

Is *Guaiacum sanctum* Effective Against Arthritis? An Ethnobotany Case

by

Eric Ribbens, Barbra Burdett, and Angela Green

Department of Biological Science

Western Illinois University

Part I—Anecdotal Evidence

Dr. Beth Tonoany is a tropical population ecologist who has been studying an unusual tree, *Guaiacum sanctum*, which once grew throughout the dry tropical forests of Central America as well as on some of the Caribbean islands. *Guaiacum sanctum* produces a wood called *lignum vitae*, and is known in Costa Rica and other Spanish-speaking countries as *guayacan real*. The wood is extremely heavy because it contains extensive deposits of resin (Howes, 1949) and it will sink if placed in water (Wilson and Eisner, 1968). During World War I and II it was extensively harvested for use in the ship-building industry because the wood, which does not split easily, is self-lubricating due to its high resin content. The wood is very durable, and was in high demand for constructing bearing sleeves to support ship propellor shafts (Scurlock, 1987). It has also been used for making railroad ties (Woods, 1951).

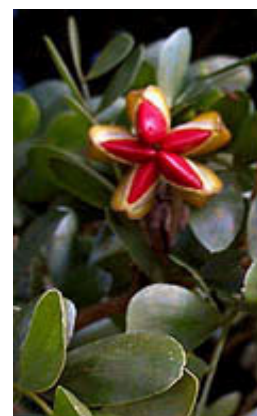


Figure 1: Seeds of *Guaiacum sanctum*

Dr. Tonoany has been studying one of the last remaining populations of *lignum vitae* in the Palo Verde Nature Preserve in northwestern Costa Rica. Probably fewer than 100 trees remain in Costa Rica, most in the Palo Verde Nature Preserve. Her research has included tracking seedlings and saplings, locating and measuring adult trees, and interviewing some of the local Ticos to learn about the tree's past history in Costa Rica. The tree, while rare now due to the dramatic conversion of tropical deciduous forest in Costa Rica into pasturelands and to selective logging of the tree for its valuable wood, was once more common, and many of the older Ticos remember that the saplings were used to make cattle switches because of the strong flexible wood in the saplings.

Interestingly, Dr. Tonoany has also heard from several Ticos that the tree also was used medicinally. Señora Milena Gonzalez, an elderly woman now living in Bagaces, told Dr. Tonoany that she remembered her grandmother “suffered from aches and pains in her legs” and would boil guayacan leaves in water to make an herbal tea she claimed made her aches go away. Señora Milena added that her grandmother said you had to keep drinking the tea for it to be effective, and that it was also necessary to have a pure heart. Señor Jorge Carrera, a retired cattle herder, remembered that Señor Lopez, who owned the ranch where he worked, would sometimes experience painful swellings of his big toe. He would apply a poultice of straw and cow manure to his foot, and drink a tea made by boiling guayacan wood in water. Señor Carrera insisted that in a day or two the swelling would disappear.

Dr. Tonoany became interested in these medicinal uses of *lignum vitae*. She spent some time in the library and discovered several references discussing medicinal uses of *Guaiacum sanctum*. Harrar and Harrar (1962) stated that the “resin has medical value as a diaphoretic in treating rheumatism.” Morton (1981) wrote that *Guaiacum sanctum* “has been used in medicine as a laxative, for gonorrhea, and in Haiti resin dissolved in alcohol is used for gout and as a dentifrice.” Sargent (1890) and Gill (1988) both mentioned that the wood of *Guaiacum sanctum* and *Guaiacum officinale*, a closely related species, was once used to treat syphilis. Dr. Tonoany also discovered that the leaves of *Guaiacum officinale* contain



Figure 2: Flowers of *Guaiacum sanctum*

several unique saponins (see [Ahmad et al. publications](#)), and that Dan Janzen found that a captive tapir refused to eat the leaves every time they were offered ([Janzen, 1982](#)).

Dr. Tonoany encouraged her graduate student, Mabel Gailke, to determine if *Guaiacum sanctum* produces a chemical that has anti-inflammatory properties: “We have lots of anecdotal evidence that *lignum vitae* is useful in treating rheumatism, arthritis, and gout, but it’s frustrating that there is absolutely no data to support these claims. I want you to design and implement a study that we can use to support or reject the idea that this species might be medically valuable.”

Questions

1. How should Mabel proceed? From talking with people around the department, she knows that for an initial trial she cannot work with humans, and due to budgetary constraints probably she will need to work with mice or rats. Design an experiment for her to implement.
2. (*Ethics question:*) Does Dr. Tonoany need permission to harvest plant material from Costa Rica?

References

- Ahmad, V.U., and Bano, N. 1985. A new saponin from *Guaiacum officinale* L. *Journal of the Chemical Society of Pakistan* 7: 137-140.
- Ahmad, V.U., Bano, N., and Bano, S. 1984. Saponins from *Guaiacum officinale*. *Phytochemistry* 23: 2613-2616.
- Ahmad, V.U., Bano, N., and Bano, S. 1986. A saponin from the stem bark of *Guaiacum officinale*. *Phytochemistry* 25: 951-952.
- Ahmad, V.U., Bano, N., Bano, S., Fatima, A., and Kenne, L. 1986. Guaianin, a new saponin from *Guaiacum officinale*. *Journal of Natural Products* 49: 784-786.
- Ahmad, V.U., Perveen, S., and Bano, S. 1989. Guaiacin A and B from the leaves of *Guaiacum officinale*. *Planta Medica* 55: 307-308.
- Ahmad, V.U., Perveen, S., and Bano, S. 1990. Saponins from the leaves of *Guaiacum officinale*. *Phytochemistry* 29: 3287-3290.
- Ahmad, V.U., and Saba, N. 1993. Guaianin N, a new saponin from flowers of *Guaiacum officinale*. *Pakistan Journal of Scientific and Industrial Research* 36: 54-56.



Figure 3: Scientists measure a specimen of *Guaiacum sanctum* in Costa Rica

- Ahmad, V.U., Saba, N., Ali, Z., Zahid, M., and Alam, N. 2000. A new triterpenoidal saponin from the bark of *Guaiacum officinale* L. *Zeitschrift für Naturforschung* 55b: 227-230.
- Ahmad, V.U., Uddin, S., and Bano, S. 1990. Isolation and structure elucidation of saponins from the fruit of *Guaiacum officinale*. *Journal of Natural Products* 53: 1168-1175.
- Ahmad, V.U., Uddin, S., Bano, S., and Fatima, I. 1989. Two saponins from fruits of *Guaiacum officinale*. *Phytochemistry* 28: 2169-2171.
- Gill, D.E. 1988. *A Naturalist's Guide to the OTS Palo Verde Field Station*. OTS, San Jose, Costa Rica.
- Harrar, E.S., and Harrar, J.G. 1962. *Guide to Southern Trees*. Dover Publications, New York.
- Howes, F.N. 1949. *Vegetable Gums and Resins*. Chronica Botanica, Waltham, Massachusetts.
- Janzen, D.H. 1982. Wild plant acceptability to a captive Costa Rican Baird's tapir. *Brenesia* 19/20: 99-128.
- Morton, J.F. 1981. *Atlas of Medicinal Plants of Middle America: Bahamas to Yucatan*. C.C. Thomas, Springfield, Illinois.
- Sargent, C.S. 1890. *Guaiacum*. *Silva of North America* 1: 59-64.
- Scurlock, J.P. 1987. *Native Trees and Shrubs of the Florida Keys*. Laurel Press, Pittsburgh, Pennsylvania.
- Wilson, E.O. and Eisner, T. 1968. *Lignum vitae*: relict island. *Natural History* 77: 52-57.
- Woods, R.P. 1951. *Timbers of South America*. Timber Development Association Limited, London, UK.
- Zeitlin, I.J., Duwiejua, M., Fabiyi, A., and Gray, A.I. 1994. Antiinflammatory activity in extracts from *Guaiacum officinale* wood cuts. *British Journal of Pharmacology* 112: 180.

Image Credits:

Figures 1, 2—Photos of flowers and seeds of *lignum vitae* by Suzanne Kores, provided courtesy of © Fairchild Tropical Garden (<http://www.fairchildgarden.org>).

Figure 3—Photo of scientists by © Eric Ribbens.

Is *Guaiacum sanctum* Effective Against Arthritis? An Ethnobotany Case

by
Eric Ribbens, Barbra Burdett, and Angela Green
Department of Biological Science
Western Illinois University

Part II—Rat Study

Mabel Gailke designed a research project to test whether *Guaiacum sanctum* resin has an anti-inflammatory effect on rats, which was approved by the Biology Department. Mabel's experiment tested the response of rat paws to swelling induced by carrageenan, a skin irritant.

All rats were weighed, sexed, and, if possible, aged. The experimental rats were divided into six groups, balanced with representatives of various weights and equal ratios of males and females.

After coating the left front paw of each rat with carrageenan to induce swelling, each of the six groups received a different oral treatment. One group was treated with a placebo, four groups were given *Guaiacum* resin in four different concentrations, and one group was treated with indomethacin, an anti-inflammatory drug used to treat arthritis. The *Guaiacum* resin was obtained by boiling leaves under reflux in 70% ethanol.

Inflamed joints were measured over an 8-hour period at hourly intervals after administration to compare swelling over time. Observations of behavior and side effects were logged at hourly intervals during the same 8-hour period. Results follow.

Table 1: Effect of Drug Treatments on Paw Swelling and Frequencies of Side Effects

Treatment	% Swelling After 8 Hours, \pm 95% C.I.	Frequency of Lethargy	Frequency of Skin Irritation	Frequency of Hyperactivity
Placebo	98.2 \pm 9.6	0.4	1.2	0.6
Resin, 100 mg/kg	95.4 \pm 12.7	0.9	3.2	0.2
Resin, 200 mg/kg	84.5 \pm 5.2	1.7	5.7	0.8
Resin, 300 mg/kg	76.3 \pm 4.6	2.6	6.3	1.3
Resin, 400 mg/kg	68.7 \pm 1.2	4.3	6.9	2.7
Indomethacin, 2.5 mg/kg	79 \pm 5.7	3.1	7.2	1.5

Questions

1. What did Mabel find out about inflammation in rats treated with *Guaiacum* resin? Did using different dosages make a difference?
2. What strength of *Guaiacum* resin was most beneficial? Why?

3. In your opinion, which medication is better, indomethacin or *Guaiacum* resin? Why?
4. Including the behavior and side effects of taking *Guaiacum* resin, what is your overall opinion of the use of *Guaiacum* resin as an anti-arthritic medication?
5. Do you think *Guaiacum sanctum* will be a good candidate for marketing and further research? In other words, can this plant compete with drugs already on the market?
6. What do these results mean for human use of this plant for rheumatoid arthritis? Should studies be conducted in humans? If so, how?
7. Because this experiment did indicate that *Guaiacum* resin can be quite effective against inflammations, Dr. Tonoany and Mabel Gailke decided to collaborate with the nearby medical research clinic to test the effectiveness of *Guaiacum* resin on humans with severe arthritis. Design an experiment for the clinic to implement. Remember that this study should test whether *Guaiacum* resin has effects specifically on people with very severe arthritis.
8. (*Ethics question:*) What concerns about intellectual property rights are raised in regard to this experiment?

Is *Guaiacum sanctum* Effective Against Arthritis? An Ethnobotany Case

by
Eric Ribbens, Barbra Burdett, and Angela Green
Department of Biological Science
Western Illinois University

Part III—Human Study

Working with a local clinic, Dr. Tonoany and Ms. Geilke selected 20 individuals with severe arthritis from a set of volunteers to participate in a double blind study. All volunteers were severely crippled with arthritis, no longer found indomethacin an effective arthritis treatment, and were between the ages of 60 and 65. Fifteen were females and five were males. All volunteers were screened to ensure normal blood pressure, urinalysis, and erythrocyte levels, and all had the highest degree of complications due to arthritic joint swelling.

Half of the subjects were given *Guaiacum* resin at 400 mg/kg and half were given a placebo. Neither the doctor nor the patient knew who was receiving the resin and who was receiving the placebo. After one month, in addition to monitoring blood pressure, urine, and erythrocyte levels, x-rays of the most arthritic joint were examined and the degree of arthritic complications was categorized as A, B, C, or D, with D being the greatest degree of complications due to swelling of the joint.

Table 2: Effects of Guaiacum Resin on Arthritic Patients

Gender	Drug	Other	X-ray
F1	resin	hair loss	A
F2	placebo	0	D
F3	resin	0	B
F4	placebo	hair loss	C
F5	resin	0	B
F6	placebo	0	D
F7	resin	hair loss	A
F8	placebo	0	D
F9	resin	skin rash	B
F10	placebo	0	D
F11	resin	0	C
F12	placebo	nausea	C
F13	resin	0	B
F14	placebo	0	D

Table 2: Effects of Guaiacum Resin on Arthritic Patients
continued

Gender	Drug	Other	X-ray
F15	resin	0	B
M1	placebo	0	C
M2	resin	0	A
M3	placebo	0	B
M4	resin	skin rash	A
M5	placebo	0	D

Questions

1. What did the clinical study show?
2. Are the side effects a problem? Why or why not?
3. What are the limitations of the experimental design?
4. Dr. Tonany has found that “probably fewer than 100 trees remain in Costa Rica, most in the Palo Verde Nature Preserve.” What ecological concerns does this experiment raise?
5. Based on these results, what should Dr. Tonoany and her colleagues do next?
6. Is it realistic to test an unknown drug on humans after a single clinical trial?
7. (*Ethics question:*) If it looks like this drug is potentially medically useful, should the native peoples be compensated for their trees and the information that led to the experiment?

Date Posted: 01/16/04 nas

Originally published at <http://www.sciencecases.org/ethnobotany/ethnobotany.asp>

Copyright © 2003 by the [National Center for Case Study Teaching in Science](#). Please see our [usage guidelines](#), which outline our policy concerning permissible reproduction of this work.