GRAVIOLA

Family: Annonaceae
Genus: *Annona*
Species: *muricata*
Synonyms: *Annona macrocarpa*, *A. bonplandiana, A. cearensis, Guanabanus muricatus*
Common names: Graviola, soursop, Brazilian paw paw, guanábana, guanábano, guanavana, guanaba, corossol épineux, huanaba, toge-banreisi, durian benggala, nangka blanda, cachiman épineux
Part Used: Leaves, fruit, seeds, bark, roots

From *The Healing Power of Rainforest Herbs*:

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		

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, is yellow-green in color, and has 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 *guanábana* in Spanish-speaking countries and *graviola* in Brazil. The fruit pulp is excellent for making drinks and sherbets and, though slightly sour-acid, can be eaten out of hand.

Tribal & 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 are 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 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 sedative, antispasmodic, hypotensive, and nervine, 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.

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 research groups have confirmed that these chemicals have significant antitumorous properties and selective toxicity against various types of cancer cells (without harming healthy cells) publishing eight clinical studies on their findings. 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 which are demonstrating the strongest anticancerous, antitumorous, and antiviral properties. In a 1997 clinical study, novel alkaloids found in graviola fruit exhibited antidepressive effects in animals.

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. 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 Institute 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 were " . . . 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." 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. 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 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 14 different acetogenins tested thus far demonstrate potent ATP-blocking properties (including several found only in graviola). They also reported that 13 of these 14 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 & 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

Biological Activites and Clinical Research

In an 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. 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; human breast solid tumor lines; prostate adenocarcinoma; pancreatic carcinoma cell lines; colon adenocarcinoma cell lines; liver cancer cell lines; human lymphoma cell lines; and multi-drug resistant human breast adenocarcinoma. 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."

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. They inoculated mice with lung cancer cells. 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% reduction of tumor mass over the control group—but 50% 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%—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."

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 10 years to successfully synthesize (chemically reproduce) 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 (despite knowing how active the natural chemical was against tumors). 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 agenies like the National Cancer Institute and the National Institute 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 40 documented naturally-occurring acetogenins including annonacin) as a complementary therapy to their cancer protocols. After all, graviola has a long history of safe use as a 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 miniscule 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. 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. Therefore, using the seeds and root of graviola is not recommended at this time.

The therapuetic 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 grams taken 3 or 4 times daily. Graviola products (capsules and tinctures) are becoming more widely available in the U.S. market, and 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 which increase or enhance cellular ATP may reduce the effect of graviola. The main supplement which 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 rain forests, such work is compelling before the great chemical diversity, contained within these endangered species, is lost."

GRAVIOLA PLANT SUMMARY

Main Actions (in order):
anticancerous, antitumorous, antimicrobial, antiparasitic, hypotensive (lowers blood pressure)

Main Uses:

1. for cancer (all types)
2. as a broad-spectrum internal and external antimicrobial to treat bacterial and fungal infections
3. for internal parasites and worms
4. for high blood pressure
5. for depression, stress, and nervous disorders

Properties/Actions Documented by Research:
antibacterial, anticancerous, anticonvulsant, antidepressant, antifungal, antimalarial, antimutagenic (cellular protector), antiparasitic, antispasmodic, antitumorous, cardiodepressant, emetic (causes vomiting), hypotensive (lowers blood pressure), insecticidal, sedative, uterine stimulant, vasodilator

Other Properties/Actions Documented by Traditional Use:
antiviral, cardiotonic (tones, balances, strengthens the heart), decongestant, digestive stimulant, febrifuge (reduces fever), nervine (balances/calms nerves), pediculicide (kills lice), vermifuge (expels worms)

Cautions: It has cardiodepressant, vasodilator, and hypotensive (lowers blood pressure) actions. Large dosages can cause nausea and vomiting.

Avoid combining with ATP-enhancers like CoQ10.	

Traditional Preparation: The therapeutic dosage is reported to be 2 g three times daily in capsules or tablets. A standard infusion (one cup 3 times daily) or a 4:1 standard tincture (2–4 ml three times daily) can be substituted if desired. See Traditional Herbal Remedies Preparation Methods page if necessary for definitions.

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 die-off of friendly bacteria in the digestive tract due to its antimicrobial properties. Supplementing the diet with probiotics and digestive enzymes is advisable if this plant is used for longer than 30 days.
- Graviola has demonstrated emetic properties in one animal study with pigs. Large single dosages may cause nausea or vomiting. Reduce the usage accordingly if this occurs.
- 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 a inhibition of serotonin release in stress-induced rats.
- 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 was observed. If sedation or sleepiness occurs, reduce the amount used.

Drug Interactions: None have been reported; however, graviola may potentiate antihypertensive and cardiac depressant drugs. It may potentiate antidepressant drugs and interfere with MAO-inhibitor drugs. See contraindications above.

WORLDWIDE ETHNOMEDICAL USES	
Brazil	for abscesses, bronchitis, chest problems, cough, diabetes, diarrhea, dysentery, edema, fever, intestinal colic, intestinal parasites, liver problems, neuralgia, nervousness, 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 digestive sluggishness, coughs, diarrhea, fever, flu, heart conditions, lactation aid, lice, nerves, parasites, pain, pellagra, sores, spasms, weakness, wounds, and as a sedative
Jamaica	for asthma, fevers, heart conditions, hypertension, lactation aid, nervousness, parasites, spasms, water retention, weakness, worms, and as a sedative

Malaysia	for boils, coughs, diarrhea, dermatosis, hypertension, rheumatism, and to reduce bleeding
Mexico	for diarrhea, dysentery, fever, chest colds, 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, lactation aid, palpitations, ringworms
U.S.A.	for cancer, depression, fungal infections, hypertension, intestinal parasites, tumors
West Indies	for asthma, childbirth, diarrhea, hypertension, lactation aid, parasites, worms
Elsewhere	for arthritis, asthma, bile insufficiency, childbirth, cancer, diarrhea, dysentery, fever, heart problems, kidney problems, lactation aid, lice, liver disorders, malaria, pain, ringworm, scurvy, stomach problems, and as a sedative

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Third-Party Published Research on Graviola

All available third-party documentation and research on graviola be found at **PubMed**. A partial listing of the third-party published research on graviola is shown below:

Anticancerous & Antitumor Actions:

Kojima, N. "Systematic synthesis of antitumor Annonaceous acetogenins" *Yakugaku Zasshi.* 2004; 124(10): 673-81.
Tormo, J. R., et al. "*In vitro* antitumor structure-activity relationships of threo/trans/threo mono-tetrahydro-furanic acetogenins: Correlations with their inhibition of mitochondrial complex I." *Oncol. Res.* 2003; 14(3): 147-54.
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: 72(25): 2853-61.
Liaw, C. C., et al. "New cytotoxic monotetrahydrofuran Annonaceous acetogenins from *Annona muricata.*" *J. Nat. Prod.* 2002; 65(4): 470-75
Gonzalez-Coloma, A., et al. "Selective action of acetogenin mitochondrial complex I inhibitors." *Z. Naturforsch*. 2002; 57(11-12): 1028-34.
Chang, F. R., et al. "Novel cytotoxic Annonaceous acetogenins from *Annona muricata.*" *J. Nat. Prod.* 2001; 64(7): 925-31.

Jaramillo, M. C., et al. “Cytotoxicity and antileishmanial activity of *Annona muricata* pericarp.” *Fitoterapia*. 2000; 71 (2): 183-6.
Betancur-Galvis, L., et al. “Antitumor and antiviral activity of Colombian medicinal plant extracts.” *Mem. Inst. Oswaldo Cruz*. 1999; 94(4): 531-35.
Kim, G. S., et al. “Muricoreacin and murihexocin C, mono-tetrahydrofuran acetogenins, from the leaves of *Annona muricata*.” *Phytochemistry*. 1998; 49(2): 565-71.
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.
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.
Zeng, L., et al. “Five new monotetrahydrofuran ring acetogenins from the leaves of *Annona muricata*.” *J. Nat. Prod.* 1996; 59(11): 1035-42.
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.
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.
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.
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): 909-5.
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.
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.

Antimicrobial Actions:

Takahashi, J.A., et al. “Antibacterial activity of eight Brazilian Annonaceae plants.” *Nat. Prod. Res*. 2006; 20(1): 21-6.
Betancur-Galvis, L., et al. “Antitumor and antiviral activity of Colombian medicinal plant extracts.” *Mem. Inst. Oswaldo Cruz* 1999; 94(4): 531-35.
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.
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.
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.
Misas, C. A. J., et al. “Contribution to the biological evaluation of Cuban plants. IV.” *Rev. Cubana Med. Trop.* 1979; 31(1): 29–35.

Antidepressant & Antistress Actions:

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.
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(20: 133-140.
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.
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.

Antiparasitic, Antimalarial, & Insecticidal Actions:

Luna, J. S., et al. “Acetogenins in *Annona muricata* L. (Annonaceae) leaves are potent molluscicides.” *Nat. Prod. Res.* 2006; 20(3): 253-7.
Jaramillo, M. C., et al. “Cytotoxicity and antileishmanial activity of *Annona muricata* pericarp.” *Fitoterapia*. 2000; 71(2): 183–6.
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.
Antoun, M. D., et al. "Screening of the flora of Puerto Rico for potential antimalarial bioactives.” *Int. J. Pharmacog*. 1993; 31(4): 255–58.
Heinrich, M., et al. “Parasitological and microbiological evaluation of Mixe Indian medicinal plants (Mexico).” *J. Ethnopharmacol.* 1992; 36(1): 81–5.
Bories, C., et al. “Antiparasitic activity of *Annona muricata* and *Annona cherimolia* seeds.” *Planta Med.* 1991;

57(5): 434–36.
Gbeassor, M., et al. “*In vitro* antimalarial activity of six medicinal plants.” *Phytother. Res.* 1990; 4(3): 115–17.
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.

Anticonvulsant, Antispasmodic, & Smooth Muscle Relaxant Actions:

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.
Feng, P. C., et al. “Pharmacological screening of some West Indian medicinal plants.” *J. Pharm. Pharmacol*. 1962; 14: 556–61.

Hypotensive & Cardiodepressant Actions

Carbajal, D., et al. “Pharmacological screening of plant decoctions commonly used in Cuban folk medicine.” *J. Ethnopharmacol.* 1991; 33(1/2): 21–4.
Feng, P. C., et al. “Pharmacological screening of some West Indian medicinal plants.” *J. Pharm. Pharmacol*. 1962; 14: 556–61.
Meyer, T. M. “The alkaloids of *Annona muricata*.” *Ing. Ned. Indie.* 1941; 8(6): 64.