Accepted manuscript

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation

Etnobotánica de *Sechium edule* (Jacq.) Sw.: de las prácticas ancestrales a la innovación científica

LUIS ÁNGEL BARRERA-GUZMÁN[1, 3]

HÉCTOR TECUMSHÉ MOJICA-ZÁRATE[1, 4]

JORGE CADENA-IÑIGUEZ[2, 3]

VÍCTOR MANUEL CISNEROS-SOLANO[1, 3]

JUAN ÁNGEL TINOCO-RUEDA[1]

JUAN GUILLERMO CRUZ-CASTILLO[1]

[1] Universidad Autónoma Chapingo, Centro Regional Universitario Oriente, Huatusco de Chicuellar (Mexico)

[2] Colegio de Postgraduados, Campus San Luis Potosí, San Luis Potosí (Mexico)

[3] Interdisciplinary Research Group of *Sechium edule* in México (GISeM), Texcoco (Mexico)

[4] Corresponding author. hectortecumshe@gmail.com

Morphological variation of domesticated and semi-domesticated chayotes.
Photos: C.H. Avendaño-Arrazate; J. Cadena-Iñiguez; V.M. Cisneros-Solano; Y.C. Ramírez-Rodas; G.B. Mejía-Montoya

Last name: BARRERA-GUZMÁN / MOJICA-ZÁRATE / CADENA-IÑIGUEZ / CISNEROS-SOLANO / TINOCO-RUEDA / CRUZ-CASTILLO

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

Short title: ETHNOBOTANY OF *SECHIUM EDULE*

Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

Received: 15-09-2024 Accepted: 05-12-2024 Published: 11-03-2025

ABSTRACT

The greatest morphogenetic diversity in wild and cultivated populations of chayote is still located in Mexico and that is where it is most observed and reported. Its use is reduced in Mesoamerica and with more emphasis in those parts of the world where the fruit is classified as introduced. This study includes in the search factors a diversity of local names throughout the globe. In this sense, the primary aim of this review was to recognize the traditional ethnobotanical knowledge of chayote cultivation to preserve it as cultural heritage, an iconic aspect of biodiversity, and the recognition of sustainable practices that encourage research from a pharmaceutical perspective and includes the diversity of local names throughout the globe. Except for the flowers, the entire plant has anthropocentric and ethnobotanical uses. Its traditional uses are concentrated on food and pharmaceuticals. This field of health includes alcoholic extracts and cucurbitacins for the treatment of various diseases including cancer. Chayote represents a valuable resource, its ancestral – rational use establishes current benefits that range from food, medicine, scientific research as well as its conservation. In current medicine, the uses of chayote include the attenuation of the symptoms of diabetes, certain heart diseases and carcinogenic diseases without ignoring the nutritional part, being a rich source of antioxidants. Wild species related to *S. edule* also play a significant role, as they exhibit valuable anthropocentric applications.

Additional key words: morphogenetic diversity; toponymy; cultural heritage; biodiversity; alcoholic extracts; cucurbitacins.

RESUMEN

El chayote es un cultivo infrautilizado en regiones de Mesoamérica y en diversas partes del mundo como especie introducida. México es el país donde se observa y reporta la mayor diversidad morfogenética en poblaciones silvestres y cultivadas de chayote. Uno de los factores de búsqueda fue incluir las diversas toponimias con las que el chayote es denominado a nivel mundial. El objetivo de esta revisión fue examinar los conocimientos tradicionales etnobotánicos de chayote en aras de preservar el patrimonio cultural, fomentar la biodiversidad, así como promover prácticas sostenibles e incentivar la investigación en el ámbito farmacéutico, e incluir las diversidad toponimias con las que el chayote es denominado a nivel mundial. A excepción de las flores, toda la planta tiene uso antropocéntrico y etnobotánico. Las aplicaciones se concentran básicamente en alimentación y usos farmacéuticos, principalmente en extractos alcohólicos y cucurbitacinas para el tratamiento de diversas enfermedades. Los usos tradicionales radican en tratamientos para regular la diabetes, problemas coronarios y como una rica fuente de antioxidantes; en investigaciones modernas subrayan su uso en enfermades cancerígenas. El chayote es un importante recurso ancestral que ofrece una amplia gama de beneficios para la alimentación, la medicina y la investigación científica, recalcando la importancia de su conservación y uso racional. Las especies silvestres relacionadas con *S. edule* también juegan un papel importante, ya que también se destacan valiosas aplicaciones antropocéntricas.

Palabras clave adicionales: diversidad morfogenética; toponimia; patrimonio cultural; biodiversidad; extractos alcohólicos; cucurbitacinas.

INTRODUCTION

Mexico is the center of origin, domestication and diversification of chayote (*Sechium edule* (Jacq.) Sw.), where its morphological structures (fruits, stems, leaves and roots) are mainly used as food and with wide potential for industry and pharmaceuticals (Newstrom, 1990, 1991; Lira *et al*., 1996, 1999; Cross *et al*., 2006; Avendaño-Arrazate *et al*., 2017). The mesophyll forest regions, located in the states of Veracruz, Puebla, Morelos, Oaxaca, Chiapas and Guerrero, have specific edaphoclimatic characteristics that promote the optimal growth and development of wild and cultivated populations of *S. edule*, as well as phylogenetically related species such as *S. compositum* (Donn. Sm.) C. Jeffrey and *S. chinantlense* Lira & F. Chiang (Newstrom, 1990; Lira *et al*., 1999; Cadena-Iñiguez and Arévalo-Galarza, 2011; Cadena-Iñiguez *et al*., 2022).

The Mexican chayote shows great morphological and genetic diversity, which is due to the biological interactions between its cultivated and wild populations, as well as the eco-geographic and cultural richness of the country. This has led to the discovery of domesticated populations that differ in morphological characteristics of the fruit, such as color, shape, size, texture, flavor and the presence or absence or thorns, which are the main criteria for naming the varietal

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

complexes described by Cadena-Iñiguez and Arévalo-Galarza (2011). Despite the morphogenetic diversity, only varieties of the *S. edule* var. *virens levis* complex are used commercially, which has uniform, light green, thornless, pear-shaped fruits and a neutral flavor. Generally, the populations of smooth-green cultivated chayote are the ones that have been most successfully introduced in different regions of the world.

The word “chayote” comes from the Nahuatl word “huitz ayotl” (thorny gourd), however, there is a rich source of linguistic variants and toponyms to name this species (Newstrom, 1990; Moreira, 2015). Archaeological evidence indicates that chayote was cultivated by the Mayan civilization in the 8th century BC, and they related it to the female gender. On the other hand, there were already indications and records of classifications of chayote populations based on their shape (spherical and elongated) and colors (green and white) (Moreira, 2015). Its introduction to other parts of the world occurred gradually. In Costa Rica and Central American countries, it was introduced in the following centuries (Newstrom, 1991); until the 18th century it was introduced to Europe and Africa (Lira *et al*., 1996); At the end of the 19th century, it was brought to Asia, mainly to China, where it is known as “Buddha's palm-melon” (Walters, 1989). Chayote fruits are used and appreciated worldwide for their nutritional value; however, other structures such as tender shoots, leaves and roots are also used. There is a wide variety of traditional and cultural knowledge that must be perpetuated to safeguard this valuable plant genetic resource.

The aim of this review was to compile and analyze the traditional ethnobotanical knowledge of *Sechium edule* to highlight its cultural significance and potential applications, fostering interest in sustainable cultivation practices and further research into its medicinal properties.

MATERIALS AND METHODS

This review paper was conducted through a comprehensive analysis of the existing scientific literature on *Sechium edule* (chayote), focusing on its ethnobotanical aspects, biofunctional applications, medicinal properties, and biotechnological advancements. A systematic search was performed in well-established academic databases such as PubMed, Scopus, Web of Science, and Google Scholar. Combinations of keywords such as "*Sechium edule*", "ethnobotany", "morphogenetics", "biodiversity", "genetic improvement", "medicinal properties", and "biotechnology" were used. Papers published in English and Spanish were included, covering a range from historical research to recent studies. The inclusion criteria focused on aspects relevant

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

to the objectives of the review, specifically studies published in peer-reviewed, high-impact journals. For the exclusion criteria, duplicate works, articles with insufficient information or unclear methodologies, and non-verifiable grey literature were excluded. The collected information was classified into thematic categories, including origin and domestication, genetic diversity, geographical distribution, traditional uses, medicinal applications, and biotechnological perspectives. For each category, similarities, divergences, and knowledge gaps were identified. The selected studies were critically evaluated based on their methodological rigor, thematic relevance, and scientific validity. Additionally, the recency of the references was verified to ensure the reliability of the information presented.

RESULTS AND DISCUSSION

Origin and domestication

The sequencing of chloroplast genes, intergenic spacers and an exhaustive analysis of biogeography and vicariance determined that Asia is the center of origin for the Cucurbitaceae (Schaefer *et al*., 2009). Transoceanic dispersals distributed the different lineages to other continents and key biodiversity regions, such as Mesoamerica. The *Sechium* genus began to diverge approximately 15 million years ago (Kumar *et al*., 2016), in two major clades: the Mexican and the Central American. *Sechium edule* is the representative species of the genus due to its anthropogenic importance. Linguistic evidence and the endemism of most *Sechium* species suggest that they all originated in Mesoamerica.

In particular, *S. edule* presents high morphogenetic diversity in southeastern Mexico and Guatemala, and with the presence of related wild species such as *S. compositum*, it is indicated that chayote was domesticated in the Chiapas-Oaxaca region, Mexico (Newstrom, 1991), where native Indians classified the fruits by morphological characteristics such as color, size and the presence of thorns (Moreira, 2015). On the other hand, most of the morphological diversity of these species is found in this geographic region and where wild populations have been found (Newstrom, 1990; Cadena-Iñiguez, 2005; Cross *et al*., 2006; Cadena-Iñiguez *et al*., 2008). In cucurbits, the main artificial selection criteria were related to the selection of large fruits, lower bitterness content (cucurbitacins) and large seeds, which are also a highly valued structure for

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

consumption (Bisognin, 2002). The Mayans cultivated chayote and according to the codices, they represented it with drawings of vines, spherical and elongated fruits of various shades of green.

In chayote-producing municipalities in Chiapas, Mexico, an ethno-agronomic study determined that pests and diseases are the main limitations in production and that they are generally controlled with chemical products, which can lead to modifying the physical-chemical structures of the soil. It is important to mention that these practices are only carried out during fruiting periods and predominantly in rainy seasons (Rodríguez-Larramendi *et al*., 2017), that is, radical actions are taken when these factors substantially affect the crop. On the other hand, the protection of the harvested fruits can be a vitally important activity, since it prevents them from germinating or changing their physical properties. In cold regions of India, farmers carry out an activity called "shezing", which consists of digging a small hole, covering it with straw and covering the surface with wood. Within this structure, different vegetables such as chayote are stored and, in this way, there is economic savings in terms of energy and input costs (Naveen *et al*., 2021; Ramírez-Rodas *et al*., 2021).

Geographical distribution

Cultivated and wild populations of *S. edule* are found mainly in the state of Veracruz, Mexico, where they show their greatest phenotypic plasticity, but there are also reports of high genetic diversity in non-neighboring states such as Jalisco and Michoacan through molecular markers (Rodríguez-Sahagún *et al*., 2023). Wild forms of chayote are also found in Guerrero and Oaxaca but with a certain phenotypic homogeneity (Lira *et al*., 1999). Geographic information systems allow the evaluation and understanding of the ecological niche of the species through machine learning algorithms. In this way, suitability has been found in various physiographic subprovinces of Mexico with a predominance in type C climates (Köppen classification) in the states of Chiapas, Guerrero, Oaxaca, Veracruz, Tabasco, Puebla, and Hidalgo (Barrera-Guzmán *et al*., 2022). Chayote is a crop that shows good adaptability in tropical and subtropical regions, where it acts as an introduced species but shows little morphological diversity, that is, most of these populations are green and rarely with thorns.

High suitability areas in Mexico coincide with the presence of species related to *S. edule: S. chinantlense* and *S. compositum* (Cross *et al*., 2006). The varietal complexes *virens levis, nigrum spinosum, nigrum xalapensis, albus dulcis* and *albus minor* are also distributed in these regions

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

(González-Santos *et al*., 2017). The risk of genetic erosion in these places is mainly due to the presence of new improved varieties that are displacing semi-domesticated populations, which generally have fruits with morphological characteristics not suitable for the market, such as the presence of thorns, small size and bitter taste. In addition, the introduction of crops such as avocado, sugarcane and coffee cause a decrease in *S. edule* populations (Cadena-Iñiguez, 2005).

Genetic diversity and cultivars

The genetic diversity of *S. edule* is well documented with various molecular markers, which are based on isoenzymes (Abdelnour and Rocha, 2008), direct amplification markers with microsatellite DNA (DAMD) (Jain *et al*., 2017), microsatellites (Machida-Hirano *et al*., 2015; Shi *et al*., 2023), inverse sequence tagged repeat (ISTR) with random amplified polymorphic DNA (RAPD) (Kapoor *et al*., 2014; Rodríguez-Sahagún *et al*., 2023), single nucleotide plymorphisms (SNP) (Wang *et al*., 2024), amplified fragment length polymorphism (AFLP) (Iñiguez-Luna *et al*., 2021), inter simple sequence repeat (ISSR) (Verma *et al*., 2017) among others. In general, the results indicate heterozygosity rates in wild populations and those with green fruits and thorns, which highlights the importance of preserving these materials (Avendaño-Arrazate *et al*., 2012).

Genetic improvement in chayote has been basically by stratified visual mass selection methods and through a farmer-researcher relationship with the transfer of knowledge related to the management and agronomic characteristics of interest of the seed (pear-shaped or spherical, color, size, thin guides, short internodes, health, absence of ribs or grooves in the fruit, no thorns, less fiber in the fruit, mainly) (Cadena-Iñiguez *et al*., 2013a). Commercial cultivars of chayote are mostly green and yellow such as cañitas, campiña, ventlali, caldero, cambray, nejalpa, chavi, vicis (fruit with thorns) and bitter variants of *S. compositum* for the pharmaceutical industry such as ‘malpaso’ and ‘talismán’. There are also more variants produced by crossing *S. edule*×*S. compositum* (Cadena-Iñiguez *et al*., 2013a) for pharmaceutical applications.

Hybridizations in chayote occur naturally, including with other species of the Mexican clade. However, the stability and fertility of the progeny is complicated by various genetic and ecological issues. The exploitation of heterosis in chayote has been little explored and studied due to the complexity, biology of the plant, seed protection issues and the monitoring it requires. Although hybridizations have been carried out to improve aspects of cucurbitacin content in wild

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

populations (Avendaño-Arrazate *et al*., 2017), quantitative genetic studies are required to demonstrate the effectiveness of selection or hybridization methods in terms of agronomic characteristics such as yield components. Moreover, chayote has been cultivated *in vitro* as a conservation strategy, as well as for the extraction of alcoholic compounds to analyze their antiproliferative effect on cancer cells (Cadena-Iñiguez *et al*., 2013b; Aguiñiga-Sánchez *et al*., 2017; Cruz-Martínez *et al*., 2017).

Traditional uses

Human feeding

Chayote fruits are the main edible structure and the base for the preparation of numerous dishes in Mesoamerica and in various parts of the world. In Asia, the tender shoots, leaves, seeds, roots and fruits are consumed, which are boiled, sautéed, fried, are a component of soups (Cheng *et al*., 2024) and the roots as substitutes for starch sources (Cheng *et al*., 2023). Particularly in India, chayote is grown traditionally or in the backyards of houses for self-consumption, however, because it is a perishable fruit, considerable losses are incurred, so it is dehydrated and a product called "*petha*" is generated, in which the handling and the amount of lime and sugar affects the organoleptic of the final product. In this way, product losses are reduced, and it has a longer lifespan (Taynath *et al*., 2020).

In North Macedonia, *S. edule* var. *albus spinosum* (a yellow fruit with slight thorns known as “mirliton”) was introduced to evaluate its agronomic response and positive results were obtained. It is a crop that has great expectations due to its nutritional properties, however, it is used as a garden plant and is rarely found in local markets (Dimitrovski, 2022). In Indonesia, chayote is locally known as “jipang” or “labusiam” and is consumed as a vegetable; when the harvest is abundant, the remainder is used to feed livestock; although it can also be used and processed as flour to feed pigs (Lalthansanga and Samanta, 2015). On the other hand, it is used in the preparation of a sweet called “dodol”, which in its original form is made with rice flour, sugar and coconut milk; but with the addition of chayote, this product is nutritionally enhanced, and its sale price is higher than that of chayote itself and can be preserved much longer (Arief *et al*., 2021).

In Malaysia, it was concluded that chayote sprouts are rich in antioxidants and minerals, so their consumption along with the fruits is encouraged (Shariff *et al*., 2023); also in Indonesia, the tendrils are consumed in traditional dishes such as "sayur" (vegetable soup that can be accompanied with coconut milk) and "kolek" (dessert made from banana, sweet potatoes, coconut milk and palm sugar). In Taiwan, it is known as "long xü cü" (vegetable with dragon whiskers) and the leaves are also used for infusions (Lim, 2012).

In Mexico, the fruits are mainly used for human consumption and for the preparation of a wide range of dishes. However, the roots, also known as "chayocamote", "chayotestle" and "inchintla" have multiple applications in Mexican cuisine. This trend of consuming roots extends to countries such as El Salvador, where they are consumed with cheese, sauces and accompanied by various vegetables such as jicama. The roots are an excellent option to create gluten-free products (Victoriano *et al*., 2017); even the flours are used to make cookies with a high content of macronutrients and minerals (Sakung *et al*., 2021). The Totonac and Nahua indigenous people of the Sierra Norte of Puebla had a wide range of horticultural products that they used and combined to enrich their gastronomy. For example, the "bean tamale" or "Pulak´la" (name of Totonac origin) was prepared with beans, chayote leaves, chili, plantain and corn dough. These crops, together with others, provided fiber, carbohydrates, vitamins, minerals and antioxidants (Lugo-Morin, 2022).

Chayotes also differ in terms of resistance to pests and diseases, flowering, fruiting periods, as well as adaptability to climate and altitude (Rubí-Zeledón *et al*., 2019). In the United States, chayote was introduced from Mesoamerica and the Caribbean through Haitian communities, where the fruit was small, unstilted, and thorny. This market disliked the presence of thorns, but still consumed it without the need to peel it, that is, they cut the fruits in half and then boiled them until the pulp could be extracted (Hill, 2022).

In Costa Rica, fruits, seeds, quelites, and roots are used to accompany or prepare dishes such as picadillos, sweets, chancletas, honey, cajeta, soups, cakes, jams, meat stew, and mixed with eggs. Due to its importance, since 2007 the chayote fair has been held in Ujarras, Paraiso, where the variability of ways of consuming this species is shown (González-Arce *et al*., 2021). Other species related to *S. edule* also have important anthropocentric applications. For example, the fruits of *S. tacaco* (a species native to the mountainous regions of Costa Rica), which are also known as "tacaco", "tacaquillo", "tacaquillo del monte", "pepino del monte" (Wunderlin, 1976), are consumed cooked in soups, rice, and mixed with various types of meat and vegetables (Hidalgo-Víquez *et al*., 2023). They can also be consumed unripe or raw to avoid the presence of fiber and hardening of the shell and thorns (Cerdas-Araya and Castro-Chinchilla, 2017). Alcoholic extracts of *S. pittieri* have insecticidal and deterrent activity against whitefly (*Bemisia tabaci*) in tomato plantations (Flores *et al*., 2008) and to combat *Hypsipyla grandella* larvae in mahogany forest plantations (*Swietenia macrophylla* King) (Mancebo *et al*., 2001; Soto *et al*., 2007).

In Papua New Guinea, *S. edule* is known as "choyote" or "choko" and its fruits and quelites are eaten in various ways, where most of the cultivation occurs in backyard areas with considerable displays of phenotypic variability (Tarepe and Bourke, 1982). In India, the fruits are added to salads or sauces where they are marinated with acidic citrus fruits either raw or cooked; the sprouts are consumed stir-fried. In Nepal it is known as "iscus" and is used to make curry (Kapoor *et al*., 2014); while in Australia it is seasoned with butter, salt, pepper and the fruits can be stuffed, baked or fried. In Italy, there are widely cultivated chayote varieties such as white-yellow with thorns and smooth green with wide culinary applications (La Mantia, 2020).

In the sport sector, the consumption of beverages is important to obtain high physical performance. Zárate-Castillo *et al*. (2018) formulated a chayote drink with lime juice [*Citrus×latifolia Tanaka ex Q. Jiménez*], which through hedonic tests obtained an acceptance of 85%. However, this drink can be enriched and made attractive with the addition of L-carnitine (Miranda-Yuquilema and Totoy-Cuji, 2024).

Medicinal

The consumption of fruits and vegetables has a beneficial effect on human health, but it is important to emphasize and investigate all the properties that a particular species can have. In recent decades, the use of alcoholic extracts of *S. edule* for the pharmaceutical industry has intensified. It is important to mention that previous experimental studies are important for future applications in humans, for example, some compounds from the fruits have been supplied to diabetic rats where their blood glucose levels have been regulated (Lukiati *et al*., 2019) and the levels of hemoglobin and hematocrit have increased in experimental rats (Zuhrawati *et al*., 2015).

Both the pulp, juice and extracts of chayote have countless medicinal, nutritional and pharmaceutical uses, since calcium oxalate, inulin, pectins, starch and mucilage have been found

(Mejía-Doria *et al*., 2023). For example, it serves as a booster and ingredient in products against UV radiation (Anggraeni *et al*., 2024); its consumption fresh or cooked provides few calories and can eliminate toxins from the body (Cheng *et al*., 2024); in Indonesia it is used to solve gastrointestinal problems such as constipation (Asmira, 2015), just to mention a few.

Chayote has chemical compounds such as vitamins, phenolic acids, flavonoids, carotenoids, terpenes, polyphenols, phytosterols, cucurbitacins that have been linked to antibacterial, anti-inflammatory, hepatoprotective, antioxidant and antiproliferative activity. Various studies have found that chayote has antigenotoxic activity (Madrigal-Santillán *et al*., 2024); protection of the cardiovascular system (Froldi, 2023); in Mayan culture it is still used to treat kidney diseases (Castañeda *et al*., 2023); as an agent to treat diabetes through its hypoglycemic, antioxidant and cell protective effects (Mejía *et al*., 2019; Huerta-Reyes *et al*., 2022); the fresh fruit has properties to lower blood pressure and regulate cholesterol levels (Daulay *et al*., 2021).

Scientific research and modern applications

The use of molecular biology in conjunction with sophisticated laboratory equipment makes it possible to maximize research on *S. edule*. The effects of alcoholic extracts are the most studied raw material in chayote fruits. Thus, the fruits of the Black Pearl variety of chayote (*S. edule* var. *nigrum minor* and *S. edule* var. *amarus silvestrys*) have antineoplastic activity in the HeLaP-388 and L-929 cell lines (Monroy-Vázquez *et al*., 2009; Salazar-Aguilar *et al*., 2017), although decades ago there was already a record of a compound called sechiumina, to which anticancer properties were attributed (Wu *et al*., 1998). Alcoholic extracts of fruits decrease the levels of agents related to coronary diseases and significantly increase high-density cholesterol levels (Neeraja *et al*., 2015). S. *edule* var. *nigrum spinosum* dried fruit powder has significant effects in reducing oxidative stress, which helps combat metabolic syndrome problems in older adults (Gavia-García *et al*., 2023).

The 36 alcoholic extracts of *S. edule* from roots and fruits have blood pressure-lowering effects (Lombardo-Earl *et al*., 2014; Fauziah *et al*., 2019); they also act as regulators of blood glucose levels (Maity *et al*., 2013; Siahaan, 2017); they protect the intestinal mucosa (Sateesh *et al*., 2012) and have antibacterial activity against gram-negative *Escherichia coli* ATCC 8739, *Salmonella typhimurium* ATCC 3224 and *Shigella flexneri* ATCC 12022 (Sibi *et al*., 2013). Other important discoveries about the chemical compounds of *S. edule* are that they have

Barrera-Guzmán, L.A., H.T. Mojica-Zárate, J. Cadena-Iñiguez, V.M. Cisneros-Solano, J.A. Tinoco-Rueda, and J.G. Cruz-Castillo. 2025. Ethnobotany of *Sechium edule* (Jacq.) Sw.: from ancestral practices to scientific innovation. Revista Colombiana de Ciencias Hortícolas 19(1), e18144. Doi: https://doi.org/10.17584/rcch.2025v19i1.18144

antioxidant effects and could decrease the effects of telomere shortening in chromosomes, which is an intrinsic characteristic in people with metabolic syndrome (Arista-Ugalde *et al*., 2022; Gavia-García *et al*., 2023). The saponins of *S. pittieri* (Cogn.) C. Jeffrey and *S. talamancense* ((Wunderlin) C. Jeffrey) show antiproliferative activity against MK-1, HeLa and B16F10 cells (Castro *et al*., 1997).

CONCLUSION

Chayote morphological structures are widely used in gastronomic, medicinal, industrial and pharmaceutical fields. Records and uses of this important crop have been kept since pre-Columbian times. The main characteristics that were selected were based on large, thorn-free fruits with a neutral flavor. Morphogenetic diversity in Mexico indicates the cultural and biological relevance, as well as the need for conservation at the level of cultivated and wild populations. Ethnobotanical knowledge highlights the importance of traditional knowledge to promote sustainability and biodiversity management. On the other hand, medicinal and pharmaceutical applications are the opening for new fields of scientific research. Wild species related to *S. edule* play an important role in the population dynamics of the genus in which valuable anthropocentric applications stand out. Chayote stands out for its nutritional content, rich in antioxidants, vitamins, minerals, and dietary fiber, as well as its potential to prevent chronic diseases such as diabetes and cardiovascular conditions. Additionally, the potential of biotechnology in chayote breeding is noteworthy, particularly in the identification of genetic markers to enable more efficient marker-assisted selection, germplasm conservation, and the development of varieties resistant to pests, diseases, and climate changes.

Conflict of interests: The manuscript was prepared and reviewed with the participation of the authors, who declare that there exists no conflict of interest that puts at risk the validity of the presented results.

Author's contributions: Barrera-Guzmán, L.A.: paper writing and information analysis; Mojica-Zárate, H.T.: Information analysis and paper translation; Cadena-Iñiguez, J.: Information search and analysis; Cisneros-Solano, V.M.: Information analysis; Tinoco-Rueda, J.A.: Meta-analysis and Cruz-Castillo, J.G.; Information analysis.

This research has no funding sources

Open data: This research has open data access under the Open Science movement.

BIBLIOGRAPHIC REFERENCES

Abdelnour, A. and O.J. Rocha. 2008. Genetic characterization of a collection chayote, *Sechium edule* (Jacq.) Swartz, in Costa Rica by using isozyme markers. Genet. Resour. Crop Evol. 55(1), 163-170. Doi: https://doi.org/10.1007/s10722-007-9225-6

Aguiñiga-Sánchez, I., J. Cadena-Íñiguez, E. Santiago-Osorio, G. Gómez-García, V.M. Mendoza-Núñez, J. Rosado-Pérez, M. Ruíz-Ramos, V.M. Cisneros-Solano, E. Ledesma-Martínez, A.J. Delgado-Bordonave, and R.M. Soto-Hernández. 2017. Chemical analyses and *in vitro* and *in vivo* toxicity of fruit methanol extract of *Sechium edule* var. *nigrum spinosum*. Pharm. Biol. 55(1), 1638-1645. Doi: https://doi.org/10.1080/13880209.2017.1316746

Anggraeni, B., A. Aminah, and M. Fawwaz. 2024. UV-protection activities of Labu Siam (*Sechium edule*) extract based on sun protection factor (SPF). Pharm. Rep. 3(1), 19-21. Doi: https://doi.org/10.33096/pharmrep.v3i1.287

Arief, R.W., N. Soraya, R.D. Tambunan, R. Asnawi, and N. Abdullah. 2021. Diversify the processing of chayote (*Sechium edule*) into dodol to increase its added value. IOP Conf. Ser. Earth Environ. Sci. 807(3), 032048. Doi: https://doi.org/10.1088/1755-1315/807/3/032048

Arista-Ugalde, T.L., E. Santiago-Osorio, A. Monroy-García, J. Rosado-Pérez, I. Aguiñiga-Sánchez, J. Cadena-Iñiguez, G. Gavia-García, and V.M. Mendoza-Núñez. 2022. Antioxidant and anti-inflammatory effect of the consumption of powdered concentrate of *Sechium edule* var. n*igrum spinosum* in Mexican older adults with metabolic syndrome. Antioxidants 11(6), 1076. Doi: https://doi.org/10.3390/antiox11061076

Asmira, S. 2015. Pengaruh penggunaan labu siam (*Sechium edule*) dengan konsentrasi yang berbeda terhadap mutu organoleptik dan kadar seratkerupuk Ikan. J. Kesehat. Perintis 2(2), 38-46.

Avendaño-Arrazate, C.H., J. Cadena-Iñiguez, M.L. Arévalo-Galarza, V.M. Cisneros-Solano, J.F. Aguirre-Medina, E. Del Carmen Moreno-Pérez, M. Cortés-Cruz, C.R. Castillo-Martínez, and P. Ramírez-Vallejo. 2012. Genetic variation of an infraspecific chayote complex evaluated by isoenzimatic systems. Pesqui. Agropecu. Bras. 47(2), 244-252. Doi: https://doi.org/10.1590/S0100-204X2012000200013

Avendaño-Arrazate, C.H., J. Cadena-Iñiguez, V.M. Cisneros-Solano, Y.C. Ramírez-Rodas, and G.B. Mejía-Montoya. 2017. Variación morfológica a nivel inter a infraespecífico en *Sechium edule* spp. AgroProductividad 10(9), 58-63.

Barrera-Guzmán, L.A., J. Cadena-Iñiguez, J.P. Legaria-Solano, J. Sahagún-Castellanos, and G. Ramírez-Ojeda. 2022. Potential distribution of domesticated *Sechium edule* (Cucurbitaceae) in Mexico. Acta Biol. Colomb. 27(3), 3. Doi: https://doi.org/10.15446/abc.v27n3.93485

Bisognin, D.A. 2002. Origin and evolution of cultivated cucurbits. Cienc. Rural 32(4), 715-723. Doi: https://doi.org/10.1590/S0103-84782002000400028

Cadena-Iñiguez, J. 2005. Caracterización morfoestructural, fisiológica, química y genética de diferentes tipos de chayote (*Sechium edule*). PhD thesis. Colegio de Postgraduados, Montecillo, Mexico.

Cadena-Iñiguez, J. and M.L.C. Arévalo-Galarza. 2011. Las variedades de chayote (*Sechium edule* (Jacq.) Sw.) y su comercio mundial. Colegio de Postgraduados; Mundi Prensa México, Mexico.

Cadena-Iñiguez, J., C.H. Avendaño-Arrazate, M.L. Arévalo-Galarza, V.M. Cisneros-Solano, L. Del Mar Ruiz-Posadas, J.F. Aguirre-Medina, K. Watanabe, R. Machida-Hirano, and L.A.

Barrera-Guzmán. 2022. Varietal descriptors for the distinction of underutilized varieties of *Sechium edule* (Jacq) Swartz. Plants 11(23), 3309. Doi: https://doi.org/10.3390/plants11233309

Cadena-Iñiguez, J., C.H. Avendaño-Arrazate, V.M. Cisneros-Solano M.L.C. Arévalo Galarza, and J.F. Aguirre Medina. 2013a. Modelo de mejoramiento genético participativo en chayote (*Sechium* spp). Editorial del Colegio de Postgraduados, Montecillo, Mexico.

Cadena-Iñiguez, J., C.H. Avendaño-Arrazate, M. Soto-Hernández, L.M. Ruiz-Posadas, J.F. Aguirre-Medina, and L. Arévalo-Galarza. 2008. Infraspecific variation of *Sechium edule* (Jacq.) Sw. in the state of Veracruz, Mexico. Genet. Resour. Crop Evol. 55(6), 835-847. Doi: https://doi.org/10.1007/s10722-007-9288-4

Cadena-Iñiguez, J., M. Soto-Hernández, A. Torres-Salas, I. Aguiñiga-Sánchez, L. Ruíz-Posadas, A.R. Rivera-Martínez, C.H. Avendaño-Arrazate, and E. Santiago-Osorio. 2013b. The antiproliferative effect of chayote varieties (*Sechium edule* (Jacq.) Sw.) on tumour cell lines. J. Med. Plants Res. 7(8), 455-460. Doi: https://doi.org/10.5897/JMPR12.866

Castañeda, R., A. Cáceres, S.M. Cruz, J.A. Aceituno, E.S. Marroquín, A.C. Barrios Sosa, W.K. Strangman and R.T. Williamson. 2023. Nephroprotective plant species used in traditional Mayan Medicine for renal-associated diseases. J. Ethnopharmacol. 301, 115755. Doi: https://doi.org/10.1016/j.jep.2022.115755

Castro, V.H., E. Ramirez, G.A. Mora, Y. Iwase, T. Nagao, H. Okabe, H. Matsunaga, M. Katano, and M. Mori. 1997. Structures and antiproliferative activity of saponins from *Sechium pittieri* and *S. talamancense*. Chem. Pharm. Bull. 45(2), 349-358. Doi: https://doi.org/10.1248/cpb.45.349

Cerdas-Araya, M. and J. Castro-Chinchilla. 2017. Caracterización postcosecha de frutos de tacaco (*Sechium edule*) en Cartago, Costa Rica. Agron. Mesoam. 28(1), 141-148. Doi: https://doi.org/10.15517/am.v28i1.22039

Cheng, S., Y. Liu, L. Su, X. Liu, Q. Chu, Z. He, X. Zhou, W. Lu, C. Jiang, and W. Zheng. 2023. Physiological, anatomical and quality indexes of root tuber formation and development in chayote (*Sechium edule*). BMC Plant Biol. 23(1), 413. Doi: https://doi.org/10.1186/s12870-023-04427-0

Cheng, Z., S. Lin, Z. Wu, C. Lin, Q. Zhang, C. Xu, J. Li and C. Long. 2024. Study on medicinal food plants in the Gaoligongshan Biosphere Reserve, the richest biocultural diversity center in China. J. Ethnobiol. Ethnomed. 20(1), 10. Doi: https://doi.org/10.1186/s13002-023-00638-9

Cross, H., S.R. Lira, and T.J. Motley. 2006. Origin and diversification of chayote. pp. 171-194. In: Motley, T.J., N. Zerega, and H. Cross (eds.). Darwin's harvest: new approaches to the origins, evolution, and conservation of crops. Columbia University Press, New York, NY. Doi: https://doi.org/10.7312/motl13316-009

Cruz-Martínez, V., O.A. Castellanos-Hernández, G.J. Acevedo-Hernández, M.I. Torres-Morán, M. Gutiérrez-Lomelí, D. Ruvalcaba-Ruiz, F. Zurita, and A. Rodríguez-Sahagún. 2017. Evaluación de la fidelidad genética en plantas de *Sechium edule* regeneradas *vía* organogénesis. S. Afr. J. Bot. 112, 118-122. Doi: https://doi.org/10.1016/j.sajb.2017.05.020

Daulay, A.S., N. Ridwanto, R.A. Syahputra, and A. Nafitri. 2021. Antioxidant activity test of chayote (*Sechium edule* (Jacq.) Swartz) ethanol extract using DPPH method. J. Phys. Conf. Ser. 1819(1), 012035. Doi: https://doi.org/10.1088/1742-6596/1819/1/012035

Dimitrovski, T. 2022. Evaluation of the tropical cucurbit chayote *Sechium edule* (Jacq.) Sw. Var. Albus spinosum under the temperate climate conditions of North Macedonia. ISPEC J. Agric. Sci. 6(1), 154-167. Doi: https://doi.org/10.46291/ISPECJASvol6iss1pp154-167

Fauziah, N.A., K. Hidajati, and A. Soejoenoes. 2019. The effect of chayote extract (*Sechium edule*) on blood pressure in pregnant women with hypertension. Indones. J. Med. 4(3), 266-277. Doi: https://doi.org/10.26911/theijmed.2019.04.03.10

Flores, G., L. Hilje, G.A. Mora, and M. Carballo. 2008. Antifeedant activity of botanical crude extracts and their fractions on *Bemisia tabaci* (Homoptera: Aleyrodidae) adults: II. *Sechium pittieri* (Cucurbitaceae). Rev. Biol. Trop. 56(4), 2115-2129. Doi: https://doi.org/10.15517/rbt.v56i4.5782

Froldi, G. 2023. The use of medicinal plants in blood vessel diseases: the influence of gender. Life 13(4), 866. Doi: https://doi.org/10.3390/life13040866

Gavia-García, G., J. Rosado-Pérez, T.L. Arista-Ugalde, I. Aguiñiga-Sánchez, E. Santiago-Osorio, and V.M. Mendoza-Núñez. 2023. The consumption of *Sechium edule* (chayote) has antioxidant effect and prevents telomere attrition in older adults with metabolic syndrome. Redox Rep. 28(1), 2207323. Doi: https://doi.org/10.1080/13510002.2023.2207323

González-Arce, R., M. Cerdas-Nuñez, and P. Sedó-Masís. 2021. El chayote. Proyecto EC-436 “Cocina Patrimonial de Costa Rica”. In: Escuela de Nutrición, Universidad de Costa Rica. https://museo.ucr.ac.cr/nutricion/n1.html; consulted: May, 2024.

González-Santos, R., J. Cadena-Íñiguez, F.J. Morales-Flores, V.M. Ruiz-Vera and J. Pimentel-López. 2017. Prediction of the effects of climate change on *Sechium edule* (Jacq.) Swartz varietal groups in Mexico. Genet. Resour. Crop Evol. 64(4), 791-804. Doi: https://doi.org/10.1007/s10722-016-0401-4

Hidalgo-Víquez, C., C. Cortés-Herrera, and M. Cerdas-Nuñez. 2023. Generation of analytical food composition data for traditionally consumed fruits and vegetables in Costa Rica. J. Food Compos. Anal. 123, 105546. Doi: https://doi.org/10.1016/j.jfca.2023.105546

Hill, L. 2022. The history of chayote (Mirliton) in the United States: “One of the Noblest Gifts the Vegetable Kingdom Can Offer Man”. In: Mirliton, https://www.mirliton.org/wp-content/uploads/2022/04/The-History-of-Chayote-Mirliton-in-the-United-States-final.pdf; consulted: May, 2024.

Huerta-Reyes, M., R. Tavera-Hernández, J.J. Alvarado-Sansininea, and M. Jiménez-Estrada. 2022. Selected species of the Cucurbitaceae family used in Mexico for the treatment of diabetes mellitus. Molecules 27(11), 3440. Doi: https://doi.org/10.3390/molecules27113440

Iñiguez-Luna, M.I., M.A. Cortés-Cruz, F.J. Morales-Flores, K.N. Watanabe, R. Machida-Hirano, M. Soto-Hernández, C.H. Avendaño-Arrazate, and J. Cadena-Íñiguez. 2021. Variabilidad genética en *Sechium* spp. (Cucurbitaceae) evaluada con marcadores AFLP. Agrociencia 55(7), 611-626. Doi: https://doi.org/10.47163/agrociencia.v55i7.2607

Jain, J.R., B. Timsina, K.B. Satyan, and S.H. Manohar. 2017. A comparative assessment of morphological and molecular diversity among *Sechium edule* (Jacq.) Sw. accessions in India. Biotech 7(2), 106. Doi: https://doi.org/10.1007/s13205-017-0726-5

Kapoor, C., A. Kumar, A. Pattanayak, R. Gopi, H. Kalita, R.K. Avasthe, and S. Bihani. 2014. Genetic diversity in local chow-chow (*Sechium edule* Sw.) germplasm of sikkim. Ind. J. Hill Farming 27(1), 228-237.

Kumar, S., G. Stecher, and K. Tamura. 2016. MEGA7: Molecular evolutionary genetics analysis version 7.0 for bigger datasets. Mol. Biol. Evol. 33(7), 1870-1874. Doi: https://doi.org/10.1093/molbev/msw054

La Mantia, T. 2020. Sulla introduzione e diffusione del *Sechium edule* (Jacq.) Sw. in Sicilia. Nat. Sicil. 444(1-2), 75-84. Doi: https://doi.org/10.5281/zenodo.4095048

Lalthansanga, J. and A.K. Samanta. 2015. Effect of feeding chayote (*Sechium edule*) meal on growth performance and nutrient utilization in indigenous pig (Zovawk) of Mizoram. Vet. World 8(7), 918-923. Doi: https://doi.org/10.14202/vetworld.2015.918-923

Lim, L.K. 2012. Edible medicinal and non-nedicinal plants. Springer, Dordrecht, Netherlands. https://doi.org/10.1007/978-90-481-8661-7

Lira, R., J. Castrejon, S. Zamudio and C. Rojas-Zenteno. 1999. Propuesta de ubicación taxonómica para los chayotes silvestres (*Sechium edule*, Cucurbitaceae) de México. Acta Bot. Mex. (49), 47-61. Doi: https://doi.org/10.21829/abm49.1999.838

Lira, R., J. Heller, and J.M.M. Engels. 1996. Chayote, *Sechium edule* (Jacq.) Sw. pp. 4-49. In: Heller, J., J.M.M. Engels, and K. Hammer (eds.). Promoting the conservation and use of neglected and underutilized crops. No. 8. IPK; IPGRI, Rome.

Lombardo-Earl, G., R. Roman-Ramos, A. Zamilpa, M. Herrera-Ruiz, G. Rosas-Salgado, J. Tortoriello, and E. Jiménez-Ferrer. 2014. Extracts and fractions from edible roots of *Sechium edule* (Jacq.) Sw. with antihypertensive activity. J. Evid. Based Complement. Altern. Med. 2014(1), 594326. Doi: https://doi.org/10.1155/2014/594326

Lugo-Morin, D.R. 2022. Looking into the past to build the future: food, memory, and identity in the indigenous societies of Puebla, Mexico. J. Ethn. Foods 9(1), 7. Doi: https://doi.org/10.1186/s42779-022-00123-w

Lukiati, B., N. Nugrahaningsih, and S.N. Arifah. 2019. The role of *Sechium edule* fruits Ethanolic extract in insulin production and malondialdehyde level in Stz-induced diabetic rat. J. Trop. Biodivers. Biotechnol. 4(1), 11. Doi: https://doi.org/10.22146/jtbb.33948

Machida-Hirano, R., M. Cortés-Cruz, B.A.A. González, J. Cadena-Íñiguez, K. Shirata, and K.N. Watanabe. 2015. Isolation and characterization of novel microsatellite markers in chayote [*Sechium edule* (Jacq.) Sw.]. Am. J. Plant Sci. 6(13), 2033-2041. Doi: https://doi.org/10.4236/ajps.2015.613203

Madrigal-Santillán, E., J. Portillo-Reyes, J.A. Morales-González, L.F. Garcia-Melo, E. Serra-Pérez, K. Vidović, M. Sánchez-Gutiérrez, I. Álvarez-González, and E. Madrigal-Bujaidar. 2024. Evaluation of the antigenotoxic potential of two types of chayote (*Sechium edule*) juices. Plants 13(15), 2132. Doi: https://doi.org/10.3390/plants13152132

Maity, S., S.M. Firdous, and R. Debnath. 2013. Evaluation of antidiabetic activity of ethanolic extract of *Sechium edule* fruits in alloxan-induced diabetic rats. World J. Pharm. Pharm. Sci. 2, 3612-3621.

Mancebo, F., L. Hilje, G.A. Mora, V.H. Castro, and R. Salazar. 2001. Biological activity of *Ruta chalepensis* (Rutaceae) and *Sechium pittieri* (Cucurbitaceae) extracts on *Hypsipyla grandella* (Lepidoptera: Pyralidae) larvae. Rev. Biol. Trop. 49(2), 501-508.

Mejía Piñeros, A.L. L.M. Pombo Ospina, J.F. Hernández Montaño, M.L. Iregui Piñeros, and J. Ronderos Osorio. 2019. Caracterización etnobotánica de las plantas medicinales empleadas en el tratamiento de las enfermedades cardiometabólicas, Villa de Leyva-Boyacá. Rev. Cuba. Plantas Med. 24(2), 1-22.

Mejía-Doria, C.M., Á.M. Morales-Trujillo, R.S. Suárez-Román, S.R. Barona, and N.M. Apóstolo. 2023. Morphoanatomical study of the *Sechium edule* (Jacq.) Sw. (Cucurbitaceae) fruit due to its potential usefulness in industrial processes. Flora 308, 152388. Doi: https://doi.org/10.1016/j.flora.2023.152388

Miranda-Yuquilema, J. and L.L. Totoy-Cuji. 2024. Chayote (*Sechium edule*) con L-Carnitina una alternativa para obtener bebidas funcionales de consumo humano. Novasinergia 7(1), 149-162. Doi: https://doi.org/10.37135/ns.01.13.09

Monroy-Vázquez, M.E., M. Soto-Hernández, J. Cadena-Iñiguez, E. Santiago-Osorio, L.M. Ruiz-Posadas, and H. Rosas-Acevedo. 2009. Estudio biodirigido de un extracto alcohólico de frutos de *Sechium edule* (Jacq.) Swartz. AgroCiencia 43(8), 777-789.

Moreira, F.A. 2015. Chayote: pre-Columbian origins and dispersal. pp. 89-144. In: Janick, J. (ed.). Horticultural reviews. Vol. 43. Wiley, Hoboken, NJ. Doi: https://doi.org/10.1002/9781119107781.ch02

Naveen, K., C. Singh, M. Kanwat, C. Chanu, H. Kalita, and S. Jinus. 2021. "Shezing" a low cost chow-chow [*Sechium edule* (Jacq) Swartz] storage by Meyor tribes in Anjaw district, Arunachal Pradesh. J. Pharmacogn. Phytochem. 10(1), 509-512. Doi: https://doi.org/10.22271/phyto.2021.v10.i1Sh.13708

Neeraja, K., R. Debnath, and S.M. Firdous. 2015. Cardioprotective activity of fruits of *Sechium edule*. Bangladesh J. Pharmacol. 10(1), 1. Doi: https://doi.org/10.3329/bjp.v10i1.21329

Newstrom, L. 1990. Origin and evolution of chayote, *Sechium edule*. pp. 141-149 In: Bates, D.M., R.W. Robinson, and C. Jeffrey (eds.). Biology and utilization of the Cucurbitaceae. Cornell University Press, Ithaca, NY. Doi: https://doi.org/10.7591/9781501745447-014

Newstrom, L.E. 1991. Evidence for the origin of chayote, *Sechium edule* (Cucurbitaceae). Econ. Bot. 45(3), 410-428. Doi: https://doi.org/10.1007/BF02887082

Ramírez-Rodas, Y., L. Arévalo-Galarza, J. Cadena-Iñiguez, A. Delgado-Alvarado, L. Ruiz-Posadas, and M. Soto-Hernández. 2021. Postharvest storage of three chayote (*Sechium edule* (Jacq.) Sw.) varieties. Sci. Agropecu. 12(2), 239-247. Doi: https://doi.org/10.17268/sci.agropecu.2021.027

Rodríguez-Larramendi, L.A., F. Guevara-Hernandez, R.A.C. Saldaña, M.Á. Salas-Marina, J.C. Gómez-Castañeda, M.L.Á. Fonseca-Flores, L. Valle-Ruíz, and J. Basterrechea-Bermejo. 2017. Traditional knowledge on integrated pest and weed management in chayote (*Sechium edule* (Jacq.) Sw.) crops from localities of Chiapas, Mexico. Acta Agron. 66(4), 466-472. Doi: https://doi.org/10.15446/acag.v66n4.57294

Rodríguez-Sahagún, A., Y. Gómez-Vélez, G.J. Acevedo-Hernández, R.C. Aarland, and O.A. Castellaos-Hernández. 2023. Evaluación de la diversidad genética de poblaciones cultivadas de *Sechium edule* en Jalisco y Michoacán mediante dos marcadores moleculares. E-CUCBA 10(20), 160-165. Doi: https://doi.org/10.32870/ecucba.vi20.308

Rubí-Zeledón, J., O. Varela-Ramírez, L. Granados-Rojas, A. Vargas-Martínez, and K. Villalobos-Moya. 2019. Efecto de la altitud sobre las características morfológicas y sensoriales vinculadas a la calidad del fruto de chayote (*Sechium edule*) tipo "quelite" producido en el Valle de Ujarrás, Costa Rica. Perspect. Rural. 17(33), 17-33.

Sakung, J.M., S. Nuryanti, A. Afadil, S.H.V. Pulukadang, M. Maryam, and M. Mar'atun. 2021. Evaluation of proximate and mineral composition of biscuit formulated using chayote (*Sechium edule*) and mung bean (*Vigna radiata*) flours. Open Access Maced. J. Med. Sci. 9(A), 373-377. Doi: https://doi.org/10.3889/oamjms.2021.6121

Salazar-Aguilar, S., L. Ruiz-Posadas, J. Cadena-Iñiguez, M. Soto-Hernández, E. Santiago-Osorio, I. Aguiñiga-Sánchez, A. Rivera-Martínez, and J. Aguirre-Medina. 2017. *Sechium edule* (Jacq.) Swartz, a new cultivar with antiproliferative potential in a human cervical cancer HeLa cell line. Nutrients 9(8), 798. Doi: https://doi.org/10.3390/nu9080798

Sateesh, G., S.F. Hussaini, G.S. Kumar, and B.S.S. Rao. 2012. Anti-ulcer activity of *Sechium edule* ethanolic fruit extract. Pharm. Innov. J. 1(5), 77-81.

Schaefer, H., C. Heibl and S.S. Renner. 2009. Gourds afloat: A dated phylogeny reveals an Asian origin of the gourd family (Cucurbitaceae) and numerous oversea dispersal events. Proc. R. Soc. B: Biol. Sci. 276(1658), 843-851. Doi: https://doi.org/10.1098/rspb.2008.1447

Shariff, A., N. Hainusa, N. Huda, M. Zakaria, S. Ullah, F. Huyop, and R. Wahab. 2023. Antioxidant activity, total phenolic content, and nutrient composition of chayote shoot (*Sechium edule*, Jacq. Swartz) from Kundasang, Sabah. J. Trop. Life Sci. 13(1), 147-156. Doi: https://doi.org/10.11594/jtls.13.01.15

Shi, M., Y. Wang, S.G. Olvera-Vazquez, J. Cadena Iñiguez, M.S. Thein and K.N. Watanabe. 2023. Comparison of chayote (*Sechium edule* (Jacq.) Sw.) accessions from Mexico, Japan, and

Myanmar using reproductive characters and microsatellite markers. Plants 12(3), 476. Doi: https://doi.org/10.3390/plants12030476

Siahaan, J.M. 2017. Effect of antihipoglycemic *Sechium edule* Jacq. Swartz. etanol extract on histopathologic changes in hyperglycemic *Mus musculus* L. Indones. J. Med. 2(2), 86-93. Doi: https://doi.org/10.26911/theijmed.2017.02.02.02

Sibi, G., K. Kaushik, K. Dhananjaya, K.R. Ravikumar, and H. Mallesha. 2013. Antibacterial activity of *Sechium edule* (Jacq.) Swartz against gram negative food borne bacteria. Adv. Appl. Sci. Res. 4(2), 259-261.

Soto, F., L. Hilje, G.A. Mora, M.E. Aguilar, and M. Carballo. 2007. Systemic activity of plant extracts in *Cedrela odorata* (Meliaceae) seedlings and their biological activity on *Hypsipyla grandella* (Lepidoptera: Pyralidae) larvae. Agric. Forest Entomol. 9(3), 221-226. Doi: https://doi.org/10.1111/j.1461-9563.2007.00338.x

Tarepe, T. and R. Bourke. 1982. Fruit crops in the Papua New Guinea highlands. pp. 86-100. In: Bourke, R.M. and V. Kesavan (eds.). Proceedings of the Second Papua New Guinea Food Crops Conference. Department of Primary Industry, Port Moresby, Papua New Guinea.

Taynath, S.J., B.K. Singh, S. Jena, and P.P. Said. 2020. Optimization of process variables for petha manufacture from chayote (*Sechium edule* Sw.). J. Food Process. Preserv. 44(11), e14872. Doi: https://doi.org/10.1111/jfpp.14872

Verma, V.K., A. Pandey, A.K. Jha, and S.V. Ngachan. 2017. Genetic characterization of chayote [*Sechium edule* (Jacq.) Swartz.] landraces of North Eastern Hills of India and conservation measure. Physiol. Mol. Biol. Plants 23(4), 911-924. Doi: https://doi.org/10.1007/s12298-017-0478-z

Victoriano, L.G., J.P.H. Uribe, and N.G. Vera. 2017. Chayotextle (*Sechium edule*), posible ingrediente en la elaboración de los productos libres de gluten. Bol. Cienc. Agropecu. ICAP 3(5), 5. Doi: https://doi.org/10.29057/icap.v3i5.2065

Walters, T.W. 1989. Historical overview on domesticated plants in China with special emphasis on the Cucurbitaceae. Econ. Bot. 43(3), 297-313. Doi: https://doi.org/10.1007/BF02858729

Wang, X., S. Shen, Y. Fu, R. Cao, Y. Wei, and X. Song. 2024. High-quality reference genome decoding and population evolution analysis of prickly *Sechium edule*. Hortic. Plant J. Doi: https://doi.org/10.1016/j.hpj.2024.02.007

Wu, T.-H., L.-P. Chow, and J.-Y. Lin. 1998. Sechiumin, a ribosome-inactivating protein from the edible gourd, *Sechium edule* Swartz. Eur. J. Biochem. 255(2), 400-408. Doi: https://doi.org/10.1046/j.1432-1327.1998.2550400.x

Wunderlin, R.P. 1976. Two new species and a new combination in *Frantzia* (Cucurbitaceae). Brittonia 28(2), 239-244. Doi: https://doi.org/10.2307/2805833

Zárate-Castillo, G., O. Rodríguez-Alcalá, L. Bello-Luna, N. Alatriste-Pérez, and N. Tehuintle-Tzitzihua. 2018. Formulación de una bebida hidratante de chayote (*Sechium edule*) y lima persa (*Citrus latifolia* Tanaka). Invest. Desarro. Cienc. Tecnol. Aliment. 3, 446-450.

Zuhrawati, Z., N. Asmilia, A. Rizky, Z. Zuraidawati, N. Nazaruddin, M. Adam, and M. Muttaqien. 2015. Pengaruh pemberian infusa daun labu siam (*Sechium edule*) terhadap kadar hemoglobin dan nilai hematokrit tikus putih (*Rattus norvegicus*) anemia. J. Med. Vet. 9(2), 2. Doi: https://doi.org/10.21157/j.med.vet..v9i2.3945