Journal of Ecohumanism
2024
Volume: 3, No: 7, pp. 4475 – 4480
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i7.4559

Annonaceae (Annona spp.) cultivated in the State of Campeche (Mexico)

Rafael Manuel de Jesús Mex-Álvarez[1], Gabriela del Carmen Canche-Naal[2], María Magali Guillen-Morales[3], Patricia Margarita Garma-Quen[4], Roger Enrique Chan-Martínez[5], Dylan Manuel Ferrer-Dzul[6]

Abstract

Plants of the Annonaceae family have great pharmacological interest thanks to their production of cytotoxic compounds which can be used in cancer treatment. Among the plants belonging to this family, the species belonging to the genus Annona stand out because they have edible fruits which are marketed in Latin American countries. In Mexico it is common to grow plants such as Annona cherimola, Annona diversifolia, Annona lutescens, Annona reticulata, Annona squamosa and Annona muricata; The Mexican southeast, where the state of Campeche is located, is no exception; Therefore, the objective of this work was to present the main species of the Annonaceae family cultivated in the state of Campeche (Mexico).

Keywords: Ethnopharmacology, ethnobiology, sustainable agronomy

Introduction

Plants of the *Annonaceae* family have great pharmacological interest, because they produce a wide variety of compounds with diverse biological activities; The species of this family have been used in traditional medicine to treat diseases since antioxidant, analgesic, anti-inflammatory, antimicrobial, antitumor properties, among others, have been attributed to it (Ilango et al., 2022; Hernández et al., 2021; Kumar et al., 2021). However, the most important activity that this family has is cytotoxic thanks to the fact that metabolites are extracted from these plants that can be used in cancer treatment; Among the compounds isolated and identified in the *Annonaceae* family are flavonoids, alkaloids and acetogenins, which provide plants with their antioxidant and cytotoxic activity (Costa et al., 2024; Duran et al., 2021; Hernández et al., 2021; Pineda-Ramírez et al., 2020).

Flavonoids are derivatives of phenolic compounds that have biological activities such as antioxidant, while alkaloids are nitrogenous compounds with activity on the central nervous system and in some cases, such as isoquinoline alkaloids, cytotoxic activity; Both flavonoids and alkaloids can be found ubiquitously in plants (Costa et al., 2024; Duran et al., 2021; Pineda-Ramírez et al., 2020). However, acetogenins have only been isolated from plants of the *Annonacea* family. These compounds are derivatives of long-chain fatty acids which are linked to a γ-lactam and have one or two tetrahydrofuran rings in their structure; They are molecules with cytotoxic activity that act by inhibiting mitochondrial complex I, which is related to the production of ATP (Duran et al., 2021; Rady et al., 2018).

Among the genera that make up this family, the genus *Annona* stands out since it contains species that produce edible fruits which are usually cultivated and marketed in different Latin American countries such as Mexico, in which several species of this genus are usually cultivated such as: *Annona cherimola, Annona diversifolia, Annona lutescens, Annona reticulata, Annona squamosa, Annona muricata,* which are commonly known by the names cherimoya, ilama, yellow anona, red anona, saramuyo and soursop, respectively (Hernández et al., 2021). The Mexican southeast is no exception in terms of the cultivation of annonas, therefore the

[1] Pharmacy Area of the Faculty of Chemical Biological Sciences of the Autonomous University of Campeche Correo. E-mail: rafammex@uacam.mx.
[2] Pharmacy Area of the Faculty of Chemical Biological Sciences of the Autonomous University of Campeche Correo.
[3] Pharmacy Area of the Faculty of Chemical Biological Sciences of the Autonomous University of Campeche Correo.
[4] Pharmacy Area of the Faculty of Chemical Biological Sciences of the Autonomous University of Campeche Correo.
[5] Pharmacy Area of the Faculty of Chemical Biological Sciences of the Autonomous University of Campeche Correo
[6] Pharmacy Area of the Faculty of Chemical Biological Sciences of the Autonomous University of Campeche Correo

Journal of Ecohumanism
2024
Volume: 3, No: 7, pp. 4475 – 4480
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i7.4559

objective of this work is to present the species of the *Annona* genus cultivated in the state of Campeche, Mexico (Romero-Soler et al., 2015).

The taxonomic classification of the species of the genus *Annona* are plants belonging to the family *Annonacea* of the order *Magnoliales* and the taxonomic class *Magnoliopsida* (of the subclass *Magnoliidae*) which is included in the division *Magnoliophyta* of the kingdom *Plantae* and taxonomic subkingdom *Tracheobionta*. (Martínez et al, 2013; Jiménez-Ramírez & Soto-Nuñez, 2015).

Annona lutescens (Yellow Annona)

The *Annona lutescens* tree is 5 to 10 meters high, with membranous and deciduous leaves, elliptical to oval in shape, 1 to 14 cm long and 3.5 to 7.5 cm wide (figura 1). Its branches are fulvo-sericeous, becoming glabrous, with green flowers opposite the leaves or implanted from the middle of an internship, they have pedicels 12 to 18 mm long, triangular sepals, 2 to 3 mm long, 6 petals, They are rudimentary and the remaining three are well developed. Its fruits are smooth globose-ovoid, yellow-green, 8 to 9 cm in diameter, barely perceptible areoles and sweet flavor (Standley & Steyermark, 1946).

Figure 1. *Annona lutescens* (Yellow Annona).

A. Tree. B. Sheet. C. Fruit (Photos: Gabriela del Carmen Canche Naal).

Gutiérrez & Luna (2016) carried out the evaluation of the diffusion assay to evaluate the antibacterial activity of the aqueous extracts of *Annona lutescens* leaves, where it was observed that these extracts inhibited the growth of *E. coli* ATCC 25922 in a dose-dependent manner, while in the aqueous extracts of *Annona lutescens* seeds they did not show antibacterial activity against any bacteria.

Annona reticulata (Red Annona)

The Annona reticulata tree is small, with an open and irregular crown, with thin and glabrous leaves, in some varieties long and narrow, 20 and 7 cm, straight and acute at the apex; in others wrinkled and up to 10 cm wide (figura 2). Its young branches are sericeous, while its mature branches are glabrescent, with flowers usually in groups of 3 or 4, with the three external petals long and the three internal ones very small. Its fruit is heart-shaped or spherical, 16 cm in diameter; The pulp varies depending on the cultivar, from juicy and very aromatic, to hard and repulsive in flavor. The external and internal color varies depending on the cultivar (Perez-Flores et al., 2023).

Journal of Ecohumanism
2024
Volume: 3, No: 7, pp. 4475 – 4480
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i7.4559

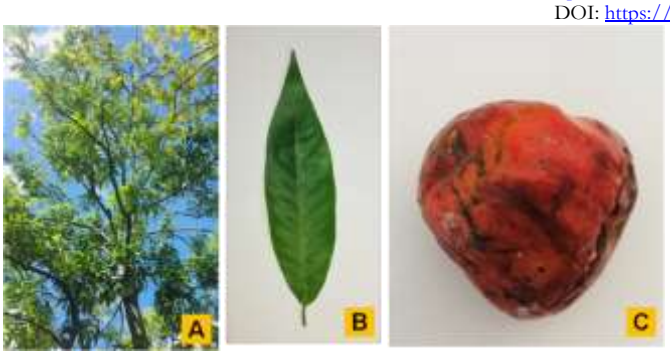

Figure 2. *Annona reticulata* (red annona).

A. Tree. B. Sheet. C. Fruit. (Photos: Gabriela del Carmen Canche Naal).

Thang et al. (2013) obtained positive results in the evaluation of NO inhibitory activity in Annona reticulata leaf extracts, so this is an explanation for its use as herbal medicine in the treatment of inflammatory diseases. Dnyandeo et al (2011) obtained in the results of their studies of Annona reticulata, that they have significant analgesic activity in extracts from the bark of the plant. Sangeetha, et al. (2016) evaluated antimicrobial activity in extracts of immature and mature pericarp of Annona reticulata fruits against fungal and bacterial strains, where they found that extracts of immature pericardium presented these benefits. (Sangeetha et al., 2016)

Jamkhande et al. (2014) found that Annona reticulata root extract, in addition to having antibacterial and antifungal activity, presents antioxidant activities, showing a concentration-dependent free radical elimination effect. While Suresh, et al. (2012) demonstrated that Annona reticulata presents cytotoxic activity against cancer cell lines and that the possible culprits are aporphin alkaloids and acetogenins present in the roots of the plants.

Annona squamosa (saramuyo)

The tree or shrub of Annona squamosa is 3 to 6 cm high, with simple crowns/leaves, alternating 5 to 11 cm in length by 2 to 5 cm wide, elliptical to lanceolate-elliptic, membranous, pubescent or glabrous in the underside and acute apex. Its branches are pubescent, it is characterized by being woody with solitary flowers or inflorescences with few flowers, pedicels 1 to 2 cm long, very small sepals, linear-oblong petals 1.5 to 2 cm long. Its fruits are berries, aggregated (syncarpic), 8 to 9 cm in diameter, globose to chordadoovoid and with a scaly surface. The pulp is white - yellowish, sugary, very aromatic and contains shiny black seeds. (Digital Library of Traditional Medicine).

Figure 3. *Annona squamosa* (Saramuyo)

A. Tree. B. Sheet. C. Fruit. (Photos: Gabriela del Carmen Canche Naal).

Annona squamosa shows pharmacological importance and the possibility of using it to produce drugs, especially for its antioxidant, antidiabetic and antiproliferative properties (Sabbah et al., 2017). They are traditionally used by different ethnic communities for the treatment of different chronic diseases, such as

Journal of Ecohumanism
2024
Volume: 3, No: 7, pp. 4475 – 4480
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i7.4559

cancerous tumors, insect bites and other skin ailments (Rashid and Amzad, 2015). Rahman et al. (2005) showed the antibacterial activity of four different seed extracts, on the other hand studies carried out by Pinto, et al. (2017), demonstrated that the leaves have broad-spectrum antibacterial properties, being more active against S. aureus, K. pneumoniae and E. faecalis, they also demonstrated the cytotoxic activity of the seeds and leaves, in which they observed an increase in the subdiploid DNA content, which suggested that the extracts activated the apoptosis pathway.

Vikas, et al. (2017), showed their antioxidant activity, where all the extracts used in the study (petroleum ether, chloroform, ethyl acetate and methanol extracts of Annona squamosa) showed significant results. Other studies have shown that aqueous extracts significantly reduced levels of glucose, lipids and lipid peroxidation, but the activity of plasma insulin and antioxidant enzymes increased (Kooti et al, 2016).

Similarly, its anthelmintic activity has been demonstrated through hexane, ethyl acetate, and ethanolic extracts of the crude drug in different concentrations (Bhattacharya and Chakraverty, 2016). Veerakumar et al., 2016, consider that the ethanolic seed extract of Annona squamosa has high anticancer potential compared to the bark and peel. The metabolites identified in the seeds were 12,15-cisquamostatin-A and bullatacin, and were shown to have significant anticancer effects on human cancer cell lines and H22 cells in mice, while Squamoxinone-D was found to be selectively active against the H460 cell line, squadiolins A and B have also been found with cytotoxic activity.

Annona muricata (soursop)

The soursop tree is evergreen or deciduous, 3 to 8 m (up to 10 m) high, with oblong-elliptic to oblong-obovate leaves, 6 to 12 cm long by 2.5 to 5 cm wide, glabrous. Its branches are cylindrical, wrinkled, rough, reddish brown and with numerous lenticels, with flowers that are solitary along the stem, sepals 3, ovate, less than 5 mm long; petals 6, the 3 outer ones are ovate, free, thick, 2 to 3 cm long, the 3 inner ones, thin and small. Its fruits are fleshy aggregate, dark-green, covered with flexible tubercles that look like thorns, ovoid-ellipsoid, 20 to 25 cm long by 10 to 12 cm in diameter, with a cottony and juicy white pulp. They have numerous seeds per fruit, one per carpel (Conabio).

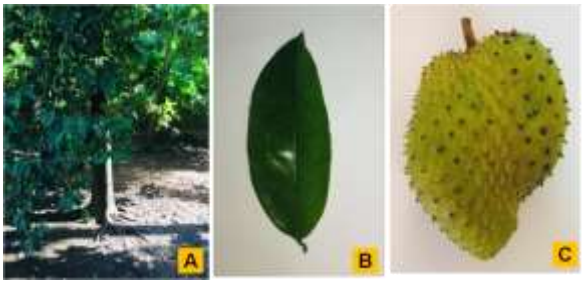

Figura 1. Annona muricata (guanábana).

A. Tree. B. Sheet. C. Fruit. (Photos: Gabriela del Carmen Canche Naal)

Jorge Arollo et al. (2009) They demonstrated that ethanolic extracts from the leaves of Annona muricata have a hypoglycemic effect in patients with type 2 diabetes and that at higher doses the hypoglycemic effect is even greater. Its cytotoxic activity has also been evaluated, Quispe et al. (2007) exposed soursop leaf extracts to mouse gastric adenocarcinoma and human lung adenocarcinoma lines, obtaining favorable results in these studies.

Poma et al. (2011), using the plantar edema method in rats, determined the anti-inflammatory activity of the aqueous extract of the Annona muricata leaf, resulting in the extract having an anti-inflammatory effect.

Journal of Ecohumanism
2024
Volume: 3, No: 7, pp. 4475 – 4480
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i7.4559

Conclusion

Annona species are of ethnobotanical importance for multiple reasons, especially because they are edible and for their use in ethnopharmacology as medicinal plants; These species described here were found in the backyards of the State of Campeche; However, a loss is qualitatively appreciated both in the culture and in the location of these species, which is why their rescue and revaluation is urgent.

References

Anón (Annona squamosa). (n.d.). NaturaLista Colombia. https://colombia.inaturalist.org/taxa/69973-Annona-squamosa

Arroyo, J., Martínez, J., Ronceros, G., Palomino, R., Villarreal, A., Bonilla, P. & Quino, M. (2009, September). Efecto hipoglicemiante coadyuvante del extracto etanólico de hojas de Annona muricata L (guanábana), en pacientes con diabetes tipo 2 bajo tratamiento de glibenclamida. In Anales de la Facultad de Medicina (Vol. 70, No. 3, pp. 163-167). UNMSM. Facultad de Medicina.

Bhattacharya, A., & Chakraverty, R. (2016). The pharmacological properties of Annona squamosa Linn: A Review. Int. J. Pharm. Eng, 4(2), 692-699.

Costa, E. V., Freitas, J. G. C., Manickchand, S. P., Araújo, M. D. S., Silva, V. R., Santos, L. D. S. & Bezerra, D. P. (2024). Gouregine, an α-Gem-Dimethyltetradehydrocularine Alkaloid, and Other Aporphinoid Alkaloids from the Bark of Guatteria olivacea (Annonaceae) and Their In Vitro Cytotoxic Activities. Molecules, 29(16), 3834

Durán, A. G., Gutiérrez, M. T., Mejías, F. J., Molinillo, J. M., & Macías, F. A. (2021). An Overview of the Chemical Characteristics, Bioactivity and Achievements Regarding the Therapeutic Usage of Acetogenins from Annona cherimola Mill. Molecules, 26(10), 2926

Dnyandeo Bhalke, R. & Jayram Chavan, M. (2011). Analgesic and CNS depressant activities of extracts of Annona reticulata Linn. bark. Phytopharmacology, 1(5), 160-5.

Gutierrez Jimenez, J., & Luna Cazares, L. M. (2016). Evaluación de extractos acuosos de Annona lutescens Safford (Annonaceae) contra Escherichia coli Escherich, 1885 (Enterobacteriaceae).

Hernández Fuentes, L. M., Montalvo González, E., García Magaña, M. D. L., Anaya Esparza, L. M., Nolasco González, Y., Villagrán, Z. & Morelos Flores, D. A. (2021). Current situation and perspectives of fruit Annonaceae in mexico: Biological and agronomic importance and bioactive properties. Plants, 11(1), 7.

Ilango, S., Sahoo, D. K., Paital, B., Kathirvel, K., Gabriel, J. I., Subramaniam, K., ... & Nirmaladevi, R. (2022). A review on annona muricata and its anticancer activity. Cancers, 14(18), 4539.

Jamkhande, P. G., Wattamwar, A. S., Pekamwar, S. S., & Chandak, P. G. (2014). Antioxidant, antimicrobial activity and in silico PASS prediction of Annona reticulata Linn. root extract. Beni-Suef University Journal of Basic and Applied Sciences, 3(2), 140-148.

Kumar, M., Changan, S., Tomar, M., Prajapati, U., Saurabh, V., Hasan, M., ... & Mekhemar, M. (2021). Custard apple (Annona squamosa L.) leaves: Nutritional composition, phytochemical profile, and health-promoting biological activities. Biomolecules, 11(5), 614.

Martínez, Fabio, Miranda L, Diego, & Magnitskiy, Stanislav. (2013). Anatomy of sugar apple (Annona squamosa L.) seeds (Annonaceae). *Agronomía Colombiana, 31*(3), 279-287.

Méndez, G. L., Castro, N. P., & Conde, C. G. (2020). Annonaceae squamosa una fuente de acetogeninas en la actualidad. Ciencia y Salud Virtual, 12(2), 88-101

Perez-Flores, F. A., Jiménez-Zurita, J. O., Bautista-Rosales, P. U., Balois-Morales, R., Ochoa-Jiménez, V. A., & Palacios-López, O. A. (2023). Generalidades de la anona (Annona reticulata L.), farmacología y fitoquímicos. Una revisión. Revista Bio Ciencias, 10.

Pineda-Ramírez, N., Calzada, F., Alquisiras-Burgos, I., Medina-Campos, O. N., Pedraza-Chaverri, J., Ortiz-Plata, A. & Aguilera, P. (2020). Antioxidant properties and protective effects of some species of the annonaceae, lamiaceae, and geraniaceae families against neuronal damage induced by excitotoxicity and cerebral ischemia. Antioxidants, 9(3), 253.

Pinto, N. C., Silva, J. B., Menegati, L. M., Guedes, M. C. M., Marques, L. B., SILVA, T. P., ... & Fabri, R. L. (2017). Cytotoxicity and bacterial membrane destabilization induced by Annona squamosa L. extracts. Anais da Academia Brasileira de Ciências, 89, 2053-2073.

Poma, E. M., Requis, E. R., Gordillo, G. C., & Fuertes, C. M. (2011). Estudio fitoquímico y actividad antiinflamatoria de la Annona muricata L.(guanábana) de Cuzco. Ciencia e Investigación, 14(2), 29-33.

Quispe, A., Zavala, D., Posso, M., Rojas, J., & Vaisberg, A. (2007). Efecto citotóxico de Annona muricata (guanabana) en cultivo de líneas celulares de adenocarcinoma gástrico y pulmonar. CIMEL Ciencia e Investigación Médica Estudiantil Latinoamericana, 12(1), 19-22.

Rady, I., Bloch, M. B., Chamcheu, R. C. N., Banang Mbeumi, S., Anwar, M. R., Mohamed, H. & Chamcheu, J. C. (2018). Anticancer properties of graviola (Annona muricata): A comprehensive mechanistic review. Oxidative medicine and cellular longevity, 2018(1), 1826170.

Rahman, M. M., Parvin, S., Haque, M. E., Islam, M. E., & Mosaddik, M. A. (2005). Antimicrobial and cytotoxic constituents from the seeds of Annona squamosa. Fitoterapia, 76(5), 484-489.

Rashid Alkhawalidy, A. S. & Amzad Hossain, M. (2015). Study on total phenolics and antioxidant activity of leaves crude extracts of Annona squamosa traditionally used for the treatment of cancerous tumours. Asian Pacific Journal of Tropical Disease, 5, S142-S144.

Romero-Soler, K. J., & CETZAL-IX, W. (2015). Las especies del género Annona (Annonaceae) cultivadas de la Península de Yucatán, México. Desde El Herbario CICY, 7, 147–153, 2015

Journal of Ecohumanism
2024
Volume: 3, No: 7, pp. 4475 – 4480
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i7.4559

Sabbah, A., Nasser, M., Hijazi, A., Rammal, H., & Nasser, G. (2017). Phytochemical screening and cytotoxic activity of two extracts from seeds of Lebanese Annona squamosa L. Int J Pharma Res Health Sci, 5(1), 1586-1591.

Sangeetha, V. S., Lawrence, B., & Babu, M. (2016). In vitro screening of Annona Reticulata L. pericarp for antimicrobial activity. International Journal of Applied Science and Engineering Research, 5, 465-476.

Jiménez-Ramírez, Jaime, & Soto-Núñez, José Carmen. (2015). Annona contrerasii (Annonaceae), especie nueva del estado de Guerrero, México. *Acta botánica mexicana*, (112), 37-43.

Standley, P. C., & Steyermark, J. A. (1946). Flora of Guatemala.

Suresh, H. M., Shivakumar, B., & Shivakumar, S. I. (2012). Phytochemical potential of Annona reticulata roots for antiproliferative activity on human cancer cell lines. Advances in life Sciences, 2(2), 1-4.

Thang, T. D., Dai, D. N., Hoi, T. M., & Ogunwande, I. A. (2013). Study on the volatile oil contents of Annona glabra L., Annona squamosa L., Annona muricata L. and Annona reticulata L., from Vietnam. Natural product research, 27(13), 1232-1236.

Términos - Atlas de las Plantas de la Medicina Tradicional Mexicana :: Biblioteca Digital de la Medicina Tradicional Mexicana. (n.d.). http://www.medicinatradicionalmexicana.unam.mx/apmtm/termino.php?l=3&t=annona-squamosa

Veerakumar, S., Amanulla, S. S. D., & Ramanathan, K. (2016). Anti-cancer efficacy of ethanolic extracts from various parts of Annona Squamosa on MCF-7 cell line. Journal of Pharmacognosy and Phytotherapy, 8(7), 147-154.

Vikas, B., BS, A., & Sujathan, K. (2017). Free radical scavenging properties of Annona squamosa. Asian Pacific Journal of Cancer Prevention, 18(10), 2725-2731.