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## Nutritional composition, bioactive components and health benefits of Chaya mansa

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**Abstract**

Leafy green vegetables Chaya mansa (*Cnidoscolus aconitifolius*) are popular around the world, particularly in Mexico and Central America. Chaya mansa has high levels of dietary fibre, vitamins A, C, and K, as well as minerals including calcium, iron, and potassium. It also includes a number of bioactive substances, including flavonoids, carotenoids, and saponins, which may have antioxidant, anti-inflammatory and hypoglycemic activities. Chaya mansa has a high-water content, a low-fat content, and a moderate protein level, according to a physio-chemical investigation. It also has a low glycemic index, which means people with diabetes may be able to eat it. According to studies, eating Chaya mansa may improve blood glucose control, reduce inflammation, and guard against oxidative stress, among other health advantages. Additionally, it might be able to fight cancer and boost bone health. The nutritional content, physio-chemical properties, bioactive components, and health advantages of Chaya mansa are discussed in this review paper.

**Keywords:** Chaya mansa, medicine, anti-oxidant, iron

**Introduction**

The shrub *Cnidoscolus chayamansa*, McVaughn (Euphorbiaceae), often known as "Chaya", grows in the northern region of Nigeria and is between 3 and 5 metres tall. The pistillate flowers are commonly found on the base fork of the white flowers, which are typically carried on cyme-branched inflorescences (Rodrigues *et al.*, 2021) [27]. The base of the lobes is where the staminate blooms extend distally. It might be used as a medicinal plant or as a leafy vegetable. The shoots and leaves of *C. chayamansa* have long been used as laxatives, diuretics, circulation enhancers, digestive aids, lactation inducers and fingernail hardeners (Soto *et al.*, 2015) [34]. The aqueous extract of the stem, leaves and roots has been used in traditional medicine to treat a variety of conditions, including diabetes, obesity, kidney stones, haemorrhoids, acne, and eye issues. For use as animal feed, the entire plant including the root can be dried and crushed. (Jimoh *et al.*, 2009). *Cnidoscolus chayamansa*, according to McVaugh. A domesticated plant popularly referred to as "chaya" belongs to the Euphorbiaceae family. Young chaya shoots and leaves have been devoured to create recipes, leaves are either boiled or mixed with uncooked beverages (Cárdenas-Ibarra *et al.*, 2017) [1]. The leaves of *C. chayamansa* are a significant source of iron, calcium, -carotene, vitamins and protein. Phytochemical investigations of the chemical makeup of this plant have permitted for cyanogenic glycoside isolation or identification, the glycosides of amentoflavone, kaempferol, and quercetin Chaya leaf extracts, both raw and cooked, showed antioxidant activity and diabetic rabbits drinking chaya tea saw their blood sugar levels drop (LOARCA. *et al.*, 2010) [16].

The plants in the Chayamansa group (*Cnidoscolus chayamansa*) are more frequently cultivated than other kinds because other varieties require gloves to harvest. To obtain defence against stinging hairs. Based on morphology, there are essentially four categories, including such as Chayamansa (the most prevalent), Estrella, Picuda and Renda (Munguía-Rosas *et al.*, 2019) [19]. Most of Chayamansa grew to a maximum of 2 meters in width and 3 meters in length. Branches are prone to breaking, so even the plant can reach a height of 6 meters, but is typically cut back to less than 2 meters (Ebel *et al.*, 2019) [5]. It has succulent stems, so when it is cut, milky sap is produced. Because it rarely produces seeds, stems are frequently used for propagation. The leaves are only harvested after the second year due to the delayed initial growth required for the cuttings' roots to form (Welzen & Fernández-Casas, 2017) [37]. The leaf contains a variety of compounds, including a glycoside of hydrocyanic acid, a poison that produces cyanide. After fifteen to twenty minutes of cooking, the poison is safely transformed

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into gas and expelled into the air while the edible portion is still safe to eat. Chaya should not be cooked in aluminum containers. It might result in a harmful reaction. (Panghal *et al.*, 2021) [25].

The people of rural communities in Central and South Mexico particularly value the domesticated plant known as "chaya", which belongs to the Euphorbiaceae family and is used as food, medicine, and ornamental plants (Dzul-Erosa *et al.*, 2018) [4]. Chaya leaves and young shoots have been eaten since pre-Columbian times. The leaves are frequently boiled to make dishes and combined uncooked to make drinks (Dinka *et al.*,

2019) [12]. The leaves of *C. chayamansa* are a significant source of calcium, iron, ascorbic acid, beta-carotene, vitamin A, and protein. Amentoflavone, kaempferol and quercetin glycosides have been isolated or identified as a result of phytochemical studies on the chemical make-up of this plant. Chaya tea reduced the glucose levels of diabetic rabbits, while raw and cooked ethanol/acetone/water/acetic acid extracts of chaya leaves indicated antioxidant activity. (LOARCA *et al.*, 2010) [16]. The proximate composition of Chaya mansa is described in the table 1.

**Table 1:** Proximate composition of *Chaya mansa*

Components	Amount	Reference
Moisture (%)	2.86-85.3- 82.86	Kuri-García & Guzmán (2017) [18]
Ash (%)	2.22-14.22-10.45	Salahdeen <i>et al.</i> , 2016; [30]
Energy (kcal/100 g)	40.69-1276	Salahdeen <i>et al.</i> , 2016 [30]
Carbohydrates (g/100 g)	43.33-44.31	Salahdeen <i>et al.</i> , 2016 [30]
Protein (%)	5.7-34.02	Kuri-García & Guzmán (2017) [18].
Lipid (%)	0.4	
Fiber (%)	1.9	
Potassium	2030-3460	Shittu, <i>et al.</i> 2014 [33]
Sodium	269.40-320	Shittu, <i>et al.</i> , 2014 [33]
Calcium	616	Shittu, <i>et al.</i> , 2014 [33]
Iron	20.6	Shittu, <i>et al.</i> , 2014 [33]
Fat	5.63	Shittu, <i>et al.</i> , 2014 [33]
Caloric value	386.39	Shittu, <i>et al.</i> , 2014 [33]

### Health Benefits of Chaya mansa

Chaya mansa (*Cnidocolus aconitifolius*) is a leafy green vegetable that is widely consumed in many parts of the world, especially in Mexico and Central America, where it has been used for centuries as a traditional medicine and food. It is known for its nutritional richness and potential health benefits. The superfood Chaya mansa is packed with necessary nutrients. It is a great source of the antioxidant vitamins A, C, and E, which defend the body from free radicals and lower the risk of chronic illnesses. Minerals including calcium, magnesium, potassium and iron are also included in Chaya mansa and are essential for a number of body processes (Devipriya & Padmasree, 2018) [3].

The antioxidants flavonoids, carotenoids and phenolic substances are particularly abundant in Chaya mansa. These anti-oxidants can aid in defending the body against oxidative stress, which is linked to a number of chronic illnesses like cancer, heart disease, and diabetes. According to studies, Chaya mansa is more antioxidant-rich than a variety of other leafy greens, such as spinach and kale (Espinosa *et al.*, 2015) [6]. It has been demonstrated that the flavonoids in Chaya mansa, such as quercetin and kaempferol, have strong antioxidant activity. Heart disease, cancer, and inflammatory risk have all been related to quercetin. Kaempferol has been demonstrated to possess anti-cancer effects and may aid in the prevention of chronic illnesses (Soto *et al.*, 2015) [34].

The immune system is strengthened by Chaya mansa's high vitamin C concentration. It improves the body's resistance to infections, encourages the generation of white blood cells, and supports the immune system's healthy operation (Kutshik *et al.*, 2020) [15]. Chaya mansa can aid in the prevention of common ailments including the flu, the common cold, and infections.

Dietary fibre, which supports digestion and reduces constipation, is abundant in Chaya mansa. It encourages regular bowel motions and aids in keeping the digestive tract in good shape. The fibre content can also aid in lowering cholesterol and enhancing heart health (Ramírez-Rodrigues *et al.*, 2022) [26]. Calcium is a mineral that is crucial for keeping healthy bones and teeth, and Chaya mansa is a great source of it. Osteoporosis risk may be decreased by ensuring enough calcium intake throughout life as part of a well-balanced diet. Chaya mansa, especially in elderly persons, can support ideal bone health via nutrition (Manzanilla & Knerr, 2020) [17].

It has been discovered that Chaya mansa contains hypoglycemic qualities, which means it can help control blood sugar levels. Chaya mansa may help increase insulin sensitivity and lower the risk of type 2 diabetes, according to research. However, people with diabetes should continue to check their blood sugar levels and speak with their doctor (Dabak *et al.*, 2020) [2]. Vitamin A, which is necessary for keeping excellent vision, is abundant in Chaya mansa. Vitamin A promotes general eye health and aids in protecting the eye's surface. Chaya mansa can help keep your eyes healthy and lower your chances of developing age-related macular degeneration and other vision issues (Srisawat *et al.*, 2022) [32]. The anti-inflammatory qualities of Chaya mansa can aid in lowering inflammatory levels in the body. Numerous illnesses, including arthritis, heart disease, and several forms of cancer, are linked to chronic inflammation. Chaya mansa may assist reduce inflammation and advance general health when added to your diet (Valenzuela-Soto *et al.*, 2019) [36].

The vegetable Chaya mansa has few calories and is high in fibre. It can make you feel satisfied for extended periods of time, lowering your risk of overeating and supporting weight

control. Additionally, the fibre content helps control blood sugar levels, avoiding sharp increases and drops that may lead to weight gain (Guzmán *et al.*, 2021) [8]. Cardiovascular health is aided by the combination of several minerals found in Chaya mansa, including potassium, magnesium, and antioxidants. These vitamins and minerals support healthy heart function, lower the risk of heart disease, and maintain normal blood

pressure. Chlorophyll, a naturally occurring substance that assists in detoxifying, is present in Chaya mansa. Chlorophyll improves liver function, encourages systemic cleaning, and aids in the removal of toxins from the body (Pérez-González *et al.*, 2019) [23]. Table 2 depicts the health benefits of Chaya mansa.

**Table 2:** Health benefits of Chaya mansa

Properties	Extract, Fraction or isolated compound	Experimental Model	Dose	Mechanism of action	Reference
Antioxidant	AcOET Extract	<i>In vitro</i>	33 g/ml	These plants are thought to have great biological potential in terms of the prevention and treatment of damage brought on by free radicals since they contain a variety of chemicals with varied antioxidant qualities.	(Kuri-García <i>et al.</i> , 2017) [18]
	Decoction	<i>In vitro</i>	ND		
	EtOH Extract	<i>In vitro</i>	33mg/ml		
	Hexane Extract	<i>In vitro</i>	33 mg/ml		
	MeOH Extract	<i>In vitro</i>	10 µg/ml 100 µg/ml 500 µg/ml 1000 µg/ml 2500 µg/ml 5000 µg/ml		Loarca Pina <i>et al.</i> 2010 [16]
	Organic Extract	<i>In vitro</i>	ND		Kuti <i>et al.</i> , 2004 [19]
Anti-inflammatory	AcOET Extract	<i>In vivo</i>	2 mg/kg- 500 mg/kg	DPPH radical-scavenging activity	Rodríguez <i>et al.</i> , 2014 [35]
	EtOH Extract	<i>In vivo</i>	2 mg/kg- 500 mg/kg		
	Hexane	<i>In vivo</i>	2 mg/kg-500 mg/kg		
Cardio protective	EtOH Extract	<i>In vivo</i>	500 mg/kg	Treated with 500 mg/kg EtOH extract of <i>Cnidocolus chayamansa</i> by oral gavage	
Hypoglycaemic Effect	Infusion	<i>In vivo</i>	ND		Soto <i>et al.</i> 2015 [34]
	MeOH Extract	<i>In vivo</i>	0.5 g/kg 1 g/kg 1.5 g/kg		Figueroa-Valverde <i>et al.</i> 2009 [7]
Antimutagenic	MeOH Extract	<i>In vitro</i>	125 µg 250 µg 500 µg 1000 µg		Loarca Pina <i>et al.</i> 2010 [16]
Anti-diabetic	MeOH Extract	<i>In vivo</i>	10 mg/kg 40 mg/kg 70 mg/kg	Some phenolics protect pancreatic b cells against oxidative stress and enhance insulin secretion	Loarca Pina <i>et al.</i> 2010 [16]
Hypo-cholesterolemic activity	MeOH Extract	<i>In vivo</i>	50 mg/kg 100 mg/kg	Natural compounds on the inhibition of HMG-CoA reductase this enzyme is rate limiting in the synthesis of endogenous cholesterol.	Miranda Velasquez <i>et al.</i> 2010 [18]

### Importance of phenolic compounds and antioxidant property

Free radicals are defined as atoms or molecules with one or more unpaired electrons. By damaging DNA, proteins and lipids through oxidative stress, which has been linked to the pathophysiology of various diseases, free radicals are to blame for tissue degeneration. Free radical damage can be lessened, according to some writers, by taking supplements of one or more antioxidants (Pillai, 2017) [21]. Plants contain a variety of chemicals with various antioxidant characteristics, and these plants are regarded as having significant biological potential in terms of the prevention and treatment of damage brought on by free radicals. Numerous medicinal plants have been researched and tested for their capacity to combat free radicals brought on by oxidative stress (Rodrigues *et al.*, 2020) [29].

The phytochemical makeup of these plants, particularly a range of minor chemicals formed from plant secondary metabolism, which have recently received study for their bioactive effects, is thought to be responsible for some of their therapeutic capabilities (Godínez-Santillán *et al.*, 2019) [7]. These include phenolic chemicals (is enlisted in Table 3), which are found in abundance in meals with a plant origin. Pigmentation and defence against pathogens and predators are the two main purposes of phenolic chemicals in plants. They are chemical compounds with at least one aromatic ring and either aromatic or aliphatic structures connected to one or more hydroxyl groups. Analyzing their features reveals that phenolic compounds come in over 10,000 different varieties, ranging from the most basic to the most complex (Isvari *et al.*, 2020) [10].

**Table 3:** Phenolic Compounds in *Chaya mansa*

Phenolic Compounds	Solvent used	Technique used	Amounts	References
Epigallocatech gallato	Aqueous	Chromatography	27.4 mg/g FM	Valenzuela-Soto <i>et al.</i> , (2015) <sup>[35]</sup>
Rosmarinic Acid	Aqueous	Chromatography	26.8 mg/g FM	
Hesperidin	Aqueous	Chromatography	16.2 mg/g FM	
Vanillin	Aqueous	Chromatography	11.3 mg/g FM	
Rutine	Aqueous	Chromatography	10.6 mg/g FM	
Chlorogenic Acid	Aqueous	Chromatography	8.6 mg/g FM, 82.14 mg/100 g	Valenzuela-Soto <i>et al.</i> , (2015) <sup>[35]</sup> Kongphapa <i>et al.</i> , (2022) <sup>[17]</sup>
Hydroxybenzoic acid	Aqueous	Chromatography	8.1 mg/g FM, 104.28 mg/100g	Valenzuela-Soto <i>et al.</i> , (2015) <sup>[35]</sup> , Kongphapa <i>et al.</i> , (2022) <sup>[17]</sup>
4-Caffeic Acid	Aqueous	Chromatography	5.4 mg/g FM	Valenzuela-Soto <i>et al.</i> , (2015) <sup>[35]</sup>
Ferulic Acid	Aqueous	HPLC-DAD/MSD	4.7 mg/g FM, 5.25 mg/100 g	Kongphapa <i>et al.</i> , (2022) <sup>[17]</sup>
Catechin	Aqueous	HPLC-DAD/MSD	4.3 mg/g FM	
Protocatechic acid	Aqueous	HPLC-DAD/MSD	4.2 mg/g FM, 67.98 mg/100 g	Kongphapa <i>et al.</i> , (2022) <sup>[17]</sup>
P-coumaric acid	Aqueous	HPLC-DAD/MSD	3.0 mg/g FM, 3.86 mg/100 g	Ramos-Gómez <i>et al.</i> (2017) <sup>[33]</sup> , Kongphapa <i>et al.</i> , (2022) <sup>[17]</sup>
Naringenin	Aqueous	HPLC-DAD/MSD	2.7 mg/g FM	Ramos-Gómez <i>et al.</i> (2017) <sup>[33]</sup>
Synaptic Acid	Aqueous	HPLC-DAD/MSD	1.7 mg/g FM	
Quercetin	Aqueous	HPLC-DAD/MSD	1.4 mg/g FM	
Ellagic Acid	Aqueous	HPLC-DAD/MSD	0.8 mg/g FM	
Galocatequin gallate	Aqueous	HPLC-DAD/MSD	0.5 mg/g FM	
Gallic acid	-	HPLC-DAD	4.92 mg/100 g	Kongphapa <i>et al.</i> , (2022) <sup>[17]</sup>
Caffeic acid	-	HPLC-DAD	561.71 mg/100 g	
Syringic Acid	-	HPLC-DAD	70.71 mg/100 g	

**Table 4:** Phenolic Contents present in *Chaya mansa*

Phenolic content	References
TFC 6.34 mg GAE/ml infusion	Valenzuela- Soto <i>et al.</i> , 2015 <sup>[35]</sup>
TFC 5.66 mg GAE/g FM; Total flavonoids 332.8 µg CE/g FM	Jimenez-Aguilar <i>et al.</i> , 2015

**Table 5:** Antioxidant Property of *Chaya mansa*

FRAP	ABTS	DPPH	References
-	75.95%	90.89%	M.Z. Pérez-González <i>et al.</i> , 2019 <sup>[23]</sup>
-	44.3%	25.5%	Ramos-Gomez <i>et al.</i> , 2017 <sup>[33]</sup>
112.97 mg FeSO <sub>4</sub> eq/g dw	29.35 mg Trolox eq/g dw	10.72 mg Trolox eq/g dw	Kongphapa <i>et al.</i> , 2022 <sup>[17]</sup>

## Conclusion

Overall, Chaya mansa is a wholesome diet that may provide a number of health advantages. To completely comprehend its potential therapeutic effects and how it might be included into the diets of various groups, more research is necessary. Chaya mansa stands out because of its exceptional nutritious profile, which includes minerals like calcium, magnesium, potassium, and iron as well as important vitamins like A, C, and E. These nutrients assist numerous biological systems and improve overall health and wellbeing. The digestive system can benefit from include Chaya mansa in the diet as well. The vegetable is an excellent source of nutritional fibre, which helps to support a healthy digestive system, promote regular bowel movements and avoid constipation. Additionally, the fibre in Chaya mansa can help with weight control, enhanced satiety and a decreased chance of developing chronic illnesses including obesity, diabetes, and cardiovascular disease.

In conclusion, Chaya mansa is a leafy green vegetable that is incredibly nutritious, has distinct physio-chemical traits, and has a wide variety of bioactive components. Its nutritional makeup and bioactive chemicals offer a variety of health advantages, including anti-inflammatory and antioxidant properties, immunological support, digestive health promotion, and possibly eye health advantages. Chaya mansa can be a beneficial addition to a balanced diet, helping to maintain

general health and lower the chance of developing a number of chronic conditions.

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