Iberian-American Fruits Rich in Bioactive Phytochemicals for Nutrition and Health

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TREE TOMATO

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Scientific name: *Solanum betaceum* Cav. (Family *Solanaceae*)

Common name: Its common name depends on the country: tree tomato (Ecuador, Colombia, United Kingdom); french tomato (Portugal); straiktomaad, terong blanda (Netherlands); tomate de arbre (France); tomatobaum (Germany); chili tomato (Spain); tamarillo (New Zealand and USA).

Origin

This fruit is native to the subtropical Andes and has been cultivated on mountainsides since long before Europeans arrived. The area of its origin is at present unknown, it is probably native to southern Bolivia (National Reserve Tucumano Boliviana, Department of Tarija) where it is found in wild status and northwestern Argentina (Provinces of Jujuy and Tucumán). Due to its genetic diversity northern Perú and southern Ecuador are considered the center of this plant domestication. As a native fruit it is found in Bolivia, Argentina, Venezuela, Ecuador, Perú and Colombia.

Production

This crop is commercially produced mainly in Colombia, Ecuador, Perú and in New Zealand where it was introduced and has been popular for more than 60 years. Countries where production is minor are U.S.A., México, countries of Central America and Africa. In Ecuador it is grown in subtropical Andean areas

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between 1500 and 2600 meters above sea level (m.a.s.l.) with average temperatures between 16 and 22 ºC (Feicán *et al.*, 1999; Santillán, 2001).

The rather acid taste arriving in international markets is hindering greater acceptance as a fruit to be eaten raw, sweeter fruit from selected cultivars will increase its popularity (National Academy of Sciences U.S.A., 1989).

Varieties

The tree tomato is related to a group of species that were included in the genus *Cyphomandra.* However, on the basis of morphological and molecular evidence, the species in genus *Cyphomandra* were transferred to the genus *Solanum,* nowadays used by the scientific community to refer to the tree tomato and wild relatives. Some wild species produce edible fruits which are harvested on occasion from the wild. Some other wild species are used for medicines and dyes, this indicates that some plants have a great potential for several purposes and should be explored (Acosta *et al*., 2013; Bohs,1989).

Since genotype is specific for each individual, several denominations such as segregants, backcrossings and cultivars may be grouped within this term (Pierce, 2009). In New Zealand, where the most extensive selection has taken place, two strains are cultivated: red and yellow. Although there is much variety in the fruits and many local preferences are based on color, there are apparently at present few cultivars. Oratia Red was the first recognized cultivar. Growers normally select their own trees for seed selection.

In Ecuador tree tomato cultivars are not preserved pure due to crosslinking among materials that are grown in farmer orchads, presenting a great genetic variability and giving as result fruits with a wide range of tones, between yellow and purple (León *et al.*, 2004; Revelo *et al.*, 2004). Within genotypes grown in Ecuador the most representatives and that are found in producer farms are cultivars of End Pointed yellow, Round orange, Giant orange, Ecuadorian mora, Giant purple and New Zealand purple; the Giant orange being of major production since it is the most accepted in Ecuadorian market (León *et al.*, 2004; Torres, 2006). The red-fleshed fruit is the most commercialized variety in Colombia (Osorio *et al*., 2012)

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Nutrition

Tree tomatoes are excellent sources of provitamin A (carotene-150 International Units per 100g), vitamin B6, vitamin C (25 mg per 100g), vitamin E, and iron. They are low in carbohydrates; an average fruit contains less than 40 calories. Small, hard, irregular stones containing large amounts of sodium and calcium occasionally appear in the outmost layers of the fruit and do not present much of a problem in fresh fruits because those layers are not eaten (National Academy of Sciences U.S.A., 1989).

Tree tomato				
Varieties	**Giant orange**	**Giant purple**	**Ecuadorian purple**	**End pointed yellow**
Water	87.1 g	89.2 g	89.2 g	88.2 g
Carbohydrates	12.7 g	7.2 mg	7.0 mg	5.9 mg
Ash	0.8 g	0.8 g	0.8 g	0.8 g
Vitamin C	30 mg	28 mg	40 mg	20 mg
Food values on 100g of fresh weight				
Source: Department of Nutrition and Quality, INIAP, 2006				

Culinary uses

Ripe tree tomatoes have fine eating qualities and can be used in many ways. They are usually cut in half and the flesh scooped out. Seeds are soft and edible. The skin is easily removed, it peels off when dipped briefly in hot water. The fruits are especially good on desserts such as cakes and ice cream, on fruit salads or in green salads. The whole fruit can be liquidized and drunk. The richly colored juice (especially of the deep and red types) seems to have much potential for blending with grapefruit and other juices whose consumer appeal may be increased by the added color. In South America, such juices are frequently blended with milk, ice and sugar to make tasty drinks.

Tree tomatoes are also cooked and eaten in stews, soups, baked goods, relishes, sweet and savory sauces. In New Zealand, diced tree tomatoes, with onion, breadcrumbs, butter and appropriate seasonings, are popular as a stuffing for roast lamb-the national dish. Being high in pectin, tree tomatoes make good jellies, jams, preserves, or chutneys, but they oxidize and discolor unless treated. Preserves give a high yield of pulp, around 83% which is high compared with other fruits. The fruit may be processed to obtain chips and dehydrated products.

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The fruit freeze well, either whole (peeled) or pureed, and can be stored this way almost indefinitely (National Academy of Sciences U.S.A., 1989).

Phytochemicals and health

Tree tomato is a promising source of natural colorants and has exhibited *in vitro* antioxidant activity that gives it an interesting added-value, anthocyanins chemical characterization were also performed (Osorio *et al.*, 2007 and 2012).

Vitamin A and carotenoids are often cited as members of antioxidant vitamins that can protective effects against oxidative stress and some chronic diseases and may be considered physiological modulators degenerative or cardiovascular diseases and are known for having antioxidant capacity (Olson, 1996). The possible protective action of carotenoids can be attributed to their properties as singlet oxygen quenchers and as antioxidants, whereas their cancer-enhancing actions in lung can be ascribed to the prooxidant action of carotenoid free radicals in damaged cells (Olson, 1999).

Total polyphenols content of the four presented cultivars are comparable to other published results for yellow and red tree tomato, where similar phenolic composition were found, however anthocyanins were absent in the yellow tree tomato as well as in the Giant orange and End Pointed yellow. Pelargonidin rutinoside (115mg/100g DM) and delphinidin rutinoside (33 mg/100g DM) were the two major anthocyanins in the red variety and hydroxycinnamic acids were higher in the red tree tomato than in the yellow one (Mertz *et al.*, 2009), anthocyanins also were only found in Giant purple and Ecuadorian purple tree tomatoes. Anthocyanins chemical characterization has also been performed in a red variety of tomato tree, obtaining five main components (Osorio *et al.*, 2012).

The carotenoid pigments of tree tomato fruit were identified and quantified. β-carotene, β-cryptoxanthin, ζ-carotene, 5,6-monoepoxy-β-carotene, lutein and zeaxanthin were detected in both the pulp and the peel. The quantitative patterns of the pulp and the peel were similar, with cryptoxanthin and β-carotene predominating. The high average vitamin A value (2475 IU/100 g edible portion) is due to the principal carotenoids that have provitamin A activity (Rodriguez-Amaya D. *et al.*, 1983). Carotenol fatty acid esters were abundant in tree tomato with β-cryptoxanthin esters being the major ones. β-carotene was the major hydrocarbon carotenoid, the carotenoid composition was similar in red and yellow tree tomato

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fruits (Mertz *et al.*, 2009). Total carotenoids of Giant orange and End Pointed yellow tree tomato were about 0.23 mg/g, no carotenoids were detected in Giant purple and Ecuadorian purple tree tomatoes.

The antioxidant capacity of purple-red and golden-yellow tree tomato fruits were determined giving 4.2 and 2.6 µmol Trolox/g sample FW respectively (Vasco *et al.*, 2009). It was also determined in several extracts of red and yellow tree tomato fruits (Mertz *et al.*, 2009).

Tree tomato fruit is a source of polyphenols, known for their antioxidant activity, carotenoids, vitamins, and minerals. The antioxidant value is largely derived from polyphenolic, flavonol and anthocyanidin compounds and may help lower blood sugar levels in type-II diabetes mellitus. Yellow varieties contain more vitamin A and carotenes than red varieties, however, red variety has more anthocyanin pigments. In addition, yellow ones are a good source of carotenes, and xanthins, compounds that are known to possess antioxidant properties and, together with vitamin A, are essential for visual health. Further, vitamin A is also required for maintaining healthy mucus membranes and skin. Consumption of natural vegetables and fruits rich in flavonoids may help to protect from lung and oral cavity cancers. They are indeed very good source of electrolyte, potassium that is an important component of cell and body fluids helps controlling heart rate and blood pressure; thus, counters the bad influences of sodium. In addition, the fruit contains a small amount of minerals such as copper, manganese, magnesium, phosphorus, zinc and iron.

Tree tomato has been traditionally used to reduce blood cholesterol levels and to treat respiratory problems. It is also known that its pulp prevents neurodegenerative diseases and arteriosclerosis, and has some antimicrobial activity.

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