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Review Paper

A Comprehensive Review on Phytochemistry and Pharmacological Properties of *Sechium Edule* (Chayote)

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ABSTRACT

Sechium edule (Jacq.) Swartz, or simply chayote, is the common name assigned to this tropical and subtropical diploid herbaceous climbing plant belonging to Cucurbitaceae, generally cultivated in Brazil, Costa Rica, Mexico, as well as across several regions in India. A review on *S. edule* includes its botanical traits, phytochemicals' composition, as well as a variety of its clinical uses. The plant grows best between 18-22°C temperatures, with annual rainfall of 1500-2500mm and soil pH ranging from 5.5 to 7.0. Phytochemical analysis shows different bioactive compounds, such as flavonoids, including vitexin, isovitexin, and orientin; alkaloids; terpenoids; cucurbitacins; phenolic compounds; and essential minerals. There are notable amounts of amino acids, vitamins, and minerals that contribute to its nutritional value. Fruits contain low calories of 19-31 Kcal/100g and significant fiber content of 0.40-7.53%. The pharmacological activities reported include antihypertensive, antidiabetic, antioxidant, anti-inflammatory, hepatoprotective, nephroprotective, and antiulcer properties. It is used for medicinal purposes in treating kidney stones, cardiovascular diseases, and a variety of inflammatory diseases. Its cosmetic applications involve the use of the plant in various personal care products. As one plant produces more than 300 fruits a year and with its high therapeutic potential. Thus, *S. edule* would represent a treasure of food security, pharmaceutical discovery, and ethnomedicine. The present comprehensive review underscores the significance of this plant but draws a note for future research to capitalize on its maximum benefit

INTRODUCTION

Sechium edule (Jacq.) Swartz (Cucurbitaceae), also known as chayote [1]. Chayote (*Sechium edule*) is a diploid perennial herbaceous climbing

plant with 28 chromosomes [2]. It is cultivated widely in countries such as Brazil, Costa Rica, the Dominican Republic, and Mexico [3]. In India, *Sechium edule* is grown in Tamil Nadu, Karnataka,

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West Bengal, Uttarakhand, Himachal Pradesh and Northeastern hill (NEH) regions [4]. Its cultivation cycle is 1 year and 6 months out of it are productive [5]. Total 10 species have been characterized: 8 are wild (*S. chinantlense*, *S. compositum*, *S. hintonii*, *S. talamancense*, *S. panamense*, *S. pittieri*, *S. venosum*, and *S. vilosum*), and 2 are cultivated (*S. tobacco* and *S. edule*) [6]. Chayote leaves are not as popular other part of the plant regardless of its content of bioactive compounds higher than the fruit [7]. *S. edule* plant, such as stems, tender leaves, and tuberous roots are typically considered to be an important component of human diets and used in food, pharmaceutical, and cosmetic industries because it consists of health-promoting ingredients [8]. The gastronomic, nutritional, and functional importance of the chayote fruit has caused its demand to increase in recent years [9]. The major nutrients present in *Sechium edule* are antioxidants, phytosterol, vitamin E, folic acid, proteins, essential amino acids, and abundant minerals [10]. aspartic acid, glutamic acid, alanine, proline, serine, tyrosine, threonine and valine; vitamins such as thiamine, riboflavin, niacin, vitamin A and ascorbic acid and the minerals calcium, phosphorus, iron, nitrogen, copper, zinc, manganese and potassium [11]. *S. edule* has a diversity of bioactive compounds such as alkaloids, saponins, flavonoids, triterpenes and steroids [12]. *Sechium edule* leaves and fruits used as Diuretic, Cardiovascular properties. Its leaves used for Arteriosclerosis, Hypertension and to dissolve kidney stone. *S. edule* fruits having Anti-diabetic properties, Antioxidant properties, Anti-epileptic and CNS depressant activity [13]. anti-inflammatory, antitumor, hepatoprotective, nephroprotective, anti-microbial properties [14]. Decoctions from its leaves or fruits for a diuretic effect, or to dissolve kidney stones [15]. Recently, the consumption of chayote has increased due to its nutritional properties; the fruit is low in calories

(19–31 Kcal/100 g) and is a good source of fiber (0.40–7.53%) and minerals such as potassium and calcium [16].

Species:

The genus *Sechium edule* includes the following species: *S. chinantlense*, *S. compositum*, *S. hintonii*, *S. mexicanum*, *S. panamensis*, *S. pittieri*, *S. tacaco*, *S. talamancensis*, *S. venosum*, *S. villosum* [17].

Vernacular Names [18]:

Taxonomy [19]:

Taxonomic Rank	Classification
Kingdom	Plantae
Phylum	Tracheophyta
Subphylum	Angiospermae
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Cucurbitales
Family	Cucurbitaceae
Subfamily	Cucurbitoideae
Tribe	Sicyeae
Genus	<i>Sechium</i>
Species	<i>edule</i>
Botanical Name	<i>Sechium edule</i>

Developmental Stages of *Sechium edule* [20]:

The specific development stages include seedling stage, rapid growth stage, flowering stage, root development stage, decay stage, and withering stage.

Climatic Requirement [18-23]:

The crop is successfully grown in tropical and sub-tropical areas temperature range from 18°C to 22°C. Chayote vines need full sun. It can also be grown hills at altitudes of 1200–1500 m elevation in high rainfall areas. The annual rainfall from 1500 to 2500 mm is best suited for its cultivation. Chayote is grown as an annual in areas where freezing weather is common. At least 5 or 6 months of growing season is required to get fruits.

Soil Requirement [22]:

This plant grows best in soils with a pH within the range of 5.5 to 7.0 but tolerates pH from 4.3 to 8.0.

Plantation And Propagation [21]:



The crop is propagated both sexually and vegetatively. Generally, the whole fruit is planted as a seed and also propagated by tuberous roots. The seed is not separated from the fruit, the whole fruit is planted in a polyethylene bag or planted directly in the field containing a good planting medium in the ratio of 3:1 topsoil and manure. The distance between two rows should be 2 to 3 m and between two vines 1 to 2 m is maintained. The fruits become ready for harvesting within 120 days or harvesting continues for 2 to 3 months. They reach the marketable size in about 30 days from flowering and are picked before they are fully mature. The plants will give good yield for continuous 3–4 years.

Yield [21]:

Since it is perennial, its production is obtained 2–3 years after the plant is established. One plant can yield more than 300 fruits per year. The average yield of fruit is vary from 25–35 tonnes per hectare per year and well-managed crop may yield approximately about 400–500 quintal/hectare in a year.

Botanical Description [18-23]:

Sechium edule belongs to genera of angiosperm and acceptable average temperature is 13°–21°C.

Stem:

The stems of Chayote are angular-grooved and glabrous, and grows simultaneously from a single root. The base of these stems widens near the root and form thin, herbaceous branches as they approach the apex.

Leaf:

Leaves are glabrous, alternate and grooved petioles that range between 8–15 cm in length. The petiole is 3.25cm long, leaf-blade is broadly ovatecircular in outline ranging 7.25cm in diameter and furrowed tendrils branch out into 3 or 5 appendages.

Flower:

Flowers are monoecious with flowers arranged in subracemose or fascicular clusters along the rachis. It is yellowish to pale green and 10–30 cm long.

Fruit:

The sizes and shapes of fruits vary greatly, with sizes ranging from 1.7 to 10.4 inches long and 1.2 to 7.6 inches wide and shapes including globose, ovoid, ellipsoid, and pyriform. Color ranges between white to yellowish or a range of greens.

Seed:

The *S. edule* consists of single large seed with smooth testa. The seed is cordate, flat, and is embedded centrally in the mature fruit.

Roots: The roots are tuberous in nature.



Fig. No. 1: Plantation of *Sechium edule*



Fig. No. 2: Morphological Features of *Sechium edule* (a) Leaf, (b) Flower, (c) Fruit, and (d) Seed.

Active Constituents [18,24]:

Sechium edule exhibits a diverse phytochemical profile characterized by multiple bioactive compound classes distributed throughout the plant. The flavonoid constituents are particularly abundant, comprising C-glycosyl flavones (including vitexin, isovitexin, orientin, and isoorientin), O-flavonoids (primarily quercetin and kaempferol derivatives), and various flavonoid glycosides with distinctive 6-C and 8-C glycosylation patterns. The alkaloid fraction contains both indole and isoquinoline derivatives, while the terpenoid profile reveals cucurbitacins (specifically cucurbitacins B, D, and E), triterpenoid saponins, and carotenoids (predominantly β -carotene, lutein, and zeaxanthin). Phenolic compounds are represented by hydroxycinnamic acids (including caffeic, p-coumaric, and ferulic acids), hydroxybenzoic acids (notably gallic and protocatechuic acids), and condensed tannins. The saponin content includes both steroidal and triterpenoid variants, with characteristic aglycone structures linked to various sugar moieties (primarily glucose, rhamnose, and arabinose). Multiple peroxidase isoforms have been identified, particularly in the fruit tissue, alongside significant quantities of

ascorbic acid (ranging from 11-20 mg/100g fresh weight). The amino acid profile reveals essential amino acids including leucine (1.2-1.8 g/100g protein), arginine (0.9-1.4 g/100g protein), phenylalanine (0.8-1.2 g/100g protein), valine (0.7-1.1 g/100g protein), lysine (0.6-1.0 g/100g protein), isoleucine (0.5-0.9 g/100g protein), threonine (0.4-0.8 g/100g protein), and histidine (0.3-0.7 g/100g protein), with notable variations between plant parts. The mineral composition encompasses substantial levels of potassium (125-175 mg/100g), calcium (12-17 mg/100g), phosphorus (18-27 mg/100g), and magnesium (12-16 mg/100g). Additional bioactive compounds include gibberellins (particularly GA3 and GA4), pectins (with varying degrees of methylation), phospholipids (predominantly phosphatidylcholine and phosphatidylethanolamine), and glycolipids (including monogalactosyldiacylglycerol and digalactosyldiacylglycerol). The leaves demonstrate particularly high concentrations of flavonoids and phenolic compounds compared to other plant parts, with unique glycosylation patterns and structural variations contributing to their distinct biological activities.

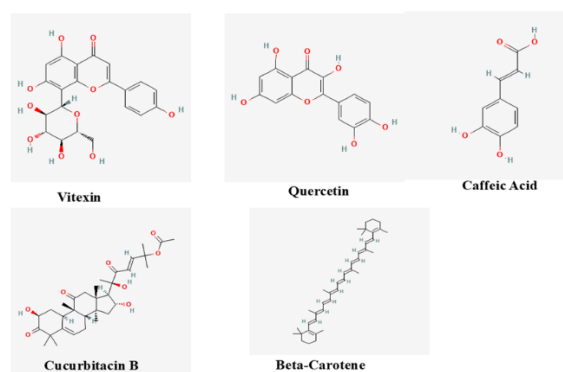


Fig. No. 3: Representative Chemical Structures of Phytoconstituents in *Sechium edule*.

Therapeutical Uses:

Antihypertensive properties [25]:

Sechium edule contains flavonoids and potassium helps to reduce the small blood pressure in the elderly with hypertension without side effects and elderly can use this juiced chayote as an alternative food that can help lower blood pressure.

Antidiabetic properties [26]:

Sechium edule having low glycemic index, high fiber content, and rich nutritional profile, which suggests it may be beneficial for individuals with diabetes. Phenolic and flavonoid contents showed reduced the blood sugar level, decreased blood urea and serum creatinine levels in STZ-ID rats.

Antioxidant properties [27]:

Phenolic and or flavonoid and or carotenoid compounds were the main contributor in antioxidant activity of *S. edule* using CUPRAC method.

Antiepileptic and CNS depressant properties [28]:

The extract significantly reduced the duration of various phases of convulsions in both MES-induced seizures and PTZ-induced convulsion. CNS depressant model, the locomotor activity was also decreased and the rotarod model shows significant loss of muscular coordination.

Anti-inflammatory properties [29]:

Consumption of *Sechium edule* having lipogenesis inhibitor properties are attributed to it. A statistically significant decrease was found in the

concentration of lipoperoxides (TBARS), 8-isoprostanes, 8-OHdG, oxidative stress score (OSS), HbA1c, blood pressure as well as an increase in total antioxidant status. So it shows anti-inflammatory response.

Hepatoprotective properties [30]:

Ethanollic extract of fruits of *Sechium edule* showed significant hepatoprotective activity by reducing the levels of AST, ALT, ALP, total bilirubin, hepatic lipid peroxidation and protect the liver cells from CCl₄ induced hepatotoxicity in rats.

Nephroprotective properties [31]:

The aqueous extract of leaves of *Sechium edule* was evaluated for its protective activity and shows decreased the level of blood urea, blood urea nitrogen, serum creatinine and improves the histology of the kidney against gentamicin, potassium dichromate-induced nephrotoxicity and streptozotocin-induced diabetic nephropathy in experimental animals.

Antiulcer properties [32]:

The ethanollic extract of *Sechium edule* fruits shows inhibition of the gastric fluid volume, free acidity, total acidity and gastric induced by pylorus ligation induced ulcer. And there is significance decrease in ulcer index, also protected the mucosal epithelial of stomach from the damage caused by ethanol. These results suggest that ethanollic extract having antiulcerogenic property.

Medicinal Benefits [28,33-35]:

The use of natural ingredients in traditional medicine has been commonly used around the world. It also used in the cosmetic industry in the manufacturing of shaving creams, deodorants, shampoos, toothpaste, mouthwashes, moisturisers, cleansers and sun lotions. Plant of *Sechium edule* has been used to treat dysentery, vaginal problems, inflammations, burning sensation, fatigue, liver disorders, and jaundice. It also used to treat symptoms such as severe headaches with ringing ears, nervousness and anxiety. It has also been used to treat urinary diseases such as bladder or urethral inflammation, pain during peeing, enlarged veins in legs and feet and venous insufficiency and to treat kidney stone. There is evidence that the tea of Chayote leaves or fruits has diuretic effects and it also be used to decrease the fats and cholesterol and in the management of blood pressure. It also used to treat severe hypokalaemia in pregnant women.

CONCLUSION:

Sechium edule stands unique as a scientifically validated yet conventionally wise, phytochemically rich plant with multiple therapeutic attributes, including antihypertensive, antioxidant, and anti-inflammatory activities. Coupled with its nutritional richness and easy adaptability in terms of cultivation, *Sechium edule* is a sustainable and versatile crop at the center of global health and nutritional concerns. It is an important resource that should receive more attention in research and development, considering the demonstrated value of the plant in food, medicine, and cosmetics.

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