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Nutritional Potential, Health Effects, and Bioactive Polysaccharides of *Sechium edule*: A Review

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Abstract: *Sechium edule*, commonly known as Chayote, is a versatile and nutritionally rich vegetable that has been consumed for centuries across various cultures. Almost every part of the crop is eaten, including young leaves, shoots, tuberous roots, and immature fruits. Different recipes are prepared according to the regions and ethnic groups, and it is also used in the food industry especially for the preparation of infant food due to its natural taste. It is a crop rich in nutrients that contains a variety of bioactive substances. *Sechium edule*'s nutritional, phytochemical, and pharmacological properties have led to its broad acceptability in diet. The purpose of this review article is to give a overview of *Sechium edule*'s nutritional potential, health benefits, and bioactive polysaccharides. The synthesis of current research findings will shed light on the importance of incorporating this vegetable into diets for enhanced nutrition and potential health benefits.

Keywords: *Sechium edule*, Chayote, nutritional composition, health effects, bioactive polysaccharides, culinary applications.

1. Introduction

Sechium edule, or Chayote, is a vegetable with historical and cultural significance in many different culinary traditions around the world. With its origins traced back to Mesoamerica, this vegetable has been a part of traditional diets for centuries (Pu et al., 2021). *Sechium edule*, a member of the Cucurbitaceae family, is distinguished by its unique pear-like shape and crisp, mild flavour, which make it an adaptable element in a variety of recipes (Coronel et al., 2017).

Archaeological discoveries indicating the consumption of *Sechium edule* as far back as pre-Columbian civilizations underscore the historical significance of this ingredient in indigenous Mesoamerican diets (Pu et al., 2021). The vegetable, which has been valued for its possible health advantages and nutritional contributions, is rich in phytonutrients and has been used for traditional medicinal purposes (Moreira, 2015).

Contemporary studies have elucidated the nutritional composition of *Sechium edule*, revealing its status as a nutrient-dense dietary source. An detailed summary of *Sechium edule*'s nutritional composition is given in a review by Vieira et al. (2019), which emphasizes its significance as a source of vitamins, minerals, and dietary fibre (Vieira et al., 2019). Furthermore, studies conducted by Cadena-Iñiguez et al. (2022) investigate the genetic diversity and history of domestication of *Sechium edule*, providing insight into the plant's evolutionary path and adaptability to various environmental circumstances (Cadena-Iñiguez, Avendaño-Arrazate, et al., 2022).

As the various aspects of *Sechium edule* has been explored, it becomes clear that comprehending its genetic diversity, nutritional importance, and historical origins is essential to appreciating its place in contemporary cuisine and encouraging its consumption for improved nutrition and possible health benefits (Verma et al., 2017; Vieira et al., 2019).

2. Nutritional Composition

Sechium edule is widely recognized for its remarkable nutritional composition, which positions it as a beneficial supplement to a variety of diets across the globe. Rich in essential nutrients, this vegetable contributes significantly to a balanced and healthful diet. *Sechium edule* is a versatile and nutrient-dense food source because of its comprehensive nutritional profile, which includes macronutrients, micronutrients, vitamins, minerals, and dietary fibre (Vieira et al., 2019).

Numerous investigations have examined the nutritional content of *Sechium edule* in great detail, illuminating possible health advantages. In a review, Vieira et al. (2019) emphasize the nutritional richness of Chayote, highlighting its content of important vitamins such as vitamin C, vitamin B complex, and minerals such as potassium and manganese (Vieira et al., 2019). The young shots, root, and seeds of the Chayote have been shown to contain high levels of calories and carbohydrates, while the fruits have sufficient amounts of macro- and micronutrients. It has been found that many bioactive compounds, including flavonoids and carotenoids such as lutein and β-carotene etc., are present (Chang et al., 2021). The nutritional diversity suggests that *Sechium edule* can play a crucial role in meeting dietary requirements and addressing potential micronutrient deficiencies (Pu et al., 2021; Veigas et al., 2020; Vieira et al., 2019). The nutritional composition of shoots, fruits and leaf is given in **Table 1** along with some bioactive compounds.

Table 1: Nutritional composition of Chayote (Booth et al., 1992; Chang et al., 2021; Leterme et al., 2006; Lira-Saade, 1996; Mashine et al., 2023; Sriwichai et al., 2016)

Nutritional Constituent	Shoot	Leaf	Fruit
Dry matter	-	11.9±0.6 g/100 g	9.2%
Calorie (kcal)	320/100 g dw	-	26.0 - 31.0/100 g
Carbohydrate	36.60 g/100 g dw	2.1 (raw) g/100 g fw 2.4 (cooked) g/100 g fw	3.5-7.7%
Protein	30.27±0.24 g/100 g dw	3 (raw) g/100 g fw 2.8 (cooked) g/100 g fw	0.9-1.1%
Fat	1.50±0.042 g/100 g dw	0.4 (raw) g/100 g fw 0.4 (Cooked) g/100 g fw	0.4-0.6%
Fibre	19.18±0.49 g/100 g dw	1.1 (raw) g/100 g fw 0.9 (cooked) g/100 g fw	0.4-1.0%
Pectin	-	0.4±0.1 g/100 g	-
Lutein	-	7.4±0.6 mg/100 g	-
β-Carotene	-	4.4±0.1 mg/100 g	-
Retinol Equivalent	-	0.32±0.10 mg/100 g	-
Ash	12.45±0.33 g/100 g dw	1.1 (raw) g/100 g fw 0.4 (Cooked) g/100 g fw	776 mg/100 g
Iron	11.92±0.69 mg/100 g dw	2 (raw) mg/100 g fw 1 (Cooked) mg/100 g fw	0.33 mg/100 g
Calcium	438.32±1.15 mg /100 g dw	30 (raw) mg/100 g fw 41 (Cooked) mg/100 g fw	18 mg/100 g
Potassium	-	316 (raw) mg/100 g fw 81 (Cooked) mg/100 g fw	203 mg/100 g
Magnesium	-	26 (raw) mg/100 g fw 16 (Cooked) mg/100 g fw	21 mg/100 g
Phosphorus	-	70 (raw) mg/100 g fw 45 (Cooked) mg/100 g fw	36 mg/100 g

Note: *fw-fresh weight, dw-dry weight*

Sechium edule has a notable amount of dietary fibre, which supports digestive health and may help with weight management. Increased fibre intake has been associated with a number of health advantages, such as better intestinal regularity and reduced risk of chronic diseases including diabetes and cardiovascular disease (Gavia-García et al., 2023). Moreover, the antioxidant properties of *Sechium edule* have been explored in scientific studies. Antioxidants present in this vegetable are essential for scavenging free radicals from the body, which may help reduce inflammation and oxidative stress (Aguiñiga-Sánchez et al., 2020; Gavia-García et al., 2023; Yullianti et al., 2023). Understanding the nutritional composition of *Sechium edule* is paramount for promoting its incorporation into diets, particularly in addressing nutritional gaps and promoting overall health and well-being.

3. Health effect

Scientific investigations on the health benefits of *Sechium edule* have revealed a range of potential advantages beyond its culinary uses. This section delves into key studies exploring the vegetable's antimicrobial, anti-inflammatory, antioxidant, and anti-diabetic properties, as well as its impact on cardiovascular health and weight management.

Both ethanolic and aqueous extracts of *Sechium edule* leaf exhibited antimicrobial efficacy against strains of multiple resistances enterococci and staphylococci (Ordoñez et al., 2003). Chayote has shown promise in exhibiting anti-inflammatory and antioxidant effects (Ordonez et al., 2006). These properties are attributed to the presence of bioactive compounds, including flavonoids and phenolic compounds. Studies suggest that consumption of *Sechium edule* on a regular basis may help reduce oxidative stress and inflammation, which may lower the chance of developing chronic illnesses (Aguiñiga-Sánchez et al., 2020; Arista-Ugalde et al., 2022; Ordoñez et al., 2003; Yang et al., 2015).

Research has explored the anti-diabetic effects of *Sechium edule*. Studies highlighted the potential of *Sechium edule* in managing diabetes and related complications. The bioactive chemicals found in this vegetable, such as flavonoids and triterpenoids, have been shown to have anti-diabetic effects by affecting insulin sensitivity and glucose metabolism (Huerta-Reyes et al., 2022; Mukherjee et al., 2022; Simpson & Morris, 2014).

Sechium edule's impact on cardiovascular health has a matter of great interest. Because of its potassium content and antioxidant properties, this vegetable may help to regulate blood pressure and lower the risk of cardiovascular diseases. The results of the research highlight the possible cardiovascular benefits associated with regular inclusion of *Sechium edule* in the diet (Arista-Ugalde et al., 2022; Cheng et al., 2023; Gavia-García et al., 2023; Neeraja et al., 2015). It has been shown that flavonoids found in Chayote shoots lower blood lipid and cholesterol levels, preventing atherosclerosis and fatty liver (Wu et al., 2014).

The dietary fiber content of *Sechium edule* (Mashine et al., 2023) plays a role in promoting satiety and supporting weight management. Fiber-rich foods are known to contribute to feelings of fullness, which potentially reducing overall caloric intake (Lattimer & Haub, 2010; Sarker, 2017). According to studies exploring the significance of dietary fibre in weight management, *Sechium edule* may be a valuable component of strategies aimed at preventing and managing obesity (Yang et al., 2015). In summary, the scientific literature suggests that *Sechium edule*'s health impacts extend beyond basic nutrition, making it a promising candidate for promoting overall health and well-being.

4. Bioactive Polysaccharides

Sechium edule is not only renowned for its nutritional content but also for the presence of bioactive polysaccharides that contribute to its potential health-promoting properties. This section explores the structural characteristics of these polysaccharides and their physiological effects, drawing on key studies that investigate their immunomodulatory and anti-cancer activities.

The bioactive polysaccharides in *Sechium edule* exhibit diverse structural characteristics that impact their functional properties. Studies shed light on the structure and composition of polysaccharides extracted from *Sechium edule*, emphasizing

both their complexity and potential biological activity. These polysaccharides often consist of various sugar units, and their unique arrangements contribute to their biological effects (Castro-Alves & Do Nascimento, 2016; Ke, Deng, et al., 2023; Ke, Zhang, et al., 2023; Shiga et al., 2015).

Polysaccharides derived from *Sechium edule* have demonstrated immunomodulatory effects. Studies suggested that these polysaccharides can enhance immune responses by stimulating the activity of immune cells. Particular interest in this immunomodulatory potential is for the development of functional foods and nutraceuticals that enhance immune function (Castro-Alves, 2017; Castro-Alves et al., 2019; Castro-Alves & Do Nascimento, 2016; Ke et al., 2020; Mukherjee et al., 2022; Shiga et al., 2015).

The anti-cancer properties of *Sechium edule* polysaccharides have been investigated in preclinical studies. The polysaccharides of Chayote have the potential of inhibiting the growth of cancer cells and inducing apoptosis. These findings provide opportunities for more research on *Sechium edule* as a natural source of bioactive substances with anti-cancer properties (Cadena-Iñiguez, Aguiñiga-Sánchez, et al., 2022; Cheng et al., 2023; Iñiguez-Luna et al., 2021; Salazar-Aguilar et al., 2017). Understanding the structural intricacies of *Sechium edule* polysaccharides and their physiological effects provides a foundation for exploring their potential applications in functional foods, dietary supplements, and pharmaceuticals.

5. Culinary Applications

In addition to its nutritional and health advantages, *Sechium edule* exhibits remarkable versatility in culinary applications. This section explores traditional and contemporary cooking methods, recipes, and culinary innovations that showcase the vegetable's adaptability in various cuisines.

Sechium edule has long been a mainstay in many traditional dishes from many cultural backgrounds. For instance, Chayote is frequently used in stews, soups, and salads in Latin American cuisines. The vegetable's soft, mildly-flavored flesh enhances the flavour and texture of many recipes. Chayote can be stuffed, roasted, or pickled in traditional dishes, demonstrating how versatile it is in terms of cooking methods (Borah et al., 2023; Lira-Saade, 1996; Verma et al., 2017). The global fusion food movement has also incorporated *Sechium edule* into innovative recipes. Its neutral flavor allows it to seamlessly blend with diverse ingredients and cuisines. The culinary versatility of this vegetable has crossed cultural barriers, as seen in its use in stir-fries in Asian cuisine to salsas infused with Chayote in Mexican-inspired recipes (Sakung et al., 2020; Vieira et al., 2019). There are several ways to prepare the fruits, including boiling, baking, stuffing, mashing, frying, scalloping, or pickling; however, the most popular preparation in Mexican and Latin American homes and restaurants is as a broth (Booth et al., 1992; Coronel et al., 2017; Lim, 2012). Certain plant parts are cooked and consumed as common vegetables in the Eastern Himalayan regions of India, the Darjeeling district, and the Tarai and Dooars regions of West Bengal (Bandyopadhyay et al., 2021). In Mexico, Costa Rica, and Indonesia, the plant's roots are also eaten as tubers and regarded as delicacies. Because the tuber root is highly nutritious and its starch is easily digestible, therefore recommended for infants and paralyzed patients (Coronel et al., 2017).

The culinary applications of *Sechium edule* extend beyond taste and texture considerations. Cooking techniques that are health-conscious, such steaming and grilling, assist to retain the vegetable's nutritional value. These techniques preserve the natural deliciousness of *Sechium edule*, and making it a favourite option for people who want their meals to have both flavour and nutrition (Riviello-Flores et al., 2018; Shariff et al., 2023; Vieira et al., 2019). The nutritional profile and unique taste of *Sechium edule* have made it popular among home cooks and chefs alike in modern culinary practices. Due to its crisp texture, the vegetable is a great choice for raw applications like slaws and salads, adding a refreshing twist to dishes. Chayote can also be thinly sliced or spiralized to provide low-carb alternatives for wraps or noodles, meeting the needs of contemporary diets (Vieira et al., 2019).

6. Future Perspectives

The different aspects of *Sechium edule* are still being discovered by researchers, and this section looks at possible directions for further study and research. These views aim to direct and motivate future research, ranging from the discovery of novel bioactive substances to genetic changes for improved nutritional content and the development of functional food products.

Upcoming investigations on *Sechium edule* may focus on the recognition and characterization of novel bioactive substances. Additional phytochemicals with possible health advantages may be found with the help of sophisticated analytical techniques like proteomics and metabolomics. Understanding the full spectrum of bioactive compounds in *Sechium edule* could open new possibilities for therapeutic applications and nutritional interventions (Aguiñiga-Sánchez et al., 2020; Iñiguez-Luna et al., 2021; Vieira et al., 2019). Genetic modifications may offer a promising avenue for enhancing the nutritional content of *Sechium edule*. Researchers can investigate methods to raise essential nutrient levels, balance out advantageous substances, and potentially introduce desirable traits like longer shelf life or greater resistance to illness through selective breeding or genetic engineering (Pu et al., 2021; Verma et al., 2017).

The development of functional food items using *Sechium edule* can be a promising endeavour. Without sacrificing the vegetable's nutritional integrity, researchers can explore innovative ways to incorporate it to the processed foods, snacks, and drinks. Such products could cater to consumer preferences for convenient, health-promoting options in the modern food landscape (Riviello-Flores et al., 2018; Sakung et al., 2020; Shariff et al., 2023; Vieira et al., 2019). *Sechium edule*'s bioactive compounds, including polysaccharides, could be explored for their nutraceutical potential. Future studies may focus on isolating and purifying these compounds for use in dietary supplements or pharmaceutical formulations targeting specific health conditions. This avenue holds promise for the development of natural, plant-based therapeutics (Castro-Alves, 2017; Castro-Alves & Do Nascimento, 2016; Ke, Deng, et al., 2023; Ke, Zhang, et al., 2023; Shiga et al., 2015).

In light of growing concerns about sustainability worldwide, future studies on Chayote may investigate ecologically friendly farming methods. To ensure the long-term survival of *Sechium edule* as a priceless agricultural resource, this includes investigating optimal cultivation practices, crop rotation strategies, and sustainable farming techniques. The prospective directions discussed here highlight the potential that *Sechium edule* has to offer as a scientific inquiry going forward, providing chances for advancement, enhancement, and sustainable utilization.

7. Conclusion

This review emphasizes the nutritional value, health benefits, and existence of bioactive polysaccharides of *Sechium edule*, popularly known as Chayote, highlighting the plant's diverse characteristics. This work highlights the significance of taking *Sechium edule* into account as a beneficial part of a healthy diet and a possible source of bioactive compounds with medicinal capabilities by synthesizing the literature.

Sechium edule's nutritional composition includes a wide range of vitamins, minerals, and dietary fibre. Its anti-inflammatory, antioxidant, and anti-diabetic qualities, among other possible health advantages, establish it as a functional diet with implications for overall well-being. The review explores the physiological impacts and structural features of the bioactive polysaccharides present in *Sechium edule*. The immunomodulatory and anti-cancer properties of these polysaccharides point to possible therapeutic uses. Beyond its medicinal properties, *Sechium edule* has a rather diverse range of culinary applications. Its popularity is influenced by its historical applications in many different international cuisines, its modern uses in creative dishes, and its promise as a nutrient-dense, low-calorie ingredient in cooking for health-conscious cooks.

The paper concludes by proposing future directions for research on *Sechium edule*. These include the creation of healthy food products, the investigation of novel bioactive substances, genetic engineering for improved nutrition, and sustainable agriculture methods. These paths offer intriguing opportunities to further explore *Sechium edule*'s potential. Considering all things, *Sechium edule* is not only a tasty and adaptable vegetable but also a possible ally in fostering wellness and averting illness. Research and focus should be directed toward the whole range of benefits of *Sechium edule* into diet trends.

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Conflict of interest

The author declares no conflict of interest.

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