

# Avocado and Chayote—Two Edible and Medicinal Plants

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**Abstract:** There are two agricultural products originating in Mexico with nutritional, medicinal and cosmetic properties. One is the Avocado, the fruit of a tree that is widely accepted in the Mexican diet due to its pleasant flavor. The other is the Chayote, a green vegetable that grows like a vine, with guides that can exceed up to 6 m in length. These two foods, in addition to being consumed nationally, are also exported, which is why they are of economic importance for Mexico. Avocado is the most exported, after coffee and tomato, with Chayote in fourth place.

**Key words:** Avocado, chayote, food.

## 1. Introduction

There are agricultural products that are part of the Mexican diet, mainly for its pleasant flavor and availability in the market throughout the year, two of them are the Avocado and the Chayote.

Both are an important source of nutrients, since they contain minerals such as potassium, calcium and magnesium mainly, as well as vitamins such as C and B6 among others.

### 1.1 Avocado

The Avocado is a pear-shaped fruit from a tree that can reach 10 m and is tall. It requires that the relief of the soil be flat, not floodable or with a very slight slope, the amount of water must range between 1,000 and 2,000 mm (39.3 and 78.7 inches) per year. The drip irrigation system is very appropriate since up to 50% of the volume of water can be saved. The Hass variety is the most economically important.

It is an important food in the Mexican diet due to its pleasant flavor, which is why it is in great internal and economic demand as it is an agricultural product for export. In 2014, Mexico contributed 30.23% of the total

world production [1], having been the largest producer worldwide.

As food it is consumed raw since it does not require cooking; It can be combined with others to improve the flavor of the dish, such is the case of meats, seafood, rice, salads, sauces, tacos (corn or flour tortilla rolled with Avocado inside), hamburgers, sandwiches (bread with Avocado inside). It has 70% water, the rest is fat, carbohydrates, proteins, minerals and vitamins. Among the minerals are phosphorus, iron and calcium and among the vitamins are B3, B6 and C.

### 1.2 Chayote

Chayote is preferably cultivated between 400 and 1,800 m of altitude. In general terms, this vegetable that goes from dark green to light green has a glossy skin and hard consistency, it can be covered by thorns [2]. It tends to grow where soil conditions are favorable for carrying out some type of agriculture and livestock; and requires moist soils with abundant organic matter. There is a wide variety of Chayotes of various sizes and shapes. Chayote is produced as a crop for national consumption and for export. It is usually eaten cooked in stews, for the preparation of baby food and also in

desserts. The stems and leaves can also be eaten. The stems, due to their flexibility and resistance, are used for the artisan manufacture of basketry and hats. Although Chayote is mainly used for culinary purposes, it can also be used for animal nutrition, pharmaceutical formulations and cosmetic products.

## 2. Materials

### 2.1 Avocado

Genetic evidence allows us to argue that the Avocado domestication process has occurred more than once and that the Mexican variety is one of the varieties that has contributed the most genetic material to modern avocado crops [3].

One of the main producers of Hass Avocado is the Municipality of Tepic Nayarit, Mexico where more than 90% is grown without irrigation since the annual rainfall is 1,220 mm (48.03 inches) on average, distributed from June to October. The soil is of volcanic origin with 30 to 80 cm (0.98 to 2.62 feet) of topsoil, brown color and subsoil from 2 to 40 m made up of a soft material called pumice stone.

Pumice is a rock with high porosity, light (densities between 0.4 and 0.9 g/cm<sup>3</sup>), friable, and is an effective thermal insulator.

The Avocado (*Persea Americana*) is a dicotyleidoneous plant that belongs to the Lauraceae family, along with avocados, cinnamon and laurels (Table 1).

In Avocados, the oval, conical, ovoid, round and pear-shaped shapes predominate. The shell colors are black and green, the latter being the dominant color in

**Table 1 Avocado Taxonomy**

Kingdom	Plants
phylum	Phanerogam
Division	Magnoliophyta
Class	magnoliopsida
Order	Lurales
Family	Lauraceae
Gender	Persea
Scientific name	American Persea Mill

[4]

different shades such as bright, light, dark and yellowish. The bark can be smooth or rough in texture.

The chemical composition of the fruit of the Mexican Creole Avocado is highly variable [5]. This oil, in turn, is made up of 9.48% to 37.13% polyunsaturated fatty acids.

### 2.2 Chayote

There is a great diversity of Chayote of different sizes, shapes, colors and flavors and that correspond to species of the genus *Sechium*, all members of the Cucurbitaceae family (Table 2).

The best known edible species is *Sechium edule* and is native to Mexico and Guatemala, and was domesticated by the Aztecs and Mayas in Pre-Columbian times [6]. In Chayote fruits, leaves and roots, specialized metabolites have been identified such as: cucurbitacins, sterols, saponins, phenols such as flavonoids, tetracyclic terpenes, among others. Some of these metabolites have been described with antihypertensive, antimicrobial, antioxidant, antitumor, nephroprotective, antiinflammatory, and hepatoprotective properties. Based on the above, it could be concluded that the functional properties attributed to Chayote may be due to the variation in the concentration of these compounds [7]. The species *Sechium edule* is a perennial, monoecious and viviparous climbing plant with awned and smooth stems, up to 15 m long, highly branched.

**Table 2 Chayote taxonomy.**

Kingdom	Plants
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Cucurbitales
Family	Cucurbitaceae
Subfamily	Cucurbitoideae
Tribe	Sicyeae
Subtribe	Sicynae
Gender	<i>Sechium</i>

Source: Ref. [8].

The stems have cords of long, strong fibers. The vines grow from a permanent vine and last one to two years.

The fruit is a solitary berry or in pairs on the same peduncle, viviparous, fleshy, indehiscent, with different shapes and sizes and with a sigmoid growth. The exocarp is smooth or finely pubescent, or with spines that vary in number and size, with the presence or absence of grooves and with dark green, light green and white tones.

The mesocarp is dry or soft fleshy, greenish to white in color, formed by a storage parenchyma that is rich in nutrients and with fibers that form a network around the endocarp. The seed is unique, large, ovoid, flattened, smooth, soft and formed by two large cotyledons [9].

### 3. Results

#### 3.1 Avocado

In addition to vitamins, minerals, healthy fats, and fiber, Avocados have bioactive compounds like carotenoids, vitamin C, vitamin E, and phenolic compounds. Avocado is very rich in folic acid (Table 3).

Each fruit contains in its central cavity a seed of varied shape, predominantly round and conical; its color is characterized by presenting different shades of coffee. It also contains nutritional properties (Table 4).

A natural antibiotic is found in avocado seeds. Some studies carried out showed that using the avocado seed a variety of pathogens are inhibited, including *Candida* and the mosquito that carries the tropical disease yellow fever.

#### 3.2 Chayote

Each Chayote has a large, flat seed, called a pepita, which is edible in addition to its pulp. Chayotes commonly weigh around 500 g, (0.035 onz) although some weigh up to 2 kg. (11.02 lb).

They can be used as a tuber replacing the potato, and can be edible for humans and animals such as cattle or pigs (Table 5).

**Table 3 Nutritional contribution in 100 gr of Avocado.**

Energy	233.00 kcal
Protein	1.88 g
Hydrates	0.40 g
Water	67.900 g
Calcium	12.00 mg
Iron	0.49 mg
Iodine	1.00ug
Magnesium	30.00 mg
Zinc	0.40 mg
Selenium	0.40 µg
Sodium	4.70 mg
Potassium	487 mg
Match	6.33 mg
Fiber	23.50 g
Vitamin A	12.00 µg
Vitamin B1	0.08 mg
Vitamin B2	0.15 mg
Vitamin B3	1.42 mg
Vitamin B6	0.36 mg
Vitamin B9	30.00 µg
Vitamin C	6.00 mg
Vitamin E	1.30 µg

Source: Ref. [10].

**Table 4 Amino acid content in Avocado seed.**

Amino acid	Criollo	Hass
Valine	5.55	5.41
Isoleucine	3.83	3.97
Threonine	3.88	3.83
Tryptophan	1.18	0.6
phenylalanine	5.25	5.33
leucine	7.22	7.27
lysine	6.86	6.22
methionine	2.58	1.9
histidine	2.5	1.99
Aspartic acid	10.52	9.72
Serine	5.25	5.88
Glutamic acid	11.76	12.93
Proline	5.21	4.70
wisteria	4.93	5.00
To the girl	5.27	5.61
cysteine	1.19	1.32
tyrosine	2.66	2.85
arginine	6.20	7.56
Protein	4.17	4.27

Source: Ref. [11].

**Table 5** Nutritional value per 100 g of Chayote.

Carbohydrates	4.51 g
Fiber	1.7 g
Fats	0.13 g
Proteins	0.82 g
Water	94.24 g
Thiamine	0.025 mg
Riboflavin	0.029 mg
Niacin	0.470 mg
Vitamin B6	0.76 mg
Vitamin C	7.7 mg
Vitamin E	0.12 mg
vitamin K	4.1 ug
Calcium	17 mg
Iron	0.34 mg
Magnesium	12 mg
Match	18 mg
Potassium	125 mg
Sodium	2 mg
Zinc	0.74 m

Source: Ref. [12].

## 4. Discussion

### 4.1 Avocado

Avocado quality can be determined using the parameters weight, color, shape, external appearance and firmness. In general, the fruits must be whole, healthy, clean; free of pests, visible damage, foreign odor and taste, and damage caused by low temperatures.

The life cycle or longevity of the Avocado is prolonged, reaching 25 years in the Creole varieties and 15 to 18 years in the improved ones.

4 stages are distinguished:

Development in nursery: 7-10 months

Young tree development: 1-4 years

Production development: 4-8 years

Adult in full production: 8-25 years

The most important nutrients for avocado cultivation are nitrogen, potassium and zinc. The temperature influences the fruiting capacity of the Avocado. Temperatures below 15 °C (59 °F) and above 40 °C (104 °F) directly affect the level of fruit set.

In addition to the temperature, other climatic factors that inhibit the development of the fruit are frost,

abundant rains and strong winds during flowering and fruiting.

On the other hand, the avocado fruit is consumed mainly fresh. It is also used frozen with lemon juice and spices (guacamole), as a fermented cheese and its pulp is used to make ice cream. Likewise, oil can be extracted from the pulp, which is used in the manufacture of cosmetics, such as cooking oil and sunscreen.

### 4.2 Chayote

In general terms, this plant has the tendency to inhabit completely abrupt and almost inaccessible areas, where soil conditions are unfavorable for carrying out some type of agriculture and livestock. The conditions of the physical environment where the wild Chayote thrives, generally interact with the Cloud Forest, and in the parts lower is found in areas between the Medium Forest and High Subperennifolia Forest. It requires moist soils with abundant organic matter or humus.

The root or tuber, called huarás, chayotextle or ichintal, is also edible and resembles potatoes. It has a rough appearance and mild flavor. In Mexico and particularly in the State of Michoacán, many stews are made with this root [12].

## 5. Conclusions

### 5.1 Avocado

Avocado is a food with availability all year round. It is widely accepted in the human diet due to its pleasant flavor.

It also contains vitamins, minerals, vitamin C and E and phenolic compounds.

These characteristics make Avocado a nutritious food.

It also has medicinal uses since it has high levels of omega 3 and folic acid, among others, and in cosmetology to prepare creams and shampoo.

### 5.2 Chayote

Chayote is a nutritious food for humans and animals

with availability throughout the year. It can be grown in confined spaces.

You can also take advantage of the seed as well as the stem and leaves.

The stems, due to their flexibility, have the peculiarity of being able to be used in the handmade manufacture of hats and basketry.

It is used for the treatment of several diseases, such as diabetes, constipation, bronchitis and hypertension, since it promotes vascular relaxation, reducing blood pressure, which is why it is included in pharmaceutical formulations and cosmetic products.

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