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

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NARANJILLA

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Scientific name: *Solanum quitoense Lam*
(Familia *Solanáceae*)

Common names: naranjilla, lulo, lulum, naranja chiquita, naranjilla de castilla, quito orange, morelle de Quito, gele terong, orange von quito, berenjena de olor.

Origin

This fruit is native to the inter-Andean region, incas called it "lulum" since it was identified as "small orange" ("chiquita orange"), later it was called naranjilla. In Ecuador it is a typical fruit being cultivated in the eastern region, mainly between the foothills of the Andes and the amazonic plains. The main production areas are in the provinces of Morona Santiago, Pastaza, Tungurahua, Pichincha and Imbabura. This crop is found in the American continent in countries like Ecuador, Peru, Colombia, Bolivia, Venezuela, Panama, El Salvador, Costa Rica, Honduras and in the southen region of the United States whereas in Oceania continent it is found in New Zealand (Pastrana, 1998; Ochse *et al.,* 1972).

Varieties

According to Soria (1989) there are two main varieties, *Solanum quitoense* var. Septentrionale with thorns and *Solanum quitoense* var. Quitoense without thorns. Since common varieties are sensitive to plagues attack that collapse production and productivity two inter-specific hybrids have been developed (Heiser, 1993). Two naranjilla varieties are known common or typical and commercial hybrids, in Ecuador the following are found (Revelo *et al*., 2010):

Common or typical varieties: Variety "agria" (*Solanum quitoense* Lamvar. *quitoense*), Variety Baeza "dulce" (*Solanum quitoense* Lamvar. *quitoense*), Variety

"espinosa" (*Solanum quitoense* Lamvar. *septentrionale*), Variety "INIAP-Quitoense 2009" (*Solanum quitoense* Lamvar. *quitoense*).

Commercial hybrids: Hybrid Puyo, obtained by cross-hybridization between naranjilla jíbara from oriente or cocona (*Solanum sessiliflorum*) and naranjilla variety "agria" (*Solanum quitoense* Lam var. *quitoense*), Hybrid INIAP Palora, obtained by cross-hybridization between naranjilla variety Baeza (*Solanum quitoense* Lam var. *quitoense*) and cocona (*Solanum sessiliflorum*), Hybrid Mera or espinuda which has similar characteristics to Hybrid Palora, it could be one of its segregators.

One of the improvements is the variety for juice INIAP Quitoense-2009, obtained by grafting in plant patterns of *Solanum hirtum and Solanum arboreum*, from a selection of variety Baeza, carried out by the Fruit Farming Program during years 2005 and 2007, this variety has been improved by plant selection considering strength, coagulating capacity, productivity and physico-chemical quality of the fruit (INIAP, 2009). The varieties Lulo de Castilla and Lulo la Selva are found in Colombia.

It is a globelike berry covered of pubescence, with even skin, when mature is edible and of intense yellow-orange color. The interior is divided in four carpels that contain a juicy pulp of green or yellow color with many seeds

Nutrition

The variety INIAP Quitoense 2009 when mature the flavor which corresponds to the relation between soluble solids and titrable acidity was 4.33, that value is also related to the major acceptability found in the sensory tests. It also has a low darkening index of 5.64% that corresponds to a minimum oxidation, together with the big size of the fruit and with its nutritional quality gives excellent properties for fresh use or for industry. It is important to consider the fruit specifications for commercialization: weight, relation length/diameter and pulp yield.

One of the properties of the fruit is acidity with values of 3.23% for variety Lulo de Castilla and 2.40% for variety INIAP Quitoense 2009 as citric acid, in this case there is a compensation by the solid solubles high content of 10.80 °Brix. The total sugars content is 59.69% and the total reducing sugars is 31.00% both as percent of total carbohydrates, it is also found a moderate amount of Vitamin C. Total carotenoids confer the yellow or orange color and antioxidant properties to this fruit. A considerable amount of calcium, phosphorus, potassium, iron and zinc is found. It also presents a moderate value of antioxidant capacity with 24.87 µmol/g.

Naranjilla	
Water	90.4 g
Protein	0.64 g
Carbohydrates	14.76 g
Ash	0.59 g
Cholesterol	g
Fiber	0.46 g
Sodium	0.5 mg
Potassium	0.31 mg
Calcium	4.8 mg
Phosphorus	9.5 mg
Magnesium	12.4 mg
Iron	0.1 mg
Zinc	0.2 mg
Vitamin C	53.33 mg

Food values on 100g of fresh weight
Source: Departament of Nutrition and Quality, INIAP, 2011

Culinary uses

The main processed product is juice in addition to pulp and frozen concentrates as well as several kind of preserves, ice creams, desserts, candies when dehydrated and osmodehydrated. It is an exotic ingredient for gourmet dishes also used with all kind of meats, fruit and vegetable salads and for decoration.

It is also used acid desserts and in recipes that need a sour touch that is part of ecuadorian gastronomy, commonly consumed as fresh drink and it is particularly appreciated for its aroma (Gancel,2008)

Phytochemistry and health

The naranjilla to seems to have good antioxidants properties; bioactive compounds as *all-trans-β carotene*, *13-cis- β carotene, 9-cis-β-carotene* and the lutein between the carotenoides was reported (Gancel, 2008), that are similar to (Acosta *et al.*, 2009) who found that the major carotenoids in naranjilla are β-carotene, lutein and zeaxantine, present with 58.4%, 32.2% and 3.2% respectively compared to total carotenoids .

Related to phenolics compounds, chlorogenic acids and their hexosides in the flesh and placental tissues, and flavonol glycosides in the skin and many

dihydrocaffeoyl spermidines was found in the skin, flesh and placental tissues. The peel had the highest of total polyphenol. It contained 1.5 and 2.6 times more that the flesh and the placental tissues, respectively (Gancel,2008).

The fruit is an important source of vitamins and minerals as Potassium 3090 µg/g fresh basis that contribute to human health with several carotenoids which are Vitamin A precursors (Vasco *et al.*, 2008).

Naranjilla juice dissolves some toxins and is recommended for persons with gout disease since it decreases uric acid content in blood.

Bibliography

Acosta Ó., Pérez A. M., Vaillant F. (2009). Chemical characterization, antioxidant properties, and volatile constituents of naranjilla (*Solanum quitoense Lam.*) cultivated in Costa Rica. *Archivos Latinoamericanos de Nutrición. Organo Oficial de la Sociedad Latinoamericana de Nutrición, 59*, 88-94.

Bravo, J. (1969). Estudio Pomológico de las Variedades de Naranjilla Cultivadas en el Ecuador. Facultad de Ciencia Agrícolas. Universidad Central del Ecuador.

Gancel, A., Alter, P., Mayer, C., Ruales, J., Vaillant, F. (2008). Identifying Carotenoids and Phenolic Compounds in naranjilla (*Solanum quitoense* Lam. Var Puyo Hybrid), an Andean Fruit. *Journal of Agricultural and Food Chemistry, 56*, 11890-11899.

Heiser, C. (1993). The naranjilla (*Solanum quitoense*), the cocona (*Solanum sessiliflorum*) and their hybrid. Gen conservation and explotation. Edited by J. P. Gustafson *et al.*, Plunum press. NewYork-USA.

INIAP N. 354 (2009). INIAP Quitoense – 2009 Variedad de Jugo Mejorada Injerta en Tres Patrones de Solanáceas Silvestres. Boletín Divulgativo. Quito-Ecuador.

Murillo, E., Meléndez-Martínez A. J., Portugal F. (2010). Screening of vegetables and fruits from Panama for rich sources of lutein and zeaxanthin. *Food Chemistry, 122*, 167-172.

Ochse, J., Soule, M., Dijkman, M., Wehlburg, C. (1972). Cultivo y Mejoramiento de Plantas Tropicales y Subtropicales. Editorial Limusa-Wiley S.A. México.

Pastrana, E. (1998). Manejo Post-Cosecha y Comercialización de Lulo *(Solanum quitoense Lam.)*. Serie de Paquetes de Capacitación sobre Manejo post-cosecha de Frutas y Hortalizas No. 11. Convenio SENA- Reino Unido. Edición Magnitud Ltda. Pereira. Bogotá -Colombia.

Revelo, J., Sandoval, P. (2003). Factores que Afectan la Producción y Productividad de la naranjilla (*Solanum quitoense* Lam) en la Región Amazónica del Ecuador. Instituto Nacional Autónomo de Investigaciones Agropecuarias. E. E. Santa Catalina. Departamento de Protección Vegetal. Quito-Ecuador.

Revelo, J., Viteri, P., Vásquez, W., Valverde, F., Gallegos, P. (2010). Manual del cultivo ecológico de la naranjilla. Manual Técnico N. 77 INIAP. Quito, Ecuador.

Soria, J. (1989). La Naranjilla que Actualmente se Cultiva y Consume en Ecuador. Boletín Divulgativo 5. Instituto Nacional de Investigaciones Agropecuarias. Quito-Ecuador

Vasco, C., Ruales, J., Kamal-Eldin, A. (2008). Total phenolic compounds and antioxidant capacities of major fruits from Ecuador. *Food Chemistry*, *111*, 816-823.

Villachica, H. (1996) Frutales y Hortalizas Promisorios de la Amazonía. Tratado de Cooperación Amazónica Secretaria Pro-Tempore; Lima-Perú.

Whalen, M., Costich, D., Heiser, C. (1981). Taxonomy of Solanum Section Lasiocarpa. GentesHer.

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