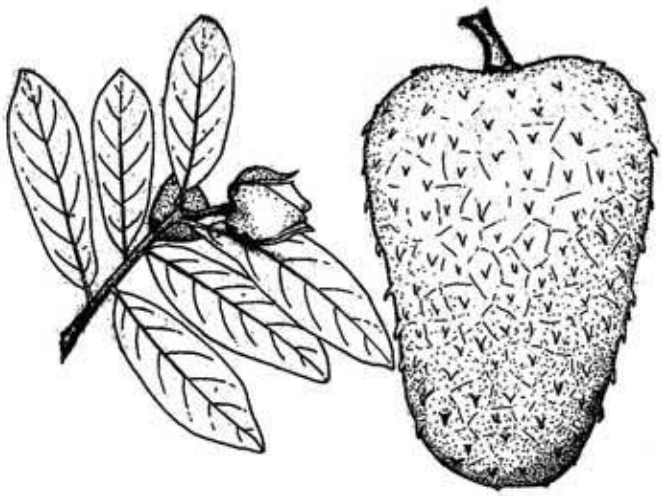
Technical Data Report

for

GRAVIOLA

(Annona muricata)



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GRAVIOLA

Herbal Properties and Actions

Main Actions	Other Actions	Standard Dosage
• kills cancer cells	• relieves depression	Leaves
• slows tumor growth	• reduces spasms	**Infusion:** 1 cup 3 times daily
• kills bacteria	• kills viruses	**Tincture:** 2-4 ml 3 times daily
• kills parasites	• reduces fever	**Capsules:** 2 g 3 times daily
• reduces blood pressure	• expels worms	
• lowers heart rate	• stimulates digestion	
• dilates blood vessels	• stops convulsions	
• sedates		

Family: Annonaceae
Genus: *Annona*
Species: *muricata*
Common Names: Graviola, soursop, guanábana, guanábano, guanavana, guanaba, corossol épineux, huanaba, toge-banreisi, durian benggala, nangka blanda, cachiman épineux
Parts Used: Leaves, fruit, seeds, bark, roots

Graviola is a small, upright evergreen tree, 5–6 m high, with large, glossy, dark green leaves. It produces a large, heart-shaped, edible fruit that is 15–20 cm in diameter and green in color, with white flesh inside. Graviola is indigenous to most of the warmest tropical areas in South and North America, including the Amazon. The fruit is sold in local markets in the tropics, where it is called graviola in Brazil, guanábana in Spanish-speaking countries, and soursop in the United States. The fruit pulp is excellent for making drinks and sherbets and, though slightly sour-acidic, can be eaten out of hand.

TRIBAL AND HERBAL MEDICINE USES

All parts of the graviola tree are used in natural medicine in the tropics, including the bark, leaves, roots, fruit, and fruit seeds. Different properties and uses a re attributed to the different parts of the tree. Generally, the fruit and fruit juice are taken for worms and parasites, to cool fevers, to increase mother's milk after childbirth, and as an astringent (drying agent) for diarrhea and dysentery. The crushed seeds are used against internal and external parasites, head lice, and worms. The bark, leaves, and roots are considered antispasmodic, hypotensive, and sedative, and a tea is made for various disorders toward those effects.

Graviola has a long, rich history of use in herbal medicine as well as a lengthy recorded indigenous use. In the Peruvian Andes, a leaf tea is used for catarrh (inflammation of mucous membranes) and the crushed seed is used to kill parasites. In the Peruvian Amazon the bark, roots, and leaves are used for diabetes and as a sedative and antispasmodic. Indigenous tribes in Guyana use a leaf and/or bark tea as a sedative and heart tonic. In the Brazilian Amazon a leaf tea is used for liver problems, and the oil of the leaves and unripe fruit is mixed with olive oil and used externally for neuralgia, rheumatism, and arthritis pain. In Jamaica, Haiti, and the West Indies, the fruit and/or fruit juice is used for fevers, parasites, and diarrhea; the bark or leaf is used as an

antispasmodic, sedative, and nervine for heart conditions, coughs, flu, difficult childbirth, asthma, hypertension, and parasites.

Today, in the United States and Europe, graviola is sold as a popular adjunctive natural therapy for cancer. This use has stemmed from published research on graviola and its naturally occurring chemicals possessing anticancerous actions, rather than its established traditional uses in South America.

PLANT CHEMICALS

Many active compounds and chemicals have been found in graviola, as scientists have been studying its properties since the 1940s. Most of the research on graviola focuses on a novel set of chemicals called Annonaceous acetogenins. Graviola produces these natural compounds in its leaf and stem, bark, and fruit seeds. Three separate re s e a rch groups have confirmed that these chemicals have significant antitumorous properties and selective toxicity against various types of cancer cells (without harming healthy cells). These groups have published eight clinical studies on their findings.[1 – 8] Many of the acetogenins have demonstrated selective toxicity to tumor cells at very low dosages—as little as 1 part per million. Four studies were published in 1998 which further specify the chemicals and acetogenins in graviola that are demonstrating the strongest anticancerous, antitumorous, and antiviral properties.[9–12]

Annonaceous acetogenins are only found in the Annonaceae family (to which graviola belongs). These chemicals in general have been documented with antitumorous, antiparasitic, insecticidal, and antimicrobial activities.[13] Mode of action studies in three separate laboratories have recently determined that these acetogenins are superb inhibitors of enzyme processes that are only found in the membranes of cancerous tumor cells. This is why they are toxic to cancer cells but have no toxicity to healthy cells. Purdue University, in West Lafayette, Indiana, has conducted a great deal of the research on the acetogenins, much of which has been funded by The National Cancer Institute and/or the National Institutes of Health (NIH). Thus far, Purdue University and/or its staff have filed at least nine U.S. and/or international patents on their work around the antitumorous and insecticidal properties and uses of these acetogenins.

In 1997, Purdue University published information with promising news that several of the Annonaceous acetogenins “not only are effective in killing tumors that have proven resistant to anti-cancer agents, but also seem to have a special affinity for such resistant cells.”[14] In several interviews after this information was publicized, the head pharmacologist in Purdue’s research explained how this worked. As he explains it, cancer cells that survive chemotherapy can develop resistance to the agent originally used as well as to other, even unrelated, drugs. This phenomenon is called multi-drug resistance(MDR). One of the main ways that cancer cells develop resistance to chemotherapy drugs is by creating an intercellular pump, which is capable of pushing anticancer agents out of the cell before they can kill it. On average, only about two percent of the cancer cells in any given person might develop this pump—but they are the two percent that can eventually grow and expand to create multi-drug-resistant tumors. Some of the latest research on acetogenins reported that they were capable of shutting down these intercellular pumps, thereby killing multi-drug resistant tumors. Purdue researchers reported that the acetogenins preferentially killed multi-drug-resistant cancer cells by blocking the transfer of ATP—the chief source of cellular energy—into them.[15]

A tumor cell needs energy to grow and reproduce, and a great deal more to run its pump and expel attacking agents. By inhibiting energy to the cell, it can no longer run its pump. When acetogenins block ATP energy to the tumor cell over time, the cell no longer has enough energy to operate sustaining processes—and it dies. Normal cells seldom develop such a pump; therefore, they don’t require large amounts of energy to run a pump and, generally, are not adversely affected by ATP inhibitors. Purdue researchers reported that fourteen different acetogenins tested thus far demonstrate potent ATP-blocking properties (including several found only in graviola).[15] They also reported that thirteen of these fourteen acetogenins tested were more potent against MDR breast cancer cells than all three of the standard drugs (adriamycin, vincristine, and vinblastine) they used

as controls.

The Annonaceous acetogenins discovered in graviola thus far include: annocatalin, annohexocin, annomonicin, annomontacin, annomuricatin A and B, annomuricin A through E, annomutacin, annonacin, annonacinone, annopentocin A through C, cis-annonacin, cis-corossolone, cohibin A through D, corepoxylone, coronin, corossolin, corossolone, donhexocin, epomuricenin A and B, gigantetrocin, gigantetrocin Aand B, gigantetrocinone, gigantetronenin, goniothalamicin, iso-annonacin, javoricin, montanacin, montecristin, muracin A through G, muricapentocin, muricatalicin, muricatalin, muri-catenol, muricatetrocin A and B muricatin D, muricatocin A through C muricin H, muricin I, muricoreacin, murihexocin 3, murihexocin A through C, murihexol, murisolin, robustocin, rolliniastatin 1 & 2, saba-delin, solamin, uvariamicin I and IV, and xylomaticin.

BIOLOGICAL ACTIVITIES AND CLINICAL RESEARCH

In a 1976 plant screening program by the National Cancer Institute, graviola leaves and stem showed active toxicity against cancer cells, and researchers have been following up on these findings since.[16] Thus far, specific acetogenins in graviola and/or extracts of graviola have been reported to be selectively toxic in vitro to these types of tumor cells: lung carcinoma cell lines;[1,3–6] human breast solid tumor lines;[4] prostate adenocarcinoma ;[9] pancreatic carcinoma cell lines;[1, 9 ,12] colon adenocarcinoma cell lines;[1, 2, 12] liver cancer cell lines;[17–20] human lymphoma cell lines;[21] and multi-drug-resistant human breast adenocarcinoma.[22] Researchers in Taiwan reported in 2003 that the main graviola acetogenin, annonacin ,was highly toxic to ovarian, cervical, breast, bladder and skin cancer cell lines at very low dosages, saying “annonacin is a promising anti-cancer agent and worthy of further animal studies and, we would hope, clinical trials.”[23]

An interesting in vivo study was published in March of 2002 by researchers in Japan, who were studying various acetogenins found in several species of plants. First they inoculated mice with lung cancer cells. Then, one third received nothing (the control group), one third received the chemotherapy drug adriamycin, and one third received the main graviola acetogenin, annonacin (at a dosage of 10 mg/kg). At the end of two weeks, five of the six in the untreated control group were still alive and lung tumor sizes were then measured. The adriamycin group showed a 54.6 percent reduction of tumor mass over the control group—but 50 percent of the animals had died from toxicity (three of six). The mice receiving annonacin were all still alive, and the tumors were inhibited by 57.9 percent—slightly better than adriamycin—and without toxicity. This led the researchers to summarize: “This suggested that annonacin was less toxic in mice. On considering the antitumor activity and toxicity, annonacin might be used as a lead to develop a potential anticancer agent.”[24]

Other studies over the years have validated some of graviola’s other uses in herbal medicine. Several early studies demonstrated that the bark as well as the leaves had hypotensive, antispasmodic, anticonvulsant, vasodilator, smooth-muscle relaxant, and cardiodepressant activities in animals.[25, 26] Researchers verified graviola leaf’s hypotensive properties in rats again in 1991.[27] Several studies over the years have demonstrated that leaf, bark, root, stem, and seed extracts of graviola are antibacterial in vitro against numerous pathogens,[28–30] and that the bark has antifungal properties.[30,31] Graviola seeds demonstrated active antiparasitic properties in a 1991 study, which validated its long standing traditional use,[3 2] and a leaf extract showed to be active against malaria in two other studies (in 1990 and 1993).[33,34] The leaves, root, and seeds of graviola demonstrated insecticidal properties, with the seeds demonstrating strong insecticidal activity in an early 1940 study.[35] In a 1997 clinical study, novel alkaloids found in graviola fruit exhibited antidepressive effects in animals.[36]

Current Practical Uses

Cancer research is ongoing on these important Annona plants and plant chemicals, as several pharmaceutical companies and universities continue to research, test, patent, and attempt to

synthesize these chemicals into new chemotherapeutic drugs. In fact, graviola seems to be following the same path as another well-known cancer drug—Taxol. From the time researchers first discovered an antitumorous effect in the bark of the pacific yew tree and a novel chemical called taxol was discovered in its bark, it took thirty years of research by numerous pharmaceutical companies, universities, and government agencies before the first FDA-approved Taxol drug was sold to a cancer patient (which was based on the natural taxol chemical they found in the tree bark).

With graviola, it has taken researchers almost ten years to successfully synthesize (chemically re p roduce) the main antitumorous chemical, annonacin. These acetogenin chemicals have a unique waxy center and other unique molecular energy properties, which thwarted earlier attempts, and at least one major pharmaceutical company gave up in the process. Now that scientists have the ability to recreate this chemical and several other active acetogenins in the laboratory, the next step is to change the chemical just enough (without losing any of the antitumorous actions in the process) to become a novel chemical, which can be patented and turned into a new (patented) cancer drug. (Naturally occurring plant chemicals cannot be patented.) Thus far, scientists seem to be thwarted again—every time they change the chemical enough to be patentable, they lose much of the antitumorous actions. Like the development of taxol, it may well take government agencies like the National Cancer Institute and the National Institutes of Health to step forward and launch full-scale human cancer research on the synthesized unpatentable natural plant chemical (which will allow any pharmaceutical company to develop a cancer drug utilizing the research, as happened with taxol) to be able to make this promising therapy available to cancer patients in a timely fashion.

In the meantime, many cancer patients and health practitioners are not waiting—they are adding the natural leaf and stem of graviola (with over forty documented naturally occurring acetogenins, including annonacin) as a complementary therapy to their cancer protocols. After all, graviola has had a long history of safe use as an herbal remedy for other conditions for many years, and research indicates that the antitumorous acetogenins are selectively toxic to just cancer cells and not healthy cells—and in minuscule amounts. While research confirms that these antitumorous acetogenins also occur in high amounts in the fruit seeds and roots of graviola, different alkaloid chemicals in the seeds and roots have shown some preliminary in vitro neurotoxic effects.[35] Researchers have suggested that these alkaloids might be linked to atypical Parkinson's disease in countries where the seeds are employed as a common herbal parasite remedy.[36] Therefore, using the seeds and root of graviola is not recommended at this time.

The therapeutic dosage of graviola leaf, (which offers just as high of an amount of acetogenins as the root and almost as much as the seed) is reported to be 2–3 g taken three or four times daily. Graviola products (capsules and tinctures) are becoming more widely available in the U.S. market, and are now offered under several different manufacturer's labels in health food stores. As one of graviola's mechanisms of action is to deplete ATP energy to cancer cells, combining it with other supplements and natural products that increase or enhance cellular ATP may reduce the effect of graviola. The main supplement that increases ATP is a common antioxidant called Coenzyme Q10 and for this reason, it should be avoided when taking graviola.

Graviola is certainly a promising natural remedy and one that again emphasizes the importance of preserving our remaining rainforest ecosystems. Perhaps—if enough people believe that the possible cure for cancer truly is locked away in a rainforest plant—we will take the steps needed to protect our remaining rainforests from destruction. One researcher studying graviola summarized this idea eloquently: "At the time of preparation of this current review, over 350 Annonaceous acetogenins have been isolated from 37 species. Our preliminary efforts show that about 50%, of over 80 Annonaceous species screened, are significantly bioactive and are worthy of fractionation; thus, this class of compounds can be expected to continue to grow at an exponential rate in the future, provided that financial support for such research efforts can be found. With the demise of the world's tropical rainforests, such work is compelling before the great chemical diversity, contained within these endangered species, is lost."[15]

Traditional Preparation

The therapeutic dosage is reported to be 2 g, three times daily, in capsules or tablets. A standard infusion (1 cup three times daily) or a 4:1 standard tincture (2–4 ml three times daily) can be substituted if desired.

Contraindications

Graviola has demonstrated uterine stimulant activity in an animal study (rats) and should therefore not be used during pregnancy.

Graviola has demonstrated hypotensive, vasodilator, and cardiodepressant activities in animal studies and is contraindicated for people with low blood pressure. People taking antihypertensive drugs should check with their doctors before taking graviola and monitor their blood pressure accordingly (as medications may need adjusting).

Graviola has demonstrated significant *in vitro* antimicrobial properties. Chronic, long-term use of this plant may lead to the death of friendly bacteria in the digestive tract due to its antimicrobial properties. Supplementing the diet with probiotics is advisable if this plant is used chronically.

One study with rats given a stem-bark extract intragastrically (at 100 mg/kg) reported an increase in dopamine, norepinephrine, and monomine oxidase activity, as well as an inhibition of serotonin release in stress-induced rats.[39]

Alcohol extracts of graviola leaf showed no toxicity or side effects in mice at 100 mg/kg; however, at a dosage of 300 mg/kg, a reduction in explorative behavior and mild abdominal constrictions were observed.[40] If sedation or sleepiness occurs, reduce the amount used.

Drug Interactions

None have been reported; however, graviola may potentiate antihypertensive and cardiac depressant drugs. See contraindications above.

Taking graviola in combination with Coenzyme Q10 and other agents that increase cellular ATP energy may reduce the effects of graviola.

Worldwide Ethnomedical Uses

Region	Uses
Brazil	for abscesses, bronchitis, chest problems, cough, diabetes, diarrhea, dysentery, edema, fever, intestinal colic, intestinal parasites, liver problems, nervousness, neuralgia, pain, parasites, rheumatism, spasms, worms
Caribbean	for chills, fever, flu, indigestion, nervousness, palpitations, rash, spasms, skin disease, and as a sedative
Curaçao	for childbirth, gallbladder problems, nervousness, and as a sedative and tranquilizer
Haiti	for coughs, diarrhea, digestive sluggishness, fever, flu, heart conditions, lice, nerves, parasites, pain, pellagra, sores, spasms, weakness, wounds, and as a lactation aid and sedative
Jamaica	for asthma, fevers, heart conditions, hypertension, nervousness, parasites, spasms, water retention, weakness, worms, and as a lactation aid and sedative

Region	Uses
Malaysia	for boils, coughs, diarrhea, dermatosis, hypertension, rheumatism, and to reduce bleeding
Mexico	for chest colds, diarrhea, dysentery, fever, ringworm, scurvy, and to reduce bleeding
Panama	for diarrhea, dyspepsia, kidney, stomach ulcers, worms
Peru	for diabetes, diarrhea, dysentery, fever, hypertension, indigestion, inflammation, lice, liver disorders, parasites, spasms, tumors, ulcers(internal), and as a sedative
Trinidad	for blood cleansing, fainting, flu, high blood pressure, insomnia, palpitations, ringworms, and as a lactation aid
United States	for cancer, depression, fungal infections, hypertension, intestinal parasites, tumors
West Indies	for asthma, childbirth, diarrhea, hypertension, parasites, worms, and as a lactation aid
Elsewhere	for arthritis, asthma, bile insufficiency, childbirth, cancer, diarrhea, dysentery, fever, heart problems, kidney problems, lice, liver disorders, malaria, pain, ringworm, scurvy, stomach problems, and as a lactation aid and sedative

Footnotes

1. Zeng, L., et al. "Five new monotetrahydrofuran ring acetogenins from the leaves of *Annona muricata*." *J. Nat. Prod.* 1996; 59(11): 1035–42.
2. Rieser, M. J., et al. "Five novel mono-tetrahydrofuran ring acetogenins from the seeds of *Annona muricata*." *J. Nat. Prod.* 1996; 59(2): 100–8.
3. Wu, F. E., et al. "Additional bioactive acetogenins, annomutacin and (2,4-trans and cis)-10R-annonacin-A-ones, from the leaves of *Annona muricata*." *J. Nat. Prod.* 1995; 58(9): 1430–37.
4. Wu, F. E., et al. "New bioactive monotetrahydrofuran Annonaceous acetogenins, annomuricin C and muricatocin C, from the leaves of *Annona muricata*." *J. Nat. Prod.* 1995; 58(6): 909–15.
5. Wu, F. E., et al. "Muricatocins A and B, two new bioactive monotetrahydrofuran Annonaceous acetogenins from the leaves of *Annona muricata*." *J. Nat. Prod.* 1995; 58(6): 902–8.
6. Wu, F. E., et al. "Two new cytotoxic monotetrahydrofuran Annonaceous acetogenins, annomuricins A and B, from the leaves of *Annona muricata*." *J. Nat. Prod.* 1995; 58(6): 830–36.
7. Rieser, M. J., et al. "Bioactive single-ring acetogenins from seed extracts of *Annona muricata*." *Planta Med.* 1993; 59(1): 91–2.
8. Rieser, M. J., et al. "Muricatacin: a simple biologically active acetogenin derivative from the seeds of *Annona muricata* (Annonaceae)" *Tetrahedron Lett.* 1991; 32(9): 1137–40.
9. Kim, G. S., et al. "Muricoreacin and murihexocin C, mono-tetrahydrofuran acetogenins, from the leaves of *Annona muricata. Phytochemistry* 1998; 49(2): 565–71.
10. Padma, P., et al. "Effect of the extract of *Annona muricata* and *Petunia nyctaginiflora* on *Herpes simplex* virus. *J. Ethnopharmacol*. 1998; 61(1): 81–3.
11. Gleye, C., et al. "Cis-monotetrahydrofuran acetogenins from the roots of *Annona muricata* 1. *J. Nat. Prod.* 1998; 61(5): 576–9.
12. Kim, G. S., et al. "Two new mono-tetrahydrofuran ring acetogenins, annomuricin E and muricapentocin, from the leaves of *Annona muricata*." *J. Nat. Prod*. 1998; 61(4): 432–36.
13. Keinan, E., et al. "Antibody-catalyzed organic and organometallic transformations and chemical libraries of Annonaceous acetogenins." *The Skaggs Institute for Chemical Biology Scientific Report* 1997–1998.
14. Anon., *Purdue News* September 1997; Purdue University, West Lafayette, IN. http://www.purdue.edu/UNS/newsandphotos.html
15. Feras, Q., et al. "Annonaceous acetogenins: Recent progress." *J. Nat. Prod.* 1999; 62(3): 504-540.

16. Anon. Unpublished data, National Cancer Institute. Nat Cancer Inst Central Files (1976). From NAPRALERT Files, University of Illinois, 1995.
17. Liaw, C. C., et al. “New cytotoxic monotetrahydrofuran Annonaceous acetogenins from *Annona muricata*.” *J. Nat. Prod.* 2002; 65(4): 470–75.
18. Chang, F. R., et al. “Novel cytotoxic annonaceous acetogenins from *Annona muricata*.” *J. Nat. Prod.* 2001; 64(7): 925–31.
19. Betancur-Galvis, L., et al. “Antitumor and antiviral activity of Colombian medicinal plant extracts.” *Mem. Inst. Oswaldo Cruz* 1999; 94(4): 531-35.
20. Chang, F. R., et al. “New Adjacent Bis-Tetrahydrofuran Annonaceous Acetogenins from *Annona muricata*.” *Planta Med.* 2003; 69(3): 241-6.
21. Jaramillo, M. C., et al. “Cytotoxicity and antileishmanial activity of *Annona muricata* pericarp.” *Fitoterapia* 2000; 71(2): 183–6.
22. Nicolas, H., et al. “Structure-activity relationships of diverse Annonaceous acetogenins against multidrug resistant human mammary adenocarcinoma (MCF-7/Adr) cells.” *J. Med. Chem*. 1997; 40(13): 2102–6.
23. Yuan, S. S., et al. “Annonacin, a mono-tetrahydrofuran acetogenin, arrests cancer cells at the G1 phase and causes cytotoxicity in a Bax- and caspase-3-related pathway. *Life Sci*. 2003 May 9; 72(25): 2853-61.
24. Wang, L. Q., et al. “Annonaceous acetogenins from the leaves of *Annona montana*.” *Bioorg. Med. Chem.* 2002; 10(3): 561-65.
25. Feng, P. C., et al. “Pharmacological screening of some West Indian medicinal plants.” *J. Pharm. Pharmacol.* 1962; 14: 556–61.
26. Meyer, T. M. “The alkaloids of *Annona muricata.*” *Ing. Ned. Indie.* 1941; 8(6): 64.
27. Carbajal, D., et al. “Pharmacological screening of plant decoctions commonly used in Cuban folk medicine.” *J. Ethnopharmacol.* 1991; 33(1/2): 21–4.
28. Misas, C. A. J., et al. “Contribution to the biological evaluation of Cuban plants. IV.” *Rev. Cubana Med. Trop.* 1979; 31(1): 29–35.
29. Sundarrao, K., et al. “Preliminary screening of antibacterial and antitumor activities of Papua New Guinean native medicinal plants.” *Int. J. Pharmacog.* 1993; 31(1): 3–6.
30. Heinrich, M., et al. “Parasitological and microbiological evaluation of Mixe Indian medicinal plants (Mexico).” *J. Ethnopharmacol.* 1992; 36(1): 81–5.
31. Lopez, Abraham A. M. “Plant extracts with cytostatic properties growing in Cuba. I.” *Rev. Cubana Med. Trop.* 1979; 31(2): 97–104.
32. Bories, C., et al. “Antiparasitic activity of *Annona muricata* and *Annona cherimolia* seeds.” *Planta Med.* 1991; 57(5): 434–36.
33. Antoun, M. D., et al. "Screening of the flora of Puerto Rico for potential antimalarial bioactives.” *Int. J. Pharmacog.* 1993; 31(4): 255–58.
34. Gbeassor, M., et al. “*In vitro* antimalarial activity of six medicinal plants.” *Phytother. Res.* 1990; 4(3): 115–17.
35. Tattersfield, F., et al. “The insecticidal properties of certain species of *Annona* and an Indian strain of *Mundulea sericea* (Supli).” *Ann. Appl. Biol.* 1940; 27: 262–73.
36. Hasrat, J. A., et al. “Isoquinoline derivatives isolated from the fruit of *Annona muricata* as 5-HTergic 5-HT1A receptor agonists in rats: unexploited antidepressive (lead) products.” *J. Pharm. Pharmacol.* 1997; 49(11): 1145–49.
37. Lannuzel, A., et al. “Toxicity of Annonaceae for dopaminergic neurons: potential role in atypical parkinsonism in Guadeloupe.” *Mov. Disord.* 2002; 1: 84-90.
38. Caparros-Lefebvre, D., et al. “Possible relation of atypical parkinsonism in the French West Indies with consumption of tropical plants: a case-control study. Caribbean Parkinsonism Study Group. *Lancet*. 1999 Jul 24; 354(9175): 281-6.
39. Padma, P., et al. “Effect of *Annona muricata* and *Polyalthia cerasoides* on brain neurotransmitters and enzyme monoamine oxidase following cold immobilization stress.” *J. Natural Remedies* 2001; 1(2): 144–46.
40. N’gouemo, P., et al. “Effects of ethanol extract of *Annona muricata* on pentylenetetrazol-induced convulsive seizures in mice.” *Phytother. Res.* 1997; 11(3): 243–45.

Graviola MONOGRAPH

Annona muricata

By Barbara Noller N.D., BHSc.
December 2003

Family: Annonaceae
Synonyms: *Annona macrocarpa, A. bonplandiana, A. cearensis, Guanabanus muricatus*
Standard Common Name: Soursop - North American (Herbs of Commerce, 2nd edition)
Other Common Names: Graviola, guanábana (Herbs of Commerce, 2nd edition)
Additional Common Names:

Graviola -	Portuguese	Huanaba -	Spanish
Guanábana -	Spanish	Toge-Banreisi -	Taiwanese
Guanábano -	Spanish	Durian benggala -	Indian
Guanavana -	Spanish	Nangka blanda -	Indian
Guanaba -	Spanish	Cachiman épineux -	French
Corossol -	French	Sauersack -	German
Epineux -	French	Stachelannone -	German

Overview

Botanical Description

Graviola is a small, upright tropical evergreen tree, 5-6 m high, with large, glossy, dark green leaves. It produces a large, heart-shaped, edible fruit that is 15-23 cm in diameter, is yellow-green in color and has white flesh inside. The fruit is popular in South America.

Ethnobotanical Uses

All parts of the graviola tree have been used medicinally in traditional herbal medicine. Traditional herbal medicine practitioners have attributed graviola with the following properties and actions: anthelmintic, antiparasitic, antipyretic, sedative, antispasmodic, nervine, hypotensive, anticonvulsant and digestive.

The traditional use of graviola has been recorded in herbal medicine systems in the following countries: Amazonia,[1] Barbados,[2] Borneo,[3] Brazil,[4-8] Cook Islands,[9] Curacao,[10] Dominica,[11] Guatemala,[12] Guam,[13] Guyana,[14] Haiti,[15,16] Jamaica,[17,18] Madagascar,[19] Malaysia,[20,21] Peru,[22,26] Suriname,[27] Togo[28] and West Indies.[29,30]

Summary of Traditional Uses of Graviola:[31]

Flower	Bronchitis, cough.
Fruit:	Colitis, diarrhea, dysentery, fevers, hydropsy, juice, lactogogue, mouth sores, parasites, tranquilizer.
Seeds:	Astringent, carminative, emetic, head lice, insecticide, parasites, skin parasites, worms.
Bark:	Asthenia, asthma, childbirth, cough, diabetesgrippe, heart tonic, hypertension, nervine, parasites, sedative, spasms.
Leaf:	Abscesses, arthritis pain, asthenia, asthma, astringent, bronchitis, catarrh, colic, cough, diabetes, diuretic, dysentery, edema, fever, gallbladder disorders, grippe, heart, hypertension, indigestion, infections, intestinal worms, lactogogue, liver disorders, malaria, nervine, nervousness, neuralgia, palpitations, parasites, parturition, rashes, rheumatism, ringworm, sedative, skin disorders, spasms, styptic, tonic, tranquilizer, tumors, ulcers, worms.
Root:	Diabetes, sedative, spasms.
Rootbark	Calmative, diabetes, spasms.

Primary Uses in Traditional Herbal Medicine Systems

Internal

Graviola is primarily employed in traditional herbal medicine systems for parasitic infections and cancer.[22,25,32,33,24] It has also been used in some herbal medicine systems for its sedative and antispasmodic properties.[24]

Chemistry

Phytochemically graviola is rich in miscellaneous lactones and isoquinoline alkaloids. The leaf, stem, bark and seeds of graviola contain varying amounts of a novel group of chemcials believed to be biologically active, called Annonaceous acetogenins. The annonaceous acetogenins in graviola include: annocatalin, annohexocin, annomonicin, annomontacin, annomuricatin A & B, annomuricin A thru E, annomutacin, annonacin, annonacinone, annopentocin A thru C, cis-annonacin, cis-corossolone, cohibin A thru D, corepoxylone, coronin, corossolin, corossolone, donhexocin, epomuricenin A & B, gigantetrocin, gigantetrocin A & B, gigantetrocinone, gigantetronenin, goniothalamicin, iso-annonacin, javoricin, montanacin, montecristin, muracin A thru G, muricapentocin, muricatalicin, muricatalin, muri-catenol, muricatetrocin A & B muricatin D, muricatocin A thru C muricin H, muricin I, muricoreacin, murihexocin 3, murihexocin A thru C, murihexol, murisolin, robustocin, rolliniastatin 1 & 2, saba-delin, solamin, uvariamicin I & IV, xylomaticin.[31]

Various acetogenins in graviola have been documented with the following biological activity:

In vivo

Cytotoxic Activity

10 mg/kg of annonacin was given intraperitoneally in mice with Lewis lung cancer; a 57.9% inhibition was seen.[34]

In vitro

Cytotoxic Activity

In vitro studies are numerous. Following are select *in vitro* studies where acetogenins were utilized against various cell lines:

- Human hepatoma hep G(2), 2, 2, 15 cell lines. A CC50=49.5 mcg/ml was seen in one study.[35-38]
- Six human tumor cell lines.[39-41]
- Prostate adenocarcinoma PC-3.[39,40]
- Pancreatic carcinoma PACA-2.[39,40]
- Murine leukemia L1210 and P388 leukemia.[30,42,43]
- Human breast adenocarcinoma MDA-MB231 and carcinoma MCF-7.[40,42,44]
- Human tumor multidrug-resistant SW480 (P-glycoprotein+, Pgp+) tumor cells.[45]
- Human lung carcinoma A-549.[44]
- Human colon cancer HT-29.[44]
- Various cancer cell lines; growth was inhibited 50% at concentrations of <10-12 ug/ml.[46]
- Adriamycin resistant tumor cells (M17/adr breast cancer cells); Non-adriamycin resistant tumor cells.[47]
- Annonacin was able to kill various cancer cell lines at an IC50=<4 ug/mL.[48]

Cytostatic Activity
Acetogenins have shown inhibition of tumor cell growth towards adriamycin resistant human mammary adenocarcinoma MCF-7/Adr cells.[43,49]

Neurological Activity

In a 2002 study cultured mesencephalic dopaminergic neurons were exposed to total alkaloids from graviola rootbark, or two of the most abundant alkaloids coreximine and reticuline. After 24 hours 50% of dopaminergic neurons degenerated with 18 mcg/ml of total extract, 4.3 mcg/ml of coreximine or 100 mcg/ml reticuline. GABAergic neurons were also affected. Neuronal death, occurring by apoptosis, was attenuated by increasing the concentration of glucose in the culture. Toxin withdrawal after short-term exposure arrested cell death.[50] Chronic exposure to these alkaloids may be an etiological factor in atypical Parkinson's disease.[51]

In a recent 2003 study one of the main acetogenins in graviola, annonacin, was added to mesencephalic cultures for 24 hours. It had an ED50 of 0.018 microM, killing dopaminergic neurons. Toxic effects were seen at lower concentrations when incubation time was extended over several days. Withdrawal of the toxin after short-term exposure arrested cell death. Annonacin also reduced the survival of non-dopaminergic neurons. Increasing glucose or mannose concentrations, along with the presence of annonacin, prevented neuronal death.[52]

Acute treatment of mesencephalic dopaminergic neurons and GABA neurons *in vitro* with a rootbark extract of coreximine or reticuline reversibly inhibited dopamine uptake without causing neuronal death. GABA uptake was not affected.[51]

Insecticidal
The acetogenins (such as squamocin) have shown activity against the following insects: *M. sanborni*, *L. decemlineata, M. persicae, Blatella germanica.*[53-55]

In vivo and *In vitro* Research and Pharmacological Actions

Anticancerous Activity

Cytotoxic Activity
The leaf, seed, stem and bark have all been documented with *in vitro* cytotoxic activity utilising various extracts including ethanol and water:

- Ethanol leaf extract showed activity against human hepatoma hep G 2,2,15.[37]
- Leaf extract showed activity against human kidney carcinoma CA-A498. IC50=0.67 mcg/ml seen.[56]
- Ethanol leaf extract showed activity against human breast carcinoma MCF-7. ED50=1.9 mcg/ml.[57]
- Ethanol leaf & stem extract showed activity against human oral epidermoid carcinoma CA-9KB. ED50=<20 mcg/ml.[3,32]
- Ethanol leaf extract showed activity against bovine kidney cell line MDBK. IC50=2 mcg/ml.[58]
- Hexane, ethyl acetate and methanol extract showed activity against human histiocytic lymphoma U-937.[59]
- Leaf & twig showed activity against human tumor cell lines.[33]

Cytostatic Activity
The leaf inhibited tumor cell growth including adriamycin resistant human mammary adenocarcinoma MCF-7/Adr cells *in vitro*.[43,49]

Antitumor Activity

Ethanol and chloroform extracts of the seed and leaf have shown antitumor activity *in vitro*.[60,61] The leaf had an LC50=0.17 mcg/ml, demonstrated through the *in vitro* anticrustacean assay system.[61]

Uterine Stimulant Activity

Water and ethanol extracts fed orally to rats at 0.033 ml/L had uterine stimulant activity.[62]

Cardioactive and Hypotensive Activity

In one study 1 ml/L water extract of the leaf fed intravenously to rats resulted in a reduction in blood pressure by more than 30%.[63] This activity may be due to the *in vivo* hypotensive activity of the leaf and stem.[62] A water extract of the bark exhibited a cardiodepressant effect in rabbits.[64]

Antispasmodic and Muscle Relaxant Activity

Ethanol and water extracts of the leaf and stem fed at 0.033 ml/L to guinea pigs had antispasmodic activity. In rabbits an ethanol extract at 3.3 ml/L relaxed smooth muscle; 2.2ml/L of a water extract had the same effect.[62]

Neurological Activity

100 mg/kg of an ethanol leaf extract given intraperitoneally to mice had anticonvulsant activity.[65]

Extracts of the fruit, leaf and seed have shown serotonin receptor binding activity *in vitro*.[66]

Alcoholic extracts of the stembark was administered to rats intragastrically at 100 mg/kg. One hour after administering the extract the rats were stressed by cold immobilization (placing animals in a restrainer for 3 hours at 4˚C). Following is the effect of graviola on brain neurotransmitters versus controls:[67]

Treatment Group	Noradrenaline (ng/gm)	Dopamine (ng/gm)	5-Hydroxytryptamine (ng/gm)	5-Hydroxy Indole-acetic acid (ng/gm)	Monoamine oxidase units/mg protein
Normal Control	445.99 ± 22.53	892.02 ± 32.19	679.22 ± 59.53	533.38 ± 59.53	5.00 ± 0.28
Restraint Control	376.30 ± 29.19	699.77 ± 72.66	750.10 ± 67.12	731.43 ± 19.72	4.24 ± 0.37
Graviola treated	588.99 ± 62.34*	930.82 ± 13.32	402.76 ± 22.24	588.24 ± 47.25	8.10 ± 0.15

* $p<0.01$ compared to restraint control

Antimicrobial and Antiprotozoal Activity

Antiparasitic

Methanol, hexane and ethyl acetate extracts of the seed, stem, bark and pericarp have demonstrated *in vitro* antiparasitic activity against *E. histolytic, N. brasiliensis, M. dessetae, A. salina, Leishmania trypansoma*, *L. braziliensis, L. panamensis* and *L. promastigotes.*[34,59,68]

Antimalarial

Ethanol leaf extracts have shown *in vitro* antimalarial activity against *Plasmodium falciparum D-6 & W-2* at IC50=20 - 63 mcg/ml.[3,28,69]

Antibacterial
Leaf, stem and bark water, acetone, methanol and ethanol extracts have demonstrated *in vitro* antibacterial activity at concentrations of 2-3 mcg/plate to 1 mg/disc. Organisms the extracts are active against include: *E. coli, P. aeruginosa, S. flexneri, S. spp., S. marcescens, S. aureus, S. albus, S. newport, B. subtilis.*[70-72]

Antiviral
A water soluble fraction from the stem had an antiproliferative effect on HIV-infected cells *in vitro* at IC50=<2mcg/ml.[73] The stem and bark in an ethanol extract at 1 mg/ml had *in vitro* activity against herpes simplex 1, while the root had activity against herpes simplex type 2 *in vitro* at CC50 and EC50=0.5 mcg/ml.[38,74]

Molluscicidal
Stem, bark and leaf ethanol extracts have demonstrated *in vitro* activity against *B. glabrata* at LD50-0.97-20.26 ppm.[6,75]

Insecticidal
The leaf had activity against the following insects *in vitro*: *M. sanborni*, *L. decemlineata, M. persicae, Blatella germanica.*[53-55]

Antiulcer Activity

Stem and bark ethanol extracts at 100 mg/kg intragastrically in rats had antiulcer activity.[76]

Antioxidant Activity

Stem and bark ethanol extracts at 100 mg/kg intragastrically in rats had antioxidant activity.[77]

Antihepatotoxic Activity

A leaf decoction reduced ASAT leakage by hepatocytes *in vitro* at 1 mg/plate.[78]

Patents Pending / Filed

Numerous patents have been filed on various acetogenins which are found in graviola and other plant members of the Annonaceae family.

Mechanism of Action

Anticancerous Activity

Cytotoxic Activity
Anticancerous and cytotoxic effects of graviola are attributed to the annonaceous acetogenins which have a number of mechanisms including:

- Inhibition of NADH oxidase in the plasma membranes of cancer cells. This enzyme is only transiently expressed in 'normal healthy' cells. By inhibiting this enzyme cellular ATP is depleted.[46,79,80]

- Inhibition of complex I (NADH:ubiquinone oxidoreductase) in mitochondrial electron

transport systems, inhibiting oxidative phosphorylation and resulting in lower ATP levels, hence inhibiting cancer cell growth.[46,80-83]

- Inhibition of cancer cells that are multidrug resistant. Increased expression of a plasma membrane pump, P-glycoprotein, is a contributor to multidrug resistance. The pump ensures elimination of the anticancer compound before it can have its effect on the cancer cell. Two intracellular ATP-binding sites are found on P-glycoprotein, and the pump activity requires ATP. The acetogenins, through depletion of ATP, can reduce the activity or shut down the P-glycoprotein pump.[46,80,84]

- Cancer cells at the S phase of their cell cycle are more vulnerable to the acetogenin annonacin. Annonacin is able to arrest the cell cycle in the G1 phase, and inhibit the S phase progression. In addition p53 and p21, cell cycle checkpoint proteins, were enhanced by annonacin.[48]

- The acetogenin annonacin is able to induce apoptotic cell death. It enhanced the expression of Bax and Bad, but not Bcl-2 or Bcl-xL.[48]

Through the above mechanisms of action the acetogenins are able to decrease oxidative phosphorylation and cytosolic ATP production. Deprivation of the cancer cells ATP results in apoptosis of the cancer cell.[46,80]

Neurological Activity

Antidepressant, sedative and tranquilizing properties of graviola may be due to the ability of certain alkaloids to have agonistic properties towards 5-HT1A receptors in calf hippocampus.[85]

Cold immobilization stress in rats causes depletion of norepinephrine and dopamine levels in the brain. It also decreases MAO (monoamine oxidase) activity which leads to increases in 5-HT and 5-HIAA levels. Pre-treatment with graviola prevented the stress-induced depletion of norepinephrine and dopamine, helping the organism cope better during stress. In addition pre-treatment with graviola reduced the stress-induced rise in brain 5-HT and 5-HIAA, and increased MAO activity. It was concluded that graviola had a normalizing effect in rats against a variety of stressors, indicating it had adaptogenic potential.[67]

The potential neurotoxic effect of the seeds, root and rootbark is discussed under Chemicals.

Antimicrobial Activity

Graviola has insecticidal activity which is attributed to the acetogenins. They are suggested for use in the control of insect pests such as cockroaches. Pest ingestion of the acetogenins produces mortality in both susceptible and insecticidal/pesticidal-resistant cockroaches. The effectiveness of the acetogenins against insecticial/pesticidal-resistant insects suggests that pesticide-resistance is associated with ATP-dependent factors.[46,83]

Overall Activity

The activity of graviola is mainly attributed to the acetogenins, which are mitochondrial respiratory chain complex I inhibitors.[52]

Dosage

Internal
Crude Preparations, Leaf and Stem
2 grams three times daily
Infusion: 1 cup (150 ml) boiling water poured over approximately 2 grams of dried leaf and stem and steep, covered, for 5-10 minutes, 3 times daily between meals
Tincture: Of a 1:2 tincture take 2-4 ml three times daily

Duration of Administration

Internal
Long-term administration (6 months) with no health complaint may deplete healthy cells of ATP. Duration of administration varies per complaint and individual.

Contraindications

Pregnancy and Lactation: Graviola has documented uterine stimulant activity in an animal study (rats) and should not be used during pregnancy.[62]

Graviola has demonstrated hypotensive, vasodilator, and cardiodepressant activities in animal studies and is contraindicated for people with low blood pressure.[63]

Drug Interactions

Graviola may potentiate antihypertensive and cardiac depressant drugs.[63,64]

It may potentiate antidepressant drugs and interfere with MAO-inhibitor drugs.[66,67]

Co-enzyme Q10 may reduce the activity of graviola. Coenzyme Q10 is required for the function of the ubiquinone oxidoreductase, which graviola has been shown to inhibit.[46,80-83]

Side Effects

Graviola has demonstrated emetic properties in one animal study with pigs. Large single dosages may cause nausea or vomiting.[31]

Safety Rating

Not rated.

Alcohol extracts of graviola leaf showed no toxicity or side effects in mice at 100 mg/kg intraperitoneally; however, at a dosage of 300 mg/kg, a reduction in explorative behavior and mild abdominal constrictions was observed.[65]

Alkaloids in the rootbark, root and seed of graviola have been linked to a levodopa-resistant parkinsonism. *In vitro* studies show they cause DNA damage and apoptosis of dopaminergic cells and GABAergic neurons.[50] Excessive consumption of these parts of the plant should be

avoided.

References

1. Schultes, R. E. And Raffauf. *The Healing Forest: Medicinal and Toxic plants of the Northwest Amazonia*. Portland: R. F. Dioscorides Press. 1990.
2. Morton, J. F. “Caribbean and Latin American Folk Medicine and its Influence in the United States.” *Q. J. Crude Drug Res*. 1980; 18(2): 57-75.
3. Leaman, D. J., et al. “Malaria remedies of the Kenyah of the Apo Kayan, East Kalimantan, Indonesian Borneo: A quantitiative assessment of local consensus as an indicator of biological efficacy.” *J. Ethnopharmacol*. 1995; 49(1): 1-16.
4. Caribé, Dr. José, and Dr. José Mariá Campos. *Plantas Que Ajudam O Homem: Guia Prático Para a Época Atual*, 5th Ed. São Paulo, Brazil: Editora Pensimento, Ltda., 1997.
5. Branch, L.C. and Da Silva, I.M. F. “Folk Medicine of Alter Do Chao, Para, Brazil.” *Acta Amazonica* 1983; 13(5/6):737-797.
6. Santos, A. F., et al. “Molluscicidal properties of some species of Annona.” *Phytomedicine* 2001; 8(2): 115-120.
7. De Almeida, E.R. *Plantas Medicinais Brasileiras, Conhecimentos Populares E Cientificos*. Hemus Editora Ltda. Sau Paulo, Brazil. 1993.
8. Mors, W. B., et. al. *Medicinal plants of Brazil*. Algonac, Michigan, Reference Publications, Inc., 2000.
9. Holdsworth, D. K. “Traditional Medicinal Plants of Rarotonga, Cook Islands.” Part I. *Int. J. Crude Drug Res*. 1990; 28(3): 209-218.
10. Morton, J. F. “A survey of medicinal plants of Curacao.” *Econ. Bot*. 1968; 22 : 87-.
11. Haddock, R. L. “Some medicinal plants of Guam including English and Guamanian common names.” Report Regional Tech Mtg Med Plants, Papeete, Tahiti, Nov, 1973; South Pacific Commission, Noumea, New Caledonia 1974 : 79.
12. Caceres, A., et al. “Plants used in Guatemala for the treatment of dermatophytic infections. 1. screening for antimycotic activity of 44 plant extracts.” *J. Ethnopharmacol.* 1991; 31(3): 263-276.
13. Hodge, W. H., et al. “The ethnobotany of the Island Caribs of Dominica.” *Webbia* 1956; 12: 513-644.
14. Grenand, P., et al. “Pharmacopees taditionnels en Guyane: Créoles, Palikur, Wayãpi.” Editorial L-Orstrom, Coll. Mem No. 108. Paris, France 1987.
15. Weniger, B. et al. “Popular medicine of the Central Plateau of Haiti. 2. Ethnopharmacological Inventory.” *J. Ethnopharmacol*. 1986; 17(1): 13-30.
16. Ibid.
17. Asprey, G. F., et al. “Medicinal plants of Jamaica. III.” *West Indian Med. J*. 1955; 4: 69-92.
18. Ibid.
19. Novy, J. W. “Medicinal plants of the Eastern Region of Madagascar.” *J. Ethnopharmacol*. 1997; 55 : 119-126.
20. Ahmad, F. B., et al. “Medicinal plants of Sabah, Malaysia, Part II. The Muruts.” *Int. J. Pharmacog.* 1994; 32(4): 378-383.
21. Ilham, M., et al. “Tumour promoting activity of plants used in Malaysian traditional medicine.” *Nat. Prod. Sci*. 1995; 1(1): 31-42.
22. Zadra, de, Adriana Alarco. *Perú—El libro de las plantas mágicas*, 2nd Ed. Lima: Concytec, 2000.
23. Duke, J. A. *Amazonian Ethnobotanical Dictionary*. Book 1994: 181-.
24. Vasquez, M. R. *Useful plants of Amazonian Peru*. Second Draft.. 1990.
25. De Feo, V. “Medicinal and magical plants in the Northern Peruvian Andes.” *Fitoterapia* 1992; 63: 417-440.
26. Zadra, de, Adriana Alarco. *Perú—El libro de las plantas mágicas*, 2nd Ed. Lima: Concytec,

2000.
27. Hasrat, J. A., et al. “Isoquinoline derivatives isolated from the fruit of *Annona muricata* as 5-HTergic 5-HT1a receptor agonists in rats: unexploited antidpressive (lead) products.” *J. Pharm. Pharmacol*. 1997; 49(11): 1145-1149.
28. Gbeassor, M., et al. “In vitro antimalarial activity of six medicinal plants.” *Phytother. Res*. 1990; 4(3): 115-117.
29. Ayensu, E. S. “Medicinal plants of the West Indies.” Unpublished Manuscript 1978; 110 P-.
30. Ibid.
31. Technical Data Report for Graviola (*Annona muricata*). Sage Press, Inc. 2002.
32. Anon. Unpublished Data, National Cancer Institute. Nat. Cancer Inst. Central Files. 1976.
33. Ye, Q., et al. “Longifolicin, longicoricin and gigantetroneninone, three novel bioactive mono-tetrahydrofuran annonaceous acetogenins from *Asimina longifolia* (Annonaceae).” *Bioorg. Med. Chem*. 1996; 4(4): 537-4.
34. Wang, L. Q., et al. “Annonaceous acetogenins from the leaves of *Annona montana*.” *Bioorg. Med. Chem*. 2002; 10(3): 561-5.
35. Chang, R. F., et al. “Novel cytotoxic annonaceous acetogenins from *Annona muricata*.” *J. Nat. Prod*. 2001; 64(7): 925-31.
36. Chang, F. R., et al. “New adjacent bis-tetrahydrofuran annonaceous acetogenins from *Annona muricata*.” *Planta Med*. 2003; 69(3): 241-6.
37. Liaw, C. C., et al. “New cytotoxic monotetrahydrofuran annonaceous acetogenins from *Annona muricata*.” *J. Nat. Prod*. 2002; 65(4): 470-5.
38. Betancur-Galvis, L., et al. “Antitumor and antiviral activity of Colombian medicinal plant extracts.” *Mem. Inst. Oswaldo Cruz.* 1999; 94(4): 531-5.
39. Woo, M. H., et al. “Cis-annonacin and (2,4)-cis-and trans-isoannonacins: cytotoxic monotetrahydrofuran annonaceous acetogenins from the seeds of *Annona cherimolia*.” *Arch. Pharm. Res*. 1999; 22(5): 524-8.
40. Kim, G. S., et al. “Muricoreacin and murihexocin c, mono-tetrahydrofuran acetogenins, from the leaves of *Annona muricata*.” *Phytochemistry* 1998; 49(2): 565-571.
41. Fang, X. P., et al. “Gigantetronenin and gigantrionenin: novel cytotoxic acetogenins from *Goniothalamus giganteus*.” *J. Nat. Prod*. 1992; 55(11): 1655-63.
42. Jossang, A., et al. “Annomonysvin: a New cytotoxic gamma-lactone-monotetrahydrofuranyl acetogenin from *Annona montana*.” *J. Nat. Prod*. 1991; 54(4): 967-71.
43. Oberlies, N. H., et al. “Structure-activity Relationships of diverse annonaceous acetogenins against multidrug resistant human mammary adenocarcinoma (MCF-7/ADR) cells.” *J. Med. Chem*. 1997; 40(13): 2102-6.
44. Zhao, G. X., et al. “Biologically active acetogenins from stem bark of *Asimina triloba*.” *Phytochemistry* 1993; 33(5): 1065-73.
45. Gonzalez-Coloma. A., et al. “Selective action of acetogenin mitochondrial complex I inhibitors.” *Naturforsch* 2002; 57(11-12): 1028-34.
46. Feras, Q., et al. “Annonaceous acetogenins: Recent progress.” *J. Nat. Prod*. 1999; 62(3): 504-540.
47. Oberlies, N. H., et al. “Tumor cell growth inhibition by several annonaceous acetogenins in an in vitro disk diffusion assay.” *Cancer Lett.* 1995; 96(1): 55-62.
48. Yuan, Shyng-Shiou F., et al. “Annonacin, a mono-tetrahydrofuran acetogenin, arrests cancer cells at the G1 phase and causes cytotoxicity in a Bax- and caspase-3-related pathway.” *Life Sciences* 2003; 72: 2853-2861.
49. Abraham, A. M. “Plant extracts with cytostatic properties growing in Cuba.” *Rev. Cubana Med. Trop*. 1979; 31(2): 97-104.
50. Lannuzel, A., et al. “Toxicity of Annonaceae for dopaminergic neurons: potential role in atypical parkinsonism in Guadeloupe.” *Mov. Disord*. 2002; 17(1): 84-90.
51. Caparros-Lefebvre, D., et al. “Possible relation of atypical parkinsonism in the French West Indies with consumption of tropical plants: a case-control study. Caribbean Parkinsonism

Study Group." *Lancet* 1999; 354(9175): 281-6.
52. Lannuzel, A., et al. "The mitochondrial complex I inhibitor annonacin is toxic to mesencephalic dopaminergic neurons by impairment of energy metabolism." *Neuroscience* 2003; 121(2): 287-296.
53. Tattersfield, F., et al. "The insecticidal properties of certain species of Annona and an Indian strain of *Mundulea sericea* (Supli)." *Ann. Appl. Biol*. 1940; 27: 262-273.
54. Guadano, A., et al. "Insecticidal and mutagenic evaluation of two annonaceous acetogenins." *J. Nat. Prod*. 2000; 63(6): 773-6.
55. Alali, F. Q., et al. "Annonaceous acetogenins as natural pesticides; potent toxicity against insecticide-susceptible and resistant german cockroaches (Dictyoptera: blattellidae)." *J. Econ. Entomol*. 1998; 91(3): 641-9.
56. Zeng, L., et al. "Five new monotetrahydrofuran ring acetogenins from the leaves of *Annona muricata*." *J. Nat. Prod*. 1996; 59(11): 1035-1042.
57. Kim, G. S., et al. "Two new mono-tetrahydrofuran ring acetogenins, annomuricin E and muricapentocin, from the leaves of *Annona muricata*." *J. Nat. Prod*. 1998; 61(4): 432-436.
58. Betancur-Galvis, L., et al. "Antitumor and antiviral activity of Colombian medicinal plant extracts." *Mem. Inst. Oswaldo Cruz* 1999; 94(4): 531-535.
59. Jaramillo, M. C., et al. "Cytotoxicity and antileishmanial activity of *Annona muricata* pericarp." *Fitoterapia*. 2000; 71(2): 183-6.
60. Li, D. Y., et al. "Annonaceous acetogenins of the seeds from *Annona muricata*." *J. Asian Nat. Prod. Res*. 2001; 3(4): 267-76.
61. Wu, F. E., et al. "Two new cytotoxic monotetrahydrofuran annonaceous acetogenins, annomuricins a and b, from the leaves of *Annona muricata*." *J. Nat. Prod*. 1995; 58(6): 830-836.
62. Feng, P. C., et al. "Pharmacological screening of some West Indian medicinal plants." *J. Pharm. Pharmacol*. 1962; 14 : 556-561.
63. Carbajal, D., et al. "Pharmacological screening of plant decoctions commonly used in Cuban folk medicine." *J. Ethnopharmacol*. 1991; 33(1/2): 21-24.
64. Meyer, T. M. "The alkaloids of *Annona muricata*." *Ing. Ned. Indie*. 1941; 8(6): 64-.
65. N'Gouemo, P., et al. "Effects of ethanol extract of *Annona muricata* on pentylenetetrazol-induced convulsive seizures in mice." *Phytother. Res.* 1997; 11(3): 243-245.
66. Hasrat, J. A., et al. "Screening of medicinal plants from Suriname for 5-HT 1a ligands: bioactive isoquinoline alkaloids from the fruit of *Annona muricata*." *Phytomedicine* 1997; 4(2): 133-140.
67. Padma, P., et al. "Effect of *Annona muricata* and *Polyalthia cerasoides* on brain neurotransmitters and enzyme monoamine oxidase following cold immobilization stress." *J. Natural Remedies* 2001; 1(2): 144-146.
68. Bories, C., et al. "Antiparasitic activity of *Annona muricata* and *Annona cherimolia* seeds." *Planta Med*. 1991; 57(5): 434-436.
69. Antoun, M. D., et al. "Screening of the flora of Puerto Rico for potential antimalarial bioactives." *Int. J. Pharmacog*. 1993; 31(4): 255-25.
70. Misas, C. A. J., et al. "Contribution to the biological evaluation of Cuban plants. IV." *Rev. Cub. Med. Trop*. 1979; 31(1): 29-35.
71. Sundarrao, K., et al. "Preliminary screening of antibacterial and antitumor activities of Papua New Guinean native medicinal plants." *Int. J. Pharmacog*. 1993; 31(1): 3-6.
72. Khan, M. R., et al. "Antibacterial activity of some annonaceae. Part I." *Fitoterapia* 1998; 69(4): 367-369.
73. Antoun, M. D., et al. "Evaluation of the flora of Puerto Rico for in vitro cytotoxic and anti-HIV activities." *Pharmaceutical Biol.* 1999; 37(4): 277-280.
74. Padma, P., et al. "Effect of the extract of *Annona muricata* and *Petunia nyctaginiflora* on herpes simplex virus." *J. Ethnopharmacol*. 1998; 61 1: 81-83.

75. Dos Santos, A F., et al. “Molluscicidal properties of some species of Annona.” *Phytomedicine*. 2001; 8(2): 115-20.
76. Padma, P., et al. “Effect of some indigenous drugs on cold immobilization stress induced gastric ulcer.” *Phytother. Res*. 1998; 12(2): 127-128.
77. Padma, P., et al. “Effect of alcohol extract of *Annona muricata* on cold immobilization stress induced tissue lipid peroxidation.” *Phytother. Res*. 1997; 11(4): 326-327.
78. Joyeux, M., et al. “Screening of antiradical, antilipoperoxidant and hepatoprotective effects of nine plant extracts used in Caribbean folk medicine.” *J. Phytother. Res*. 1995; 9(3): 228-230.
79. Morre, D. J., et al. “Mode of action of bullatacin, a potent antitumor acetogenin: inhibition of NADH oxidase activity of HeLa and HL-60, but not liver, plasma membranes.” *Life Sci*. 1995; 56(5): 343-8.
80. Oberlies, N. H., et al. “Structure-activity relationships of diverse annonaceous acetogenins against multidrug resistant human mammary adenocarcinoma (MCF-7/Adr) cells.” *J. Med. Chem*. 1997; 40(13): 2101-2106.
81. Tormo, J. R., et al. “Epoxy-acetogenins and other polyketide epoxy derivatives as inhibitors of the mitochondrial respiratory chain complex I.” *Planta Med*. 2000; 66(4): 318-23.
82. Tormo, J. R., et al. “Kinetic characterization of mitochondrial complex I inhibitors using annonaceous acetogenins.” *Arch. Biochem. Biophys*. 1999; 369(1): 119-26.
83. Alali, F. Q., et al. “Annonaceous acetogenins: recent progress.” *J. Nat. Prod*. 1999; 62(3): 504-40.
84. Gonzalez-Coloma, A., et al. “Selective action of acetogenin mitochondrial complex I inhibitors.” Z. *Naturforsch* 2002; 57(11-12): 1028-34.
85. Hasrat, J. A., et al. “Isoquinoline derivatives isolated from the fruit of *Annona muricata* as 5-Htergic 5-HT1A receptor agonists in rats: unexploited antidepressive (lead) products.” *J. Pharm. Pharmacol*. 1997; 49(11): 1145-9.

Ethnomedical Information for Graviola (Annona muricata)

Part / Location	Documented Ethnomedical Use	Type Extract / Route	Used For	Ref #
Leaf Amazonia	Used as a strong diuretic for swollen feet (edema) and as a tonic.	Infusion Oral	Human Adult	ZZ1005
Seed Amazonia	Used as a carminative.	Dried Oral	Human Adult	ZZ1005
Leaf Barbados	Used as a sedative.	Hot H2O Ext Oral	Human Adult	T05032
Leaf Borneo	Used for the spleen and for fever.	Leaves External	Human Adult	K27823
Flower + Bud Brazil	Used for bronchitis and resistant coughs.	Decoction Oral	Human Adult	ZZ1072
Fruit Brazil	Used for dysentery, mouth sores, fever and hydropsy.	Juice Oral	Human Adult	ZZ1072
Leaf Brazil	Used for liver problems. Used as an anthelmintic and antirheumatic. Used for neuralgia, rheumatism, arthritis pain and as an antiparasitic. Used for dysentery, intestinal colic, cough, and bronchitis. Used for abscesses, edema, rheumatism. Used for spasms, diarrhea, cough, and chest problems.	Hot H2O Ext Oral Infusion Oral Maceration External Hot H2O Ext Oral Maceration External Decoction Oral	Human Adult Human Adult Human Adult Human Adult Human Adult Human Adult	ZZ1024 L15585 ZZ1002 ZZ1072 ZZ1072 ZZ1099
Leaf + Shoot + Flower Brazil	Used for cough and chest problems.	Not stated	Human Adult	ZZ1099
Seed Brazil	Considered emetic and astringent.	Not stated	Human Adult	ZZ1099
Rootbark Brazil	Considered calmative, antispasmodic, and antidiabetic.	Decoction Oral	Human Adult	ZZ1099
Leaf Cook Islands	Used to treat skin rashes, skin diseases, and skin infections. Used to treat indigestion.	Decoction External Decoction Oral	Human Adult Human Adult	K20471
Leaf Curacao	Decoction drunk for gallbladder trouble. Used for nervousness.	Hot H2O Ext Oral	Human Adult	A05332
Leaf Dominica	Tea is drunk by women in labor (parturition).	Hot H2O Ext Oral	Human (pregnant)	A01962
Leaf Guatemala	Used for ringworm.	Hot H2O Ext Oral	Human Adult	M27151
Leaf Guam	Tea used by asthma sufferers.	Hot H2O Ext Oral	Human Adult	W01267
Leaf Guyana	Tea used as a sedative and heart tonic.	Hot H2O Ext Oral	Human Adult	ZZ1033

Part / Location	Documented Ethnomedical Use	Type Extract / Route	Used For	Ref #
Bark Guyana	Tea used as a sedative and heart tonic.	Hot H2O Ext Oral	Human Adult	ZZ1033
Fruit Haiti	Used for fevers, parasites, diarrhea and as a lactogogue.	Fruit Oral	Human Adult	AA1008
Leaf Haiti	Used as an antispasmodic, sedative, and nervine. Used for grippe, coughs, and asthenia.	Not stated Decoction Oral	Human Adult Human Adult	AA1008 T13846
Bark Haiti	Used for heart conditions, coughs, and grippe.	Decoction Oral	Human Adult	AA1008
Fruit Jamaica	Used for fevers, parasites, diarrhea and as a lactogogue.	Fruit Oral	Human Adult	ZZ1020
Leaf Jamaica	Infusion used as an antispasmodic. Beverage prepared as a lactagogue.	Hot H2O Ext Oral Hot H2O Ext Oral	Human Adult Human Female	W01316
Leaf Jamaica	Used as an antispasmodic, sedative, and nervine for heart conditions, coughs, grippe, difficult childbirth, asthma, asthenia, hypertension and parasites.	Not Stated	Human Adult	ZZ1020
Bark Jamaica	Used as an antispasmodic, sedative, and nervine for heart conditions, coughs, grippe, difficult childbirth, asthma, asthenia, hypertension, and parasites.	Hot H2O Ext Oral	Human Adult	ZZ1020
Leaf Madagascar	Used to treat heart palpitations, liver maladies and malaria.	Infusion Oral	Human Adult	L15693
Leaf Malaysia	Used for high blood pressure and diarrhea. Used as an astringent and a styptic.	Decoction Oral Leaves External	Human Adult Human Adult	K26834 J13478
Fruit Peru	Used to tranquilize the nervous system and digestion. Reduces inflammation of the colon, fortifies the intestinal flora and reduces inflammation.	Not stated	Human Adult	ZZ1093
Bud Peru	Used for indigestion and catarrh.	Not stated	Human Adult	ZZ1093
Leaf Peru	Used to treat catarrh, liver disorders, diarrhea, dysentery, fevers, hypertension, sores, internal ulcers, diabetes. Used as a sedative and antispasmodic. Used for indigestion and catarrh. Fresh leaves crushed with salt are used in a cataplasm to “ripen” malignant tumors.	Decoction Oral Decoction Oral Decoction Oral Cataplasm External	Human Adult Human Adult Human Adult Human Adult	L04137 ZZ1045 ZZ1093 ZZ1093

Part / Location	Documented Ethnomedical Use	Type Extract / Route	Used For	Ref #
Seed Peru	Used to kill parasites. Crushed seeds and seed oil used as an insecticide, for skin parasites and lice.	Decoction Oral Maceration External	Human Adult Human Adult	ZZ1027 ZZ1093
Bark Peru	Used to treat diabetes. Used as a sedative and antispasmodic.	Decoction Oral	Human Adult	ZZ1045
Root Peru	Used to treat diabetes. Used as a sedative and antispasmodic.	Hot H2O Ext Oral	Human Adult	ZZ1045
Not stated South America	Used for chills, colds, diarrhea, dysentery, dyspepsia, fever, flu, gallbladder attacks, hypertension, insomnia, kidneys, nervousness, palpitations, pediculosis, ringworm, sores and internal ulcers.	Not stated	Human Adult	ZZ1050
Leaf Surinam	Claimed to be a tranquillizer.	Infusion Oral	Human Adult	J14527
Leaf Togo	Used for malaria.	Decoction Oral	Human Adult	M23556
Leaf Trinidad	Used to lower high blood pressure and as a galactagogue.	Hot H2O Ext Oral	Human Adult	T05032
Leaf West Indies	Decoction used to ease delivery. Used for hypertension, worms and diarrhea. Used for difficult childbirth, asthma, hypertension, and parasites.	Hot H2O Ext Oral Hot H2O Ext Oral Hot H2O Ext Oral	Human (pregnant) Human Adult Human Adult	T00701 T00701 ZZ1021
Fruit West Indies	Used for fevers, parasites, diarrhea and as a lactogogue.	Fruit Oral	Human Adult	ZZ1021
Bark West Indies	Used for hypertension and parasites.	Hot H2O Ext Oral	Human Adult	ZZ1021

Presence of Compounds in Graviola (Annona muricata)

Compound	Chemical Type	Plant Part	Plant Origin	Quantity	Ref #
Annocatacin A	Misc Lactone	Leaf Seed	Taiwan	Not stated	AA1034
Annocatacin B	Misc Lactone	Leaf Seed	Taiwan	Not stated	AA1034
Annocatalin	Misc Lactone	Leaf	Taiwan	Not stated	AA1009
Annohexocin	Misc Lactone	Leaf	Not stated	Not stated	H17799
Annomonicin	Misc Lactone	Seed	Guyana	00.00566%	H07609
Annomontacin	Misc Lactone	Seed	Guyana	00.00603%	H07609
Annomontacin, cis	Misc Lactone	Seed	Taiwan	Not stated	AA1009
Annomuricatin B	Misc Lactone	Seed	China	00.00906%	H21843
Annomuricin A	Misc Lactone Misc Lactone	Leaf Pericarp	Indonesia Colombia	00.0004% 00.0021%	H16272 L07801
Annomuricin B	Misc Lactone	Leaf	Indonesia	00.00035%	H16272
Annomuricin C	Misc Lactone	Leaf	Indonesia	00.0004%	H16273
Annomuricin E	Misc Lactone	Leaf	Indonesia	00.000235	H24563
Annomuricin-D-one, cis:	Misc Lactone	Leaf	Indonesia	00.0003%	H19306
Annomuricin-D-one, trans	Misc Lactone	Leaf	Indonesia	00.0003%	H19306
Annomutacin	Misc Lactone	Leaf	Indonesia	00.00035%	H17568
Annonacin	Misc Lactone	Pericarp Seed Seed Seed Root Leaf	Colombia Brazil USA Guyana Guinea Indonesia	00.0032% 01.0% 00.06818% 00.02674% Not stated 00.05411%	L07801 K20560 K10338 H07236 H19768 H16272

Compound	Chemical Type	Plant Part	Plant Origin	Quantity	Ref #
Annonacin A	Misc Lactone	Pericarp Leaf Seed Seed	Colombia Indonesia China China	00.0021% Not stated 00.00142% 00.00521%	L07801 H16274 H22999 H22999
Annonacin B Mesitoate	Misc Lactone	Not stated	China	Not stated	H20484
Annonacin, cis:	Misc Lactone	Seed	Dominican Republic	00.00109%	H18307
Annonacin, iso:	Misc Lactone	Seed	USA	00.00277%	K10338
Annonacin, iso: 2-4-cis:	Misc Lactone	Leaf	Indonesia	Not stated	H16274
Annonacin, iso: 2-4-trans:	Misc Lactone	Leaf Seed	Indonesia China	Not stated Not stated	H16274 AA1011
Annonacin, iso: 10-one, 2,4-trans	Misc Lactone	Seed	China	Not stated	AA1011
Annonacin-10-one	Misc Lactone	Seed	USA	00.00136%	K10338
Annonacin-10-one, cis:	Misc Lactone	Seed	Dominican Republic	00.000909%	H18307
Annonacin-10-one, iso:	Misc Lactone	Seed	USA	00.00113%	K10338
Annonacin-10-one, iso: neo:	Misc Lactone	Seed	China	Not stated	H15501
Annonacin-A-one, cis-2-4: 10(r):	Misc Lactone	Leaf	Indonesia	00.00017%	H17568
Annonacin-A-one, trans-2-4: 10(r):	Misc Lactone	Leaf	Indonesia	00.00017%	H17568
Annonacinone	Misc Lactone	Seed Seed Seed Seed	Guyana Guyana Brazil Guyana	00.01811% 00.2% 01.07% 00.00697%	H07609 H07609 K20560 H07236
Annonaine	Isoquinoline Alkaloid	Fruit	Surinam	Not stated	J14527
Annopentocin A	Misc Lactone	Leaf	Indonesia (cult)	00.0004%	H19306
Annopentocin B	Misc Lactone	Leaf	Indonesia (cult)	00.0005%	H19306
Annopentocin C	Misc Lactone	Leaf	Indonesia (cult)	00.00035%	H19306

Compound	Chemical Type	Plant Part	Plant Origin	Quantity	Ref #
Anomuricine	Isoquinoline Alkaloid	Root Bark Leaf	Guyana Guyana Guyana	Not stated Not stated Not stated	T02076 T04073 T04073
Anomurine	Isoquinoline Alkaloid	Root Bark Leaf	Guyana Guyana Guyana	Not stated Not stated Not stated	T02076 T04073 T04073
Anonaine	Isoquinoline Alkaloid	Fruit	Surinam	Not stated	J10986
Anonol	Alkanol C5 or More	Leaf Leaf	Dominican Republic West Indies	Not stated Not stated	A04099 W02289
Asimilobine	Isoquinoline Alkaloid	Fruit	Surinam	Not stated	J10986
Atherospermine	Isoquinoline Alkaloid	Stembark	Philippines	Not stated	A04095
Atherosperminine	Isoquinoline Alkaloid	Root Bark	Bark Bark	Not stated Not stated	T02076 T04073
Coclaurine,(+):	Isoquinoline Alkaloid	Root Bark Leaf	Guyana Guyana Guyana	Not stated Not stated Not stated	T02076 T04073 T04073
Cohibin A	Misc Lactone	Seed Root	Brazil Guinea	Not stated 00.00116%	H26434 H19768
Cohibin B	Misc Lactone	Seed Root	Brazil Guinea	Not stated Not stated	H26434 H19768
Cohibin C	Misc Lactone	Seed	Brazil	Not stated	H26434
Cohibin D	Misc Lactone	Seed	Brazil	Not stated	H26434
Corepoxylone	Misc Lactone	Seed	Brazil	00.00062%	H12235
Coreximine, (+):	Isoquinoline Alkaloid	Root	Guyana	Not stated	T02076
Coreximine, (-):	Isoquinoline Alkaloid	Bark Leaf	Guyana Guyana	Not stated Not stated	T04073 T04073
Coronin	Misc Lactone	Root	Guinea	00.0003%	H28460

Compound	Chemical Type	Plant Part	Plant Origin	Quantity	Ref #
Corossolin	Misc Lactone	Seed Seed Seed	Guyana Brazil Taiwan	00.00290% 01.01% Not stated	H07236 K20560 H28040
Corossolone	Misc Lactone	Seed Seed Seed Seed	Guyana Brazil Brazil Taiwan	00.00232% 01.02% 00.00042% Not stated	H07236 K20560 H14312 H28040
Corossolone, cis	Misc Lactone	Leaf	Taiwan	Not stated	AA1009
Donhexocin	Misc Lactone	Seed	China	00.0005%	H22999
Epomuricenin A	Misc Lactone	Seed Root	Brazil Guinea	00.00278% Not stated	H14312 H19768
Epomuricenin B	Misc Lactone	Seed Root	Brazil Guinea	00.00278% Not stated	H14312 H19768
Gentisic Acid	Benzenoid	Leaf	Trinidad	Not stated	A06190
Gigantetrocin	Misc Lactone	Seed	USA	00.00221%	K10338
Gigantetrocin A	Misc Lactone	Seed	Dominican Republic	00.00181%	H12985
Gigantetrocin B	Misc Lactone	Seed	Dominican Republic	00.00136%	H12985
Gigantetrocinone, 2,4-cis	Misc Lactone	Seed	China	Not stated	AA1011
Gigantetrocinone, 2,4-trans	Misc Lactone	Seed	China	Not stated	AA1011
Gigantetronenin	Misc Lactone	Leaf	Indonesia	Not stated	H16273
Goniothalamicin	Misc Lactone	Seed Seed Leaf Seed Seed	Guyana USA Indonesia Dominican Republic Brazil	00.01660% 00.00059% Not stated 00.00568% Not stated	H07609 K10338 H16272 H18307 K20560
Goniothalamicin, cis:	Misc Lactone	Seed	Dominican Republic	00.00127%	H18307
Javoricin	Misc Lactone	Seed	Dominican Republic	00.00072%	H18307

Compound	Chemical Type	Plant Part	Plant Origin	Quantity	Ref #
KCL	Inorganic	Leaf Leaf	West Indies Dominican Republic	Not stated Not stated	W02289 A04099
Lignoceric Acid	Lipid	Leaf	Dominican Republic	Not stated	A04099
Linoleic Acid	Lipid	Leaf Leaf	West Indies Dominican Republic	Not stated Not stated	W02289 A04099
Longifolicin	Not stated	Seed	China	Not stated	AA1017
Montanacin	Misc Lactone	Seed	Guyana	00.02490%	H07609
Montecristin	Misc Lactone	Root	Guinea	00.00233%	H19211
Muracin A	Misc Lactone	Seed	Taiwan	Not stated	H28040
Muracin B	Misc Lactone	Seed	Taiwan	Not stated	H28040
Muracin C	Misc Lactone	Seed	Taiwan	Not stated	H28040
Muracin D	Misc Lactone	Seed	Taiwan	Not stated	H28040
Muracin E	Misc Lactone	Seed	Taiwan	Not stated	H28040
Muracin F	Misc Lactone	Seed	Taiwan	Not stated	H28040
Muracin G	Misc Lactone	Seed	Taiwan	Not stated	H28040
Muricapentocin	Misc Lactone	Leaf	Indonesia	00.00028%	H24563
Muricatalicin	Misc Lactone	Leaf	China	Not stated	AA1027
Muricatalin	Misc Lactone	Leaf	China	Not stated	AA1027
Muricatenol	Misc Lactone	Seed	China	Not stated	AA1011
Muricatetrocin A	Misc Lactone	Seed Leaf Seed	Dominican Republic Indonesia Taiwan	00.00045% Not stated Not stated	H12985 H16272 H28040
Muricatetrocin B	Misc Lactone	Seed Leaf Seed	Dominican Republic Indonesia Taiwan	00.00045% Not stated Not stated	H12985 H16272 H28040

Compound	Chemical Type	Plant Part	Plant Origin	Quantity	Ref #
Muricatin D	Misc Lactone	Seed	China	00.00085%	H21114
Muricatocin A	Misc Lactone	Leaf	Indonesia	00.00045%	H16274
Muricatocin B	Misc Lactone	Leaf	Indonesia	00.0004%	H16274
Muricatocin C	Misc Lactone	Leaf	Indonesia	Not stated	H16273
Muricin H	Misc Lactone	Seed	Taiwan	Not stated	AA1009
Muricin I	Misc Lactone	Seed	Taiwan	Not stated	AA1009
Muricine	Alkaloid-misc	Bark	Not stated	Not stated	A04104 A05062
Muricinine	Alkaloid-misc	Bark	Not stated	Not stated	A04104 A05062
Muricoreacin	Misc Lactone	Leaf	Indonesia	00.00038%	H22688
Murihexocin 3	Misc Lactone	Leaf	USA	Not stated	H17719
Murihexocin A	Misc Lactone	Leaf	USA	Not stated	H17719
Murihexocin C	Misc Lactone	Leaf	Indonesia	00.00015%	H22688
Murihexol	Misc Lactone	Seed	China	00.00035%	H22999
Murin A, epoxy:	Misc Lactone	Stembark	India	Not stated	H12242
Murisolin	Misc Lactone	Seed Seed Seed Seed	French Guiana China Brazil Guyana	00.00930% 00.00311% 00.00060% 00.0093%	H06211 H21114 H14312 H07236
N-fatty acyl tryptamines	Lipid	Seed	China	Not stated	AA1011
Oleic Acid	Lipid	Leaf Leaf	Dominican Republic West Indies	Not stated Not stated	A04099 W02289
Otivarin	Not stated	Not stated	Italy	Not stated	AA1022
Panatellin, cis	Misc Lactone	Root	Guinea	00.00216%	H21880

Compound	Chemical Type	Plant Part	Plant Origin	Quantity	Ref #
Reticulatacin, cis:	Misc Lactone	Root	Guinea	00.00083%	H21880
Reticuline	Isoquinoline Alkaloid	Stembark	Philippines	Not stated	A04095
Reticuline, (+)	Isoquinoline Alkaloid	Root Bark Leaf	Guyana Guyana Guyana	Not stated Not stated Not stated	T02076 T04073 T04073
Robustocin	Misc Lactone	Seed	Brazil	00.00043%	H26304
Rolin B, epoxy:	Misc Lactone	Seed	China	00.00285%	H21114
Rolliniastatin 1	Misc Lactone	Seed	Brazil	Not stated	K20560
Rolliniastatin 2	Misc Lactone	Seed	Brazil	Not stated	K20560
Sabadelin	Misc Lactone	Seed	Guinea	00.00116%	H25221
Solamin	Misc Lactone	Seed Stembark Seed Root Seed	Brazil India Brazil Guinea French Guiana	00.00036% Not stated Not stated 00.00005% 00.00116%	H14312 H12242 K20560 K20560 H07234
Solamin, cis:	Misc Lactone	Root	Guinea	00.00216%	H21880
Tyramine, n-para-coumaroyl:	Isoquinoline Alkaloid	Leaf	Indonesia	Not stated	H17568
Uvariamicin I, cis:	Misc Lactone	Root	Guinea	00.00083%	H21880
Uvariamicin IV, cis	Misc Lactone	Root	Guinea	00.0005%	H21880
Xylomaticin	Misc Lactone	Seed	Taiwan	Not stated	AA1009

OTHER PHYTOCHEMICAL SCREENING:

Alkaloids Absent	Leaf + Stem	T05306	Leucoanthocyanins Present	Entire Plant	T06830
Alkaloids Present	Bark + Leaf + Seed	L16047	Quinones Absent	Entire Plant	T06830
	Leaf	A04099	Saponins Absent	Entire Plant	T06830
	Entire Plant	T06830	Hydrocyanic Acid Absent	Entire Plant	T06830

Documented Biological Activities for Extracts of Graviola (Annona muricata)

IN VIVO RESEARCH

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Leaf Gabon	Toxic Effect (general)	ETOH(95%) Ext	IP Mouse	100.0 mg/kg	Inactive	No toxicity noted.	K29500
Leaf Gabon	Toxic Effect (general)	ETOH(95%) Ext	IP Mouse	300.0 mg/kg	Active	Reduction in explorative behavior and abdominal constrictions observed.	K29500
Leaf + Stem Jamaica	Toxicity Assessment (quantitative)	H2O Ext	IP Mouse	Various		Minimum toxic dose 1.0 ml/animal.	A03360
Leaf Not stated	Cytotoxic / Antiproliferative Activity	Fraction: Annonacin	IP Mouse	10 mg/kg	Active	Inhibited the growth of Lewis lung carcinoma tumors by 57.9% without toxicity	AA1032
Leaf + Stem Jamaica	Uterine Stimulant Effect	ETOH(95%) Ext H2O Ext	Oral Rat Oral Rat	0.033 ml/liter 0.033 ml/liter	Active Active	Uterus (unspec.cond). Uterus (unspec.cond).	A03360
Leaf + Stem Jamaica	Hypertensive Activity	ETOH(95%) Ext H2O Ext	IV Dog IV Dog	0.1 ml/kg 0.1 ml/kg	Active Active		A03360
Bark Not stated	Cardiac Depressant Activity	H2O Ext	Rabbit	Not stated	Active	Heart	A04104
Leaf Cuba	Hypotensive Activity	H2O Ext	IV Rat	1.0 ml/animal	Active	BP fell by more than 30%.	M29843
Leaf + Stem Jamaica	Vasodilator Activity	ETOH(95%) Ext	IP Rat	0.033 ml/liter	Active	Hind Quarter (isolated)	A03360
Leaf Gabon	Anticonvulsant Activity	ETOH(95%) Ext	IP Mouse	100.0 mg/kg	Active	vs. pentylenetetrazol-induced seizures. Results significant at $P < 0.05$ Level.	K29500
Leaf Nigeria	Anticonvulsant Activity	ETOH(70%) Ext	IP Mouse	Dose Variable	Inactive	vs. metrazole-induced convulsions and vs. strychnine-induced convulsions.	T06510

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Leaf Brazil	Analgesic Activity	ETOH-H2O (1:1) Ext	IG Mouse	1.0 gm/kg	Inactive	vs. writhing test.	M18488
Leaf Brazil	Analgesic Activity	ETOH-H2O (1:1) Ext	IG Mouse	1.0 gm/kg	Inactive	vs. tail flick test.	M18488
Leaf + Stem Jamaica	Smooth Muscle Relaxant Activity	ETOH(95%) Ext H2O Ext	Rabbit Rabbit	3.3 ml/liter 2.2 ml/liter	Active Active	Duodenum	A03360
Leaf + Stem Jamaica	Spasmogenic Activity	ETOH(95%) Ext H2O Ext	Guinea Pig Guinea Pig	0.033 ml/liter 0.033 ml/liter	Active Active	Ileum	A03360
Leaf Cuba	Inotropic Effect Positive	Hot H2O Ext	Guinea Pig	0.032 ml/liter	Inactive	Atrium	M29843
Stembark India	Antioxidant Activity	ETOH(95%)Ext	IG Rat	100.0 mg/kg	Active	vs. cold immobilization stress-induced increase in lipid peroxidation.	J10426
Stembark India	5-hydroxyindole-3-acetic Acid Inhibition	ETOH(100%)Ext	IG Rat	100.0 mg/kg	Active	Brain	L19052
Stembark India	Antiulcer Activity	ETOH(100%)Ext	GI Rat	100.0 mg/kg	Weak Activity	Statistical data in report indicating significant results vs. cold stress-induced ulcers.	J19242
Leaf Surinam	Serotonin (5-ht) Receptor Binding Activity	CHCL3 Ext	Calf Hippocampus	100.0 mcg/ml	Weak Activity	Inhibited the binding of 3h- rauwolscine to serotonin receptors.	J10986
Fruit Surinam	Serotonin (5-HT) Receptor Binding Activity	Juice CHCL3 Ext	Calf Calf	100.0 mcg/ml 100.0 mcg/ml	Active Active	Inhibited the binding of 3h-rauwolscine to serotonin receptors.	J10986
Seed Surinam	Serotonin (5-HT) Receptor Binding Activity	MEOH Ext	Calf Hippocampus	100.0 mcg/ml	Active	Inhibited the binding of 3h-rauwolscine to serotonin receptors.	J10986
Stembark India	Dopamine Increase	ETOH(100%)Ext	IG Rat	100.0 mg/kg	Active	Brain	L19052
Stembark India	Norepinephrine Level Increase	ETOH(100%)Ext	IG Rat	100.0 mg/kg	Active	Brain	L19052

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Stembark India	Monoamine Oxidase Activity Increase	ETOH(100%)Ext	IG Rat	100.0 mg/kg	Active	Brain	L19052
Stembark India	Serotonin (5-ht) Release Inhibition	ETOH(100%)Ext	IG Rat	100.0 mg/kg	Active	Brain	L19052

Documented Biological Activities for Extracts of Graviola (Annona muricata)

IN VITRO RESEARCH

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Leaf Malaysia	Epstein-barr Virus Early Antigen Induction	Ether Ext	Cell Culture	1.0 mcg/ml	Inactive	Virus - Epstein-barr (Assay designed to test for tumor promoting activity.)	J13478
Leaf Borneo	Cytotoxic Activity	ETOH(95%) Ext	Cell Culture	20.0 mcg/ml	Active	CA-9KB. (Results significant at $p < 0.05$ level)	K27823
Leaf Costa Rica	Cytotoxic Activity	ETOH(95%) Ext	Cell Culture	ED50<20 mcg/ml	Active	CA-9KB	X00001
Leaf USA-FL	Cytotoxic Activity	ETOH(95%) Ext	Cell Culture	ED50<20 mcg/ml	Active	CA-9KB	X00001
Leaf Colombia	Cytotoxic Activity	ETOH(100%) Ext	Cell Culture	IC50=2.0 mcg/ml	Active	Cells-MDBK	L12082
Leaf Indonesia	Cytotoxic Activity	ETOH(95%)Ext	Cell Culture	ED50=1.9 mcg/ml	Active	CA-Mammary-MCF-7	H24563
Leaf Indonesia	Cytotoxic Activity	Not stated	Cell Culture	IC50=0.67 mcg/ml	Active	CA-A498	H19306
Stem Costa Rica	Cytotoxic Activity	ETOH(95%)Ext	Cell Culture	ED50<20.0 mcg/ml	Active	CA-9KB	X00001
Leaf Taiwan	Cytotoxic Activity	ETOH(95%)Ext	Cell Culture	Not stated	Active	Human hepatoma Hep G 2,2,15	AA1009
Seed China	Cytotoxic Activity	Fractions: Acetogenins	Cell Culture	Not stated	Active	Human hepatoma Hep G(2) and 2,2,15	AA1017

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Seed Korea	Cytotoxic Activity	Fractions: Acetogenins	BST	Not stated	Active	Six human tumor cell lines including prostate adenocarcinoma (PC-3) and pancreatic carcinoma (PACA-2) cell lines.	AA1020
Seed + Leaf Taiwan	Cytotoxic Activity	Fractions: Acetogenins	Cell Culture	Not Stated	Strong Activity	Human hepatoma cell lines Hep G2, 2, 2, 15.	AA1034
Seed France	Cytotoxic Activity	Fractions: Acetogenins	Not stated	Not stated	Active	Murine leukemia L1210, human breast adeno-carcinoma MDA-MB231, human breast carcinoma MCF-7.	AA1031
Leaf USA	Cytotoxic Activity	Fractions: Muricoreacin Murihexocin C	Cell Culture	Not stated	Active	Six human tumor cell lines including prostate adenocarcinoma (PC-3) and pancreatic carcinoma (PACA-2) cell lines.	H22688
Leaf USA	Cytotoxic Activity	Fractions: Annonacin	Cell Culture	Not stated	Strong Activity	Selective toxicity to a panel of human tumor cells, including multidrug-resistant SW480 (P-glycoprotein+, Pgp+) tumor cells.	AA1033
Seed Not Stated	Cytoxic Activity	Fraction: Annonacin	Cell Culture	Not stated	Active	Annonacin activated p21 in a p53-independent manner and arrested T24 cells at the G1 phase. It also induced Bax expression, enhanced caspase-3 activity, and caused apoptotic cell death in T24 cells.	AA1036
Not Stated	Cytotoxic Activity	Fractions: Acetogeninis	Cell Culture	Not stated	Active	Colon, breast, lung, liver, and ovarian tumor cell lines. The acetogenins were more potent than doxorubicin.	AA1035

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Stembark USA	Cytotoxic Activity	Fractions: Acetogenins	Cell Culture	Not stated	Active	Human tumor cell lines A-549 (lung carcinoma), MCF-7 (breast carcinoma), HT-29 (colon adenocarcinoma).	AA1025
Not Stated	Cytotoxic Activity	Fractions: Acetogeninis	Cell Culture	Not stated	Active	Colon, breast, lung, liver, and ovarian tumor cell lines.	AA1037
Bark USA	Cytotoxic Activity	Fraction: Gigantetronenin	Cell Culture	Not stated	Active	Human tumor cell lines.	AA1026
Leaf + Twig USA	Cytotoxic Activity	Not Stated	Cell Culture	Not stated	Active	Human tumor cell lines.	AA1023
Bark Venezuela	Cytotoxic Activity	Fraction: Xylomaticin	Cell Culture	Not stated	Active	Human solid tumor cell lines.	AA1024
Pericarp Colombia	Cytotoxic Activity	Hexane Ext Ethyl acetate Ext MEOH Ext	Cell Culture	Not stated	Active	U-937	AA1029
Leaf Colombia	Cytotoxic Activity	MTT	Cell Culture	CC50=49.5 mcg/ml	Active	Human hepatoma 2.	AA1030
Leaf Cuba	Cytostatic Activity	H2O Ext ETOH Ext Ketonic Ext	Agar plate	Not stated	Active	*Neurospora crassa*	AA1013
Acetogenins USA	Cytotoxic Activity	Fractions: Acetogenins	Cell Culture	Not stated	Active	Murine P388 leukemia, P03, M17/adr cancer cell lines, human H8,H125 cancer cell lines, adriamycin resistant tumor cells, non-adriamycin resistant tumor cells.	AA1021
Acetogenins France	Cytotoxic Activity	Fractions: Acetogenin analogs	Cell Culture	Not stated	Active	L1210 leukemia cells (Predicts antitumor activity.)	AA1015
Acetogenins USA	Cytostatic Activity	Fractions: Acetogenins	Not stated	Not stated	Active	Adriamycin resistant human mammary adenocarcinoma (MCF-7/Adr) cells.	AA1015
Seed China	Antitumor Activity	CHC13 Ext	Cell Culture	Not stated	Active	Demonstrated antitumor activity.	AA1011

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Acetogenins USA	Antiproliferative Activity	Fractions: Acetogenins	Cell Culture	Not stated	Inactive	Non-cancerous GI epithelial cell line (I18).	AA1021
Leaf Indonesia	Anticrustacean Activity	ETOH(95%) Ext	Artemia salina larvae	LC50=0.17 mcg/ml	Active	Assay system is intended to predict for antitumor activity.	H16272
Stem Puerto Rico	Cytotoxic / Anti-HIV Activity	H2O Soluble Fraction	Cell Culture	IC50<2.0 mcg/ml	Active	vs. CEM-SS Cells. Results indicate it has an anti-proliferative effect rather than a cytotoxic effect on HIV-infected cells.	L09586
Stem Puerto Rico	Antiviral Activity	H2O Soluble Fraction	Agar Plate	Not stated	Inactive	Virus - HIV	L09586
Colombia	Antiviral Activity	MTT	Cell Culture	CC50 & EC50 = 0.50 mcg/ml	Active	Virus - HSV-2	AA1030
Stembark India	Antiviral Activity	ETOH(95%) Ext	Cell Culture	1.0 mg/ml	Active	Virus- *Herpes simplex* 1	J19169
Leaf Cuba	Antifungal Activity	Acetone Ext ETOH(95%) Ext H2O Ext	Agar Plate	50%	Inactive	*Neurospora crassa*	T08589
Leaf Guatemala	Antifungal Activity	Hot H2O Ext	Broth Culture	1.0 ml	Inactive	*Epidermophyton floccosum* *Microsporum canis* *Microsporum gypseum* *Trichophyton mentagrophytes* *Trichophyton rubrum*	M27151
Stem Cuba	Antifungal Activity	Acetone Ext ETOH(95%) Ext H2O Ext	Agar Plate	50%	Inactive	*Neurospora crassa*	T08589
Leaf Dominican Republic	Antihepatotoxic Activity	Decoction	Cell Culture	1.0 mg/plate	Weak Activity	Hepatocytes (Measured by leakage of LDH and ASAT. Reduced the leakage of ASAT)	K23019
Leaf Dominican Republic	Antioxidant Effect	Decoction	Cell Culture	1.0 mg/plate	Inactive	Hepatocytes (Monitored by production of malo-naldehyde.)	K23019

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Leaf Dominican Republic	Radical Scavenging Effect	Decoction	Not stated	250.0 mg/liter	Inactive	Measured by decoloration of diphenylpicryl hydroxyl radical solution.	K23019
Stembark France	Antiparasitic Activity	MEOH Ext	In vitro	Not stated	Active	*Leishmania trypansoma*	AA1032
Pericarp Colombia	Antiparasitic Activity	Hexane Ext Ethyl Acetate Ext MEOH Ext	In vitro	Not stated	Active	*Leishmania braziliensis* *L. panamensis* *L. promastigotes*	AA1029
Seed France	Antiparasitic Activity	MEOH Ext	In vitro	Not stated	Active	*E. histolytica* *N. brasiliensis* *M. dessetae* *A. salina*	M28527
Leaf Puerto Rico	Antimalarial Activity	ETOH(95%) Ext	RBC	IC50=20.0 mcg/ml	Weak Activity	*Plasmodium falciparum* W-2	K16971
Leaf Puerto Rico	Antimalarial Activity	ETOH(95%) Ext	RBC	IC50 > 63 mcg/ml	Inactive	*Plasmodium falciparum* D-6	K16971
Leaf Togo	Antimalarial Activity	ETOH(95%) Ext	RBC	IC50=39.9 mcg/ml	Active	*Plasmodium falciparum*	M23556
Leaf Borneo	Antimalarial Activity	ETOH(95%) Ext	RBC	20.0 mcg/ml	Active	*Plasmodium falciparum* D-6 & W-2. (Results significant at P < 0.01 Level)	K27823
Leaf Cuba	Antibacterial Activity	H2O Ext	Agar Plate	Not stated	Active	*Escherichia coli* *Pseudomonas aeruginosa* *Shigella flexneri*	K09159
Leaf Cuba	Antibacterial Activity	Acetone Ext	Agar Plate	Not stated	Active	*Escherichia coli* *Pseudomonas aeruginosa* *Salmonella B* *Salmonella newport* *Salmonella typhosa* *Serratia marcescens* *Shigella flexneri* *Shigella flexneri 3a* *Staphylococcus albus* *Staphylococcus aureus*	K09159
Stembark Papua-New Guinea	Antibacterial Activity	MEOH Ext	Agar Plate	1 mg/disc	Active	*Staphylococcus aureus* *Escherichia coli*	L03211

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Stem Cuba	Antibacterial Activity	Acetone Ext	Agar Plate	Not stated	Active	*Escherichia coli* *Salmonella B* *Salmonella newport* *Salmonella typhosa* *Shigella flexneri* *Shigella flexneri 3A*	K09159
Stem Cuba	Antibacterial Activity	H2O Ext	Agar Plate	Not stated	Active	*Escherichia coli* *Pseudomonas aeruginosa* *Salmonella newport* *Salmonella typhosa* *Salmonella B* *Shigella flexneri*	K09159
Stembark Papua-New Guinea	Antibacterial Activity	ETOH(95%) Ext	Agar Plate	2-3 mcg/plate	Active Active Inactive Inactive	*Bacillus subtilis* *Staphylococcus albus* *Klebsiella pneumoniae* *Pseudomonas aeruginosa*	K15021
Leaf Papua-New Guinea	Antibacterial Activity	ETOAC Ext MEOH Ext	Agar Plate	1.0 mg/disc	Weak Activity	*Staphylococcus aureus*	L03211
Leaf Cuba	Antibacterial Activity	Acetone Ext	Agar Plate	Not stated	Inactive	*Sarcina lutea*	K09159
Stembark Papua-New Guinea	Antibacterial Activity	ETOAC Ext	Agar Plate	1.0 mg/disc	Weak Activity	*Escherichia coli* *Staphylococcus aureus*	L03211
Leaf Papua-New Guinea	Antibacterial Activity	ETOAC Ext	Agar Plate	1.0 mg/disc	Inactive	*Escherichia coli*	L03211
Leaf Cuba	Antibacterial Activity	ETOH(95%) Ext	Agar Plate	Not stated	Inactive	*Escherichia coli* *Pseudomonas aeruginosa* *Salmonella B* *Salmonella newport* *Salmonella typhosa* *Sarcina lutea* *Serratia marcescens* *Shigella flexneri* *Shigella flexneri 3a* *Staphylococcus albus* *Staphylococcus aureus*	K09159

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Leaf Trinidad	Antibacterial Activity	ETOAC Ext	Agar Plate	1000 mcg/ml	Inactive	*Escherichia coli* *Pseudomonas aeruginosa* *Salmonella typhimurium* *Staphylococcus aureus* *Staphylococcus epidermidis* *Streptococcus faecalis*	L13922
Stem Cuba	Antibacterial Activity	Acetone Ext	Agar Plate	Not stated	Inactive	*Pseudomonas aeruginosa* *Sarcina lutea* *Serratia marcescens* *Staphylococcus albus* *Staphylococcus aureus*	K09159
Leaf Cuba	Antibacterial Activity	H2O Ext	Agar Plate	Not stated	Inactive	*Salmonella B* *Salmonella newport* *Salmonella typhosa* *Sarcina lutea* *Serratia marcescens* *Shigella flexneri 3a* *Staphylococcus albus* *Staphylococcus aureus*	K09159
Leaf Trinidad	Antibacterial Activity	Pet Ether Ext	Agar Plate	1000 mcg/ml	Equiv. Equiv. Inactive Inactive Inactive	*Staphylococcus aureus* *Streptococcus faecalis* *Escherichia coli* *Salmonella typhimurium* *Staphylococcus epidermidis*	L13922
Stem Cuba	Antibacterial Activity	H2O Ext	Agar Plate	Not stated	Inactive	*Sarcina lutea* *Serratia marcescens* *Shigella flexneri 3A* *Staphylococcus albus* *Staphylococcus aureus*	K09159
Stem Cuba	Antibacterial Activity	ETOH(95%) Ext	Agar Plate	Not stated	Inactive	*Escherichia coli* *Pseudomonas aeruginosa* *Salmonella B* *Salmonella newport* *Salmonella typhosa* *Sarcina lutea* *Serratia marcescens* *Shigella flexneri* *Staphylococcus albus* *Staphylococcus aureus*	K09159

Plant Part / Origin	Activity Tested For	Type Extract	Test Model	Dosage	Results	Notes / Organism Tested	Ref #
Leaf Puerto Rico	Antimycobacterial Activity	ETOH(95%) Ext	Agar Plate	Not stated	Inactive	*Mycobacterium tuberculosis*	L12432
Stem Brazil	Molluscicidal Activity	ETOH(100%) Ext	Not stated	100.0 ppm	Inactive	*Biomphalaria glabrata*	L15585
Dried Stembark Brazil	Molluscicidal Activity	ETOH(100%) Ext	Adult snail Egg masses	LD50 = 0.97 ppm LD50 = 1.0 ppm	Active	*Biomphalaria glabrata* *Biomphalaria glabrata*	L15585
Leaf Brazil	Molluscicidal Activity	ETOH(100%) Ext	Adult Snail Egg Masses	LD50 = 1.59 ppm LD50 = 20.26 ppm	Active	*Biomphalaria glabrata*	L15585
Leaf Brazil	Molluscicidal Activity	Not stated	Adult Snail Egg Masses	LD90 < 20 ppm LD90 < 20 ppm	Active	*Biomphalaria glabrata*	AA1028
Brazil	Molluscicidal Activity	Not stated	Adult Snail Egg Masses	LD50 = 11.86 ppm LD50 = 49.62 ppm	Active	*Biomphalaria glabrata*	AA1012
Leaf + Stem India	Larvicidal Activity	H2O Ext	Not stated	0.03 gm/ml	Inactive	*Culex quinquefasciatus*	M19731
Leaf Not Stated	Insecticide Activity	ETOH(95%) Ext	Not stated	5.0%	Weak Activity	*Macrosiphoniella sanborni*	W00220
Spain	Insecticide Activity	Fraction: Squamocin	Agar plate	Not stated	Active	*L. decemlineata* *M. persicae*	AA1018
USA	Insecticide Activity	Fraction: Acetogenins	In vitro	Not stated	Active	*Blattella germanica* (L.)	AA1019
Spain	Antifeedant Activity	Fraction: Annonacin	Agar plate	Not stated	Active	*L. decemlineata*	AA1018
Root bark Taiwan	Dopaminergic modulation	Alkaloid Ext	Cell culture	18 mcg/ml	Equiv.	Dopaminergic nerve cells and GABAergic nerve cells.	AA1010

Literature Cited - Graviola (Annona muricata)

AA1008	POPULAR MEDICINE OF THE CENTRAL PLATEAU OF HAITI. 2. WENIGER, B. ET.AL. ETHNOPHARMACOLOGICAL INVENTORY J ETHNOPHARMACOL 17 1: 13-30 (1986)
AA1009	NEW CYTOTOXIC MONOTETRAHYDROFURAN ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA. LIAW, CC: CHANG, FR: LIN, CY: CHOU, CJ: CHIU,HF: WU,MJ: WU,YC: J NAT PROD 65 4: 470-5 (2002) (GRAD INST OF NAT PROD, KAOHSIUNG MED UNI, TAIWAN)
AA1010	TOXICITY OF ANNONACEAE FOR DOPAMINERGIC NEURONS: POTENTIAL ROLE IN ATYPICAL PARKINSONISM IN GUADELOUPE. LANNUZEL,A: MICHEL,PP: CAPARROS-LEFEBVRE,D: ABAUL,J: HOCQUERMILLER,R: RUBERG,M: MOV DISORD 17 1:84-90 (2002) (CENTRE HOSPITALIER UNIVERSITAIRE DES ANTILLES ET DE LA GUYANE, FRANCE)
AA1011	ANNONACEOUS ACETOGENINS OF THE SEEDS FROM ANNONA MURICATA. LI,DY. YU,JG. ZHU,JX. YU,DL. LUO,XZ. SUN,L. YANG,SL. J ASIAN NAT PROD RES 3 4: 267-76 (2001) (INSTITUTE OF MED PLANT DEVELOPMENT, BEIJING)
AA1012	THE MOLLUSCICIDAL ACTIVITY OF PLANTS USED IN BRAZILIAN FOLK MEDICINE. DOS SANTOS,AF. SANT'ANA,AE. PHYTOMEDICINE. 6 6: 431-8 (2000) (DEPARTAMENTO DE QUIMICA DO CCEN, BRAZIL)
AA1013	PLANT EXTRACTS WITH CYTOSTATIC PROPERTIES GROWING IN CUBA. LOPEZ ABRAHAM,AM. ROJAS HERNANDEZ,NM. JIMENEZ MISAS,CA. REV CUBANA MED TROP. 31 2:97-104 (1979)
AA1014	ANTITUMORAL EFFECTS OF SQUAMOCIN ON PARENTAL AND MULTIDRUG RESISTANT MCF7 (HUMAN BREAST ADENOCARCINOMA) CELL LINES. RAYNAUD,S. NEMATI,F. MICCOLI,L. MICHEL,P. POUPON,MF. FOURNEAU,C. LAURENS,A. HOCQUEMILLER,R. LIFE SCI 65 5: 525-33 (1999) (LABORATOIRE DE PHARMACOGNOSIE, FRANCE)
AA1015	STRUCTURE-ACTIVITY RELATIONSHIPS OF DIVERSE ANNONACEOUS ACETOGENINS AGAINST MULTIDRUG RESISTANT HUMAN MAMMARY ADENOCARCINOMA (MCF-7/ADR) CELLS. OBERLIES,NH. CHANG,CJ. MCLAUGHLIN JL. J MED CHEM 40 13: 2102-6 (1997) (DEPT CHEM AND MOLECULAR PHARM, PURDUE UNI, USA)
AA1017	NOVEL CYTOTOXIC ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA. CHANG,RF. WU,YC. J NAT PROD. 64 7: 925-31 (2001) (GRADUATE INSTITUTE OF NATURAL PRODUCTS, CHINA)
AA1018	INSECTICIDAL AND MUTAGENIC EVALUATION OF TWO ANNONACEOUS ACETOGENINS. GUADANO,A. GUTIERREZ,C. DE LA PENA E. CORTES,D. CONZALEZ-COLOMA,A. J NAT PROD. 63 6: 773-6 (2000) (CENTRO DE CIENCIAS MEDIOAMBIENTALES, SPAIN)
AA1019	ANNONACEOUS ACETOGENINS AS NATURAL PESTICIDES; POTENT TOXICITY AGAINST INSECTICIDE-SUSCEPTIBLE AND RESISTANT GERMAN COCKROACHES (DICTYOPTERA: BLATTELLIDAE). ALALI,FQ. KAAKEH,W. BENNETT,GW. MCLAUGHLIN,JL. J ECON ENTOMOL. 91 3: 641-9 (1998) (DEPT MED CHEM AND MOLECULAR PHARM, PURDUE UNI, USA)
AA1020	CIS-ANNONACIN AND (2,4)-CIS-AND TRANS-ISOANNONACINS: CYTOTOXIC MONOTETRAHYDROFURAN ANNONACEOUS ACETOGENINS FROM THE SEEDS OF ANNONA CHERIMOLIA. WOO,MH. CHUNG,SO. KIM,DH. ARCH PHARM RES 22 5: 524-8 (1999) (DEPT PHARMACY, KOREA)

AA1021	TUMOR CELL GROWTH INHIBITION BY SEVERAL ANNONACEOUS ACETOGENINS IN AN IN VITRO DISK DIFFUSION ASSAY. OBERLIES,NH. JONES,JL. CORBETT,TH. FOTOPOULOS,SS. MCLAUGHLIN,JL. CANCER LETT. 96 1: 55-62 (1995) (DEPT MED CHEM AND PHARM, PURDUE UNI, USA)
AA1022	NATURAL SUBSTANCES (ACETOGENINS) FROM THE FAMILY ANNONACEAE ARE POWERFUL INHIBITORS OF MITOCHONDRIAL NADH DEHYDROGENASE (COMPLEX I). DEGLI ESPOSTI,M. GHELLI,A. RATTA,M. CORTES,D. ESTORNELL,E. BIOCHEM J. 301 (PT 1): 161-7 (1994) (DIPARTIMENTO DI BIOLOGIA, ITALY)
AA1023	LONGIFOLICIN, LONGICORICIN AND GIGANTETRONENINONE, THREE NOVEL BIOACTIVE MONO-TETRAHYDROFURAN ANNONACEOUS ACETOGENINS FROM ASIMINA LONGIFOLIA (ANNONACEAE). YE,Q. ALFONSO,D. EVERT,D. MCLAUGHLIN,JL. BIOORG MED CHEM. 4 4: 537-4 (1996) (DEPT MED CHEM AND PHARM, PURDUE UNI, USA)
AA1024	BIOACTIVE ANNONACEOUS ACETOGENINS FROM THE BARK OF XYLOPIA AROMATICA. COLMAN-SAIZARBITORIA,T. ZAMBRANO,J. FERRIGNI,NR. GU,ZM. NG,JH. SMITH,DL. MCLAUGHLIN,JL. J NAT PROD 57 4: 486-93 (1994) (FACULTAD DE FARMACIA, UNIVERSIDAD CENTRAL DE VENEZUELA)
AA1025	BIOLOGICALLY ACTIVE ACETOGENINS FROM STEM BARK OF ASIMINA TRILOBA. ZHAO,GX. RIESER,MJ. HUI,YH. MIESBAUER,LR. SMITH,DL. MCLAUGHLIN,JL. PHYTOCHEMISTRY 33 5: 1065-73 (1993)(DEPT MED CHEM AND PHARM, PURDUE UNI, USA)
AA1026	GIGANTETRONENIN AND GIGANTRIONENIN: NOVEL CYTOTOXIC ACETOGENINS FROM GONIOTHALAMUS GIGANTEUS. FANG,XP. ANDERSON, JE. SMITH,DL. MCLAUGHLIN,JL. WOOD,KV. J NAT PROD. 55 11:1655-63 (1992) (DEPT MED CHEM AND PHARM, PURDUE UNI, USA)
AA1027	STUDIES ON THE CHEMICAL CONSTITUENTS OF ANNONA MURICATA. YU,JG. GUI,HQ. LUO,XZ. SUN,L. ZHU,P. YU,ZL. YAO XUE XUE BAO 32 6: 431-7 (1997) (INST MED PLANT DEV, BEIJING
AA1028	MOLLUSCICIDAL PROPERTIES OF SOME SPECIES OF ANNONA. DOS SANTOS,AF. SANT'ANA,AE. PHYTOMEDICINE. 8 2: 115-20.(2001)(LABORATORIO DE PESQUISAS EM RECURSOS NATURAIS, BRAZIL)
AA1029	CYTOTOXICITY AND ANTILEISHMANIAL ACTIVITY OF ANNONA MURICATA PERICARP. JARAMILLO,MC. ARANGO,GJ. GONZALEZ,MC. ROBLEDO,SM. VELEZ,ID. FITOTERAPIA. 71 2: 183-6 (2000) (FACULTAD DE QUIMICA FARMACEUTICA, COLOMBIA)
AA1030	ANTITUMOR AND ANTIVIRAL ACTIVITY OF COLOMBIAN MEDICINAL PLANT EXTRACTS. BETANCUR-GALVIS,L. SAEZ,J. GRANADOS,H. SALAZAR,A. OSSA,J. MEM INST OSWALDO CRUZ. 94 4: 531-5 (1999) (LABORATORIO DE VIROLOGIA, COLOMBIA)
AA1031	ANNOMONYSVIN:: A NEW CYTOTOXIC GAMMA-LACTONE-MONOTETRAHYDROFURANYL ACETOGENIN FROM ANNONA MONTANA. JOSSANG,A. DUBAELE,B. CAVE,A. BARTOLI,MH. BERIEL,H. J NAT PROD. 54 4: 967-71 (1991) (LABORATOIRE DE CHIMIE, FRANCE)
AA1032	ANNONACEOUS ACETOGENINS FROM THE LEAVES OF ANNONA MONTANA. WANG,LQ; MIN,BS; LI,Y; NAKAMURA,N; QIN,GW; LI,CJ; HATTORI,M; BIOORG MED CHEM. 2002 MAR;10(3):561-5. (INSTITUTE OF NATURAL MEDICINE, TOYAMA MEDICAL AND PHARMACEUTICAL UNIVERSITY) (TOYAMA, JAPAN)

AA1033	SELECTIVE ACTION OF ACETOGENIN MITOCHONDRIAL COMPLEX I INHIBITORS. GONZALEZ-COLOMA A, GUADANO A, DE INES C, MARTINEZ-DIAZ R, CORTES D.Z NATURFORSCH [C] 2002 NOV-DEC;57(11-12):1028-34 (CENTRO DE CIENCIAS MEDIOAMBIENTALES, CSIC, SERRANO 115-DPDO., 28006 MADRID, SPAIN.)
AA1034	NEW ADJACENT BIS-TETRAHYDROFURAN ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA. CHANG, FR: LIAW, CC: LIN, CY: CHOU, CJ: CHIU, HF: WU, YC: PLANTA MED 69 3: 241-6 (2003) (GRADUATE INSTITUTE OF NATURAL PRODUCTS, KAOHSIUNG MEDICAL UNIVERSITY, KAOHSIUNG, TAIWAN, R.O.C.)
AA1035	IN VITRO ANTITUMOR STRUCTURE-ACTIVITY RELATIONSHIPS OF THREO/TRANS/THREO MONO-TETRAHYDROFURANIC ACETOGENINS: CORRELATIONS WITH THEIR INHIBITION OF MITOCHONDRIAL COMPLEX I. TORMO JR, ROYO I, GALLARDO T, ZAFRA-POLO MC, HERNANDEZ P, CORTES D, PELAEZ F.; ONCOL RES. 2003;14(3):147-54. (CIBE-MERCK RESEARCH LABORATORIES, MERCK, SHARP & DOHME DE ESPANA S.A., C/JOSEFA VALCARCEL, 38, MADRID 28027, SPAIN. JOSE_TORMO@MERCK.COM)
AA1036	ANNONACIN, A MONO-TETRAHYDROFURAN ACETOGENIN, ARRESTS CANCER CELLS AT THE G1 PHASE AND CAUSES CYTOTOXICITY IN A BAX- AND CASPASE-3-RELATED PATHWAY. YUAN SS, CHANG HL, CHEN HW, YEH YT, KAO YH, LIN KH, WU YC, SU JH. LIFE SCI. 2003 MAY 9;72(25):2853-61. (DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, KAOHSIUNG MEDICAL UNIVERSITY, KAOHSIUNG, TAIWAN 807, ROC. YUANSSF@MS33.HINET.NET)
AA1037	IN VITRO ANTITUMOR SAR OF THREO/CIS/THREO/CIS/ERYTHRO BIS-THF ACETOGENINS: CORRELATIONS WITH THEIR INHIBITION OF MITOCHONDRIAL COMPLEX I. ROYO I, DEPEDRO N, ESTORNELL E, CORTES D, PELAEZ F, TORMO JR. ONCOL RES. 2003;13(12):521-8. (CIBE-MERCK RESEARCH LABORATORIES, MERCK, SHARP & DOHME DE ESPANIA S.A., C/ JOSEFA VALCARCEL, 38 MADRID 28027, SPAIN. IMMACULADA_ROYO@MERCK.COM)
A00785	SURVEY OF PLANTS FOR ANTIMALARIAL ACTIVITY. SPENCER,CF: KONIUSZY,FR: ROGERS,EF: SHAVEL JR,J: EASTON,NR: KACZKA,EA: KUEHL JR,FA: PHILLIPS,RF: WALTI,A: FOLKERS,K: MALANGA,C: SEELER,AO: LLOYDIA 10 : 145-174 (1947) (RES LAB MERCK + CO,INC RAHWAY NJ USA)
A01962	SOME MEDICINAL PLANTS OF GUAM INCLUDING ENGLISH AND GUAMANIAN COMMON NAMES. HADDOCK,RL: REPORT REGIONAL TECH MTG MED PLANTS, PAPEETE, TAHITI, NOV, 1973, SOUTH PACIFIC COMMISSION, NOUMEA, NEW CALEDONIA 1974 : 79- (1974) (ENVIRON HEALTH & CONSUMER PROT AGANA 96910 GUAM)
A03360	PHARMACOLOGICAL SCREENING OF SOME WEST INDIAN MEDICINAL PLANTS. FENG,PC: HAYNES,LJ: MAGNUS,KE: PLIMMER,JR: SHERRAT,HSA: J PHARM PHARMACOL 14 : 556-561 (1962) (UNIV COLL WEST INDIES KINGSTON 7 JAMAICA)
A04095	THE ALKALOIDS OF ANNONA MURICATA. SANTOS,GA: LIBREA,JR: SANTOS,AC: PHILIPPINE J SCI 96 : 399- (1967) (COLL AGR UNIV PHILIPPINES LAGUNA PHILIPPINES)
A04099	CHEMICAL EXAMINATION OF THE LEAVES OF ANNONA MURICATA. CALLAN,T: TUTIN,F: PHARM J 87 : 743- (1914)
A04100	THE COMPOSITION OF THE FRUIT ANNONA CHERIMOLIA. CUTOLO,A: STAZ SPER AGR ITAL 48 : 889- (1915)

A04102	THE VITAMIN CONTENT OF PHILIPPINE FOODS. II. VITAMIN C IN FRUITS AND VEGETABLES. HERMANO,AJ: SEPULVEDA JR,G: PHILIPPINE J SCI 53 : 379- 1934
A04104	THE ALKALOIDS OF ANNONA MURICATA. MEYER,TM: ING NED INDIE 8 6: 64- (1941)
A04105	PUERTO RICAN FATTY OILS. II. THE CHARACTERISTICS AND COMPOSITION OF GUANABANA SEED OIL. ASENJO,CF: GOYCO,JA: J AMER CHEM SOC 65 : 208- (1943) (UNIV PUERTO RICO SAN JUAN PUERTO RICO)
A04107	ORNITHINE CYCLE AMINO ACIDS AND OTHER FREE AMINO ACIDS IN FRUITS OF ANNONA SQUARNOSA AND A. MURICATA. VENTURA,MM: LIMA,IH: PHYTON(BUENOS AIRES) 17 : 39- (1961) (UNIV CEARA CEARA BRAZIL)
A05062	ALKALOID BEARING PLANTS AND THEIR CONTAINED ALKALOIDS. WILLAMAN,JJ: SCHUBERT,BG: ARS, USDA, TECH BULL 1234, SUPT DOCUMENTS, GOVT PRINT OFF, WASHINGTON DC, 1961 : - (1961)
A05332	A SURVEY OF MEDICINAL PLANTS OF CURACAO. MORTON,JF: ECON BOT 22 : 87- (1968) (MORTON COLLECTANEA UNIV MIAMI CORAL GABLES FL USA)
A05825	THE MEDICINAL AND POISONOUS PLANTS OF SOUTHERN AND EASTERN AFRICA. 2ND ED, E.+S. LIVINGSTONE,LTD.,LONDON. WATT,JM: BREYER-BRANDWIJK,MG: BOOK : - (1962) (SOUTH AFRICAN INST MED RES JOHANNESBURG SOUTH AFRICA)
A06190	ON THE DISTRIBUTION OF GENTISIC ACID IN GREEN PLANTS. GRIFFITHS,LA: J EXP BIOL 10 : 437- (1959) (REG RES CENT IMPERIAL COLL TROP AGR TRINIDAD/TOBAGO)
H06211	MURISOLIN: A NEW CYTOTOXIC MONO-TETRAHYDROFURAN-GAMMA-LACTONE FROM ANNONA MURICATA. MYINT,SH: LAURENS,A: HOCQUEMILLER,R: CAVE,A: DAVOUST,D: CORTES,D: HETEROCYCLES 31 5: 861-867 (1990) (LAB PHARMACOG FAC PHARM UNIV PARIS SUD CHATENAY-MALABRY 92290 FRANCE)
H06944	MURICATACIN: A SIMPLE BIOLOGICALLY ACTIVE ACETOGENIN DERIVATIVE FROM THE SEEDS OF ANNONA MURICATA (ANNONACEAE). RIESER,MJ: KOZLOWSKI,JF: WOOD,KV: MC LAUGHLIN,JL: TETRAHEDRON LETT 32 9: 1137-1140 (1991) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H07234	SOLAMIN, A CYTOTOXIC MONO-TETRAHYDROFURANIC GAMMA-LACTONE ACETOGENIN FROM ANNONA MURICATA SEEDS. MYINT,SH: CORTES,D: LAURENS,A: HOCQUEMILLER,R: LEBCEUF,M: CAVE,A: COTTE,J: QUERO,AM: PHYTOCHEMISTRY 30 10: 3335-3338 (1991) (LAB PHARM CNRS UNIV PARIS-SUD CHATENAY-MALABRY 92296 FRANCE)
H07236	COROSSOLONE AND COROSSOLINE,TWO NEW CYTOTOXIC MONOTETRAHYDROFURAN GAMMA LACTONES. CORTES,D: MYINT,SH: LAURENS,A: HOCQUEMILLER,R: LEBOEUF,M: CAVE,A: CAN J CHEM 69 1: 8-11 (1991) (LAB PHARM FAC MED PHARM UNIV ROUEN ST ETIENNE DU ROUVRAY 76800 FRANCE)
H07609	CYTOTOXIC GAMMA LACTONE MONOTETRAHYDROFURAN ANNOMONTACIN: A NEW ACETOGEN FROM ANNONA MONTANA. JOSSANG,A: DUBAELE,B: CAVE,A: BARTOLI,MH: BERIEL,H: J NAT PROD 54 4: 967-971 (1991) (LAB CHIM MUSEUM NATL HIST NAT PARIS 75231 FRANCE)

H12235	COREPOXYLONE, A POSSIBLE PRECURSOR OF MONO-TETRAHYDROFURAN GAMMA-LACTONE ACETOGENINS: BIOMIMETIC SYNTHESIS OF COROSSOLONE. GROMEK,D: FIGADERE,B: HOCQUEMILLER,R: CAVE,A: TETRAHEDRON 49 24: 5247-5252 (1993) (LAB MATER MED U.E.R. CHIM THER CENT ETUDE PHARM CHATENAY-MALABRY F-92290 FRANCE)
H12242	EPOXYMURINS A AND B, TWO BIOGENETIC PRECURSORS OF ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA. HISHAM,A: SREEKALA,U: PIETERS,L: DE BRUYNE,T: VANDEN HEUVEL,H: CLAEYS,M: TETRAHEDRON 49 31: 6913-6920 (1993) (DEPT CHEM RES CENT COLL ENG TRIVANDRUM INDIA)
H12985	MURICATETROCINS A AND B AND GIGANTETROCIN B: THREE NEW CYTOTOXIC MONOTETRAHYDROFURAN-RING ACETOGENINS FROM ANNONA MURICATA. RIESER,MJ: FANG,XP: ANDERSON,JE: MIESBAUER,LR: SMITH,DL: MC LAUGHLIN,JL: HELV CHIM ACTA 76 7: 2433-2444 (1993) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H14312	TWO ACETOGENINS FROM ANNONA MURICATA SEEDS. ROBLOT,F: LAUGEL,T: LEBQEUE,M: CAVE,A: LAPREVOTE,O: PHYTOCHEMISTRY 34 1: 281-285 (1993) (LAB PHARM FAC PHARM CHATENAY 92296 FRANCE)
H15501	ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA. 2. YANG,RZ: WU,SJ: XU,RS: QIN,GW: YUNNAN ZHIWU YANJIU 16 2: 187-190 (1994) (SOUTH CHINA INST BOT CHIN ACAD SCI GUANGZHOU 510650 CHINA)
H16153	ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA. YANG,RZ: WU,SJ: XU,RS: QIN,GW: FAN,DJ: CHIH WU HSUEH PAO 36 10: 805-808 (1994) (SOUTH CHINA INST BOT ACAD SIN CANTON 510650 CHINA)
H16272	TWO NEW CYTOTOXIC MONOTETRAHYDROFURAN ANNONACEOUS ACETOGENINS, ANNOMURICINS A AND B, FROM THE LEAVES OF ANNONA MURICATA. WU,FE: GU,ZM: ZENG,L: ZHAO,GX: ZHANG,Y: MC LAUGHLIN,JL: J NAT PROD 58 6: 830-836 (1995) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H16273	NW BIOACTIVE MONOTETRAHYDROFURAN ANNONACEOUS ACETOGENINS, ANNOMURICIN C AND MURICATOCIN C, FROM THE LEAVES OF ANNONA MURICATA. WU,FE: ZENG,L: GU,ZM: ZHAO,GX: ZHANG,Y: SCHWEDLER,JT: MC LAUGHLIN,JL: SASTRODIHARDJO,S: J NAT PROD 58 6: 909-915 (1995) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H16274	MURICATOCINS A AND B, TWO NEW BIOACTIVE MONOTETRAHYDROFURAN ANNONACEOUS ACETOGENINS FROM THE LEAVES OF ANNONA MURICATA. WU,FE: ZENG,L: GU,ZM: ZHAO,GX: ZHANG,Y: SCHWEDLER,JT: MC LAUGHLIN,JL: SASTRODIHARDJO,S: J NAT PROD 58 6: 902-908 (1995) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H17568	ADDITIONAL BIOACTIVE ACETOGENINS, ANNOMUTACIN AND (2,4-TRANS AND CIS)-10R-ANNONACIN-A-ONES, FROM THE LEAVES OF ANNONA MURICATA. WU,FE: ZHAO,GX: ZENG,L: ZHANG,Y: SCHWEDLER,JT: MC LAUGHLIN,JL: SASTRODIHARDJO,S: J NAT PROD 58 9: 1430-1437 (1995) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H17719	MURIHEXOCINS A AND B, TWO NOVEL MONO-THF ACETOGENIS WITH SIX HYDROXYLS, FROM ANNONA MURICATA(ANNONACEAE). ZENG,L: WU,FE: GU,ZM: MC LAUGHLIN,JL: TETRAHEDRON LETT 36 30: 5291-5294 (1995) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)

H17799	ANNOHEXOCIN, A NOVEL MONO-THF ACETOGENIN WITH SIX HYDROXYLS, FROM ANNONA MURICATA (ANNONACEAE). ZENG,L: WU,FE: MC LAUGHLIN,JL: BIOORG MED CHEM LETT 5 16: 1865-1868 (1995) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H18307	FIVE NOVEL MONO-TETRAHYDROFURAN RING ACETOGENINS FROM THE SEEDS OF ANNONA MURICATA. RIESER,MJ: GU,ZM: FANG,XP: ZENG,L: WOOD,KV: MC LAUGHLIN,JL: J NAT PROD 59 2: 100-108 (1996) (EGREVO RES CENT PIKEVILLE NC 27863 USA)
H18888	MURIDIENIN-1 AND -2: THE MISSING LINKS IN THE BIOGENETIC PRECURSORS OF ACETOGENINS OF ANNONACEAE. GLEYE,C: LAURENS,A: HOCQUEMILLER,R: FIGADERE,B: CAVE,A: TETRAHEDRON LETT 37 52: 9301-9304 (1996) (LAB PHARMACOG FAC PHARMACIE UNIV PARIS SUD CHATENAY FRANCE)
H19211	ISOLATION OF MONTECRISTIN, A KEY METABOLITE IN BIOGENESIS OF ACETOGENINS FROM ANNONA MURICATA AND ITS STRUCTURE ELUCIDATION BY USING TANDEM MASS SPECTROMETRY. GLEYE,C: LAURENS,A: HOCQUEMILLER,R: CAVE,A: LAPREVOTE,O: SERANI,L: J ORG CHEM 62 3: 510-513 (1997) (LAB PHARMACOG FAC PHARM UNIV PARIS XI CHATENAY-MALABRY 92296 FRANCE)
H19306	FIVE NEW MONOTETRAHYDROFURAN RING ACETOGENINS FROM THE LEAVES OF ANNONA MURICATA. ZENG,L: WU,FE: OBERLIES,NH: MC LAUGHLIN,JL: SASTRODIHADJO,S: J NAT PROD 59 11: 1035-1042 (1996) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H19768	COHIBINS A AND B, ACETOGENINS FROM ROOTS OF ANNONA MURICATA. GLEYE,C: LAURENS,A: HOCQUEMILLER,R: LAPREVOTE,O: SERANI,L: CAVE,A: PHYTOCHEMISTRY 44 8: 1541-1545 (1997) (LAB PHARMACOG FAC PHARM UNIV PARIS XI CHATENAY-MALABRY 92296 FRANCE)
H20437	MURICATALICIN,A NEW PENTA-HYDROXY DERIVATIVE OF ACETOGENIN FROM ANNONA MURICATA (ANNONACEAE). GUI,HQ: YU,JG: CHIN CHEM LETT 7 6: 561-564 (1996) (INST MED PLANT DEVELOPMENT CHINESE ACAD MED SCI BEIJING 100094 CHINA)
H20484	STUDIES ON THE CHEMICAL CONSTITUENTS OF ANNONA MURICATA. YU,JG: GUI,HQ: LUO,XZ: SUN,L: ZHU,P: YU,ZL: YAO HSUEH HSUEH PAO 32 6: 431-437 (1997) (INST MED PLANT DEVELOPMENT CHINESE ACAD MED SCI BEIJING 100094 CHINA)
H21114	ACETOGENINS FROM SEED OF ANNONA MURICATA. LI,CM: MU,Q: SUN,HD: ZHENG,HL: TAO,GD: YUNNAN ZHIWU YANJIU 19 4: 440-442 (1997) (LAB PHYTOCHEM KUNMING INST BOT CHIN ACAD SCI KUNMING 650204 CHINA)
H21343	MURICADIENIN, MURIDIENINS AND CHATENAYTRIENINS, THE EARLY PRECURSORS OF ANNONACEOUS ACETOGENINS. GLEYE,C: RAYNAUD,S: HOCQUEMILLER,R: LAURENS,A: FOURNEAU,C: SERANI,L: LAPREVOTE,O: ROBLOT,F: LEBOEUF,M: FOURNET,A: DE ARIAS,AR: FIGADERE,B: CAVE, A: PHYTOCHEMISTRY 47 5: 749-754 (1998) (LAB PHARMACOG FAC PHARM UNIV PARIS-SUD CHATENAY-MALABRY 92296 FRANCE)
H21843	CYCLOPEPTIDE FROM THE SEEDS OF ANNONA MURICATA. LI,CM: TAN,NH: ZHENG,HL: MU,Q: HAO,XJ: HE,YN: ZOU,J: PHYTOCHEMISTRY 48 3: 555-556 (1998) (INSTITUTE OF BOTANY ACADEMIA SINICA KUNMING YUNNAN 650204 CHINA)

H21880	CIS-MONOTETRAHYDROFURAN ACETOGENINS FROM THE ROOTS OF ANNONA MURICATA. GLEYE,C: DURET,P: LAURENS,A: HOCQUEMILLER,R: CAVE,A: J NAT PROD 61 5: 567-579 (1998) (LAB PHARMACOG FAC PHARM UNIV PARIS XI CHATENAY-MALABRY 92296 FRANCE)
H22688	MURICOREACIN AND MURIHEXOCIN C, MONO-TETRAHYDROFURAN ACETOGENINS, FROM THE LEAVES OF ANNONA MURICATA. KIM,GS: ZENG,L: ALALI,F: ROGERS,LL: WU,FE: SASTRODIHARDJO,S: MC LAUGHLIN,JL: PHYTOCHEMISTRY 49 2: 565-571 (1998) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H22999	MURIHEXOL, A LINEAR ACETOGENIN FROM ANNONA MURICATA. YU,JG: GUI,HQ: LUO,XZ: SUN,L: PHYTOCHEMISTRY 49 6: 1689-1692 (1998) (PEKING UINON MED COLL INST MED PLANT DEV CHINA ACAD MED SCI BEIJING 100094 CHINA)
H24563	TWO NEW MONO-TETRAHYDROFURAN RING ACETOGENINS, ANNOMURICIN E AND MURICAPENTOCIN, FROM THE LEAVES OF ANNONA MURICATA. KIM,GS: ZENG,L: ALALI,F: ROGERS,LL: WU,FE: MC LAUGHLIN,JL: SASTRODIHARDJO,S: J NAT PROD 61 4: 432-436 (1998) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
H25182	MASS SPECTROMETRY AND STRUCTURE ELUCIDATION OF 15-PALMITOYL- AND 15-OLEYLSOLAMIN, THE FIRST KNOWN FATTY ACID ESTERS OF ACETOGENINS FROM ANNONA MURICATA L. GLEVE,C: LAURENS,A: HOCQUEMILLER,R: FAUCHEUR,N: SERANI,L: LAPREVOTE,O: RAPID COMMUN MASS SPECTROM 17 16: 1051-1056 (1998) (LAB PHARMACOG FAC PHARM UNIV PARIS CHATENAY-MALABRY FRANCE)
H25221	ISOLATION AND STRUCTURE ELUCIDATION OF SABADELIN, AN ACETOGENIN FROM ROOTS OF ANNONA MURICATA. GLEYE,C: LAURENS,A: LAPREVOTE,O: SERANI,L: HOCQUEMILLER,R: PHYTOCHEMISTRY 52 8: 1403-1408 (1999) (LAB PHARMACOG FAC PHARM UNIV PARIS CHITENAY-MALABRY FRANCE)
H26304	ROBUSTOCIN, A NEW ACETOGENIN FROM THE SEEDS OF ANNONA MURICATA. GLEYE,C: RAFIDIARISON,N: DURET,P: LAURENS,A: HOCQUEMILLER,R: NAT PROD LETT 14 4: 239-245 (2000) (LAB PHARMACOG FAC PHARM UNIV PARIS XI CHATENAY MALABRY FRANCE)
H26434	COHIBINS C AND D, TWO IMPORTANT METABOLITES IN THE BIOGENESIS OF ACETOGENINS FROM ANNONA MURICATA AND ANNONA NUTANS. GLEYE,C: RAYNAUD,S: FOURNEAU,C: LAURENS,A: LAPREVOTE,O: SERANI,L: FOURNET,A: HOCQUEMILLER,R: J NAT PROD 63 9: 1192-1196 (2000) (LAB PHARMACOG UPRES A BIOCIS PHARM UNIV PARIS XI CHATENAY MALABRY FRANCE)
H26863	MURICATENOL, A LINEAR ACETOGENIN FROM ANNONA MURICATA (ANNONACEAE). LI,DY: YU,JG: LUO,XZ: SUN,L: YANG,SL: CHIN CHEM LETT 11 3: 239-242 (2000) (INST MED PLANT DEVELOPMENT CHINESE ACAD MED SCI BEIJING 100094 CHINA)
H28040	NOVEL CYTOTOXIC ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA. CHANG,FR: WU,YC: J NAT PROD 64 1: 925-931 (2001) (GRADUATE INST NAT PRODUCTS KAOHSIUNG MED COLL KAOHSIUNG TAIWAN)
H28460	CORONIN FROM ROOTS OF ANNONA MURICATA, A PUTATIVE INTERMEDIATE IN ACETOGENIN BIOSYNTHESIS (1). GLEYE,C: AKENDENGUE,B: LAURENS,A: HOCQUEMILLER,R: PLANTA MED 67 6: 570-572 (2001) (LAB PHARMACOGNOSIE FACULTE PHARM UNIV PARIS PARIS FRANCE)

J10426	EFFECT OF ALCOHOL EXTRACT OF ANNONA MURICATA ON COLD IMMOBILIZATION STRSS INDUCED TISSUE LIPID PEROXIDATION. PADMA,P: CHANSOURIA,JPN: KHOSA,RL: PHYTOTHER RES 11 4: 326-327 (1997) (DEPT PHARM BANARAS HINDU UNIV VARANASI 221 005 INDIA)
J10986	SCREENING OF MEDICINAL PLANTS FROM SURINAME FOR 5-HT 1A LIGANDS: BIOACTIVE ISOQUINOLINE ALKALOIDS FROM THE FRUIT OF ANNONA MURICATA. HASRAT,JA: PIETERS,L: DE BACKER,JP: VAUQUELIN,G: VLIETINCK,AJ: PHYTOMEDICINE 4 2: 133-140 (1997) (DEPT PHARM SCI UNIV ANTWERP ANTWERP B-2610 BELGIUM)
J13478	TUMOUR PROMOTING ACTIVITY OF PLANTS USED IN MALAYSIAN TRADITIONAL MEDICINE. ILHAM,M: YADAY,M: NORHANOM,AW: NAT PROD SCI 1 1: 31-42 (1995) (INST ADV STUD UNIV MALAYA KUALA LUMPUR MALAYSIA)
J14527	ISOQUINOLINE DERIVATIVES ISOLATED FROM THE FRUIT OF ANNONA MURICATA AS 5-HTERGIC 5-HT1A RECEPTOR AGONISTS IN RATS: UNEXPLOITED ANTIDPRESSIVE (LEAD) PRODUCTS. HASRAT,JA: DE BRUYNE,T: DE BAKCER,JP: VAUQUELIN,G: VLIETINCK,AJ: J PHARM PHARMACOL 49 11: 1145-1149 (1997) (DEPT PHARM SCI UNIV ANTWERP ANTWERP B-2610 BELGIUM)
J18701	USE OF MEDICINAL PLANTS FOR DIABETES IN TRINIDAD AND TOBAGO. MAHABIR,D: GULLIFORD,MC: PAN AM J PUBLIC HEALTH 1 3: 174-178 (1997) (NUTR METABOL DIV MINISTRY HEALTH TRINIDAD & TOBAGO SPAIN)
J19078	USE OF MEDICINAL PLANTS FOR DIABETES IN TRINIDAD AND TOBAGO. MAHABIR,D: GULLIFORD,MC: REV PANAM SALUD PUBL/PAN AM J PUBL HEALTH 1 3: 174-179 (1997) (NUTR METABOL DIV MINISTRY HEALTH TRINIDAD TOBAGO SPAIN)
J19169	EFFECT OF THE EXTRACT OF ANNONA MURICATA AND PETUNIA NYCTAGINIFLORA ON HERPES SIMPLEX VIRUS. PADMA,P: PRAMOD,NP: THYAGARAJAN,SP: KHOSA,RL: J ETHNOPHARMACOL 61 1: 81-83 (1998) (DEPT PHARMACEUT BANARAS HUNDU UNIV VARANASI 221 005 INDIA)
J19242	EFFECT OF SOME INDIGENOUS DRUGS ON COLD IMMOBILIZTION STRESS INDUCED GASTRIC ULCER. PADMA,P: CHANSOURIA,JPN: KHOSA,RL: PHYTOTHER RES 12 2: 127-128 (1998) (DEPT PHARMACATICS BANARAS HINDU UNIV VARANASI 221005 INDIA)
K09159	CONTRIBUTION TO THE BIOLOGICAL EVALUATION OF CUBAN PLANTS. IV. MISAS,CAJ: HERNANDEZ,NMR: ABRAHAM,AML: REV CUB MED TROP 31 1: 29-35 (1979) (DEPT MICROBIOL INST MED TROP UNIV DE LA HABANA HAVANA CUBA)
K10338	BIOACTIVE SINGLE-RING ACETOGENINS FROM SEED EXTRACTS OF ANNONA MURICATA. RIESER,MJ: FANG,XP: RUPPRECHT,JK: HUI,YH: SMITH,DL: MC LAUGHLIN,JL: PLANTA MED 59 1: 91-92 (1993) (DEPT MED CHEM & PHARMACOGNOSY SCH PHARM & PHARM SCI PURDUE UNIV WEST LAFAYETTE IN 47907 USA)
K15021	PRELIMINARY SCREENING OF ANTIBACTERIAL AND ANTITUMOR ACTIVITIES OF PAPUA NEW GUINEAN NATIVE MEDICINAL PLANTS. SUNDARRAO,K: BURROWS,I: KUDUK,M: YI,YD: CHUNG,MH: SUH,NJ: CHANG,IM: INT J PHARMACOG 31 1: 3-6 (1993) (DEPT CHEM BIOL UNIV PAPUA NEW GUINEA PAPUA PAPUA-NEW GUINEA)
K16971	SCREENING OF THE FLORA OF PUERTO RICO FOR POTENTIAL ANTIMALARIAL BIOACTIVES. ANTOUN,MD: GERENA,L: MILHOUS,WK: INT J PHARMACOG 31 4: 255-258 (1993) (DEPT PHARM SCI SCH PHARM UNIV PUERTO RICO SAN JUAN 00936 PUERTO RICO)

K19153	PARASITOLOGICAL AND MICROBIOLOGICAL EVALUATION OF MIXE INDIAN MEDICINAL PLANTS (MEXICO). HEINRICH,M: KUHNT,M: WRIGHT,CW: RIMPLER,H:0 PHILLIPSON,JD: SCHANDELMAIER,A: WARHURST,DC: J ETHNOPHARMACOL 36 1: 81-85 (1992) (INST PHARM BIOL UNIV SCHANZLESTR FREIBURG D7800 GERMANY)
K20471	TRADITIONAL MEDICINAL PLANTS OF RAROTONGA, COOK ISLANDS. PART I. HOLDSWORTH,DK: INT J CRUDE DRUG RES 28 3: 209-218 (1990) (WAU ECOL INST WAU MOROBE PROV PAPUA PAPUA-NEW GUINEA)
K20560	QUALITATIVE AND QUANTITATIVE EVALUATION OF ANNONACEOUS ACETOGENINS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY. GROMEK,D: HOCQUEMILLER,R: CAVE,A: PHYTOCHEM ANAL 5 3: 133-140 (1994) (LAB PHARMACOG FAC PHARM UNIV PARIS-SUD CHATENAY MALABRY 92290 FRANCE)
K21053	ANNONACEOUS ACETOGENINS FROM ANNONA MURICATA(III). YANG,RZ: WU,SJ: YUNNAN ZHIWU YANJIU 16 3: 309-310 (1994) (SOUTH CHINA INST BOT CHIN ACAC SCI CANTON 510650 CHINA)
K23019	SCREENING OF ANTIRADICAL, ANTILIPOPEROXIDANT AND HEPATOPROTECTIVE EFFECTS OF NINE PLANT EXTRACTS USED IN CARIBBEAN FOLK MEDICINE. JOYEUX,M: MORTIER,F: FLEURENTIN,J: PHYTOTHER RES 9 3: 228-230 (1995) (CENT ESSAIS REC EVIRON PHARM METZ 57000 FRANCE)
K24899	PLANTS USED IN GUATEMALA FOR THE TREATMENT OF GASTROINTESTINAL DISORDERS. 1. SCREENING OF 84 PLANTS AGAINST ENTEROBACTERIA. CACERES,A: CANO,O: SAMAYOA,B: AGUILAR,L: J ETHNOPHARMACOL 30 1: 55-73 (1990) (CEMT APARTADO POSTAL 01001 GUATEMALA)
K26492	MEDICINAL PLANTS OF NICARAGUA'S ATLANTIC COAST. BARRETT,B: ECON BOT 48 1: 8-20 (1994) (JOHNS HOPKINS UNIV HEALTH CHILD SURVIVAL FELLOW INCAP GUATEMALA GUATEMALA)
K26834	MEDICINAL PLANTS OF SABAH, MALAYSIA, PART II. THE MURUTS. AHMAD,FB: HOLDSWORTH,DK: INT J PHARMACOG 32 4: 378-383 (1994) (FAC RES SCI TECHNOL UNIV MALAYSIA SARAWAK SARAWAK MALAYSIA)
K26851	MEDICINAL PLANTS OF RODRIGUES. GURIB-FAKIM,A: SWERAJ,MD: GUEHO,J: DULLOO,E: INT J PHARMACOG 34 1: 2-14 (1996)(CHEM DEPT FAC SCI UNIV MAURITIUS REDUIT MAURITIUS)
K27070	ETHNOBOTANY OF THE GARIFUNA OF EASTERN NICARAGUA. COEE,FG: ANDERSON,GJ: ECON BOT 50 1: 71-107 (1996) (SCH PHARM UNIV CONNECTICUT STORRS CT 06268 USA)
K27077	INDIGENOUS PHYTOTHERAPY OF GASTROINTESTINAL DISORDERS IN A LOWLAND MIXE COMMUNITY (OAXACA, MEXICO): ETHNOPHARMACOLOGIC EVALUATION. HEINRICH,M: RIMPLER,H: BARRERA,NA: J ETHNOPHARMACOL 36 1: 63-80 (1992) (IST PHARM BIOL ALBERT LUDWIGS UNIV FREIBURG GERMANY)
K27819	MEDICINAL AND OTHER ECONOMIC PLANTS OF THE PAYA OF HONDURAS. LENTZ,DL: ECON BOT 47 4: 358-370 (1993) (ELECTRONIC MICROSCOPY LABR. UNIV. OF MISSISSIPPI JACKSON MS 39216 USA)

K27823	MALARIA REMEDIES OF THE KENYAH OF THE APO KAYAN, EAST KALIMANTAN,INDONESIAN BORNEO: A QUANTITIATIVE ASSESSMENT OF LOCAL CONSENSUS AS AN INDICATOR OF BIOLOGICAL EFFICACY. LEAMAN,DJ: ARNASON,JT: YUSUL,R: SANGAT-ROEMANTYO,H: SOEDJITO,H: ANGERHOFER,CK: PEZZUTO,JM: J ETHNOPHARMACOL 49 1: 1-16 (1995) (DEPT BIOL UNIV OTTAWA OTTAWA K1N 6N5 CANADA)
K29079	ISODESACETYLUVARICIN-INSECT ANTIFEEDANT AGAINST LONGITARSUS NIGRIPENNIS MOTS. SANTHOSH-BABU,PB: PADMAJA,V: HISHAM,A: INDIAN J EXP BIOL 34 4: 377-379 (1996) (REG RES LAB TRIVANDRUM 695 019 INDIA)
K29500	EFFECTS OF ETHANOL EXTRACT OF ANNONA MURICATA ON PENTYLENETETRAZOL-INDUCED CONVULSIVE SEIZURES IN MICE. N'GOUEMO,P: KOUDOGBO,B: TCHIVOUNDA,HP: AKONO-NGUEMA,C: ETOUA,MM: PHYTOTHER RES 11 3: 243-245 (1997) (LAB MED EXP INSERM INST BIOL MONTPELLIER FRANCE)
L03211	ANTIBACTERIAL ACTIVITY OF SOME ANNONACEAE. PART I. KHAN,MR: KOARNINE,K: OMOLOSO,AD: FITOTERAPIA 69 4: 367-369 (1998) (DEPT APPL SCI PAPUA NEW GUINEA UNIV TECHNOL PAPUA-NEW GUINEA)
L04137	AMAZONIAN ETHNOBOTANICAL DICTIONARY. DUKE,JA: BOOK : 181- (1994) (USA)
L07398	SESQUITERPENE LACTONE CONTAINIG MEXICAN INDIAN MEDICINAL PLANTS AND PURE SESQUITERPENE LACTONES AS POTENT INHIBITORS OF TRANSCRIPTION FACTOR NF-KB. BORK,PM: SCHMITZ,ML: KUHNT,M: ESCHER,C: HEINRICH,M: FEBS LETT 402 1: 85-90 (1997) (INST PHARMACEUT BIOL ALBERT-LUDWIGS UNIV FREIBURG 79104 GERMANY)
L07801	CYTOTOXICITY AND ANTILEISHMANIAL ACTIVITY OF ANNONA MURICATA PERICARP. JARAMILLO,MC: ARANGO,GJ: GONZALEZ,MC: ROBLEDO,SM: VELEZ,ID: FITOTERAPIA 71 2: 183-186 (2000) (FAC QUIM FARMACEUT UNIV ANTIOQUIA MEDELLIN COLOMBIA)
L09586	EVALUATION OF THE FLORA OF PUERTO RICO FOR IN VITRO CYTOTOXIC AND ANTI-HIV ACTIVITIES. ANTOUN,MD: MARTINEZ,E: CABALLERO,R: OQUENDO,I: PROCTOR,GR: WEISLOW,OS: MC CLOUD,TG: KISER,R: STALEY,P: CLANTON,D: PHARMACEUTICAL BIOL 37 4: 277-280 (1999) (DEP PHARMACEUT SCI SCH PHARM MED SCI UNIV PUERTO RICO SAN JUAN PUERTO RICO)
L12082	ANTITUMOR AND ANTIVIRAL ACTIVITY OF COLOMBIAN MEDICINAL PLANT EXTRACTS. BETANCUR-GALVIS,L: SAEZ,J: GRANADOS,H: SALAZAR,A: OSSA,JE: MEM INST OSWALDO CRUZ RIO DE JANEIRO 94 4: 531-535 (1999) (LAB VIROL DEPT MICROBIOL PARASITOL UNIV ANTIOQUIA MEDELLIN COLOMBIA)
L12432	PLANTS FROM PUERTO RICO WITH ANTI-MYCOBACTERIUM TUBERCULOSIS PROPERTIES. FRAME,AD: RIOSOLIVARES,E: DE JESUS,L: ORTIZ,D: PAGAN,J: MENDEZ,S: P R HEALTH SCI J 17 3: 243-253 (1998) (DIV SCI INTER AMER UNIV PUERTO RICO SAN JUAN PUERTO RICO)
L13378	BRINE SHRIMP TOXICITY OF FRACTIONATED EXTRACTS OF MALAYSIAN MEDICINAL PLANTS. MACKEEN,MM: KHAN,MN: SAMADI,Z: LAJIS,NH: NAT PROD SCI 6 3: 131-134 (2000) (DEPT BIOTECHNOLOGY UNIV PUTRA MALAYSIA SELANGOR MALAYSIA)
L13922	SCREENING OF MEDICINAL PLANTS FROM TRINIDAD AND TOBAGO FOR ANTIMICROBIAL AND INSECTICIDAL PROPERTIES. CHARIANDY,CM: SEAFORTH,CE: PHELPS,RH: POLLARD,GV: KHAMBAY,BPS: J ETHNOPHARMACOL 64 3: 265-270 (1999) (DEPT LIFE SCI CHEM FAC AGRICULT NATURAL SCI UNIV WEST INDIES ST AUGUSTINE TRINIDAD/TOBAGO)

L14918	SCREENING OF ACETOGENIN-PRODUCING PLANTS IN BRAZILIAN FLORA. FONTANA,J: ALMEIDA,ERA: BARON,M: GUIMARAES,MF: DESCHAMPS,FC: SCHWARTSMANN,G: CERVI,AC: ZANETTE,F: LILEGAS,J: LANCAS,FM: APPL BIOCHEM BIOTECHNOL 45 46: 295-313 (1994) (FEDERAL UNIV PARANA CURITIBA BRAZIL)
L15585	MOLLUSCICIDAL PROPERTIES OF SOME SPECIES OF ANNOA. SANTOS,AFD: SANT ANA,AEG: PHYTOMEDICINE 8 2: 115-120 (2001) (DEPT QUIMICA LAB PESQUISAS RECUR NAT UNIV FEDERAL ALAGOAS MACEIO BRAZIL)
L15693	MEDICINAL PLANTS OF THE EASTERN REGION OF MADAGASCAR. NOVY,JW: J ETHNOPHARMACOL 55 : 119-126 (1997) (CENT CONSERVATION BIOL DEPT BIOL SCI STANFORD CA 94305 USA)
L15725	MEDICINAL PLANTS USED FOR INTESTINAL DISEASES IN MBALMAYO REGION, CENTRAL PROVINCE, CAMEROON. NOUMI,E: YOMI,A: FITOTERAPIA 72 3: 246-254 (2001) (LAB BIOLOGIE ECOLE NORMALE UNIV YAOUNDE YAOUNDE CAMEROON)
L16047	SCREENING OF MEDICINAL PLANTS USED BY THE GARIFUNA OF EASTERN NICARAGUA FOR BIOACTIVE COMPOUNDS. COE,FG: ANDERSON,GJ: J ETHNOPHARMACOL 53 : 29-50 (1996) (DEPT ECOL EVOLUNT BIOL UNIV CONNECTICUT STORRS CT 06269 USA)
L16750	VOLATILE COMPONENTS OF SOURSOP (ANNONA MURICATA). PINO,JA: AGUERO,J: MARBOT,R: J ESSENT OIL RES 13 2: 140-141 (2001) (INST INVEST PINDUST ALIMENT HAVANA 19200 CUBA)
L19052	EFFECT OF ANNONA MURICATA AND POLYALTHIA CERASOIDES ON BRAIN NEUROTRANSMITTERS AND ENZYME MONOAMINE OXIDASE FOLLOWING COLD IMMOBILIZATION STRESS. PADMA,P: CHANSAURIA,JPN: KHOSA,RL: RAY,AK: J NATURAL REMEDIES 1 2: 144-146 (2001) (DEPT PHARMACEU BANARAS HINDU UNIV VARANASI INDIA)
L19321	ESSENTIAL OIL COMPOUNDS OF THE ANNONA MURICATA FRESH FRUIT PULP FROM CAMEROON. JIROVETZ,L: BUCHBAUER,G: NGASSOUM,MB: J AGR FOOD CHEM 46 9: 3719-3720 (1998) (INST PHARMACEU CHEM UNIV VIENNA VIENNA AUSTRIA)
M18488	SCREENING IN MICE OF SOME MEDICINAL PLANTS USED FOR ANALGESIC PURPOSES IN THE STATE OF SAO PAULO. DI STASI,LC: COSTA,M: MENDACOLLI,LJ: KIRIZAWA,M: GOMES,C: TROLIN,G: J ETHNOPHARMACOL 24 2/3: 205-211 (1988) (DEPT FARMACOL ESCOLA PAULISTA MED SAO PAULO BR-04023 BRAZIL)
M19731	EXTRACTS OF INDIAN PLANTS AS MOSQUITO LARVICIDES. EVANS,DA: RAJ,RK: INDIAN J MED RES 88 1: 38-41 (1988) (DEPT BIOCHEM UNIV KERALA TRIVANDRUM KERALA INDIA)
M23556	IN VITRO ANTIMALARIAL ACTIVITY OF SIX MEDICINAL PLANTS. GBEASSOR,M: KEDJAGNI,AY: KOUMAGLO,K: DE SOUZA,C: AGBO,K: AKLIKOKOU,K: AMEGBO,KA: PHYTOTHER RES 4 3: 115-117 (1990) (DEPT PHYSIOL FAC SCI UNIV BENIN LOME TOGO)
M25852	PESTICIDAL SUBSTANCES IN TROPICAL PLANTS. INSECTICIDAL SUBSTANCES FROM ANNONACEAE SEEDS. OHSAWA,K: KATO,S: HONDA,H: YAMAMOTO,I: NOGAKU SHUHO (TOKYO NAGYO DAIGAKU) 34 4: 253-258 (1990) (DEP AGRI CHEM TOKYO UNIV AGRIC TOKYO 156 JAPAN)
M27151	PLANTS USED IN GUATEMALA FOR THE TREATMENT OF DERMATOPHYTIC INFECTIONS. 1. SCREENING FOR ANTIMYCOTIC ACTIVITY OF 44 PLANT EXTRACTS. CACERES,A: LOPEZ,BR: GIRON,MA: LOGEMANN,H: J ETHNOPHARMACOL 31 3: 263-276 (1991) (FAC CHEM SCI UNIV SAN CARLOS GUATEMALA 01012 GUATEMALA)

M28527	ANTIPARASITIC ACTIVITY OF ANNONA MURICATA AND ANNONA CHERIMOLIA SEEDS. BORIES,C: LOISEAU,P: MYINT,SH: HOCQUEMILLER,R: GAYRAL,P: CAVE,A:LAURENS,A: PLANTA MED 57 5: 434-436 (1991) (LAB PARAS FAC PHARM UNIV PARIS-SUD CHATENAY-MALALBRY FRANCE)
M29843	PHARMACOLOGICAL SCREENING OF PLANT DECOCTIONS COMMONLY USED IN CUBAN FOLK MEDICINE. CARBAJAL,D: CASACO,A: ARRUZAZABALA,L: GONZALEZ,R: FUENTES,V: J ETHNOPHARMACOL 33 1/2: 21-24 (1991) (DEPT PHARM NATL CENTER SCI RES HAVANA CITY CUBA)
T00701	MEDICINAL PLANTS OF THE WEST INDIES. AYENSU,ES: UNPUBLISHED MANUSCRIPT : 110 P- (1978) (OFFICE OF BIOLOGICAL CONSERVATION SMITHSONIAN INSTITUTION WASHINGTON DC 20560 USA)
T01287	ETHNOPHARMACOGNOSITC OBSERVATIONS ON PANAMANIAN MEDICINAL PLANTS. PART I. GUPTA,MP: ARIAS,TD: CORREA,M: LAMBA,SS: Q J CRUDE DRUG RES 17 3/4: 115-130 (1979) (ORG AMER ST PHARMACOG RES UNIT FAC CIENC NAT Y FARM UNIV PANAMA PANAMA CITY 10767 PANAMA)
T01928	COMPOSITION OF ANNONA MURICATA SEED OIL. IZZO,R: RIV SOC ITAL SCI ALIMENT 8 : 241-244 (1979) (SEZ AGRAR SC SUPER STUDI UNIV PERFEZIONA PISA ITALY)
T02076	ANOMURINE AND ANOMURICINE,TWO NEW ISOQUINOLINE ALKALOIDS FROM ANNONA MURICATA.(ABSTRACT). LEBOEUF,M: LEGUET,C: CAVE,A:DESCONCLOIS,JF: FORGASCS,P: PLANTA MED 39 : 204-205 (1980)(FAC PHARM CHATENAY-MALABRY FRANCE)
T04073	ALKALOIDS OF ANNONACEAE. XXXIX. ALKALOIDS OF ANNONA MURICATA. LEBOEUL,M: LEGUEUT,C: CAVE,A: DESCONCLOIS,JF: FORGACS,P: JACQUEMIN,H: PLANTA MED 42 : 37-44 (1981) (LAB MATER MED U.E.R. CHIM THER CENT ETUDE PHARM CHATENAY-MALABRY F-92290 FRANCE)
T04621	TERRESTRIAL PLANTS MOLLUSCICIDAL TO LYMNAEID HOSTS OF FASCILIASIS HEPATICA IN PUERTO RICO. MEDINA,FR: WOODBURY,R: J AGR UNIV PUERTO RICO 63 : 366-376 (1979) (PUERTO RICO JUNIOR COLLEGE RIO PIEDRAS PUERTO RICO)
T05032	CARIBBEAN AND LATIN AMERICAN FOLK MEDICINE AND ITS INFLUENCE IN THE UNITED STATES. MORTON,JF: Q J CRUDE DRUG RES 18 2: 57-75 (1980) (MORTON COLLECTANEA UNIV MIAMI CORAL GABLES FL USA) \
T05306	A CONTRIBUTION TO THE THAI PHYTOCHEMICAL SURVEY. CANNON,JR: DAMPAWAN,P: LOJANAPIWATNA,V: PHURIYAKORN,B: SINCHAI,W: SIRIRUGSA,P: SUVATABHANDHU,K: WIRIYACHITRA,P: J SCI SOC THAILAND 6 : 46-53 (1980) (DEPT CHEM FAC SCI PRINCE OF SONGKLA UNIV HAT YAI THAILAND)
T05549	PHYTOTHERAPEUTIC PROFILE OF NIGERIAN HERBS. 1. ANTI-INFLAMMATORY AND ANTI-ARTHRITIC AGENTS. IWU,MM: ANYANWU,BN: J ETHNOPHARMACOL 6 3: 263-274 (1982) (DEPT PHARM PHYTOTHER RES LAB UNIV NIGERIA NSUKKA NIGERIA)
T06510	STUDIES ON SOME PLANTS USED AS ANTICONVULSANTS IN AMERINDIAN AND AFRICAN TRADITIONAL MEDICINE. ADESINA,SK: FITOTERAPIA 53 : 147-162 (1982) (DRUG RES UNIT FAC PHARM UNIV IFE ILE-IFE NIGERIA)
T06830	CHEMOTAXONOMY OF SOME ANNONACEAE. NARAYANA,LL: SUNDARI,IT: RADHAKRISHNAIAH,M: CURR SCI 50 : 1079-1080 (1981) (DEPT BOTANY KAKATIYA UNIV WARANGAL AP 506009 INDIA)

T08589	POTENTIAL ANTINEOPLASTIC ACTIVITY OF CUBAN PLANTS. IV. LOPEZ ABRAHAM,AN: ROJAS HERNANDEZ,NM: JIMENEZ MISAS,CA: REV CUBANA FARM 15 1: 71-77 (1981) (DEPT MICROBIOL INST MED TROPICAL UNIV HAVANA HAVANA CUBA)
T09008	DETERMINATION OF SEVEN FLAVOR COMPONENTS OF CUSTARD APPLE BY GAS CHROMATOGRAPHY. ESCARRAMAN MATA,S: DEL REFUGIO,M: JUAREZ,F: GONZALEZ PEREZ,A: TECNOL ALIMENT (MEXICO CITY) 17 6: 3-4-6-7 (1982) (DEPT ANAL ESPEC CROMATOGR COM NAC FRUTICULT MEXICO MEXICO)
T13846	POPULAR MEDICINE OF THE CENTRAL PLATEAU OF HAITI. 2. ETHNOPHARMACOLOGICAL INVENTORY. WENIGER,B: ROUZIER,M: DAGUILH,R: HENRYS,D: HENRYS,JH: ANTON,R: J ETHNOPHARMACOL 17 1: 13-30 (1986) (LAB PHARMACOG FAC PHARM STRASBOURG 67048 FRANCE)
T15121	LESSER- KNOWN PLANTS OF POTENTIAL USE IN AGRICULTURE AND FORESTRY. VIETMEYER,ND: SCIENCE 232 4756: 1379-1384 (1986) (NATL RES COUNC WASHINGTON DC USA)
W00220	THE INSECTICIDAL PROPERTIES OF CERTAIN SPECIES OF ANNONA AND AN INDIAN STRAIN OF MUNDULEA SERICEA (SUPLI). TATTERSFIELD,F: POTTER,C: ANN APPL BIOL 27 : 262-273 (1940) (NO ADDRESS GIVEN)
W00903	THE WEST INDIAN WEEDWOMAN OF THE UNITED STATES VIRGIN ISLANDS. OAKES,AJ: MORRIS,MP: BULL HIST MED 32 : 164- (1958)
W01267	THE ETHNOBOTANY OF THE ISLAND CARIBS OF DOMINICA. HODGE,WH: TAYLOR,D: WEBBIA 12 : 513-644 (1956) (LONGWOOD GARDENS PHILADELPHIA PA USA)
W01316	MEDICINAL PLANTS OF JAMAICA. III.ASPREY,GF: THORNTON,P: WEST INDIAN MED J 4 : 69-82 (1955) (UNIV PENNSYLVANIA PHILADELPHIA PA USA)
W02289	CHEMICAL EXAMINATION OF THE LEAVES OF ANONA MURICATA. CALLAN,T: TUTIN,F: PHARM J 87 : 743-745 (1912) (WELLCOME CHEM RES LABS LONDON ENGLAND)
W04546	THE CLINICAL PICTURE OF VENO-OCCLUSIVE DISEASE OF THE LIVER IN JAMAICAN CHILDREN. JELLIFFE,DB: BRAS,G: STUART,KL: ANN TROP MED PARASITOL 48 : 386-396 (1954) (DEPT MED & PATHOL UNIV COLL WEST INDIES KINGSTON JAMAICA)
X00001	UNPUBLISHED DATA, NATIONAL CANCER INSTITUTE. ANON: NAT CANCER INST CENTRAL FILES : - (1976) (NO ADDRESS GIVEN)
ZZ1002	PLANTAS MEDICINAIS BRASILEIRAS, CONHECIMENTOS POPULARES E CIENTIFICOS. DE ALMEIDA, E.R.,1993. HEMUS EDITORA LTDA.: SAU PAULO, BRAZIL.
ZZ1005	THE HEALING FOREST: MEDICINAL AND TOXIC PLANTS OF THE NORTHWEST AMAZONIA. SCHULTES, R. E. AND RAFFAUF. PORTLAND: R.F. DIOSCORIDES PRESS. (1990)
ZZ1020	MEDICINAL PLANTS OF JAMAICA. III ASPREY, GF. & THORNTON, P. WEST INDIAN MED J 4: 69-92 (1955)
ZZ1021	MEDICINAL PLANTS OF THE WEST INDIES. UNPUBLISHED MANUSCRIPT: AYENSU, ES. 110P(1978) OFFICE OF BIOLOGICAL CONSERVATION SMITHSONIAN INSTITUTION, WASHINGTON, DC

ZZ1024	"FOLK MEDICINE OF ALTER DO CHAO, PARA, BRAZIL." BRANCH, L.C. AND DA SILVA, I.M.F. ACTA AMAZONICA 13(5/6):737-797 (1983)
ZZ1027	MEDICINAL AND MAGICAL PLANTS IN THE NORTHERN PERUVIAN ANDES. DE FEO,V. FITOTERAPIA 63: 417-440 (1992)
ZZ1033	PHARMACOPEES TADITIONNELS EN GUYANE: CRÉOLES, PALIKUR, WAYÃPI. GRENAND, P., MORETTI, C., JACQUEMIN, H. EDITORIAL L-ORSTROM, COLL. MEM NO. 108. PARIS, FRANCE (1987).
ZZ1045	USEFUL PLANTS OF AMAZONIAN PERU. SECOND DRAFT. VASQUEZ,MR. 1990. (FILED WITH USDA'S NATIONAL AGRICULTURAL LIBRARY. USA)
ZZ1050	MEDICINAL PLANTS OF THE WORLD. DUKE, JA: WAIN, KK: COMPUTER INDEX WITH MORE THAN 85,000 ENTRIES. 3 VOLS. 1981. P 1654.
ZZ1072	CARIBÉ, DR. JOSÉ, AND DR. JOSÉ MARIÁ CAMPOS. PLANTAS QUE AJUDAM O HOMEM: GUIA PRÁTICO PARA A ÉPOCA ATUAL, 5TH ED. SÃO PAULO, BRAZIL: EDITORA PENSIMENTO, LTDA., 1997.
ZZ1093	ZADRA, DE, ADRIANA ALARCO. PERÚ—EL LIBRO DE LAS PLANTAS MÁGICAS, 2ND ED. LIMA: CONCYTEC, 2000.
ZZ1099	MORS, W. B., C. T. RIZZINI, AND N. A. PEREIRA. MEDICINAL PLANTS OF BRAZIL. ALGONAC, MICHIGAN, REFERENCE PUBLICATIONS, INC., 2000.