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## Review Article

# Exotic Pepino: A Shrub for Prophylactic Consequence & Nutritional Regime

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The pepino (*Solanum muricatum*) is an herbaceous Andean domesticated grown shrub for its juicy and aromatic fruits. Although it was a very important crop in the Andean region in pre-Columbian times, its 20th century prominence has not equaled that of its close relatives the tomato (*Solanum lycopersicum L.*) and potato (*Solanum tuberosum L.*). However, in the last three decades, there has been growing interest in the pepino from exotic fruit markets, and its cultivation has spread from its ancestral home in the Andes of South America to other countries such as New Zealand, Spain, and the Netherlands. The taste of a pepino melon tends to be very sweet and juicy, with a faintly floral aroma; many people compare them to cantaloupes and honeydews, two well-known melon varieties. The pepino is entirely edible, including skin and seeds and hence tastes like a cross between a pear and a banana. It's also prized for its medicinal applications. Aqueous extract of its fruits could attenuate the progression of diabetes due to its anti-inflammatory, anti-glycative and antioxidant effects. However, its antioxidant activity is effective at moderate temperature. A medium serving (~100g) of its fruit provides 80 calories of energy and 5g of dietary fibres similar to oatmeal, which helps to lower cholesterol, and it's easy to digest. Plus the fiber also helps with constipation and it tends to soothe away gastric ulcers too! The fruit is rich in minerals and vitamin C but low in starch and sugars. The minerals contained in pepino fruits are Fe, Zn, Cu, Mn, Ca & P. It has been observed that level of glucose and fructose decreases during ripening, whereas, sucrose concentration increases as the ripening progresses. A discernible reduction has also been noticed in contents of protein and fat as the fruit turns from raw to mature. Pepino is known as a source of beta-carotene, 27 mg per 100 grams of fruit flesh. An excellent feature of this fruit is the absence of oxalate content in it. In this present review, therapeutic significance and gastronomic nuance of pepino fruit is delineated precisely.

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## 1. INTRODUCTION

The pepino melon is an exotic fruit and hence it is also called as melon. Pepino is a delicious subtle flavoured small satin-like fruit, streaked with purple stripes and varying in colour from golden-yellow to apricot. The pale yellowish-green flesh has a juicy melon-like texture<sup>1</sup>.

The Spanish conquistadors reported that it was being cultivated on the coast of the Moche Valley of Peru. Recently it has been introduced to the Nilgiri hills in Tamil Nadu from the Northern Andes. Attempts have been made to produce commercial cultivators and to export the fruit in New Zealand, Turkey and Chile. For people who live in subtropical zones, these melons can be grown from cuttings; this plant is technically a perennial, although harsh weather can damage the plant. They have a distinctive teardrop shape and a yellow rind which is streaked with green and purple when ripe.



**Fig 1, 2: Exotic Pepino Fruits**

Around the world, pepino is known by many names like melon pear, melon shrub, melon fruit, peino dulce and sweet papino. In Europe, the demand for pepino has increased significantly due to its high nutrition value, flavor and attractive appearance (Fig. 1 & 2). Pepino melons come into season in the late fall to mid-spring, and, as with true melons, a number of things can be used to tell if a pepino is ripe and juicy.

Closely related to the tomato this shrub grows in a sprawling habit and makes an excellent ground cover plant. It tends to fruit better when grown over a trellis. The foliage is susceptible to damage by light to moderate frosts, however will quickly recover with warmer weather. "Pepino" means cucumber in Spanish.

However, since the pepino is more like a melon, it is called pepino melon, melon pear or bush melon referencing the parent bush. But, in fact, it is related to the tomato and the potato. The taste of pepino melon could be described as across between pear and a sweet melon, like cantaloupe. Often pepino is chilled and



**Fig 3: Flower & Flower Bud**

**Fig 4: Ripened & Unripened Papino Fruit**

enjoyed raw, just slice in half and scoop out the seeds<sup>2</sup>. Pepino pairs well in savory salads with avocado and as an accompaniment to cured meats. As a dessert this fruit can be poached in a simple syrup and served with ice cream. It is also used as a garnish or pureed and combined with other fruits, such as mango, to make sorbet. On ripening, pepino fruit is highly juicy, moderately sweet and gives off an exotic fragrance. Unripe green pepino melon is often cooked like squash is used to make an invigorating and refreshing juice<sup>2</sup>. The fruit is grown commercially in New Zealand, Chile and Western Australia. The pepino melon plant or bush is about 1 m high and looks a lot like a potato plant (Fig. 3 & 4). The flowers are small, blue, violet-purple or white marked with purple and they are similar to unopened potato flowers. The plant will not set fruit until the night temperature reaches above 18° C. The fruits show considerable diversity in the shape; some being oblong while others are pear or heart shaped. It is up to 15 cm long and 7 cm in diameter. The color of the smooth skin is from pale green to golden yellow with purple stripes.

The fruit flesh is greenish to yellowish-orange and very juicy. The taste is a combination of cantaloupe melon and a cucumber and not particularly sweet. The fruit

flesh contains a lot of sweet seeds (Fig. 5 & 6), which are edible.



**Fig 5: Halves of Pepino Fruit**



**Fig 6: Pepino Fruit with Seeds & Flesh**

The ripe fruit is generally eaten fresh like an apple. Both the skin and the fruit flesh can be eaten. It can, however, also be cut in halves and eaten like other melons. The unripe fruit can be baked like a squash<sup>3</sup>.

## 2. NUTRITIONAL CONSEQUENCE OF PEPINO MELON

Pepino Melon breaks down into glucose for great energy to get you through your day and increases stamina. And it is also chocked full of great  $\beta$ -carotene [- a provitamin A in the body is converted into vitamin A, which is useful in the process of vision, reproduction, and metabolism. B-carotene is an antioxidant that plays an important role in reducing the concentration of peroxy radicals. Ability to work as an antioxidant  $\beta$ -carotene derived from its ability to stabilize carbon-core radicals. Because  $\beta$ -carotene is effective at low concentrations of oxygen, could complement the antioxidant properties of vitamin E is effective at high concentrations of oxygen<sup>4</sup>. This type of antioxidant is also known as an element of cancer prevention, especially the skin and lung cancer.  $\beta$ -carotene can reach more parts of the body in a relatively longer time than vitamin A, thereby providing optimal protection against cancer].

Pepino Melon is packed full of great nutrients and that's why it is called it Super Fruit. It helps with liver disease, lowers blood pressure, helps those that suffer from strokes to heal faster, and promotes cardiovascular health. Pepino Melon can also help prevent cancer and diabetes (tends to regulate blood

sugar levels because of the high fiber content), plus lower cholesterol. Plus Pepino Melon is anti-inflammatory in action helping to sooth away your aches and pains. Pepino Melon has lots of Vitamin A, C, K and also B Vitamins, protein, plus Fe and Cu, which are essential for a healthy immune system, and Ca for bones, K which is needed for relaxing and lowering blood pressure, and Pepino is a good diuretic too<sup>5-9</sup>.

Pepino Melon has fiber similar to oatmeal, which also helps to lower cholesterol, and it's easy to digest. Plus the fiber also helps with constipation and it tends to sooth away gastric ulcers too! Dietary fiber (dietary fiber) pepino fruit is very good, 1 to 1.5 grams/ 100 grams. In the digestive tract, fiber binds bile acids (the end product of cholesterol). In addition to preventing cholesterol, fiber aids the digestive system. Fiber is able to shorten transit time, i. e. the time it takes food from the oral cavity until released as feces. Fiber binds carcinogenic (causes cancer). Thanks to the short transit time, settling time of carcinogenic substances in the body is also getting shorter, so the smaller the chance of bodily harm. Pepino purple contain  $\beta$ -carotene is good for children's intelligence and also prevent dementia for adults. Other health benefits of this fruit is that it can reduce high blood pressure, cure liver disease, heart disease, stroke up to speed healing and accelerate expenditure kidney stones<sup>9-12</sup>.

### *Gastronomic Nuance & Nutritional Significance*

The flavor of pepino fruits is described as a delicious blend of cucumber and honeydew melon. Recently, pepino has elicited an increasing interest from exotic fruit commercially. Contrary to other fruits, in pepino original flavor is retained during canning process, and hence, it has a better preference among consumers.



**Fig 7: Brighten salad with Pepino melon**

With its beautiful tear-drop shape and purple-streaked satiny-smooth skin, the Pepino Melon is an eye-catching little fruit. Also known as Pepino Dulce, Melon Pear, Mellow Fruit or Tree Melon, the Pepino is now in season and available at supermarkets. Not a true melon, the Pepino is actually in the nightshade family, which includes tomatoes and eggplants. Inside this thin-skinned beauty is a golden-yellow flesh with the texture of a fine, juicy melon and the distinctive aroma of honeydew, pear and vanilla. The Pepino has a subtle, mellow flavor with less-sweet hints of melon and cucumber. (Actually, “pepino” means cucumber in Spanish.) Although the skin is technically edible, it peels off easily (like a blanched tomato), and there are just a few small, edible seeds inside a small, hollow cavity. Choose Pepinos with a sweet aroma and no bruises. As the fruit ripens, the purple streaks become more pronounced and the aroma intensifies. The flesh should be firm and juicy – like a crisp cantaloupe – not mealy. The mellow “background” flavor of the Pepino Melon pairs well with other ingredients, from sweet fruits to chilies to chicken.

A drizzle of lime juice, honey or a sprinkling of salt and fresh basil will enhance the mild flavor. Add to that a sprinkle of chili powder or a dash of hot sauce for a refreshing appetizer. Excellent paired with prosciutto or filled with seafood or chicken salads (Fig.6). [Besides consumed as fresh fruit, pepino fruit can also be processed as a raw material or as a complement to a salad dish of meat and vegetable

dishes. To make the salad should select a less matang. Buah cut-dice-shaped pieces, then mixed with other fruit or sayuran. Buah can also be processed into juice. In order to feel fresh and sweeter, when juiced usually add honey, milk, or gula. Pepino also be blended with other fruits. The more a mixture of fruit used, the more vibrant flavors of juice produced and the greater its effect on health.] However it's prepared, this culinary curiosity is delicious across a wide spectrum of dishes<sup>7,17</sup>.

### 3. RESEARCH APPRAISAL

#### 3.1 Antioxidant Activity

It has been found that ethyl acetate extract of ripe pepino fruit exhibits excellent scavenging activity with  $EC_{50}$  values of 0.16, 0.82, 39.51, 1.06 & 0.26mg/ml for DPPH radical, reducing power, iron chelation, ABTS radical, FRAP and hydroxyl radical respectively. The antioxidant characteristics were postulated to be attributable to the persistence of polyphenols in the fruit extracts<sup>13</sup>. The total phenol and flavonoid content of pepino extract were found to be 20.43mg GAE/g dry wt, 53.85mg/g dry wt. the total antioxidant capacity observed in the ripe ethyl acetate extract of pepino fruit was 238.27nM GAE/g.

#### 3.2 Anticancer Activity

It has been observed that pepino extract exhibit anticancer selective activity against all the human tumor cell lines being tested which includes: prostate (PC3, DU145); stomach (MKN45), liver (QGY7721, SK-HEP1), breast (MDA-MB435); ovarian (OVACAR); colon (HT29) and lung (NCI-H209) cancer cells. NHP (prostate), HUPEC (umbilical vein endothelial cells), and WI38 (lung diploid fibroblasts) normal cells with  $LD_{50}$  values from 561-825 $\mu$ g/ml. The extract was found to show a much lower cytotoxicity to NPH, HUVEC and WI38 normal cell lines with  $LD_{50}$  values of 2.8-3.2mg/ml which was 3-6 fold higher than on tumor cells. Injection of pepino extract (100 $\mu$ g)



directly into tumor mass was found to reduce tumor volume dramatically in mice inoculated with MKN45 gastric cancer cells. The pepino extract mediated tumor growth inhibition through induction of apoptotic morphology, DNA formation and PARP cleavage assay<sup>14</sup>.

### 3.3 Antidiabetic Activity

Due to anti-oxidative, anti-inflammatory and anti-glycative effects, PAE was found to attenuate the progression of diabetes. Also, PAE & PEE were found to exert similar effects on TPAs. PAE was found to contain higher AA & TFs than PEE. PAE treatments with pepino extract at 2% & 4% administered for 5 weeks was found to lower significantly elevated level of plasma insulin. PAE treatments significantly decreased the levels of malonyldialdehyde and ROSs in kidney and oxidized glutathione formation and increased glutathione level were also observed to be reduced. It was found that catalase and renal glutathione activities were found to be retained. TNF- $\alpha$  levels and RIL-6 were lowered significantly at 2% & 4% PAE treatments. Sorbatol production in the kidney, ARA levels of MCP-I and RIL-1 $\beta$  were investigated to be diminished at 4% treatments<sup>15</sup>.

### 3.4 Constitutional incredibility

From 3 cultivars of pepino fruit, 30 volatile compounds have been identified. The main constituents of the volatile fraction in pepino were 3-methylbut-2-en-1-ol, 3-methylbut-2-en-1-yl acetate, 3-methylbut-3-en-1-yl (Z)-non-6-en-1-ol, 3 methylbut-2-en-1-yl acetate, 3-methyl but-3-en-1-yl acetate, butylacetate and hexyl acetate (all of them related to fruity aromas) and a series of linear C9 aldehydes (related to green-herbaceous odors). It was confirmed that 3-methyl-2-buten-1-ol, 3-methyl-3-buten-1-ol and their acetates were also major components of pepino fruit from two cultivars. Volatile components of pepino fruit were found to comprise 24 esters (acetates, 3-

methylbutanoates and 3-methylbut-2-enoates), 7 aldehydes (especially hexanals and non-enols), 6 ketones, 9 alcohols, 3 lactones, 2 terpenes,  $\beta$ -damascenone, and mesifurane (2,5-dimethyl-4-methoxy-3 (2H)-furanone). Among these compounds, 17 were found to contribute significantly to pepino aroma. OCVs (odor contributing volatiles) were assigned to 3 groups according to their odor quality: fruity fresh (acetates & phenols) comprising butyl acetate, pentyl acetate, hexyl acetates, 3-methyl butyl acetate, 3-methylbut-2-en-1-yl acetate, 3-methylbut-3-en-1-yl acetate C6 & C9 aldehydes comprising hexanal, (E)-hex-2-enal, and exotic comprising lactones –  $\gamma$ -nonalactone (4-nonanolide),  $\gamma$ -decalactone (4-decanolide), massoia lactone (5-dec-2-enolid), mesifuran and  $\beta$ -damascenone.



**Fig 8: Astounding Pepino Fruit**

## 4. CONCLUSION

The name of this fruit, pepino melon or pepino is slightly misleading. The word pepino means 'cucumber' in Spanish, suggesting that this fruit is a cross between cucumber and melon. In fact, the pepino differs significantly from a cucumber, and neither is it a melon. It is in fact a member of the *Solanaceae* family, commonly known as nightshade. Other species of this botanical family include tomato, potato, peppers and eggplant. Although it is less tasty, pepino rich in  $\beta$ -carotene and nutrients that can ward off cancer, stroke, hypertension, diabetes, and lower blood cholesterol levels. Pepino melons contains low amount of calories.<sup>16, 17</sup> Hence it helps in losing weight. All the calories

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in the pepino melon come from its carbohydrate content. The carbohydrates in the pepino melon are broken down into glucose during digestion, and they are used as your body's preferred source of fuel. Pepino melons are an excellent source of fiber. The fiber in the melon slows digestion, helping you feel longer. It also adds bulk to your stool and softens it, makes it easier for you to have a bowel movement. Consuming more fiber lowers your risk of diabetes and some forms of cancer. The fruit has also been regarded as a high-quality ascorbatic. The pepino melon is also Na-free. Decreasing your daily intake of Na lowers your blood pressure and reduces your risk of developing illnesses related to high blood pressure, such as heart illness and kidney ailments.

## 5. ABBREVIATIONS

EC<sub>50</sub> - Half Maximal Effective Concentration; DPPH - 2,2-Diphenyl-1-(2,4,6-trinitrophenyl)hydrazyl; ABTS - 2,2'-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid; FRAP ; Fluorescence Recovery After Photobleaching; GAE; Gallic Acid Equivalent; RE -*Rutin* Equivalent; PC3 - Prostate Cancer3-lines; LD<sub>50</sub> - Lethal Dose 50%; PARP - Poly ADP Ribose Polymerase; TPA - Total Phenolic acid; PAE - Pepino Aqueous Extract; PEE - Pepino Ethanol Extract; AA - Ascorbic Acid; TF - Total Flavonoid; ROS - Reactive Oxygen Species; RIL - Renal Interleukin; ARA - Aldose Reductase Activity.

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