Citrus aurantifolia Swingle
Citrus maxima (L.) Osbeck
Citrus medica L.
Citrus reticulata Blanco
Rutaceae

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Synonyms

***Citrus maxima* (L.) Osbeck:** *Aurantium decumanum* (L.) Mill.; *Aurantium maximum* Burm.; *Citrus* x *aurantiifolia* (Christm.) Swingle; *Citrus* x *aurantium* fo. *grandis* (L.) Hiroë; *Citrus* x *aurantium* L.; *Citrus* x *aurantium* subsp. *decumana* (L.) Tanaka; *Citrus* x *aurantium* var. *decumana* L.; *Citrus* x *aurantium* var. *grandis* L.; Citrus x limetta Risso; *Citrus* x *nobilis* Lour.; *Citrus* x *paradisi* Macfad.; *Citrus* x *sinensis* (L.) Osbeck; *Citrus aurantiifolia* (Christm.) Swingle; *Citrus aurantium* L. *Citrus aurantium* var. *decumana* L.; *Citrus aurantium* var. *grandis* L.; *Citrus aurantium* var. *sinensis* L.; *Citrus costata* Raf.; *Citrus decumana* (L.) L.; *Citrus grandis* (L.) Osbeck.; Citrus *grandis* var. *pyriformis* (Hassk.) R.K. Karaya; *Citrus grandis* var. *sabon* (Siebold ex Hayata) Hayata; *Citrus kwangsiensis* H.H. Hu; *Citrus limetta* Risso; *Citrus maxima* (Burm.) Merr., *Citrus maxima* var. *uvacarpa* Merr.; *Citris medica* subfo. *pyriformis*

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(Hassk.) Hiroë; *Citrus obovoidea* Yo. Tanaka; *Citrus pampelmos* Risso; *Citrus paradisi* Macfad.; *Citrus pompelos* Risso; *Citrus pyriformis* Hassk.; Citrus *sabon* Siebold ex Hayata; *Citrus sinensis* (L.) Osbeck; *Limonia* x *aurantiifolia* Chritsm.; *Limonia aurantifolia* Christm.

***Citrus medica* L.:** *Aurantium medicum* (L.) M. Gómez; *Citreum vulgare* Torn. ex Mill.; *Citrus* x *aurantium* subvar. *amilbed* Engl.; *Citrus* x *aurantium* subvar. *ckakotra* Engl.; *Citrus* x *limon* (L.) Osbeck; *Citrus* x *limon* var. *digitata* Risso; *Citrus* x *limonia* (L.) Osbeck; *Citrus* x *limonum* Risso; *Citrus alata* (Tanaka) Tanaka; *Citrus cedra* Link; *Citrus cedrata* Raf.; *Citrus fragrans* Salisb.; *Citrus limon* (L.) Osbeck; *Citrus medica* fo. *monstrosa* Guillaumin; Citrus *medica* subsp. *bajoum* H. Perrier; *Citrus medica* var. *alata* Tanaka; *Citrus medica* var. *digitata* Risso; *Citrus medica* var. *ethrog* Engl.; *Citrus medica* var. *limon* L.; *Citrus medica* var. *proper* Hook. f.; *Citrus medica* var. *sarcodactylis* (Hoola van Nooten) Swingle; *Citrus odorata* Roussel; *Citrus sacrodactulis* Hoola van Nooten; *Citrus tuberosa* Mill; *Sarcodactilis helicteroides* Gaertn.

***Citrus reticulata* Blanco:** *Citrus* x *aurantium* fo. *deliciosa* (Ten.) Hiroë; *Citrus aurantium* var. *tachibana* Makino; *Citrus* x *nobilis* Lour.; *Citrus* x *nobilis* subfo. *deliciosa* (Ten.) Hiroë; *Citrus* x *nobilis* subfo. *erythrosa* (Yu. Tanaka) Hiroë; *Citrus* x *nobilis* subfo. *reticulata* (Blanco) Hiroë; *Citrus* x *nobilis* subfo. *succosa* (Tanaka) Hiroë; *Citrus* x *nobilis* subfo. *tachibana* (Makino) Guillaumin; *Citrus* x *nobilis* var. *unshiu* (Marcov.) Hiroë; *Citrus* x *nobilis* var. *deliciosa* (Ten.) Guillaumin; *Citrus* x *nobilis* var., *major* Ker Gawl.; *Citrus* x *nobilis* var. *ponki* Hayata; *Citrus* x *nobilis* var. *spontanea* Ito; *Citrus* x *nobilis* var. *sunki* Hayata; *Citrus* x *nobilis* var. *tachibana* (Makino) Ito; *Citrus* x *nobilis* var. *ushiu* (Marcov.) Tanaka ex Swingle; *Citrus* x *nobilis* var. *vangasy* (Bojer) Guillaumin; *Citrus aurantium* subsp. *suntra* Engl.; *Citrus chrysocarpa* Lush.; *Citrus daoxianensis* S.W. He & G.F. Liu; *Citrus deliciosa* Ten.; *Citrus depressa* Hayata; *Citrus erythrosa* Yu. Tanaka; *Citrus madurensis* var. *deliciosa* (Ten.) Sagot; *Citrus mangshanensis* S.W. He & G.F. Liu; *Citrus nobilis* Lour.; *Citrus nobilis* var. *deliciosa* (Ten.) Swingle; *Citrus ponki* Yu. Tanaka; *Citrus pooensis* Yu. Tanaka; *Citrus reticulata* subsp. *deliciosa* (Ten.) Rivera & et al.; *Citrus reticulata* subsp. *tachibana* Rivera & et al.; *Citrus reticulata* subsp. *uinshu* (Marcov.) Rivera & et al.; *Citrus reticulata* var. *australe* Swingle; *Citrus succosa* Tanaka; *Citrus suhuiensis* Hayata; *Citrus sunki* hort. ex Tanaka; *Citrus tachibana* (Makino) Yu. Tanaka; *Citrus tachibana* subfo. *depressa* (Hayata) Hiroë; *Citrus tachibana* subfo. *ponki* (Yu. Tanaka) Hiroë; *Citrus tachibana* subfo. *suhuiensis* (Hayata) Hiroë; *Citrus tangerina* Yu. Tanaka; *Citrus tankan* Hayata; *Citrus unshiu* Marcov.; *Citrus vangasy* Bojer; *Citrus vonagasay* Bojer

Local Names

***Citrus aurantifolia*: Bolivia:** Naranja, Flor de naranja (Spanish) (Bussmann et al. 2016); **Colombia:** Hoja del limón, Limón (Bussmann et al. 2018)

***Citrus* x *aurantium*: Colombia:** Limón, Limón criollo; Naranja ácida, Naranja agria (Spanish) (Bussmann et al. 2018); **Ecuador:** Naranja agria, Cajel, Hoja de naranja,

Naranja, Naranja dulce (Spanish) (de la Torre et al. 2008); **Peru:** Hojas de naranja (Spanish)
***Citrus maxima*: Colombia:** Naranja común, Naranja dulce, Naranjo, Pamplemusa, Toronja; **Peru:** Toronja, Lima
***Citrus medica*: Colombia:** Cidra; **Bolivia:** Cidra (Spanish) (Justo and Moraes 2015; Bussmann et al. 2016); **Ecuador:** Wichilla limón (Spanish-Kichwa), Ppairi pia, Saija'i pairi pia (Pai coca), Cidra, Limón, Limón real (Spanish), Lemon (English) (de la Torre et al. 2008)
***Citrus reticulata*: Colombia:** Mandarina, Mandarina común, Mandarina reina, Mandarina satsuma, Limón mandarino; **Ecuador:** Limón dulce, Mandarina (Spanish), Mandarin orange (English); **Peru:** Mandarina (Spanish)

Botany and Ecology

***Citrus aurantifolia*:** This species is native to the region between northwestern India and the border areas of China and Burma. It's probably a hybrid between zamboa and mandarin. It was introduced in Europe by the Arabs, who used it for medicinal purposes and as an ornamental plant in their gardens. It was the first citrus fruit that arrived in the American continent. Medium to large, leafy tree with open growth habit, although somewhat more erect than the sweet orange; more rustic and resistant, hence its use as rootstocks of that. With the presence of thorns. Elliptical leaves medium to large size with full margin and longer petiole than the sweet orange tree with developed wings. Medium-sized flowers, with white petals and yellow anthers. They give off a much appreciated fragrance to the essential oils present, known as neroli oil. Usually, the fruits are of average size and spherical shape, globose, although also you can find somewhat flattened fruits. They present a slight depression both in the basal zone as in the apical zone. The bark, intense orange in color in maturity is thick and rough to the touch. Juicy pulp, pale orange, acidic, and with a characteristic bitter taste. When maturity is reached, it becomes hollow. Presence of numerous seeds, polyembryonic, with the purple chalaza.
***Citrus maxima*:** The large size of its fruits, the largest of citrus fruits, is reflected in its botanical name (*C. maxima*, formerly *C. grandis*). Its origin is located in Indonesia and Malaysia, where it can be found in the wild. It is a highly prized fruit in Southeast Asian countries. Description Large trees of open bearing, vigorous, and with the presence of thorns. The young shoots, green in color, are pubescent unlike pomelos. Leaves very large, elliptical, dark green with slightly serrated or entire margin. It has developed wings on the petiole. The flowers are usually born in terminal clusters and are the largest in the genus. Aromatic, yellow anthers, hairy calyx and thick white petals, turned back when they are in full bloom. The fruit is very big. Its shape can be from spherical to flattened or even pear-shaped, depending on the different varieties. The bark, of great thickness, is pale yellow, sometimes showing a greenish hue. The pulp, with a firm texture, can be greenish yellow, yellow, or with reddish tones. Large, hollow or semisolid central axis. The membranes that wrap the segments are very hard and can be

removed easily. The juice vesicles are the largest of citrus fruits. Seed content varies from low to very high; They are large and monoembryonic. We can find varieties from very juicy to practically dry, as well as with a lot of acidity or insipid. Uses: Peeled segments are consumed fresh and used in the preparation of salads and desserts. The juice is also appreciated. The flowers are used to make perfumes. The hard wood is suitable for the manufacture of tools. In the Philippines and Southeast Asia, it has different applications in traditional medicine; The decoctions of leaves, flowers, and bark are administered for their sedative effect in cases of epilepsy and convulsive cough. The bark is sometimes used to make jam and can also be confit. In China, it is added to be sautéed with pork (Figs. 1, 2, and 3).

***Citrus medica*:** The latest research indicates that it could be a direct cross between bitter orange and citron. The origin of the lemon is a mystery, but it could be located in northwestern India, northern Burma, and China. Description The lemon tree is a tree of medium to large size, vigorous, and with habit of open growth. It has abundant small spines on the branches. Although more resistant to cold than Mexican lime and citron, it is more sensitive than other commercial citrus. The young shoots are deep purple. Large pale green leaves, which give off a pleasant scent of lemon when squeezed. Shape of the elliptical limbus and dentate margin. Petiole not winged or with presence of very small wings. Large flowers, purple petals, yellow anthers, and in large percentage staminated by abortion of the pistil. If conditions are favorable, you may have several florations per year. The fruit is light

Fig. 1 *Citrus maxima* (Rutaceae), Beni, Bolivia. (Photo R.W. Bussmann and N.Y. Paniagua-Zambrana)

Fig. 2 *Citrus maxima* (Rutaceae), Granada, Spain. (Photo R.W. Bussmann and N.Y. Paniagua-Zambrana)

Fig. 3 *Citrus maxima* (Rutaceae), Granada, Spain. (Photo R.W. Bussmann and N.Y. Paniagua-Zambrana)

yellow, ellipsoidal, with a more or less pronounced mamelon in the apical zone. Bark smooth or slightly rough. It may have a neck at the base of the fruit. Pulp yellow and juicy, very acidic. Solid or semisolid central axis. It presents seeds with a low degree of polyembryony. Uses: Lemon is mainly used as juice and essential oils. Lemon Juice is used as an ingredient for lemonade and other soft drinks, as well as pastry and restoration; the oils, both of the leaf and the fruit, are used in perfumery. In the past, it was of great importance in maritime navigation to prevent scurvy, a disease caused by the lack of Vitamin C. Citrus lemon juice is widely known as diuretic, astringent, and febrifuge. The wood is compact and easy to work with. In Mexico, it is used to carve chess pieces, toys, small spoons, and other items.

***Citrus reticulata*:** Satsuma is the name of an old Japanese province, now Prefecture of Kagoshima, on the southern tip of the island of Kyushu, where it is believed to have originated this species. In Japan, where it is well known and appreciated, it receives the name of unshû mikan, hence its specific name unshiu. Tree of small to medium size, slow growing. Open bearing, somewhat disheveled, with distribution of scattered branches that sometimes grow inclined towards the floor, which gives it a weepy look. It does not have thorns. It's the commercial citrus more resistant to cold and unfavorable conditions for most of them. Leaves medium size, leathery, and lanceolate. Petiole slightly winged and entire margin. The flowers are medium sized, white petals, and anthers of color white or pale yellow, without pollen. The fruit is of medium size, flattened, and orange color, although it is collected with green tones since the bark is very prone to swelling This, slightly rough, comes off very easily. Intense orange pulp, with hollow central axis and large amount of juice, of not very good quality for its low values of both acidity and sugar.

It does not produce seeds. In the case of any appearance of seeds, they are polyembryonic (Figs. 4, 5, and 6).

Fig. 4 *Citrus pomelo* (Rutaceae), market, Tbilisi, Georgia. (Photo R.W. Bussmann and N.Y. Paniagua-Zambrana)

Fig. 5 *Citrus sinensis* (Rutaceae), Beni, Bolivia. (Photo R.W. Bussmann and N.Y. Paniagua-Zambrana)

Fig. 6 *Citrus sinensis* (Rutaceae), market, Cappadokia, Turkey. (Photo R.W. Bussmann and N.Y. Paniagua-Zambrana)

Local Medicinal Uses

***Citrus aurantiifolia*: Bolivia:** Fresh or dried leaves and flowers are used to treat heartache, high blood pressure, gallbladder, nerves, to accelerate childbirth, cough, mucus in the lungs, tonsils, hemorrhage, for wound healing, as tranquilizer, and to stay young (Bussmann et al. 2016). **Colombia:** Leaves are used to treat heartburn; leaves and fruits are used to treat throat inflammation, pleural inflammation, indigestion, high blood pressure, headache, general malaise, gallbladder, flatulence, conjunctivitis, cirrhosis, Arthritis, sores, as analgesic, and as tranquilizer; fruits are used to treat stye (Bussmann et al. 2018). Used in **Kenya** to treat malaria and sexually transmitted diseases (Njoroge and Bussmann 2006a, b).

***Citrus* x *aurantium*: Boilvia:** For heart and nervous system (Quiroga et al. 2012). **Colombia:** Fresh leaves are used as sedative; fruits used to treat liver problems, gallbladder (Bussmann et al. 2018). The fruit of the lemon is considered one of the most useful medicinal plant products, since it cures a great variety of diseases. The main applications of lemon are: as eye drops applying 1 or 2 drops inside the eye, prepared as infusion, to cure chronic conjunctivitis and propensity to styes; it is also used as a digestive and reliever in intestinal diseases, as a disinfectant, and is frequently used to treat dysentery and gastrointestinal diseases; it cures inflammations of the tissues that line the lungs and the thoracic cavity, and it is used in the treatment of liver cirrhosis, rheumatism, sores, to relieve headaches, and biliary conditions. Lemon juice with bicarbonate used in the form of gargles cures throat plaques and chest sores. Lemon is also considered as a powerful depurative of the blood and as a soothing of the imbalances of the nervous system. The lemon consumed in a good amount on an empty stomach is very good to cure and relieve arthritis and very high blood pressure (Fonnegra Gómez and Villa-Londoño 2011; Fonnegra Gómez et al. 2012; García Barriga 1975; Martínez Correa and Montes Martínez 2017; Pérez Arbeláez 1996). **Ecuador:** Fresh peel and fruits are used to treat scurvy, stomachache, high blood pressure, as deodorant, and for bad air (mal aire) (Béjar et al. 2002; Bussmann and Sharon 2006a, 2007a). **Peru:** Small leaves and stems, dried, are used for nerves and stomach (Bussmann and Sharon 2006b, 2007b, 2015a, b; Bussmann and Glenn 2011a, b; Bussmann et al. 2010a). Orange leaves are regularly sold in local markets (Bussmann et al. 2007). No known toxicity (Bussmann et al. 2011b).

In **Madagascar**, the species is used to treat cough (Rabearivony et al. 2015) and stomachache (Rakotoarivelo et al. 2015), and to treat malaria (Razafindraibe et al. 2013).

***Citrus maxima*: Bolivia:** For nervous system and heart problems, gallbladder, stomach pain, gastritis, and colds (Quiroga et al. 2012). It is used in **Colombia** to make juices and consume as fresh fruit in the treatment of digestive discomfort (García Barriga 1975; Pérez Arbeláez 1996). The species is especially widely used in **Peru**, especially in its variety *limetta* (lime). It is used to remedy nervous system problems, stomach inflammation, gastritis, heart disease, heartburn, and helps to refresh the stomach, as well as to lower Cholesterol and lose weight (Bussmann and Sharon 2006b, 2007b, 2015a, b; Bussmann and Glenn 2010, 2011a; Bussmann et al. 2010a). Also used to treat colds, bronchial problems, cough, flu, liver problems, diarrhea, dysentery, and nausea (Monigatti et al. 2013). It has limited antibacterial activity (Bussmann et al. 2009, 2010b, c, 2011a; Bussmann and Glenn 2011c). Like many plants, *Citrus maxima* is used in herbal mixtures (Bussmann et al. 2010d). Recently, the species is used to treat diabetes and cancer (Bussmann and Glenn 2011d). In **Madagscar, it is** used to treat cough (Rakotoarivelo et al. 2015), malaria, and to expel the placenta (Razafindraibe et al. 2013).

***Citrus medica*: Bolivia:** Dried fruits are used to treat gallbladder, gallstones, cold, cough, diabetes, and for rage (Justo and Moraes 2015; Bussmann et al. 2016). The fruit of citron is used in **Colombia** as a stimulant and corrective of digestion (García Barriga 1975; Pérez Arbeláez 1996). **Ecuador:** Bathing with an infusion of branches

reduces fever (Mestiza-Pichincha). Roasted fruit is scrubbed on the part affected by scabies. The fruit is used to treat dutch disease (aviral skin disease) (Kichwa de la Sierra-Imbabura). Roasted fruit is effective in treating cough. The fruit juice is used to clean wounds and treat inflammations of the mouth and throat (unspecified ethnicity – Pichincha). The juice of the fruit, mixed with different remedies, is taken to treat nausea and lower fever (Kichwa of the East-Napo). Fruit juice is used to lower uric acid levels and treat gout, in addition, it relieves diarrhea, colds, respiratory conditions and lowers fever (Mestiza-Pichincha; Kichwa of the East-Napo; unspecified ethnicity – Pichincha, Others (Coast region)). The fruit juice has antiscorbutic, refrigerant, and febrifuge properties (Kichwa del Oriente-Sucumbíos; unspecified ethnic group – Azuay, Cañar). It is used to clarify the view. It is used to treat foot fungus (unspecified ethnicity – Other (Coast Region)). It is used to treat arthritis, rheumatism, influenza, angina, cuts, mumps, nosebleeds, and gallbladder pain (Mestiza-Pichincha; unspecified ethnicity-Other (Costa Region)) (de la Torre et al. 2008).

***Citrus reticulata*:** The oil extracted from the bark and leaves is used in **Colombia** to remove skin spots. The infusion of mandarin leaves is used as an antispasmodic. The juice of the fruit is used in the inflammation of the peripheral nerves, as antiscorbutic, laxative, antiflatulent, and sedative (Fonnegra Gómez and Villa-Londoño 2011; García Barriga 1975). **Ecuador:** The flowers, in infusion, are used to treat the nerves (ethnicity not specified – Loja). **Peru:** Flowers and fruit peel are used fresh for nerves (Bussmann and Sharon 2006b, 2007b, 2015a, b; Bussmann and Glenn 2011a; Bussmann et al. 2010a).

Local Food Uses

***Citrus* x *aurantium*: Ecuador:** The leaves are used to prepare aromatic waters (unspecified ethnic group – Imbabura) (de la Torre et al. 2008). It is eaten in **Ethiopia** (Bussmann et al. 2011c).

***Citrus maxima*:** Used widely for curing ceremonies in **Peru**, especially spiritual flowering, sucking the pain away, refreshing the patient, and taking bitterness away (Bussmann and Sharon 2006b, 2007b, 2015a, b; Bussmann and Glenn 2011a; Bussmann et al. 2010a). A common ingredient in emollients (Bussmann et al. 2015).

***Citrus medica*: Ecuador:** The fruit is edible and, in certain regions, is used to prepare soft drinks and confectionery (Secoya-Sucumbíos; Kichwa del Oriente-Napo; Mestiza-Imbabura, Pichincha, Tungurahua, Costa Region; unspecified ethnic group-Esmeraldas, Pichincha, Azuay, Cañar, Loja). The leaves are used to prepare aromatic waters (Kichwa del Oriente-Napo) (de la Torre et al. 2008). Fruit juice is used as a salad seasoning (Mestizo-Pichincha; Kichwa del Oriente-Napo) (de la Torre et al. 2008).

***Citrus reticulata*: Ecuador:** The fruit is edible (Secoya-Sucumbíos; Kichwa del Oriente, Shuar Napo; Mestiza-Manabí, Imbabura, Tungurahua, Azuay, Loja; unspecified ethnic group-Manabí, Loja, Others (Coast Region)). The leaves are used to prepare aromatic waters (East Kichwa-Napo; unspecified ethnicity – Loja).

Local Handicraft and Other Uses

***Citrus aurantifolia*: Bolivia:** So that the kari kari (a bad spirit) stays away (Bussmann et al. 2016).
***Citrus medica*: Ecuador:** Fruit juice is used to prevent hair loss and dandruff (unspecified ethnicity-Pichincha). The leaves, in infusion, are used to control bad breath (unspecified ethnicity – Imbabura). It is mixed with bicarbonate to remove bad odors from the armpits (unspecified ethnic group – Other (Coast Region)). Social: The fruit is used to treat "vices" (unspecified ethnicity – Pichincha) (de la Torre et al. 2008).
***Citrus reticulata*: Ecuador:** It has beekeeping use (unspecified ethnicity – Loja) (de la Torre et al. 2008).

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