# Xylosma G. Forst. Genus

Subjects: Chemistry, Medicinal

Contributor: Rodrigo Duarte-Casar, Juan Romero-Benavides

*Xylosma* G. Forst. is a genus of plants belonging to the *Salicaceae* family with intertropical distribution in America, Asia, and Oceania. Of the 100 accepted species, 22 are under some level of conservation risk. Around 13 species of the genus used as medicinal plants were found, mainly in Central and South America, with a variety of uses, among which antimicrobial is the most common.

Keywords: Xylosma ; ethnopharmacology ; phytochemicals ; Salicaceae

## 1. Genus

The *Salicaceae* Mirb. family, to which the *Xylosma* genus belongs, is famously medicinal because of the *Salix* genus (willow), the pharmacological properties of which were already used in ancient Mesopotamia, and were extolled in the first century CE, in Dioscorides' *De Materia Medica* [1][2].

The *Xylosma* genus is one of the 55 that conform the *Salicaceae* family [2], and is composed of 100 accepted species [3], although others list 45 [4]. Until recently, it was included in the now-deprecated *Flacourtiaceae* family, but has now been assigned to *Salicaceae* [5]. The name stems from the Greek words for "wood" and "smell" in reference to odoriferous quality of the wood of some Pacific species of the genus [4], presumably *X. orbiculata* and *X. suaveolens* used to perfume coconut oil by early South Pacific inhabitants [6]. At first, the genus was named *Myroxylon* (myrrh-wood) but was changed to *Xylosma* to avoid confusion with South American balsam trees [7]. Not all species in the genus are sweet-smelling: *X. maidenii* timber, for example, is foul-smelling. *Xylosma* species are described in detail by Woodson et al. [8].

> In shrubs or small trees, often with axillary spines, the branchlets commonly lenticellate. Leaves alternate, sometimes borne in fascicles, usually short-petiolate, estipulate, the blade is often ±coriaceous, usually glandular-dentate, penninerved, rarely entire-margined, without pellucid-glands. Inflorescences axillary, fasciculate or contracted-racemose, and are rarely racemose. Flowers are small, dioecious, or rarely polygamous; pedicels are articulated above the base, and the bracts are minute; sepals 4-5(-6), imbricate, usually scale-like, slightly connate at the base, often ciliolate along the margins, usually persistent; petals none; stamens ∞ (8–35 in Panamanian spp.), usually surrounded by an annular or glandular, fleshy disc, the filaments free, filiform, short- to usually long-exserted, the anthers minute, basifixed, extrose, longitudinally dehiscent; ovary sessile, inserted on an annular disc, 1-locular, with 2–3, rarely 4–6, parietal placentas, each placenta with 2, sometimes 4–6, ovules, the style entire or ±divided, sometimes very short, the stigmas scarcely dilated to dilated; rudimentary ovary wanting in male flowers. Fruits baccate, rather dry, indehiscent, surmounted by the persistent style, the pericarp rather thin-coriaceous, the seeds 2–8, +angular by mutual pressure, the testa thin; endosperm copious; embryo large, the cotyledons broad.

Species in the *Xylosma* genus have several uses and properties, from landscaping (*Xylosma congesta* (Lour.) Merr.), beekeeping (*Xylosma venosa* N. E. Br. [9]), timber, firewood, to food and medicine; notably *Xylosma longifolia* Clos. Due to the thorns that some species of the genus have, common names such as "do not touch me" (*Xylosma coriacea* (Poit.) Eichler) or "deer antlers" (*Xylosma spiculifera* (Tul.) Triana and Planch.) are used for them [10]. Eleven species of the genus, particularly *Xylosma vincentii* Guillaumin, are known to be nickel hyperaccumulators [11][12] which presents potential for phytoremediation and phytomining [13].

## 2. Distribution and Localization

Species belonging to the *Xylosma* genus are present in subtropical America, Southeast Asia, and Oceania. Of the 100 species listed in the genus [3], 61 are found in America, 8 in Asia, and 31 in Oceania. **Figure 1** shows examples of species of the genus. The map in **Figure 2** shows the intertropical, and to a lesser extent, temperate, distribution of *Xylosma* species, by country.

**Figure 1.** *Xylosma flexuosa* (Kunth) Hemsl. leaves and berries, left. *Xylosma congesta* (Lour.) Merr. inflorescence, right. Image sources: left, Public Domain (CC0); right, Miwasatosi, GDFL license.

**Figure 2.** Worldwide *Xylosma* distribution, by country, after [3].

Of the 100 species of the genus, 7 are listed as vulnerable, 9 as endangered, and 6 as critically endangered. In total, 22% of the species in the genus are considered as species of concern [14]. This should be considered when evaluating potential industrial uses for these species.

## 3. Ethnopharmacological and Ethnoveterinary Usage

Of the 100 species of the genus, few appear in the scientific literature, and even fewer are mentioned from an ethnopharmacological or ethnoveterinary perspective. Notwithstanding, *Xylosma* species are a part of the traditional Chinese medicinal system, with documented uses of *X. congesta* appearing as early as the XVI century CE [15].

Few of the *Xylosma* species are recognized as medicinal. **Table 1** summarizes the species with reported medicinal use along with their stated ethnopharmacological uses, when available. The Anatomical Therapeutic Chemical (ATC) Classification by the World Health Organization (WHO) is used to classify the uses for each species [16]. Not all species are identified in the literature, with general mentions as "*Xylosma* sp." in some cases.

**Table 1.** Medicinal and veterinary use of *Xylosma* species, listed in alphabetical order.

| No. | Species | Region | Plant Organs Used | Use | Form of Usage | ATC Category | Ref. |
|---|---|---|---|---|---|---|---|
| 1 | ***Xylosma benthamii*** **(Tul.) Triana and Planch.** | **Brazil** | **NS** | **Medicinal (not specified)** | **NS** | **NS** | [17] |
| 2 | ***Xylosma characantha*** **Standl.** | **Nicaragua** | **Leaves** | **Placentary retention in cattle** | **Decoction** | **Vet.** | [18] |
| 3 | ***Xylosma chlorantha*** **Donn. Sm.** | **Costa Rica** | **Bark** | **Medicinal (not specified)** | **NS** | **NS** | [19] |
| 4 | ***Xylosma ciliatifolia*** **(Clos) Eichler** | **Brazil** | **Root bark** | **Antibacterial** | **NS** | **V** | [20] |

| No. | Species | Region | Plant Organs Used | Use | Form of Usage | ATC Category | Ref. |
|---|---|---|---|---|---|---|---|
| 5 | ***Xylosma congesta*** **(Lour.) Merr.** | China<br>Japan<br>Korea | Bark<br>Leaves | NS<br>Anti-inflammatory<br>Disease prevention in suckling piglets<br>Birthing aid | Bark ashes<br>Poultice | NS<br>D<br>G<br>Vet. | [21]<br>[22]<br>[23]<br>[24] |
| 6 | ***Xylosma controversa*** **Clos.** | Guangxi, China | Roots<br>Leaves | NS | NS | NS | [25] |
| 7 | ***Xylosma flexuosa*** **(Kunth) Hemsl.** | Mexico | NS | Antipyretic<br>Anti-tuberculosis | NS | N<br>R | [26]<br>[27] |
| 8 | ***Xylosma horrida*** **Rose.** | Mexico<br>Nicaragua<br>Costa Rica | Bark | Kidneys | Decoction | G | [28] |
| 9 | ***Xylosma intermedia*** **(Seem.) Triana and Planch.** | Bolivia | Bark | Toothache | NS | N | [29] |
| 10 | ***Xylosma longifolia*** **Clos** | India<br>China | Leaves<br>Stem bark | Antifungal<br>Antispasmodic<br>Antidiarrheic<br>Anti-tuberculosis<br>Muscle sprains<br>Narcotic | Paste<br>Decoction<br>Extract | D<br>A<br>A<br>R<br>M<br>N | [30]<br>[31]<br>[32]<br>[33]<br>[34] |
| 11 | ***Xylosma panamensis*** **(Turcz)** | Panama<br>Mexico | Bark<br>Leaves | Cough<br>Bronchitis | Dried | R | [35] |
| 12 | ***Xylosma spiculifera*** **(Tul.) Triana and Planch** | Colombia, Venezuela | Leaves | Ulcers, Dermatitis | Decoction | D | [36] |
| 13 | ***Xylosma tessmanii*** **Sleumer** | Ecuador | Leaves | Medicinal (NS) | NS | NS | [37] |
| 14 | ***Xylosma sp.*** **(not specified)** | Panama | Stem<br>Root | Spider bites | Infusion | V | [38] |
| 15 | ***Xylosma sp.*** **(not specified)** | Perú | Bark | Bronchitis (with other plant species) | Decoction | R | [39] |

NS: Not specified. ATC categories are as follows. A: Alimentary tract and metabolism, B: Blood and blood forming organs, C: Cardiovascular system, D: Dermatological, G: Genito urinary system and sex hormones, H: Systemic hormonal preparations, excluding sex hormones and insulins, J: Anti-infective for systemic use, L: Antineoplastic and immunomodulating agents, M: Musculo-skeletal system, N: nervous system, P: Antiparasitic products, insecticides, and repellents, R: Respiratory system, S: Sensory organs; V: Various [16]; STDs: Sexually transmitted diseases, Vet: veterinary.

Most *Xylosma* species in use are from Central and South America (38% and 31%), followed by China (23%) and India (8%). This is roughly in accordance with the local abundance of species. There are no reports of ethnomedicinal uses of *Xylosma* in Oceania. Uses by country are shown in **Figure 3**.

**Figure 3.** Ethnopharmacological and ethnoveterinary uses of *Xylosma* spp. Circle diameter proportional to use reports for the country.

According to the ATC classification, the most frequent uses of *Xylosma* spp. in ethnopharmacology are dermatological, nervous system, and respiratory system, with 17% of the uses each, alimentary tract and metabolism with 11%, and

genitourinary system and sex hormones with 6%. Additionally, 11% of the uses are veterinary.

As to the morphological structures used, the most common are leaves and barks with 33% each, and both stems and roots with 11% each.

## 4. Biological Activity

Biological activity tests of *Xylosma* have been carried out mostly in vitro, with no reported in vivo research, with plant extracts, be they leaf, root, bark, or the whole plant. Different solvents and solvent mixtures have been used for the extracts, mainly methanol and ethanol.

### In Vitro Activity

In vitro research on biological activity of *Xylosma* species centers around 7 identified species and one unspecified one. The research figures are summarized in **Figure 4**, and the research is detailed in **Table 2**.

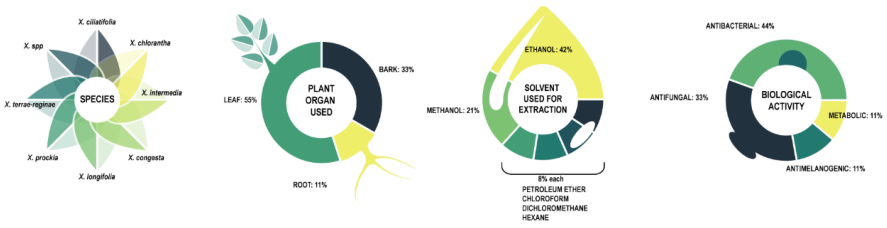


**Figure 4.** Summary of in vitro activity of *Xylosma* species.

**Table 2.** In vitro activity of *Xylosma* extracts. Species are in alphabetical order.

| Species | Extract | Plant Organs Used | Biological Activity | Biological Model | Effect | Methodology | Ref. |
|---|---|---|---|---|---|---|---|
| ***X. ciliatifolia*** | Ethanol/Hexane partition | Root bark | Antibacterial | ***S. aureus*** ***S. epidermis*** ***S. typihimurium*** ***E. coli*** | Effective against ***S. aureus*** ***S. epidermis*** MIC (µg/mL) 250, 500 | Disk diffusion assay | [20] |
| ***X. clorantha*** | Ethanol | Leaves | Metabolic syndrome | HepG2 cells | LXR 2.14 ± 0.11: 100 µg/mL | LXR transcriptional activity | [40] |
| ***X. congesta*** | Ethanol | Leaves | Anti-melanogenic | B16F10 cells | Melanin synthesis inhibition: up to 57.9% | α-MSH | [22] |
| ***X. intermedia*** | DCM/Ethanol | Bark | Antibacterial | ***Bacillus cereus*** ***S. aureus*** | MIC (ppm) 156 512 | Microbroth dilution | [41] |
| ***X. longifolia*** | Petroleum ether Chloroform Methanol | Leaves, Stem bark | Antifungal | ***Microsporum boullardii***, ***M. canis***, ***M. gypseum*** ***Trichophyton ajelloi*** ***T. rubrum*** | MIC (mg/mL) 0.141–9.0 | Agar diffusion Micro wells diffusion | [30] |
| ***X. prockia*** | Ethanol | Leaves | Antifungal | ***Cryptococcus*** spp. | MIC (ppm) 8–64 | Antifungal microdilution susceptibility standard test | [42] |
| ***X. terrae reginae*** | Methanol | Root | Antibacterial Antifungal | ***S. aureus*** ***C. albicans*** | MIC (mg/mL) 2.5 1.2 | Dilution method | [43] |
| ***X. sp II*** | Methanol | Leaves | Antibacterial | ***Flavobacterium columnae*** | MIC 375 µg/mL | Agar diffusion assay | [44] |

DCM: Dichloromethane; MIC: Minimum inhibitory concentration; α-MSH: melanocyte-stimulating hormone. LXR: LXRα Fold Activation.

In vitro biological activity tests devote the most attention to leaves (55%), with bark (33%) and root (11%) used to a lesser extent. Extraction solvents are ethanol (42%), methanol (21%), and to a lesser extent petroleum ether, chloroform, dichloromethane, and hexane, with 8% each. The solvent choices support the assumption that most active compounds are polar, and are thus extracted with polar solvents.

Testing centers on antibacterial (44%) and antifungal (44%) activity reflects the main ethnopharmacological use but appears to leave other traditional uses unexplored.

Cytotoxicity assays involving *Xylosma* extracts show no significant cytotoxicity for *Xylosma prockia* nor for *Xylosma congesta* leaf extracts [42][45]. Moderate cytotoxicity was reported for methanol *Xylosma terrae reginae* extracts [43]. 2,6-dimethoxybenzoquinone (**33**) isolated from *Xylosma velutina* is reported as cytotoxic [46].

Even though there is no in vivo research concerning *Xylosma* species in the literature, there are several patents that include *Xylosma* extracts for cosmetic, veterinary, and traditional medicinal uses, such as hangover cures [23].

## References


1. Calixto, J.B. The Role of Natural Products in Modern Drug Discovery. An. Acad. Bras. Ciênc. 2019, 91, e20190105.
2. Salicaceae Mirb.|Plants of the World Online|Kew Science. Available online: http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:30002644-2 (accessed on 25 January 2022).
3. Xylosma G. Forst.|Plants of the World Online|Kew Science. Available online: http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:332071-2 (accessed on 25 January 2022).
4. WFO. Xylosma G. Forst. Available online: http://www.worldfloraonline.org/taxon/wfo-4000041044;jsessionid=402EBB0471E61A8E4D367F550003835E (accessed on 25 January 2022).
5. The Angiosperm Phylogeny Group. An Update of the Angiosperm Phylogeny Group Classification for the Orders and Families of Flowering Plants: APG IV. Bot. J. Linn. Soc. 2016, 181, 1–20.
6. Uphof, J. The Dictionary of Economic Plants; Cramer: Lehre, Germany, 1968; ISBN 978-3-7682-0001-1.
7. Berry, S.S.; Chapman, J.; Jones, G.; Jones, J.; Pass, J.; Roper, C.F.E.; Wilkes, J. Encyclopaedia Londinensis, or, Universal Dictionary of Arts, Sciences, and Literature: Comprehending, under One General Alphabetical Arrangement, All the Words and Substance of Every Kind of Dictionary Extant in the English Language: In Which the Improved Departments of the Mechanical Compiled, Digested, and Arranged, by John Wilkes, of Milland House…; Assisted by Eminent Scholars of the English, Scotch, and Irish, Universities; Champante and Whitrow: London, UK, 1810.
8. Woodson, R.E.; Schery, R.W.; Robyns, A. Flora of Panama. Family 128. Flacourtiaceae. Ann. Mo. Bot. Gard. 1968, 55, 93.
9. Vossler, F.G. Flower Visits, Nesting and Nest Defence Behaviour of Stingless Bees (Apidae: Meliponini): Suitability of the Bee Species for Meliponiculture in the Argentinean Chaco Region. Apidologie 2012, 43, 139–161.
10. García, R.; Pegüero, B.; Jiménez, F.; Veloz, A.; Clase, T. Lista Roja de La Flora Vascular en República Dominicana; Ministerio de Educación Superior Ciencia y Tecnología (MESCyT): Santo Domingo, Dominican Republic, 2016.
11. Reeves, R.D.; Baker, A.J.M.; Jaffré, T.; Erskine, P.D.; Echevarria, G.; Ent, A. A Global Database for Plants That Hyperaccumulate Metal and Metalloid Trace Elements. New Phytol. 2018, 218, 407–411.
12. Seregin, I.V.; Kozhevnikova, A.D. Physiological Role of Nickel and Its Toxic Effects on Higher Plants. Russ. J. Plant Physiol. 2006, 53, 257–277.
13. Chaney, R.L.; Angle, J.S.; Broadhurst, C.L.; Peters, C.A.; Tappero, R.V.; Sparks, D.L. Improved Understanding of Hyperaccumulation Yields Commercial Phytoextraction and Phytomining Technologies. J. Environ. Qual. 2007, 36, 1429–1443.
14. IUCN. The IUCN Red List of Threatened Species. Available online: https://www.iucnredlist.org/en (accessed on 1 February 2022).
15. Ye, H.; Li, C.; Ye, W.; Zeng, F.; Liu, F.; Liu, Y.; Wang, F.; Ye, Y.; Fu, L.; Li, J. Medicinal Angiosperms of Flacourtiaceae, Tamaricaceae, Passifloraceae, and Cucurbitaceae. In Common Chinese Materia Medica; Ye, H., Li, C., Ye, W., Zeng, F., Eds.; Springer: Singapore, 2021; pp. 51–130. ISBN 9789811658792.

16. WHO. Anatomical Therapeutic Chemical (ATC) Classification. Available online: https://www.who.int/tools/atc-ddd-toolkit/atc-classification (accessed on 8 June 2021).
17. Van den Berg, M.E.; da Silva, M.H.L.; da Silva, M.G. Plantas Aromáticas Da Amazônia. In Proceedings of the 1er Simpósio do Trópico Úmido, 1986; Volume II, p. 95.
18. Rodríguez-Flores, O.; Torréz-Centeno, E.; Valenzuela-Betanco, R. Plantas Utilizadas Para el Tratamiento de Enfermedades en los Animales Domésticos, Reserva Natural El Tisey, Estelí. Ph.D. Thesis, Universidad Católica Agropecuaria del Trópico Seco Pbro, Francisco Luis Espinoza Pineda, Estelí, Nicaragua, 2005.
19. Juep, A. Rescate del Conocimiento Tradicional y Biológico Para el Manejo de Productos Forestales no Maderables en la Comunidad Indígena Jameykari, Costa Rica. Master's Thesis, Centro Agronómico Tropical de Educación y Enseñanza, Turrialba, Costa Rica, 2008.
20. Philippsen, A.F.; Miguel, O.G.; Miguel, M.D.; de Lima, C.P.; Kalegari, M.; Lordello, A.L.L. Validation of the antibacterial activity of root bark of Xylosma ciliatifolia (Clos) Eichler (Flacourtiaceae/Salicaceae sensu lato). Rev. Cuba. Plantas Med. 2013, 18, 258–267.
21. Shizhen, L. Ben Cao Gang Mu, Volume II: Waters, Fires, Soils, Metals, Jades, Stones, Minerals, Salts; University of California Press: Berkeley, CA, USA, 2021; ISBN 978-0-520-97697-9.
22. Lee, J.Y.; Ahn, E.-K.; Ko, H.-J.; Cho, Y.-R.; Ko, W.C.; Jung, Y.-H.; Choi, K.-M.; Choi, M.-R.; Oh, J.S. Anti-Melanogenic, Anti-Wrinkle, Anti-Inflammatory and Anti-Oxidant Effects of Xylosma congesta Leaf Ethanol Extract. J. Appl. Biol. Chem. 2014, 57, 365–371.
23. Yungui, W. A Disease Control Method for Suckling Piglets. Patent CN108235969A, 3 July 2018.
24. Duke, J.A.; Ayensu, E.S. Medicinal Plants of China; Medicinal Plants of the World; Reference Publications: Algonac, MI, USA, 1985; ISBN 978-0-917256-20-2.
25. Xu, Z.-R.; Chai, X.-Y.; Bai, C.-C.; Ren, H.-Y.; Lu, Y.-N.; Shi, H.-M.; Tu, P.-F. Xylocosides A-G, Phenolic Glucosides from the Stems of Xylosma controversum. Helv. Chim. Acta 2008, 91, 1346–1354.
26. Cornejo-Báez, A. Evaluación de la actividad antibacteriana de los extractos y fracciones de Bidens pilosa L. y Xylosma flexuosum (H. B. & K.) Hemsl y estudio quimiométrico de la actividad antituberculosa de los perfiles cromatográficos de Bidens pilosa L. Master's Thesis, Universidad Veracruzana, Xalapa, Mexico, 2016.
27. Grijalva Pineda, A. Flora útil: Etnobotánica de Nicaragua; Ministerio del Ambiente y Recursos Naturales de Nicaragua, Ed.; MARENA: Managua, Gobierno de Nicaragua, 2006; ISBN 978-99924-903-8-9.
28. Pérez-Torres, F. Manual de Plantas Medicinales más Comunes del Occidente de Nicaragua; Universidad Autónoma de Nicaragua: León, Spain, 2007.
29. Grandtner, M.M. Elsevier's Dictionary of Trees: With Names in Latin, English, French, Spanish and Other Languages, 1st ed.; Elsevier: Amsterdam, The Netherlands; San Diego, CA, USA, 2005; ISBN 978-0-444-51784-5.
30. Devi, W.R.; Singh, S.B.; Singh, C.B. Antioxidant and Anti-Dermatophytic Properties Leaf and Stem Bark of Xylosma longifolium Clos. BMC Complement. Altern. Med. 2013, 13, 155.
31. Truong, B.N.; Pham, V.C.; Mai, H.D.T.; Nguyen, V.H.; Nguyen, M.C.; Nguyen, T.H.; Zhang, H.; Fong, H.H.S.; Franzblau, S.G.; Soejarto, D.D.; et al. Chemical Constituents from Xylosma longifolia and Their Anti-Tubercular Activity. Phytochem. Lett. 2011, 4, 250–253.
32. Swapana, N.; Noji, M.; Nishiuma, R.; Izumi, M.; Imagawa, H.; Kasai, Y.; Okamoto, Y.; Iseki, K.; Singh, C.B.; Asakawa, Y.; et al. A New Diphenyl Ether Glycoside from Xylosma longifolium Collected from North-East India. Nat. Prod. Commun. 2017, 12, 1934578X1701200.
33. Salam, S. Medicinal Plant Used for the Treatment of Muscular Sprain by the Tangkhul Tribe of Ukhrul District, Manipur, India. Int. J. Adv. Res. 2020, 8, 167–170.
34. Khare, C.P. Indian Medicinal Plants: An Illustrated Dictionary; Springer Reference; Springer: New York, NY, USA, 2007; ISBN 978-0-387-70637-5.
35. Joly, L.G.; Guerra, S.; Séptimo, R.; Solís, P.N.; Correa, M.; Gupta, M.; Levy, S.; Sandberg, F. Ethnobotanical Inventory of Medicinal Plants Used by the Guaymi Indians in Western Panama. Part I. J. Ethnopharmacol. 1987, 20, 145–171.
36. García-Barriga, H. Flora Medicinal de Colombia: Botánica Médica; Instituto de Ciencias Naturales: Bogotá, Colombia, 1992.
37. Cerón, C.; Montalvo, C. Reserva Biológica Limoncocha: Formaciones Vegetales, Diversidad y Etnobotánica. Cinchonia 2000, 1, 20.
38. Caballero-George, C.; Gupta, M. A Quarter Century of Pharmacognostic Research on Panamanian Flora: A Review. Planta Med. 2011, 77, 1189–1202.

39. Brown, M. Una paz Incierta: Comunidades Aguarunas Frente al Impacto de la Carretera Marginal; Serie Antroplógica; CAAAP: Magdalena, Perú, 1984; ISBN 84-89290-008-0.
40. Vasquez, Y. Biological and Chemical Investigation of Panamanian Plants for Potential Utility against Metabolic Syndrome; University of Mississippi: Oxford, MS, USA, 2016.
41. Setzer, M.C.; Moriarity, D.M.; Lawton, R.O.; Setzer, W.N.; Gentry, G.A.; Haber, W.A. Phytomedicinal Potential of Tropical Cloudforest Plants from Monteverde, Costa Rica. Rev. Biol. Trop. 2003, 51, 647–673.
42. Folly, M.L.C.; Ferreira, G.F.; Salvador, M.R.; Sathler, A.A.; da Silva, G.F.; Santos, J.C.B.; dos Santos, J.R.A.; Nunes Neto, W.R.; Rodrigues, J.F.S.; Fernandes, E.S.; et al. Evaluation of In Vitro Antifungal Activity of Xylosma prockia (Turcz.) Turcz. (Salicaceae) Leaves Against Cryptococcus spp. Front. Microbiol. 2020, 10, 3114.
43. Mosaddik, M.A.; Banbury, L.; Forster, P.; Booth, R.; Markham, J.; Leach, D.; Waterman, P.G. Screening of Some Australian Flacourtiaceae Species for in vitro Antioxidant, Cytotoxic and Antimicrobial Activity. Phytomedicine 2004, 11, 461–466.
44. Castro, S.B.R.; Leal, C.A.G.; Freire, F.R.; Carvalho, D.A.; Oliveira, D.F.; Figueiredo, H.C.P. Antibacterial Activity of Plant Extracts from Brazil against Fish Pathogenic Bacteria. Braz. J. Microbiol. 2008, 39, 756–760.
45. Kuete, V.; Seo, E.-J.; Krusche, B.; Oswald, M.; Wiench, B.; Schröder, S.; Greten, H.J.; Lee, I.-S.; Efferth, T. Cytotoxicity and Pharmacogenomics of Medicinal Plants from Traditional Korean Medicine. Evid. Based Complement. Alternat. Med. 2013, 2013, 341724.
46. Jones, E.; Ekundayo, O.; Kingston, D.G.I. Plant Anticancer Agents. XI. 2,6-Dimethoxybenzoquinone as a Cytotoxic Constituent of Tibouchina pulchra. J. Nat. Prod. 1981, 44, 493–494.