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Remarks on the Presence of *Cananga odorata* (Lam.) Hook. F. & Thoms (Annonaceae) in Cuba

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Abstract

Context: The presence of Annonaceae plants in the Hotel Guantanamo (Guantanamo), which do not belong to any of the species of this family recorded in the preliminary inventory of Cuban vascular plants encouraged researchers to study their identity, origin, and properties.
Aim: To unveil the identity of the species, through a detailed study of its presence and record in Cuba, provide an analytical key to contrast it from the other akin taxa, and compile associated elements with the main properties that characterize it, including its practical use.
Methods: Botanical methods were used in the study, such as working with collections, comparison of descriptions, and keys in specific catalogs, along with the scientific description and illustration. The adjacent population was surveyed to establish the use given to the plant.
Results: The presence of *Cananga odorata* (Lam.) Hook. F. & Thoms in Cuba was confirmed. The taxon was described and illustrated, and an analytical key was established to contrast the species from the other representatives of this genus in Cuba. A few remarks were made on the usefulness of the plant for gardening and medicine.
Conclusions: *C. odorata* must be included in the catalogs and specialized papers on the Cuban flora. Its usefulness for gardening and traditional medicine, and its antiviral, antibacterial, and antioxidant properties must be taken into account by the Cuban economic botany.

Keywords: *Annonaceae, Cuban flora, Guantanamo flora, ornamental plants.*

Introduction

The gardens of the Hotel Guantanamo have a notorious tree due to the exquisite fragrance of the flowers. Its identity, at first, was unknown to the gardening staff of the hotel. Accordingly, a formal request was issued to the botany teachers at the Department of Botany of the University of Guantanamo, Cuba, to determine the plant nomenclature, taxonomy, origin, and usefulness, among other elements.

A preliminary study corroborated that the plant qualifies within the Annonaceae family, frequently observed in Cuban gardens. However, this specimen does not correspond to any of the taxa from this family recorded in the preliminary inventory of vascular plants in Cuba (Greuter & Rankin, 2017). Hence, a detailed study was done, which lasted longer than initially foreseen.

This paper aims to publish the results from studies conducted to unveil the identity of the species, through a detailed study of its presence and record in Cuba, to provide a description and an analytical key to contrast it from the other akin taxa, and compile the related elements as part of the main properties that characterize it.

Materials and Methods

This research was done as part of one of the tasks of institutional project Education of Natural Sciences for Local Development in Guantanamo, implemented by the Raul Gomez Garcia Campus of the University of Guantanamo. The notes on the phytochemistry and usefulness of the taxon also contribute to project *Installing a center of excellence in the Central-Eastern region of Cuba to enhance production and research on bioactive plants*, by the Ignacio Agramonte University of Camaguey, in collaboration with other Cuban and Belgium institutions, funded by the VLIR-UOS program, of the Council of Flemish Universities (Belgium).

The *in situ* study included the collection of herbal specimens and digital images, together with the morphological evaluation of vegetative and reproductive structures of the plant. The measurements were made using a tape measure and a gauge caliper.

The local population was surveyed to determine their knowledge about the species observed by students, its possible common names given, and to establish the initial origin of the propagation material. The herborized samples were added to the Julián Acuña Galé Herbarium, the University of Camaguey (HIPC, according to Thiers, 2020).

The species was identified through comparisons using descriptors, keys, and images described in the Tropical Plants Database (Fern, 2021); Nurhayani et al. (2019); Jingjing et al. (2015); Hern et al. (2015); Parrotta (2014); Orwa et al. (2009), and Manner & Elevitch (2006). Also the digital samples from several herbariums were consulted, such as, NY, BM, COL, IFAN, LINN, BR, L, K, SING, BJA, TOGO, NCU and MO (according to Thiers, 2020), whose access was made possible by, JSTOR, EOL, Redflora and Tropics. Information was also consulted at the following sites: GBIF, NCBI, NIH, and BHL. The Font Quer terminology was used to describe the plants.

The search for documentary evidence of the presence of this species in Cuba included the review of materials deposited in the herbariums, namely, HAC, HIPC, and ULV (Thiers, 2020), and a bibliographic review.

Results and discussion

The plant studied belongs to *Cananga* (DC) Hook. f. & Thomson (Annonaceae). Consequently, the number of genera from this family recorded in Cuba increased to 10 (Gómez de la Maza & Roig, 1914; Hammer et al., 1990; Esquivel et al., 1992; Greuter & Rankin, 2017). *Artabotris* R. Br., cited by Roig (1965), was excluded, with no accurate data about its presence in the country, which has not been confirmed by any other author.

The following analytical key was suggested to distinguish the Annonaceae genera recorded in Cuba:

1 Carpels and monocarps together in a single gynoecium and fruit.....2

1* Free carpels and monocarps a split gynoecium and fruit.....2

2 Syncarpous fruit (merged monocarps, unseen) *Monodora*

2* Paracarp fruit (merged but evident monocarps) ……..…….... 3

3 Outer petals without spur or wing in the outer part *Annona*

3* Outer petals with spur or wing in the outer part……...……...*ollinia*

4 Multiple ovules in every carpel (several seeds in each monocarp) ……..……..….……..5

4* Single ovules in every carpel (a single seed in each monocarp) ……. 8

5 Connective (anther) with an acute-lanceolate apex.……*Cananga*

5* Connective (anther) with a dilated-truncated apex……..….....6

6 Valvate petals ……...…… 7

6* Imbricate petals……*Uvaria*

7 Transversally-septed anther cells……. *Xylopia*

7* Non-transversally-septed anther cells…*Desmopsis*

8 Connective (anther) with an acute-lanceolate apex…….*Oxandra*

8* Connective (anther) with a dilated-truncated apex..... 9

9 Imbricate petals..... *Guatteria*

9* Valvate petals..... *Polyalthia*

Since genus *Cananga* is not described in the scientific literature of the Cuban flora, the data of its nomenclature, phenotypic characterization, distribution, ethnobotanics, and behavior in the country, is the following:

Cananga (Dunal) Hook. f. & Thomson, Fl. Ind. 129. 1855, *nom. cons*., non-*Cananga* Aubl., *nom. rejic*. Lectotype (Hutchinson Bull. Misc. Inform. Kew: 250. 1923): *Canangium odoratum* (Lam.) Baill. ex-king [*Uvaria odorata* Lam., *Unona odorata* (Lam.) Dunal, *Cananga odorata* (Lam.) Hook. f. & Thomson].

Up to 40 m-high trees with a gray or pale brown crust; horizontally extended branches covered with furry hair when young, hairless when adult; brown lenticelate twigs. Simple, alternate, petiolate, distal leaves with no stipules; pale green petioles covered with furry hair; ovate-elliptical-lanceolate lamina, hairless, and smooth, dark green when fresh; undulate edge; a generally round-obtuse base; acute-acuminate short; 5-10 pairs of lateral glabrous veins, occasionally pubescent with tiny straight, pointed, and somewhat rigid hair. *Inflorescence* in bunches, on dangling axillary buds, with 4-20 flowers distributed in fascicles (solitary rarely). *Flowers* in bunches, star-like, fragrant; elongated pedicel by the fruit. *Calix*: 3 disepals, valvate, ovate, acute at the apex, yellowish-green, extended. *Corolla*: dipetalous; 6 petals in 2 verticils, valvate, long-tapering, sub-equal, fleshy, yellowish-green. *Androecium*: having numerous stamens; anther having an acute-lanceolate connective. *Gynoecium*: apocarp, having many or few carpels; hairy receptacle; free carpels having several ovules, biseriate; hairless-like. *Fruit*: apocarp; numerous monocarps, stipitate-long, ovoid to sub-globose, 2-12 seminate, initially green, purple when ripe. *Seeds*: small, flat, brown and bright.

This genus is made of four species spread through tropical Asia, Malaysia, and Australia (Kessler, 1993).

The species was identified as *Cananga odorata* (Lam.) Hook. F. & Thomson. Other details of the nomenclature, description, distribution, ethnobotany, and behavior in Cuba are shown below:

Cananga Hook. f. & Thomson. Fl. Ind. 1: 130. 1855 ≡ *Uvaria odorata* Lam. Encycl. 1: 595, 1785 ≡ *Canangium odoratum* (Lam.) King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 61(1): 41. 1892. Lectotype (Turner & Veldkamp *Gardens' Bulletin Singapore 61* (1), 196. 2009): China, *Sonnerat s.n.*, annot. Alanguilan de la Chine (P-LAM #286083 n.v.). Figure 1.

10-40 m tall tree having a pyramid-like growth. *Stem*: single, straight, about 45 cm diameter, cylindrical to the first branch, without spurs; smooth crust, pale brown; slightly thick foliage; pendular branches. *Leaves*: 6-15 mm light green petioles; 13-29 x 4-10 cm ovate-oblong lamina, widely elliptical or lanceolate, soft and dark green, bright on the face, and paler and slightly pubescent on the back; undulated edges; round or obtuse base; acute to thinly acuminate apex; central veins and lateral veins (5-10), whitish and hairy on both sides. *Bunches* or *chasms* on axillary buds, 1-4 cm long, with 1-numerous flowers, leafless; 2-5 cm peduncles. *Flowers*: dangling, fragrant; 1-5 cm pubescent pedicel, bracteolate. *Sepals:* 3, 5-6 x 0,4-06 cm, ovate, acute on the apex, both surfaces thickly and thinly puberulent. *Petals*: 6, in two 5-8 x 0,3-0,8 cm, yellowish-green verticils, linear-oblong to long-tapering, narrow at the base, acute and undulated on the apex. *Stamins*: numerous, of up to 3 mm, clavate; acute-lanceolate connectives on the apex. *Gynoecium*: 10-12-carpel-like; 4 mm carpels, initially puberulent, glabrescent when mature; clavate lamellate stigma having a U-shape. *Fruit*: made of 8-16 individual monocarps; 1.5–2.5 x 1.5 cm ovoid, globose, and oblong monocarps, glabrous, having a 1.2–1.8 cm stipites, purple-black and juicy when ripe, 2-12 seminate. *Seeds*: 9 x 6 x 2.5 mm ovoid-discoid to ellipsoid, pale brown, peak-shaped surface, hard, having a rudimentary aryl.

C. odorata is native to Cambodia, Indonesia, Laos, Malaysia, Myanmar, Papua, New Guinea, the Philippines, Salomon Islands Thailand, Vietnam, and Australia. It has been spotted in other countries, such as, Cameroon, China, Comoros, Cote d'Ivoire, India, Jamaica, Madagascar, Reunion, Seychelles, Sri Lanka (Orwa et al., 2009); Mariana Islands and Carolinas, Fiji, New Caledonia, Taiwan (CABI, 2000); the Philippines, Pacific Islands of Java and del the south of India (Roig, 1974); La Española and Guadeloupe (Little & Wadsworth, 1964). It has also been reported in: Guatemala (Standley & Steyermark, 1946), Ecuador (Dodson & Gentry, 1978; Jorgensen & León-Yánez, 1999); Costa Rica (Zamora Jiménez & Poveda, 2000); Panama (Correa et al., 2004); El Salvador (Linares, 2005); Honduras (Nelson, 2008), Mexico (García-Mendoza & Meave, 2011), The United States of America, Puerto Rico, Virgin Islands, and Colombia (Betancourt, 2000).

Its presence in Cuba has been recorded by: Anonymous (1958); Little & Wadsworth (1964), Roig (1965, 1974); Betancourt (2000); Hammer et al., 1990; Esquivel et al. (1992). According to Roig (1974), the species was introduced by the Experimental Agronomic Station in 1904, but it spread slowly at first. Currently, it is grown in all the provinces of the country, though not abundantly. However, no mention is made of the plant in: Gómez de la Maza & Roig (1916); León & Alain (1951), Alain (1969); Acevedo & Strong (2012), or Greuter & Rankin (2017).

In Cuba, it is known by the name of ilang (Anonymous, 1958; Roig, 1974; Hammer et al., 1990; Esquivel et al., 1992). Internationally, it is known as ylang-ylang, perfume tree, cananga, and

cadmia (Manner & Elevitch, 2006; Turner & Veldkamp, 2009).

There is no information regarding its naturalization in Cuba, which should be monitored in the future. Although it was a spontaneously generated species in agroforestry areas until it grew by itself (MacMillan, 1962; Manner & Elevitch, 2006; Orwa et al., 2009), it is rarely considered a pest (Pacific Island Ecosystems at Risk, 2004). As a pioneer of disrupted areas, growing fast and reaching up to 30 m high, it has invading traits that might entail a negative environmental impact (CABI, 2000). It has been recorded under the same conditions in Seychelles (Senterre et al., 2021), Comoros (Pagad, & Jenna Wong, 2020), and southeast Asia (Datiles, 2015). It is considered a weed in Central Africa and Micronesia (Randall, 2012; Moverly et al., 2020), and as persistent in Puerto Rico (Liogier & Martorell, 2000).

Specimens observed: Cuba. Guantánamo, City of Guantánamo, Hotel Guantánamo (20.16075 - 75.21139), grown plant, 4-III-2021, *M. Chibás* HPC-*12695* (HIPC). University of Guantánamo, Regino Eladio Boti Campus (20.15337 - 75.19292). 20-IV-2021, *M. Chibás* HPC-*12696* (HIPC). Camagüey. City of Camagüey, La Caridad (21.373566 - 77.912646). *R. González*. HPC-*12697* (HIPC).

It has also been reported in Havana, San Lázaro Hospital, Rincón (Roig, 1974); The National Botanical Garden (National Botanical Garden, The University of Havana, 1993-94); Plaza de la Revolución, The Quinta de los Molinos (Albert-Puentes et al., 2011). Cienfuegos, Lajas, Soledad de Cartagena Settlement (Ramírez et al., 2021); The Botanical Garden of Cienfuegos (Domínguez et al., 2016). Villa Clara, Santa Clara (Ramírez et al., 2021). Granma, Media Luna (Fombellida, 2016).

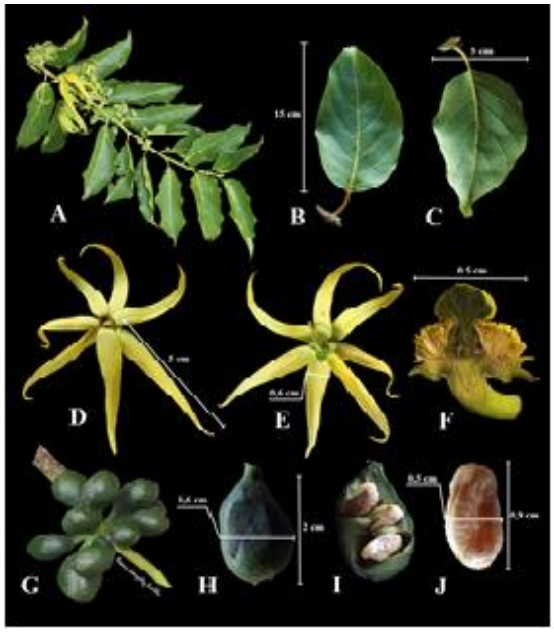

Fig. 1. *Cananga odorata* (Lam.) Hook. f. & Thomson. A. Flowered branch B. Leaf, face. C. Leaf, back. D. Flower, upper view. E. Flower, lower view. F. Androceum and gynoecium, longitudinal section. G. Fruit. H. Monocarp. I. Monocarp, longitudinal section. J. Seed. Photos and photographic composition: Photos taken by Roeris Gonzalez Sivilla.

C. odorata has a variety of uses due to its medicinal and traditional properties (Tan et al., 2015). This species is used against malaria in Vietnam (Nguyen-Pouplin et al., 2007). The cream made from fresh crushed flowers has been used to treat asthma; the flowers and the crust are used against pneumonia and stomachache by local communities and traditional healers from the north of the Marianas Islands (Nandwani et al., 2008). The essential oil from the flowers, which contain caryophyllene has been useful to treat hepatitis (Orwa et al., 2009), whereas in Indonesia it is thought to increase elation and pleasure during sex, and to reduce anxiety during contact (Holt, 1999). Several anti-depressive properties, and as a blood pressure regulator have been reported (Saedi & Crawford, 2006).

In India, and other territories, in the Indian Ocean, the direct application of the leaves is used to ease itching and fight dandruff (Jain & Srivastava, 2005). The oil is used against headaches, eye swelling, and gout (Holdsworth, 1990). A beverage made of the crust has been used to treat rheumatism, phlegm, ophthalmia, ulcers, and fever (Roloff et al., 2012).

The essential oil is used for aromatherapy. It has been thought to normalize seborrhea on the skin, and it is considered as an aphrodisiac (The North University, n/a). This substance is widely used to make perfumes, oriental settings, or flower settings.

The essential oil from the flowers is obtained by distilling (Ekundayo, 1989), and its composition contains sesquiterpenes, alcohols, esters, ethers, phenols, and aldehydes (Sacchetti et al., 2005). The commercial specification (extra grade, first, second, and third), is basically established depending on the proportion of the above compounds. The content of oxygenated compounds (methyl benzoate, p-methylanisole, benzyl benzoate, linalool, etc.) is fundamental to determine the commercial quality, whereas the increase of sesquiterpenes deteriorates its properties. It has been used as an indispensable product in French perfume making, included in the finest world-class cosmetic preparations (Galletti & Bonaga, 1988).

The annual production of the essential oil from the flowers worldwide is calculated in 100 tons. Among the main producers are Comoros (50-65 tons), Mayotte (10-20 tons) and Madagascar (20-25 tons). Indonesia produces little amounts from a different subspecies of the tree, which may be used as a substitute of the product, labeled as third grade.

Imports are almost exclusively dominated by France (Ylang Oil, 2014).

Other uses have been acknowledged in other areas, such as foods (Facciola, 1998), to produce candies, glace, baked products, sodas, and chewing gum; fragrant components for soap, detergent, creams, lotions, and perfumes (especially floral and oriental), containing a maximum of 1% (Albert & Steven, 2003). The wood is used as firewood occasionally. In Indonesia, the treated crust is used to make rope (Orwa et al., 2009).

The ilang ilang flowers in bouquets, fruit arrangements, and wood aromas. In Indonesia, the flowers are spread on the beds of spouses; in the Philippines they are put together with *Jasminum sambac* (L.) Aiton (Oleaceae), to make loops that people wear on their necks, and adorn religious images (UEIA, 2007).

Conclusions

Cananga odorata (Lam.) Hook. f. & Thomson. has been grown in Cuba for 122 years, so it must be acknowledged as part of the economic flora of the nation, and be included in the specific catalogs of the Cuban flora.

Author contribution statement

Mario Chibás Creagh: Conception of the article, content curator, location and identification of the plant, specimen herborization, overall redaction of the article.

Isidro E. Méndez Santos: General conception of the article, content curator, plant identification, partial redaction (nomenclature, analytical key design), and review of the original manuscript.

Roeris Gonzalez Sivilla: Location and identification of the plant, specimen herborization, photo composition, partial redaction, and review of the original manuscript.

Yadis Ramón Hope: Location of the plant, partial redaction, and review of the original manuscript.

Conflicts of interests

The authors declare there are no conflicts of interests.

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