydroxymethoxypsoralen, and 8-hydroxymethoxypsoralen [5]. Phenols found in celery seeds include isoquercitrin, apiin, tannin, apigenin, Graurobioside A, Graurobioside B, and phytic acid. Celery seeds also contain various compounds such as fatty acids, alcohol sesquiterpenes, and essential oils. Isolated compounds from celery seeds include camphene, limonene, terpinolene, cymene, selenin, sabinene, α -pinene, α -thuyene, β -phellendrene, β -pinene, γ -terpinene, p-cymene, stearic acid, palmitic acid, linoleic acid, petrocellinic acid, myristic acid, oleic acid, myristic acid, myristoleic acid, α -eudesmol, santeudesmol, sedanenolide, phthalide, and 3-n-butyl phthalide. Celery tubers contain 5-methoxypsoralen, methoxsalen (8-methoxypsoralen), and allergens (Api g1) that can prevent allergies [6].

The primary compounds contributing to the scent and flavor of celery are butylphthalide and sedanenolide. Celery is also known for containing limonene, selinene, furocoumarin glycosides, flavonoids, and vitamins A and C, making it widely utilized in traditional medicine [7].

SIGNIFICANCE OF APIUM GRAVEOLENS L [6-10]

(a) CELERY SEED (APIUM GRAVEOLENS) ESSENTIAL OIL

Celery is globally recognized as a versatile vegetable. In North America and Europe, its crisp petioles (leaf stalks) are commonly consumed, while in Europe, the hypocotyl is prized as a root vegetable. Celery leaves, known for their robust flavor, are sparingly used in soups, stews, and as a seasoning component in culinary traditions like the "holy trinity" of Louisiana Creole cuisine and the French Mirepoix. Celery is a staple ingredient in numerous soups and enriches dishes such as the Iranian Khoresh Karafs[8].

(b) LEAVES

Celery leaves impart a subtle pungent flavor to culinary dishes, reminiscent of black pepper but milder. Dried celery leaves are used as a spice for baking, frying, or roasting fish and meats, and as part of fresh herb blends for soups and stews. They can also be enjoyed raw in salads or as a garnish[9].

(c) SEEDS

Celery is cultivated for its seeds in temperate regions. These tiny fruits produce valuable essential oil used in perfumery, containing the chemical compound apiole. Celery seeds are utilized whole or crushed as a spice or flavoring agent[10].

(d) CELERY SALT

Grinding celery seeds and combining them with salt produces celery salt. It can be made from root extracts or dried leaves and is used as a seasoning in various culinary applications, including enhancing the flavor of Bloody Mary cocktails, Chicago-style hot dogs, and Old Bay Seasoning. Celery salt and powder combinations are also used to season and preserve cured meats as a natural alternative to industrial curing salts.

(e) CELERY JUICE

In 2019, a trend swept the United States where celery juice was consumed for its purported detoxification benefits, popularized through various media but lacking scientific evidence. This trend significantly increased celery prices temporarily.

(f) NUTRITION

Raw celery is composed primarily of water (95%), with 3% carbohydrates, 0.7% protein, and negligible fat. A 100-gram serving provides 16 calories and is notably high in vitamin K, offering 28% of the Daily Value, although it lacks other major micronutrients. Ethnobotanical studies highlight the comprehensive use of every part of the celery plant: the seeds possess anti-spasmodic, anti-rheumatic, anti-bronchitis, and anti-asthma properties; the root is effective against kidney stones; and the herb addresses conditions related to uric acid, irregular menstruation, and hypertension, acting as a tonic, stomachic, and diuretic.

PHARMACOLOGICAL EFFECTIVENESS

Apium graveolens has demonstrated pharmacological effectiveness in various domains, including antimicrobial, antifungal, anti-parasitic, anti-inflammatory, anti-cancer, anti-ulcer, antioxidant, anti-diabetic, anti-infertility, anti-platelet, anti-spasmodic, hepatoprotective, cardioprotective, neuroprotective, cytoprotective, hypolipidemic, and analgesic activities.

ANTIFUNGAL ACTIVITY

A methanol extract of celery at a concentration of 200 µg/mL demonstrated significant antifungal activity against various fungi, including *Aspergillus flavus*, *Fusarium solani*, *Trichophyton longifusus*, *Microsporium canis*, *Candida glabrata*, and *Candida albicans*.

CYTOPROTECTIVE ACTIVITY

Sedanolid, a primary active component in celery oil, has been studied for its cytoprotective properties. Celery is traditionally used in treating conditions like rheumatism and gout. In vitro studies using human liver cancer cells and specialized colon cancer cells evaluated sedanolid's impact on cell survival. Results indicated higher survival rates in intestinal cells compared to liver cells when exposed to high concentrations of sedanolid, suggesting potential harmful effects on liver cells without protective benefits.

HEPATOPROTECTIVE ACTIVITY

The methanol extract from celery seeds exhibits potent hepatoprotective effects against liver damage induced by substances like paracetamol and carbon tetrachloride. Celery extract shows promise in reducing hepatotoxicity markers, including liver enzymes, compared to silymarin. Histological studies demonstrate the extract's ability to reverse structural liver damage caused by paracetamol. Dietary supplementation with celery, barley, and chicory has also shown beneficial effects in reducing triglycerides, total cholesterol, and serum liver enzyme levels.

CARDIOPROTECTIVE ACTIVITY

Research on rabbits administered water and ethanol extracts of celery evaluated their effects on mean blood pressure and atrial contraction. Findings suggest that the ethanol extract of celery exhibits a stronger hypotensive effect compared to the water extract. Atropine administration inhibited the hypotensive effects of both aqueous and ethanol extracts of celery, indicating potential interactions with physiological mechanisms.

HYPOLIPIDEMIC ACTIVITY

Studies on rats administered an ethanol extract of celery evaluated its hypolipidemic effects. Daily oral doses of celery extract significantly reduced total serum cholesterol, triglycerides, and low-density lipoproteins while increasing high-density lipoproteins over a 60-day period. These findings support celery's traditional use for managing lipid levels and suggest potential mechanisms involving appetite suppression, increased energy expenditure, and reduced nutrient absorption.

ANALGESIC ACTIVITY

Celery seed ethanol extract demonstrates potent analgesic effects in rats subjected to acetic acid-induced pain, as measured by the hot plate and writhing test methods. The analgesic properties are linked to celery's impact on cytochrome P450, observed to decrease in hepatic homogenate.

ANTIDIABETIC ACTIVITY

A study using n-butanol extract from celery seeds examined its antidiabetic effects in male rats with streptozotocin-induced diabetes. The extract showed significant antioxidant activity, reduced lipid peroxidation, improved weight gain, and helped maintain normal blood glucose levels. These findings suggest potential therapeutic benefits of celery in managing diabetes-related complications.

CONCLUSION

Celery (*Apium graveolens*), a member of the Apiaceae family, is widely distributed in Asia, Europe, and parts of Africa with tropical climates. It is cultivated and consumed globally. The diverse phytochemicals, minerals, and pharmacological activities of celery indicate its potential as a therapeutic plant. Further research is essential to validate and expand upon its efficacy in clinical applications.

REFERENCES

1. Malhotra, SK. 2012, "Celery. In Handbook of Herbs and Spices", 2nd ed.; Woodhead Publishing Limited: Sawston, UK.
2. Roslon, W.; Osinska, E.; Gajc-Wolska, J. 2010, "The influence of raw material stabilization on the quality of celery (*Apiumgraveolens* L.) leaves", *ActaHortic*, 877, 201-208.
3. Mezeyová, I.; Hegedúsová, A.; Mezey, J.; Šlosár, M.; Farkaš, J. 2018, "Evaluation of quantitative and qualitative characteristics of selected celery (*Apiumgraveolens* var. Dulce) varieties in the context of juices production", *Potravin. Potr. S. J. F*, 12, 173–179.
4. Fazal, S.S.; Singla, R.K. 2012, "Review on the pharmacognostical & pharmacological characterization of *Apiumgraveolens* Linn" *Indo Glob. J. Pharmaceut. Sci.*, 2, 36–42.
5. Burmeier, S.; Jensen, K.A.I. 2008, "Is the endangered *Apiumrepens* (Jacq.) Lag. rare because of a narrow regeneration niche?" *Plant. Species Biol*, 23, 111–118.

6. Radhika Chikatipalli, Saravanakumar K, Chandra Sekhar Kothapalli Bannoth, Pharmacognostic evaluation and free radical scavenging activity of Bombax ceiba leaf extracts, International Journal of Green Pharmacy 2021, 15 (1), 59-65.
7. Ronse, A.; Popper, Z.; Preston, J.; Watson, M, 2010, "Taxonomic revision of European *Apium* L. s.l.: *Helosciadium*, W.D.J.Koch restored", Plant. Syst. Evol., 287, 1–17.
8. Rubatzky, V.; Yamaguchi, M. Carrot. 1997, "Celery, and Other Vegetable Umbels. In World Vegetables: Principles, Production, and Nutritive Values', Chapman & Hall: New York, NY, USA, pp. 418–456.
9. Srinivasa B, Desu R, Sivaramakrishna K. 2012, "Antidepressant activity of methanolic extract of *Apium graveolens* seeds", International Journal of Research in Pharmacy and Chemistry, 2(4): 1124-1127.
10. Garg SK, Gupta SR, Sharma ND. 1979, "Apiumoside, a new furano coumarin glucoside from the seeds of *Apium graveolens*", Phytochemistry