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THE FIRST TRULY INDEPENDENT WATCHDOG FOR THOSE WORKING WITH NATURAL AROMATIC MATERIALS

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Cropwatch's Rosewood Biblio (*Aniba rosaedora* Ducke) together with other related & unrelated *Aniba* spp.

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[To be continuously corrected, revised & expanded].

Cropwatch Notes: There are some forty species of the *Aniba* genus native to Central & Southern America (mainly concentrated in Guiana and Amazonian districts) & the West Indies. Many *Aniba* spp. possess fragrant woods.

Rosewood oil Brazilian (syn. 'bois de rose' in French or 'pau-rosa' in Brazilian) is the volatile essential oil produced by the steam distillation of the chipped or comminuted wood of the felled Amazonian tree *Aniba rosaeodora* Ducke, and less possibly other *Aniba* spp. such as *A. amazonica* Ducke, *A fragrans* Ducke & *A. parviflora* (Meissner) Mez. [ISO 3761 defines *Aniba rosaeodora* Ducke & *Aniba parviflora* (Meisn.) Mez. as the botanical source of Rosewood oil Brazil - as summarised in ISO 4720 (2nd edn): Essential Oils – Nomenclature]. Other authorities maintain that it is *A. rosaeodora* var. *amazonica* Ducke which is the main source of the Brazilian oil in practice.

Maia *et al.* (2007) discuss the disagreement on the botanical status of various *Aniba* spp. used for rosewood oil production, describing & analyzing the essential oil from the following morphological types of Rosewood, as identified by wood collectors and field observers: "pau-rosa preciosa", "pau-rosa tachi", "pau-rosa itaúba" and "pau-rosa imbaúba" (the wood collectors reportedly prefer the PR-preciosa" type for its higher oil yield). Interestingly, the final conclusion of the authors is the composition of essential oil from *A. rosaeodora* Ducke and *A. duckei* Koster (syn. *A. rosaeodora* Ducke var. *amazonica*) is quite different as previously reported, and that **these two species best represent the rosewood plant 'on the ground'**. This is in agreement with the earlier description by Kubitzki & Renner (1982) that that the two accepted sources of rosewood oils are from the exploited trees of a single species, *A. rosaedora* in North Amazonia and *A. rosaedora* var. *amazonica* in South Amazonia.

The relentless exploitation of *Aniba rosaedora* for its essential oil by suppliers to the perfumery trade, has led to its' endangered status (EN A 1d+2d) on the IUCN Red List (2009), and its classification into Appendix II of the Convention in

International Trade (CITES) at the 15th Conference of the Parties in Doha, Quatar in March 2010. For more on the sustainability of individual *Aniba* species, see Cropwatch's *Updated List of Threatened Aromatic Plants Used in the Aroma & Cosmetic Industries v1.21* (*Mar. 2010)* which can be found at http://www.cropwatch.org/Threatened%20Aromatic%20Species%20v1.21.pdf

Rosewood oil Cayenne, formerly available to the perfumery trade**,** has been ascribed to an *Ocotea* species (*Ocotea caudate* Koeller) – this product is said to be able to be differentiated by its' isovaleraldehyde and furfural content – and to *Aniba parviflora* (Meiss.) Mez. However most authorities would follow either Kostermans naming of the French Guiana tree *Aniba duckei* as the former source of Cayenne Rosewood oil, or more likely, the identification & naming by Ducke (*Aniba rosaedora*).

Contents.

***Aniba* spp. – General.**

Ferreira Z.S., Gottlieb O.R. & Roque N..F. (1980) "Chemosystematic implications of benzyltetrahydroisoquinolines in *Aniba*. *Biochem. Syst. Ecol.* **8**. 51-4.

Gottlieb O.R. & Kubitzki K. (1981) "Chemogeography of *Aniba* (Lauraceae)." *Pl. Syst. Evol.* **137,** 281-9.

Gottlieb O.R. & Kubitzki K. (1981) Chemosystematics of *Aniba. Biochem Syst Ecol* **9**, 5-12.

Kubitzki K. & Renner S. (1982) Lauraceae I (*Aniba* and *Aiouea*). *Flora Neotropica* Mon. No. **31**. 1-125. ***Cropwatch comments:*** See page 5 for SEM photos of leaf surfaces of four *Aniba.* spp. Note also that the authors maintain that the two accepted sources of rosewood oils are from the exploited trees of a single

species, *A. rosaedora* in North Amazonia and *A. rosaedora* var. *amazonica* in South Amazonia.

Mors W.B., Rizzini C.T. & Pereira N .A. (2000) *Useful Plants of Brazil* pp63-4 Holden Day Inc. San Francisco CA.

Rossi M.H., Yoshida M. & Maia J.G.S. (1997) "Neolignans, styrylpyrones and flavonoids from an *Aniba* species." *Phytochemistry* **45**(6), 1263-1269. Abstract. The trunk wood and barks from an *Aniba* species contain four esters of benzoic acid with cinnamyl alcohol, five benzofuran neolignans, licarin-A, burchellin, *cis*-burchellin, burchellin-rearranged and *cis*-burchellin-rearranged, one tetrahydrofuran neolignan, aristolignin, three bicyclooctane guianin-type neolignans, (7*S*, 8*S*, 1′*R*, 5′*R*)-4-hydroxy-3,3′- dimethoxy-4′,6′-dioxo-8.1′, 7.5′-neolignan-Δ: 1,3,5,2′,8′ and the new (7*S*, 8*S*, 1′*R*, 4′*R*, 5′ *S*)-4′-hydroxy-3,4,3′-trimethoxy-6′-oxo-8.1′, 7.5′-neolignan-Δ: 1,3,5,2′,8′ and (7*S*, 8*S*, 1′*R*, 4′*R*, 5′*S*)-4,4′-dihydroxy-3,3′-dimethoxy-6′-oxo-8.1′, 7.5′-neolignan-Δ: 1,3,5,2′,8′, one new bicyclooctane canellin-type neolignan (7*S*, 8*S*, 1′*S*, 4′*R*, 5′*R*, 6′*S*)-4′,6′-dihydroxy-3,4-dimethoxy-3′-oxo-8.1 ′, 7.5′-neolignan-Δ: 1,3,5,8′, two styrylpyrones, 4-methoxy-6-(11,12-dimethoxy-*trans*-styryl)-2-pyrone and 6-(11,12-methylenedioxy-*trans*-styryl)-4-methoxy-2-pyrone, two styrylpyrone dimers: 4′-methoxy-8-(11,12-dimethoxyphenyl)-7-[6-(4- methoxy-2-pyronyl)-6-(*E*)-styryl-1′-oxabicyclo[4,2,O]octa-4′-en-2′-one and the new 11,12-dimethoxyphenyl-7, 7′-di-[6-(4-methoxy-2-pyronyl)]-cyclobutane and six flavonoids, 3,5-dihydroxy-7,4′-dimethoxyflavone,5-hydroxy-3,7,4′ -trimethoxyflavone, 3,5,4′-trihydroxy-7-methoxyflavone, 2,3-dihydro-5-hydroxy-7,4′-dimethoxyflavone, 2,3-dihydro-3,5-dihydroxy-7-methoxyflavone, 2,3-dihydro-3,5-dihydroxy-7,4′-dimethoxyflavone and a new flavan, 6,7,3′,4′,5′-pentamethoxyflavan.

Schultes R.E. & Raffauf R.F. (1990) *The Healing Forest* pub. Discorides Press, Portland, Oregan. ***Cropwatch comments*** The authors review the status of Lauraceae in S. America, noting synonymy between *Aniba*, *Nectandra* and *Ocotea* species, and the rich occurrence of alkaloids in the group

***Aniba canelilla* (H.B.K.) Mez.**

Cropwatch comments: There is some limited commercial availability of this oil, the best samples of which have a warm spicy woody odoured note, but with an associated unpleasant top-note, which is green/styrene like (Burfield unpublished information)..

Gottlieb O. & Magalhaes M. (1959) "Communications Occurrence of 1-nitro-2-phenylethane in *Octea pretiosa* and *Aniba canelilla*." *J of Org Chem* (1959) **24**, 2070 *et seq.*

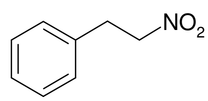
Gottlieb O. & Magalhaes M.T. (1960) "Essential oil of the bark and wood of *Aniba canelilla*." *Perf. & Essential Oil Record* **51**, 69.

Lahlou S. Magalhães P.J.C., RJB de Siqueira, AF (2005) "Cardiovascular effects of the essential oil of *Aniba canelilla* Bark in normotensive rats." *J of*

Cardiovascular Pharmacology **46**(4). Abstract. Cardiovascular effects of intravenous (i.v.) treatment with the essential oil of the bark of *Aniba canelilla* (EOAC) were investigated in normotensive rats. In both pentobarbital-anesthetized and conscious rats, i.v. bolus injections of EOAC (1 to 20 mg/kg) elicited similar and dose-dependent hypotension and bradycardia. Pretreatment of anesthetized rats with bilateral vagotomy significantly reduced the bradycardia without affecting the hypotension. In conscious rats, pretreatment with hexamethonium (30 mg/kg, i.v.) significantly reduced the EOAC-induced bradycardia without affecting the hypotension. The opposite effect was observed after i.v. pretreatment with the nitric oxide synthase inhibitor, NG-nitro-L-arginine methyl esther (L-NAME, 20 mg/kg). However, both EOAC-induced hypotension and bradycardia were significantly reduced by pretreatment with methylatropine (1 mg/kg, i.v.). In rat endothelium-containing aorta preparations, EOAC (1-600 [mu]g/mL) induced a concentration-dependent reduction of potassium (60 mM)-induced contraction [IC50 (geometric mean +/- 95% confidence interval) = 64.5 (45.6-91.2) [mu]g/mL)], an effect that was significantly reduced by the addition of atropine (10 [mu]M) in the perfusion medium [IC50 = 109.5 (72.5-165.4) [mu]g/mL)]. Furthermore, the vasorelaxant effects of the EOAC were also but significantly reduced [IC50 = 139.1 (105.2-183.9) [mu]g/mL)] by removal of the vascular endothelium. Furthermore, the CaCl2-induced contractions in calcium-free medium were reduced and even fully abolished by EOAC (100 and 600 [mu]g/mL), respectively. However, EOAC (600 [mu]g/mL) was without significant effect on caffeine-induced contractions in calcium-free medium. These data show that i.v. treatment of rats with EOAC induces dose-dependent hypotension and bradycardia, which occurred independently. The bradycardia appears mainly dependent upon the presence of an operational and functional parasympathetic drive to the heart. However, the hypotension is due to an active vascular relaxation rather than withdrawal of sympathetic tone. This relaxation seems partly mediated by an endothelial L-arginine/nitric oxide pathway through peripheral muscarinic receptor activation (endothelium-dependent relaxation) and predominantly through an inhibition of calcium inward current (endothelium-independent relaxation).

de Lima A.B., Santana M.B., Cardoso A.S., da Silva J.K., Maia J.G., Carvalho JC, Sousa P.J. (2008) "Antinociceptive activity of 1-nitro-2-phenylethane, the main component of *Aniba canelilla* essential oil." *Phytomedicine*. 2008 Dec 20. Abstract *Aniba canelilla* (H.B.K.) Mez is a medicinal plant used in the Amazon folk therapeutic as antispasmodic, antidiarreic, carminative, tonic agent and a stimulant of the digestive and central nervous system. Our preliminary studies showed that the plant essential oil has analgesic activity in mice. Now, we are reporting the antinociceptive effect of the compound 1-nitro-2-phenylethane (97.5%), the main component of the essential oil of *Aniba canelilla*, which was obtained by column chromatographic purification. In the writhing test this compound was dosed at 15, 25 and 50mg/kg reducing the abdominal writhes in a significant manner; in the hot plate test it was assayed at 50, 100 and 200mg/kg producing no alterations in the latency time when compared to the control; and in the formalin test the 1-nitro-2-phenylethane was tested at 50 and 25mg/kg decreasing significantly the second phase of the algic stimulous. The study suggests that the 1-nitro-2-phenylethane has analgesic activity, probably of peripheral origin. The mechanism involved is not completely understood, however, the results suggest that the opiod receptors are involved in the antinociceptive action observed to 1-nitro-phenylethane.

Naranjo P, Kijjoa A., Giesbrecht A.M. & Gottlieb O.R. (1981) "*Ocotea quixos*, American cinnamon". *J. Ethnopharmacol*. **4**(2), 233-6. ***Cropwatch comments***: The authors report that 1-nitro-2-phenylethane is responsible for the cinnamon odour of bark and leaves of *Aniba canelilla* (H.B.K.) Mez [and *Ocotea pretiosa* (Nees) Mez.].



1-nitro-2-phenylethane

Oger J.M., Richomme P., Guinaudeau H., Bouchara J.P. & Fournet A. (1994) "*Aniba canelilla* (H.B.K.) Mez essential oil: analysis of chemical constituents, fungistatic properties." *Journal of Essential Oil Research* **6**(5), 493-497. Abstract. The composition of the essential oil and of the hexane extract of the stem bark of *Aniba canelilla* was analyzed by means of GC/MS, MS and NMR spectroscopy. In addition to confirming the presence of some previously identified constituents such as 1-nitro-2-phenylethane, safrole and eugenol, this study allowed us to identify beta-sitosterol, alpha-pinene, beta-pinene, benzaldehyde, phenylacetaldehyde, methoxy eugenol, methyl eugenol, and (-)-selin-11-en-4 alpha-ol. 1-Nitro-2-phenylethane was found to exhibit a high toxicity towards yeasts especially *Candida albicans*. The LD50 of a petroleum ether extract from this plant was determined to be greater than 800 mg/kg for BALB/c mice.

Paz da- L. M., D., da Silva T.M., das Graças B., Zoghbill M., Andrade E.H.A (2004). *Acta Amaz* **34**(2) Abstract. The essential oil of the leaves and fine stems of *Aniba canelilla* (Kunth) Mez collected in the city of Manaus, AM, Brazil, were obtained by hydrodistillation and analyzed by GC/MS. Forty-two components were identified, of which 1-nitro-2-phenylethane, as expected, was the major (71.2%-68.2%).

de Siqueira R.J., Macedo F.I., Interaminense L.de F., Duarte G.P., Magalhães P.J., Brito T.S., da Silva J.K., Maia J.G., Sousa P.J., Leal-Cardoso J.H. & Lahlou S. (2010) "1-Nitro-2-phenylethane, the main constituent of the essential oil of *Aniba canelilla*, elicits a vago-vagal bradycardiac and depressor reflex in normotensive rats." *Eur J Pharmacol*. **638**(1-3), 90-8. Abstract. Previously, it was shown that intravenous (i.v.) treatment with the essential oil of *Aniba canelilla* (EOAC) elicited a hypotensive response that is due to active vascular relaxation rather than to the withdrawal of sympathetic tone. The present study investigated mechanisms underlying the cardiovascular responses to 1-nitro-2-phenylethane, the main constituent of the EOAC. In pentobarbital-anesthetized normotensive rats, 1-nitro-2-phenylethane (1-10mg/kg, i.v.) elicited dose-dependent hypotensive and bradycardiac effects which were characterized in two periods (phases 1 and 2). The first rapid component (phase 1) evoked by 1-nitro-2-phenylethane (10mg/kg) was fully abolished by bilateral vagotomy, perineural treatment of both cervical vagus nerves with capsaicin (250 microg/ml) and was absent after left ventricle injection. However, pretreatment with capsazepine (1mg/kg, i.v.) or ondansetron (30 microg/kg, i.v.) did not alter phase 1 of the cardiovascular responses to 1-nitro-2-phenylethane (10mg/kg, i.v.). In conscious rats, 1-nitro-2-phenylethane (1-10mg/kg, i.v.) evoked rapid hypotensive and bradycardiac (phase 1) effects that were fully abolished by methylatropine (1mg/kg, i.v.). It is concluded that 1-nitro-2-phenylethane induces a vago-vagal bradycardiac and depressor reflex (phase 1) that apparently results from the stimulation of vagal pulmonary rather than cardiac C-fiber afferents. The transduction mechanism of the 1-nitro-2-phenylethane excitation of C-fiber endings is not fully understood and does not appear to involve activation of either Vanilloid TPRV(1) or 5-HT(3) receptors. The phase 2 hypotensive response to 1-nitro-2-phenylethane seems to result, at least in part, from a direct vasodilatory effect since 1-nitro-2-phenylethane (1-300 microg/ml) induced a concentration-dependent reduction of phenylephrine-induced contraction in rat endothelium-containing aorta preparations.

Schultes R.E. & Raffauf R.F. (1990) "*The Healing Forest – medicinal and toxic plants of the NW Amazonia* Dioscorides." Press Portland, Oregon 1990. ***Cropwatch comments:*** The authors describe the smell of the bark as being a cross between cinnamon & roses.

Silva da- J.K., Sousa P.J., Andrade E.H. & Maia J.G. (2007) "Antioxidant capacity and cytotoxicity of essential oil and methanol extract of *Aniba canelilla* (H.B.K.) Mez." *J Agric Food Chem*. **55**(23), 9422-6. Abstract. The leaves and fine stems, bark, and trunk wood oils of *Aniba canelilla* showed yields ranging from 0.2 to 1.3%. The main volatile constituent identified in the oils was 1-nitro -2-phenylethane (70.2-92.1%), as expected. The mean of DPPH radical scavenging activity (EC 50) of the oils (198.17 +/- 1.95 microg mL(-1)) was low in comparison with that of wood methanol extracts (4.41 +/- 0.12 microg mL(-1)), the value of which was equivalent to that of Trolox (4.67 +/- 0.35 microg mL(-1)), used as antioxidant standard. The mean amount of total phenolics (TP) (710.53 +/- 23.16 mg of GAE/g) and this value calculated as Trolox equivalent antioxidant capacity (TEAC) (899.50 +/- 6.50 mg of TE/g) of the wood methanol extracts confirmed the high antioxidant activity of the species. On the other hand, in the brine shrimp bioassay the values of lethal concentration (LC50) for the oils (21.61 +/- 1.21 microg mL(-1)) and 1-nitro-2-phenylethane (20.37 +/- 0.99 microg mL(-1)) were lower than that of the wood methanol extracts (91.38 +/- 7.20 microg mL(-1)), showing significant biological activities.

Taveira F.S.N., de Paz. L. W.N., Andradec E.H.A. & Maia J.G.S. (2003) "Seasonal essential oil variation of *Aniba canelilla*." *Biochemical Systematics and Ecology* **31**(1), 69-75. Abstract. The essential oils of leaves, stem bark and trunk wood of *Aniba canelilla*, collected in the rainy and dry season from different soil types, were obtained by hydrodistillation and analysed by GC/MS. It has been observed that methyleugenol is also an important volatile constituent in the essential oil of *A. canelilla*, as well as 1-nitro-2-phenylethane. The percentage content of these two compounds was depending on the season time. In the rainy period the 1-nitro-2-phenylethane reach values near 95%, while methyleugenol remain below 18%. By contrast, in the dry period 1-nitro-2-phenylethane decrease to 39%, while methyleugenol reach 45%. The leaf oils produced from specimens collected at different soil types in the dry season presented the lower percentage contents to 1-nitro-2-phenylethane and methyleugenol. In contrast, the mono- and sesquiterpenes compounds present in the same oils showed the higher percentage contents.

***Aniba duckei* Kosterm.**

***Cropwatch comments*:** The Dutch botanist Kostermans ascribed the name *Aniba duckei* to the French Guiana tree *after* the botanist Alfred Ducke had named the unidentified French Guiana tree known as "bois de rose" as *Aniba rosaedora,* and named the Brazilian variety *A. rosaedora* var. *amazonica*. Maia *et al*. (2007) (see below) have further investigated the botanical status of *Aniba rosaeodora* Ducke and *Aniba duckei* Kosterm. The oil from native Guiana trees has for many years has been said to be very scarce, but a study on essential oil chemical variability for *A. rosaedora* Ducke from French Guiana was published by Chantraine *et al.* (2009).

Alencar J. da C. & Araujo, V.C. de (1981) "[Yearly increment of *Aniba duckei* Kostermans Lauraceae, in humid primary tropical forest] *Acta Amazonica* **11**(3), 547-582.

Alencar J.C., Fernandes N.P. (1978) "Desenvolvimento de árvores nativas em ensaios de espécies. 1. Pau rosa (*Aniba duckei* Kostermans)." *Acta Amazônica* **8**(4),523-541.

Araujo V.C. de. (1967) "Sobre a germinação de *Aniba* (Lauraceae) I. *Aniba duckei* Kostermans (Pau-rosa Itauba)." Manaus: INPA, 1967. (Botânica, 23).

Carvalho J.O.P. de. (1983) Abundância, freqüência e grau de agregação do pau-rosa (*Aniba duckei* Kortermans) na Floresta Nacional do Tapajós. Belém: EMBRAPA – CPATU, 1983. 17p.

FAO (1986) *Aniba duckei* Kostermans. In *Databook on Endangered Tree and Shrub Species and Provenances*. Forestry Paper No. 77. Rome: FAO. pp. 60-68.

Magalhaes L.M.S.& Alencar J. da C. (1979) "[Phenology of a natural population of (*Aniba duckei* Kostermans), Lauraceae in a tropical rain forest in the central Amazonian area [Brazil]]." *Acta Amazonica* **9**(2), 227-232.

Maia J.G.S., Andrade E H.A., Couto H.A.R., da Silva C.A.M, Marx F. & Henke C. (2007). "Plant sources of rosewood oil." *Quím. Nova* **30**(8), 1906-1910. Abstract. The aim of this study is to reevaluate the plant sources of the Amazon rosewood oil which have been named *Aniba rosaeodora* Ducke and *Aniba duckei* Kosterm. There is some disagreement on the exact botanical status of these species.

Some Lauraceae specialists analyzing available material from both species concluded that there is no basis for regarding them as different. Based on our results we are confirming that the chemical composition of both species is quite different from that previously reported. So we are suggesting to bring back the previous botanical rosewood status as proposed by Adolph Ducke.

Terezo de M.- E.F., de Araujo V.C., de Araujo V.F`do Nascimento & J. da C. Souza (1972) 2O extravisimo do pau-rosa (*Aniba duckei* Kosterm., *Aniba rosaedora* Ducke)." *Sudam. Doc. Amaz. Belem*, Brazil **3**(1/4), 5-55.

***Aniba firmula* Mez.**

Gottlieb O. R. & Mors W. B. (1959) "The chemistry of rosewood. III. Isolation of 5,6-dehydrokavain and 4-methoxyparacotoin from *Aniba firmula* Mez." *The Journal of Organic Chemistry,* Jan 1959 p17.

***Aniba fragrans* Ducke.**

Mors W. B., Magalhaes M. T., Gottlieb O. R. (1960) "*Aniba fragrans* Ducke, a valid species." Anais da Associação Brasileira de Química, v. 19, p. 193-197. 1960. (The chemistry of the genus *Aniba*, 10). ***Cropwatch comments*:** The authors proposed that *Aniba fragrans* is not synonymous with *A. firmula* Mez as Kostermans suggested in his revision of the Lauraceae, because the volatile oils of the wood of the two trees differs. Maia & Andrade (2007) suggest that *A. fragrans* does produces "…(an)...oil bouquet (which) is not accepted as those of the traditional rosewood oils."

Aniba panurensis

Klausmeyer P.. Chmurny G. N., McCloud T.G., Tucker K.D. Shoemaker R.H. (2004) "A novel antimicrobial indolizinium alkaloid from *Aniba panurensis." J Natural Products* **67**(10),1732-1735. Abstract. Activity-guided fractionation of an *Aniba panurensis* organic solvent extract has led to the isolation of the novel alkaloid 6,8-didec-(1Z)-enyl-5,7-dimethyl-2,3-dihydro-1H-indolizinium, as the trifluoroacetic acid salt (1). Its structure was determined by NMR and mass spectrometry. Bioassays performed in vitro demonstrated toxicity of compound 1 to a drug-resistant strain of *Candida albicans*.

***Aniba parviflora* (Meissn.) Mez.**

Mageswaran S., Ollis W. D. & Sutherland I.O.(1971) "The natural occurrence of 6-styryl-2-pyrones and their synthesis." *Tetrahedron* **27**(5), 1043-1048. Abstract. Three representatives of a new type (IV) of natural 6-styryl-2-pyrones have been isolated from the wood of *Aniba parviflora* (Meissn.) Mez. Their constitutions (IVa, IVb, and IVc), proposed mainly on spectroscopic evidence, have been confirmed by synthesis.

Tranchida P.Q., de Souza R. de C Z., Barata E.S., Mondello M., Dago P., Dugo G. & Mondello L. (2008) "Analysis of Macacaporanga (*Aniba parviflora*) leaf essential oil by using comprehensive two-dimensional gas chromatography with rapid-scanning quadrupole mass spectrometery." *Chromatography Today* **1**(4), 5-9. Abstract. The present research focuses on the use of a comprehensive 2D

GC methodology, in the analysis of a Brazilian essential oil, viz Macacaporanga leaf oil. A rapid scanning quadrupole mass spectrometer (qMS), employed as detection system and operated a 20Hz scanning frequency, supplied high quality mass spectra. The effectiveness of the three-dimensional GC x GC-qMS experiment was compared to that of a GC-qMS analysis on the same sample. Peak identification, in both applications, was achieved through MS library matching with the support of linear retention (LR) data.

***Aniba riparia* (Nees) Mez.**

Araújo F.L., Melo C.T., Rocha N.F., Moura B.A., Leite C.P., Amaral J.F., Barbosa-Filho J.M., Gutierrez S.J., Vasconcelos S.M., Viana G.S. & de Sousa FC. (2009) "Antinociceptive effects of (O-methyl)-N-benzoyl tyramine (riparin I) from Aniba riparia (Nees) Mez (Lauraceae) in mice." *Naunyn Schmiedebergs Arch* Pharmacol. **380**(4), 337-44. Abstract. The present study examined the antinociceptive effects of (O-methyl) N-benzoyl-tyramine (riparin I, ripI) isolated from the unripe fruit of *Aniba riparia* in chemical and thermal behavioral models of pain, such as acetic acid-induced abdominal writhing, formalin, and hot-plate tests in mice. Moreover, the involvement of the nitric oxide pathway as well as the opioid system in the antinociceptive action of ripI in the formalin test was investigated. RipI was administered both orally and intraperitoneally to male mice at single doses of 25 and 50 mg/kg. In the acetic acid-induced abdominal writhing, ripI decreased the number of writhings at both doses. In addition, in the formalin test, ripI reduced the paw licking time at both phases of the test. The effect of the highest dose of ripI in mice formalin test on the early phase was not reversed by naloxone (opioid receptor antagonist) but it was reversed by l-arginine (a nitric oxide precursor) in the late phase, suggesting that ripI may not act through opioid system and possibly acts through inhibition of nitric oxide pathway. In the hot-plate test, ripI increased the reaction time in the hot-plate test at the dose of 25 mg/kg, i.p., confirming the result found in the formalin test. Based on the obtained results, it is suggested that ripI presents antinociceptive activity that may be due to peripheral mechanisms (nitric oxide pathway) and central mechanisms, discarding the involvement of opioid system.

de Sousa F.C., Monteiro A.P., de Melo C.T., de Oliveira G.R., Vasconcelos S.M., de França Fonteles M.M., Gutierrez S.J., Barbosa-Filho J.M., Viana G.S. (2005) "Antianxiety effects of riparin I from *Aniba riparia* (Nees) Mez (Lauraceae) in mice." *Phytother Res*. **19**(12), 1005-8. Abstract. This work presents the behavioral effects of riparin I (methyl ether of N-benzoyl tyramine) from unripe fruit of *Aniba riparia* (Lauraceae) on the elevated plus maze, open field, rota rod and hole board tests in mice. Riparin I was administered acutely by intraperitoneal (i.p.) and oral routes to male mice at doses of 25 and 50 mg/kg. The results showed that riparin I (25 and 50 mg/kg, i.p. and per os) increased the number of entries and the time of permanence in the open arms in the plus maze test. Similarly, in the hole board test, riparin I in both routes increased the number of head dips. Riparin I with both doses and routes had no effects on spontaneous motor activity in mice or in the rota rod test, but decreased the number of groomings. These results showed that riparin I by both administration routes has effects on the central nervous system with antianxiety effects on the plus maze and hole board tests. The substance is devoid of myorelaxant effects.

Thomas G., Branco U.J., Barbosa Filho J.M., Bachelet M. & Vargaftig B.B. (1994) "Studies on the mechanism of spasmolytic activity of (O-methyl-)-N-(2,6-dihydroxybenzoyl)tyramine, a constituent of *Aniba riparia* (Nees) Mez. (Lauraceae), in rat uterus, rabbit aorta and guinea-pig alveolar leucocytes." *J Pharm Pharmacol.* **46**(2), 103-7. Abstract. The mechanism of action of a nonspecific smooth muscle relaxant, (O-methyl-)-N-(2,6-dihydroxybenzoyl)tyramine (riparin), a constituent of *Aniba riparia* (Nees) Mez. (Lauraceae) was studied in relation to Ca2+ metabolism in smooth muscle tissues and in guinea-pig alveolar leucocytes. In rat depolarized uterus, riparin inhibited in a reversible and noncompetitive manner CaCl2-induced contraction, a response mediated through voltage-dependent Ca2+ channels. The pD2 value (mean +/- s.e.m.) for riparin was 4.98 +/- 0.06. When compared with sodium nitroprusside (IC50 2.5 microM), an antagonist of receptor-operated Ca2+ channels, riparin was ineffective in suppressing noradrenaline-induced sustained contractions of rabbit aortic strips. However, in the aorta, the compound inhibited intracellular calcium-dependent transient contractions of noradrenaline and riparin (IC50 10.1 microM) was approximately two and a half times more potent than procaine (IC50 25.5 microM) a known inhibitor. In guinea-pig alveolar leucocytes, riparin (IC50 3.2 microM) inhibited intracellular Ca2+ accumulation induced by the calcium ionophore A23187. The results suggest that the inhibition of Ca2+ influx and of Ca2+ release from intracellular stores contribute to the spasmolytic effects of riparin, which may not involve cyclic AMP generation as the levels of this nucleotide were not increased in alveolar macrophages treated with riparin (10-100 microM).

***Aniba rosaedora* Ducke.**

***Cropwatch comments*:** As mentioned above, Maia *et al.* (2007) conclude that the composition of essential oil from *A. rosaeodora* Ducke and *A. duckei* Koster (syn. *A. rosaeodora* Ducke var. *amazonica*) is quite different but that these two species best represent the rosewood plant 'on the ground'.

***Aniba rosaedora* - Biocidal Activity.**

Ando Y (1994) "[Breeding control and immobilizing effects of wood microingredients on house dust mites]." *Nippon Koshu Eisei Zasshi*. **41**(8), 741-50. Abstract. The possible effects of essential oils as wood microingredients on house dust mites (*Tyrophagus putrescentiae*, *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus*) were investigated. 1. Whether small pieces of 5 types of wood had any control effect on mite breeding was studied. Mite breeding using only normal feed was compared with breeding using feed mixed with small pieces of wood. In addition, mite breeding using feed mixed with small pieces of wood with no essential oil was studied. 2. Effects of 6 different wood essential oils in immobilizing mites were studied with regard to respired and contact toxicities. 3. The immobilizing effects of 10 ingredients in Hinoki oil were also specifically studied with regard to contact toxicity. The results of the 3

experiments were as follows: 1) It was confirmed that the small pieces of Hinoki, cedar, pine and Lauan had control effects on mite breeding. However, the small pieces of spruce did not demonstrate an effect. Woods which had no essential oils had reduced or no breeding control effects. 2) It was confirmed that the 6 different wood essential oils had mite immobilizing effects associated with respired and contact toxicities. Rosewood oil, White Pine oil and Taiwan Hinoki oil had strong immobilizing effects. Hinoki oil, however, had only a weak effect. 3) Among the 10 ingredients of Hinoki oil, specifically Linalool, Geranyl acetate and alpha-Terpineol had strong mite immobilizing effects.

Choi W.I., Lee E.H., Choi B.R., Park H.M. & Ahn Y/J.. (2003) "Toxicity of plant essential oils to *Trialeurodes vaporariorum* (Homoptera: Aleyrodidae)." *J Econ Entomol.* **96**(5), 1479-84. Abstract. A total of 53 plant essential oils were tested for their insecticidal activities against eggs, nymphs, and adults of *Trialeurodes vaporariorum* Westwood, using an impregnated filter paper bioassays without allowing direct contact. Responses varied according to oil type and dose, and developmental stage of the insect. Bay, caraway seed, clove leaf, lemon eucalyptus, lime dis 5 F, pennyroyal, peppermint, rosewood, spearmint, and tea tree oils were highly effective against *T. vaporariorum* adults, nymphs, and eggs at 0.0023, 0.0093, and 0.0047 microl/ml air, respectively. These results indicate that the mode of delivery of these essential oils was largely a result of action in the vapor phase. Significant correlations among adulticidal, nymphicidal, and ovicidal activities of the test oils were observed. The essential oils described herein merit further study as potential fumigants for *T. vaporariorum* control.

Costa L.G.S., Ohashi S.T. & Daniel O. (1995) "O pau-rosa – *Aniba rosaeodora*, Ducke." Belém: FCAP, 1995.

Hammer K.A., Carson C.F. & Riley T.V. "Antimicrobial activity of essential oils and other plant extracts." *Journal of Applied Microbiology* **86**(6), 985 - 990. Abstract. The antimicrobial activity of plant oils and extracts has been recognized for many years. However, few investigations have compared large numbers of oils and extracts using methods that are directly comparable. In the present study, 52 plant oils and extracts were investigated for activity against *Acinetobacter baumanii*, *Aeromonas veronii* biogroup *sobria*, *Candida albicans*, *Enterococcus* faecalis, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Salmonella enterica* subsp. *enterica* serotype *typhimurium*, *Serratia marcescens* and *Staphylococcus aureus*, using an agar dilution method. Lemongrass, oregano and bay inhibited all organisms at concentrations of ≤2·0% (v/v). Six oils did not inhibit any organisms at the highest concentration, which was 2·0% (v/v) oil for apricot kernel, evening primrose, macadamia, pumpkin, sage and sweet almond. Variable activity was recorded for the remaining oils. Twenty of the plant oils and extracts were investigated, using a broth microdilution method, for activity against *C. albicans*, *Staph. aureus* and *E. coli*. The lowest minimum inhibitory concentrations were 0·03% (v/v) thyme oil against C. *albicans* and *E. coli* and 0·008% (v/v) vetiver oil against *Staph. aureus*. These

results support the notion that plant essential oils and extracts may have a role as pharmaceuticals and preservatives.

Lis-Balchin M, Deans S. & Hart S (1994). Paper presented at 25th International Symposium on Essential oils, Grasse, France. ***Cropwatch comments:*** Lis-Balchin *et al.* found no anti-oxidant action for Rosewood, found it potently active against 24/25 bacteria, but only 12 out of 20 *Listeria monocytogenes* varieties. It was described as moderately active against three out of three fungi

Lobato A.M., Ribeiro A., Pinheiro M.F.S.v& Maia J.G.S. (1989) "Antimicrobial activity of essential oils from the Amazon" *Acta Amazonia* **19**, 355-363. ***Cropwatch comments*** The authors examine the action of a number of Amazonian oils against *Pseudomonas aeruginosa, Proteus mirabilis*, *Escherichia coli*, *Edwardsiela tarda*, *Klebsiella pneumoniae*, *Enterobacter aerogenes* and *Salmonella* spp, however *Aniba rosaedora* oil was only active against five of the above.

Maruzella J.C. & Ligouri L. (1958) *J Am Pharm Assn* **47**, 280.

Simić A., Soković M.D., Ristić M., Grujić-Jovanović S, Vukojević J. & Marin PD. (2004) "The chemical composition of some Lauraceae essential oils and their antifungal activities." *Phytother Res*. 18(9), 713-7 Abstract. The antifungal activity of *Aniba rosaeodora*, *Laurus nobilis*, *Sassafras albidum* and *Cinnamomum zeylanicum* essential oils were investigated against 17 micromycetes. Among the tested fungal species were food poisoning, spoilage fungi, plant and animal pathogens. In order to determine fungistatic and fungicidal concentrations (MIC and MFC) macrodilution and microdilution tests were used. Linalool was the main component in the essential oil of *A. rosaeodora*, while 1.8-cineole was dominant in *L. nobilis*. In sassafras essential oil safrole was the major component and in the oil of *C. zeylanicum* the main component was *trans*-cinnamaldehyde. The essential oil of cinnamon showed the strongest antifungal activity

Aniba rosaedora – Chemistry/Perfumery

Alleluia I. B., Braz Filho R., Gottlieb O. R., Magalhães E. G. & Marques R. (1978) *Phytochemistry* **17**, 517-521.

Arctander S (1960) "Rosewood Oil." in *Perfume and Flavour Materials of Natural Origin* pub. Elizabeth NJ (USA).

Barata L.E.S. & Discola K.F. (2002) "Scents of Amazon aromatic plants" Presented at *33rd Int. Symposium on Essential Oils, Lisbon, Portugal .(2002).*

Barata L. (2007) "Scents of the Amazon: Replacing rosewood in perfumery? Part I." *P&FNow* March 21 2007.

Barata L. (2007) "Scents of the Amazon: Replacing rosewood in perfumery? Part II." *P&FNow* March 21 2007. April 4th 2007, ***Cropwatch comments***: This is not the first time that this quote has appeared from Barata: " Chiral GC/MS analysis of rosewood leaf oil showed 90% dextro (+) and only 20% laevo."

Cropwatch has previously written to Barata to ask why the figures do not add up to 100%, but we have yet to receive a reply. We further learn in the article that the production of rosewood leaf oil (which Cropwatch has seen samples of and been disappointed) will reach 1,000 L. (only) in its 5th year. This compares with a production figure of 38 tons per year of conventional rosewood wood oil (quoted by Barata) – but this figure does not taken into account increased distribution volumes via subsequent adulteration by industry. We might speculate therefore that 1,000L./annum will satisfy less than 2% of the demand, so we don't agree with Barata that a scheme to produce rosewood leaf oil will ease the ecological pressure on the rosewood tree.

Benchimol S. (2001) "Production of Brazilian Rosewood Oil, Copaiba Balsam and Tonka Beans." Paper presented to *the International Conference on Essential Oils and Aromas, Buenos Aires, Argentina, 11 to 15 November 2001.*

Braga H.C. (1971) *Os óleos essenciais do Brasil: estudo econômico*. Rio de Janeiro: Ministério da agricultura, 1971. 86 p.

Cambell de Araujo V. *et al* " (1972) Óleos Essencias de Especies do Gêneor Aniba" *An. Acad. Brasil. Cienc*., **44** (Suppl), 303-306 (1972); *Acta Amazonia* **2**(1), 1-4 (1972) through Lawrence B.M. (1984) "Progress in Essential Oils" *Perfumer & Flavourist* Vol **9** (Oct/Nov 1984) p87-8.

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Gottlieb O. R. & Mors, W. B. (1958) *Bol. Inst. Quim. Agric*. (Rio de Janeiro) 1958, **53**, 7.

Gottlieb O. R. & Mors W. B. (1958) *J. Am. Chem. Soc* 1958, **80**, 2263.

Gottlieb O.R. & Mors W.B. (1959) "The Chemistry of Rosewood. III. Isolation of 5, 6-dehydrokavain and 4-methoxyparacotoin from *Aniba*."…*J Organic Chemistry*, 1959 ACS.

Gottlieb O. R., Fineberg M., Guimarães M. L., Magalhães M. T. & Maravalhas N. (1964) *Perf. Essent. Oil Record* **55**, 253.

Guenther E. (1930) "Oil of bois de rose". In *The Essential Oils*, Vol. 4. pp. 183-193 R.E. Publishing Co. Inc., Huntingdon, New York.

Homma A.K.O. (2005) "O Extrativismo do óleo essencial de pau-rosa na Amazônia." *XLIII Congresso da Sociedade Brasileira de Economia, Administração e Sociologia Rural: "Instituições, Eficiência, Gestão e Contratos no Sistema Agroindustrial". Ribeirão Preto, 24 a 27 de Julho de 2005, Palestra*.

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Lawrence B.M. (1995) "Progress in Essential Oils" *Perfumer & Flavourist* Vol **20** July/August 1995 p30.

Magalhaes L.M.S. & Alencar J.C. (1979) Fenologia do pau-rosa (Aniba duckei Kostermans), Lauraceae, em floresta primária na Amazônia Central. *Acta Amazonica* 9(2), 227-232, 1979.

Mors W.B., Gottlieb O.R. & Djerassi C. (1957) "The chemistry of rosewood. isolation and structure of anibine and 4-methoxyparacotoin." *JACS* (1957), 4507. Abstract. From the wood of the South American rosewood trees (genus *Aniba*) there has been isolated a new alkaloid, $C_{11}H_9NO_3$, which has been named anibine. By various degradations, in particular by alkaline cleavage, it was shown that anibine is 4-methoxy-6-(3'-pyridyl)-a-pyron (IV). A neutral companion substance of anibine, when subjected to similar reactions, was proved to be 4-methoxy-6-piperonyl-a-pyrone (X) (4-methoxyparacotoin) and attention is called to the structural similarity with the constituents of the closely related Coto barks.

Naves Y.P. (1951) [Essential oil of Amazonian rosewood rich in dextrorotatory linalol.] *C R Hebd Seances Acad Sci*. **233**(10), 585-6.

Pagan T.C. (2003) "Características del aceite esencial de Palo rosa (*Aniba rosaeodora* Ducke) obtenido por dos métodos de destilacíon." Lima: *Universidade Federal de Molina. Dissertação para o grau de Engenheiro Florestal, 2003. 86 folhas.*

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Zellner B.D.A., Prestl M.L., Barata L.E.S., Dugo P. & Mondello I. (2006) "Evaluation of leaf-derived extracts as an environmentally sustainable source of essential oils by using gas chromatography-mass spectrometry and enantioselective gas chromatography-olefactometry." *Anal. Chem.* **78**, 883-890. Abstract In consideration of the world's present environmental situation and the threat of species extinction, investigations concerning alternative sustainable sources of natural substances represent an extremely important issue. In this respect, the present research is focused on the analytical evaluation of Brazilian rosewood (*Aniba rosaeodora* Ducke) leaves, as an alternative source (with respect to wood) of rosewood essential oil and, as such, of natural linalool, which is extensively used in perfumery. Enantioselective-gas chromatography-olfactometry (Es-GC-O) was used as a tool for the simultaneous stereodifferentiation and olfactive evaluation of the volatile optically active components present in the analyzed samples. In addition to Es-GC-O analyses, direct olfactive analyses were also performed, enabling the evaluation of the global aroma exerted by each sample and the influence of each linalool antipode, as also other minor compounds. The samples were also submitted to gas chromatography-mass spectrometric analysis, thus establishing their chemical

profiles. The assessment of enantiopure chiral compounds through Es-GC-O, along with direct olfactive analyses, confirmed that the leaves are a potential substituent for wood in the extraction of Brazilian rosewood essential oil, representing a sustainable nonwood source of natural linalool. ***Cropwatch comments***: The authors fail to grasp the factors which give rosewood oil its unique perfumery value. This isn't primarily to do with enantiometric purity of the inherent linalol content, but more to do with the minor compounds which support, reinforce and modify the character compounds in the oil itself.

***Aniba rosaedora* – Ecology, Sustainability Issues.**

Anon (2007) "Brazilian women promote sustainable harvesting of endangered rosewoods." *HerbalGram* **73**,56. Abstract. In the paste several years, a group of women in Brazil have struggled to promote & reform sustainable harvesting of rosewood trees. The group called AVIVE for its acronym in Portuguese (meaning "Green Life Association of Amazonia" in English). Was founded in 1999 and is composed of 43 women from the Silves district of the northern Amazonian state of Brazil. These women manufacture and sell soaps and products scented with rosewood oil and other natural aromas, while tending rosewood plantations for future sustainable use. Such practices aim to both reduce local poverty and improve the survival of the species sadly depleted over the years.

Araujo de-, V. C., Corrêa R. G. C., Maia J. G. S., Silva M. L., Gottlieb O. R., Marx M. C. & Magalhães, M. T. (1971) *Acta Amazonica* **1**, 45.

Araujo de-, V.C. *et al* " (1972) Óleos Essencias de Especies do Gêneor *Aniba*" *An. Acad. Brasil. Cienc*., 44 (Suppl), 303-306 (1972); *Acta Amazonia* 2(1), 1-4 (1972).

Barata L.E.S & May P. (2004) "Rosewood Exploitation in the Brazilian Amazon: Options for sustainable production." *Economic Botany* **58**, 257-265.

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Barreto D C de S, Gonçalves J F de C., dos Santos Júnior U.M, Fernades A.V. Bariani V A. & SampaioV P.T.B. (2007) "Biomass accumulation, photochemical efficiency of photosystem II, nutrient contents and nitrate reductase activity in young rosewood plants (*Aniba rosaeodora* Ducke) submitted to different NO3-:NH4+ ratios." *Acta Amaz.* **37**(4). Abstract. The rosewood (*Aniba rosaeodora* Ducke) is a native tree species of Amazon rainforest growing naturally in acidic forest soils with reduced redox potential. However, this species can also been found growing in forest gaps containing oxide soils. Variations in the forms of mineral nitrogen (NO3- or NH4+) may be predicted in these different edaphic conditions. Considering that possibility, an experiment was carried out to analyze the effects of different NO3-:NH4+ ratios on the growth performance, mineral composition, chloroplastid pigment contents, photochemical efficiency photosystem II (PSII), and nitrate redutase activity (RN, E.C.1.6.6.1) on *A. rosaeodora* seedlings. Nine-month-old seedlings were grown in pots with a washed sand capacity of 7.5 kg and submitted to different NO3-:NH4+ ratios (T1 = 0:100%, T2 = 25:75%, T3 = 50:50%, T4 = 75:25%, and T5 = 100:0%). The lowest relative growth rate was observed when the NO3-:NH4+ ratio was equal to 0:100%. In general, high concentrations of NO3- rather than NH4+ favored a greater nutrient accumulation in different parts of the plant. For the chloroplastid pigment, the highest Chl a, Chl b, Chltot, Chl a/b and Chltot/Cx+c contents were found in the treatment with 75:25% of NO3-:NH4+, and for Chl b and Cx+c it was observed no difference. In addition, there was a higher photochemical efficiency of PSII (Fv/Fm) when high NO3- concentrations were used. A linear and positive response for the nitrate reductase activity was recorded when the nitrate content increased on the culture substrate. Our results suggest that *A. rosaeodora* seedlings have a better growth performance when the NO3- concentrations in the culture substrate were higher than the NH4+ concentrations.

Burfield T. (2010) "Rosewood & Guaiacwood oils Controlled Under CITES Appendix II." – see http://www.aromaconnection.org/2010/03/rosewood-guaiacwood-oils-controlled-under-cites-appendix-ii.html

Chantraine J.-M., Dhenin J.-M. & Moretti C. (2009) "Chemical variability of rosewood (*Aniba rosardora* Ducke) essential oil in French Guiana," *JOER* **21**, 486-495. Abstract. Eighty-two samples of *Aniba rosaedora* Ducke were collected from ten localities in French Guinea. Essential oils were extracted from different parts of the tree (trunk wood, branch wood, roots, leaves) and analyzed. Yield measurements were performed by hydro distillation; total linalool content and percentage of (-)-linalool or (+)-linalool were obtained by gas chromatography. Variations in essential oil yield were correlated with various parameters such as part of the tree, age of the tree, season, phonological status and geographic origin. Oil yields from the wood samples (trunk, branch, shoot) ranged from 0.4 – 3.2%, while yields from roots & leaves varied little with an average of 0.15% and 0.45% respectively. In young trees, wood yield was 1.6%, higher than in older trees (1.3%). Collection time had no obvious influence on wood and leaf yields. Nevertheless, fruit-bearing trees gave a higher yield than fruitless ones. For a given tree, a decreasing yield gradient was observed from trunkwood to branches, smaller branches, and leaves. Linalool percentages in oil ranged from 73-99%. All trunk wood oil contained a percentage of (-)-linalool close to 100%, except for two trees from Paracou station, where a low proportion of (+)-linalool was present. Oils from small branches contained 5-28% of (+)-linalool. All leaf oils showed a high percentage (78-89%) of (+)-linalool. The linalool form in oil from shoot, bark and root samples was purely (-)-linalool. Measure performed on different parts of the same tree showed that the linalool from the trunk wood and thick branches was purely (-)-linalol, whereas the proportion of (+)-linalool increased with the thickness of the branches and reached 85% in leaves.

CITES CoP15 Prop 29. See http://www.cites.org/eng/cop/15/prop/E-15-Prop-29.pdf See also Press Release at www.**cites**.org/eng/news/press/2010/20100317_cop15.shtml

CITES CoP 15 Prop 29 IUCN-Traffic Analysis – see www.traffic.org/**cites**-cop-papers/CoP15_Prop29_Analysis.pdf

Contim L.A.S., de Carvalho C.R., Martins F.A. de Freitas D.V. (2005) "Nuclear DNA content and karyotype of rosewood (*Aniba rosaeodora*)" *Genet. Mol. Biol.* **28**(4) Oct./Dec. 2005. Abstract Rosewood (*Aniba rosaeodora* Ducke, Lauraceae) is ecologically and economically important to the Amazon region. As a consequence of its economic importance, rosewood populations have been decimated in the Amazon forest. Species of nine genera of the Lauraceae family have characterized karyotypes with n = x = 12 chromosomes in the gametophytic phase but the genus Aniba is one of the least studied Lauraceae genera with a previously undescribed genome. We used cytogenetic techniques to determine that the *A. rosaeodora* karyotype contained 12 pairs (2n = 24) of relatively small submetacentric chromosomes with lengths ranging from 1.34 to 2.25 mm and a nucleolar organizer region (NOR) in the short arm of chromosome 7. Flow cytometry gave 2C = 2.32 pg of DNA, equivalent to approximately 2.24 x 109 base pairs.

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Gonçalves J.F.C., Barreto D.C.S., Santos Junior U.M., AV (2005) "Crescimento, fotossíntese e indicadores de estresse em plantas jovens de pau-rosa (*Aniba rosaeodora* Ducke) sob diferentes intensidades luminosas. [Growth, photosynthesis and stress indicators in young rosewood plants (*Aniba rosaeodora* Ducke) under different light intensities.]" *Braz. J. Plant Physiol.*, July/Sept. 2005, **17**(3), 325-334. Abstract. *Aniba rosaeodora* is an Amazonian tree species that belongs to the family Lauraceae. Due to intense exploitation for extraction of essential oils (mainly linalol), *A. rosaeodora* is now considered an endangered species. On the other hand, there is little information about its ecophysiology which would be useful to support future forest planting programs. Hence, the effect of different light intensities on the growth and photosynthetic characteristics of young plants of *A. rosaeodora* was studied. Nine-month-old plants were subjected to four light treatments (T1= 10 a 250 µmol.m-2.s-1 / control; T2=500 to 800, T3=700 to 1000 and T4=1300 to 1800 µmol.m-2.s-1 / full sunlight). Allometric variables, gas exchange, contents of pigments and chlorophyll a fluorescence were analysed. As to the relative growth rates, it was found that plants of *A. rosaeodora* showed higher biomass accumulation when grown under intermediary irradiance conditions (T2). The best photosynthetic performance was achieved under conditions of T3. When growth was correlated with photosynthesis, it was found that plants under treatments T2 and T3 presented better responses in comparison with the lowest (T1) and highest (T4) light extremes. The highest pigment contents were obtained for plants in the shade (T1) and the lowest for those exposed to full sunlight (T4). The photochemical efficiency of photosystem II (Fv/Fm) was found that only plants in the shade treatment (T1) presented no stress from high irradiance. These findings suggest that both treatments (T1 and T4) altered the function of the *A. rosaeodora* plants, inhibiting photosynthesis and growth. Plants of *A. rosaeodora* developed photo-protection mechanisms under full sunlight. However, the species presented better photosynthetic response and biomass gain under intermediary irradiance conditions, displaying relative physiological plasticity, during the seedling phase.

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Kostermans, A. J. G. H (1938) *Recueil Trav. Bot. Néerl*. **35**, 924.

Kubitzki K. (1982) "*Aniba*.". In *Flora Neotropica. Lauraceae*. Monograph No. 31. 84 pp.

Leite A.M.C. (1999) *Informacoes preliminares sobre a ecologia de pupulacao do pau-rosa - Aniba rosaeodora Ducke (Lauraceae).* Manaus: Embrapa Amazonia Ocidental, 1999.. 6p..

Leite A.M.C., Salomao A.N. & Lleras E. (1991) *Areas Prioritarias para Conservacao de Cinco Especies da Floresta Tropical Umida* [incl. *Aniba rosaeodora*]. 26 pp. Brasilia: EMBRAPA.

Lupe F., Souze R & Barata L. (2008) "Seeking a sustainable alternative to Brazilian rosewood." *Perf & Flav*. **33** (July 2008) pp40-43. ***Cropwatch comments:*** this article has been extensively critiqued at http://www.cropwatch.org/v105.pdf.

Maia N.B., Bovi O.A., Perecin M.B. Marques M.O.M. & Granja N.P. (2004) "New crops with potential to produce essential oil with high linalool content helping preserved *A. rosaedora* – an endangered Amazonian species." *Acta Hort*. (2004), 629. Abstract. Rosewood (*Aniba rosaeodora*) is a world famous tree of the Lauraceae family, growing wild in the Amazon rainforest. Essential oil rich in linalool (up to 86 % w/w) is extracted from its trunk and traded to the perfume industry. Nowadays, this essential oil is primarily used in the higher priced/fine perfumes, in earlier times the lumber was used for carpentry. The predatory exploration of the tree for extraction of the essential oil began in the 1920s. Because of the growing harvest pressure on the tree and the high demand for the oil, this species is now becoming endangered, despite many restrictive regulations by the Brazilian government designed to help in its conservation. Other Essential oils of *Coriandrum sativum* L, *Bursera delpechiana, Citrus spp, Citrus aurantium subsp. amara* L, *Laurus nobilis* L, *Cinnmamomun camphora,* *Cinnamomun verum* L, *Matricaria chamomilla* L, *Salvia sclarea* L., *Lavandula officinalis* Chaix *et* Villars and *Ocimum basilicum*, were analysed to determine the linalool content and the potential to substitute for rosewood oil. Despite the different chromatographic profile of rosewood essential oil and compared with, O. *basilicum*, this plant species has agronomic advantages over the others, easier cultivation and propagation, that makes it a potential alternative source for the rosewood oil under certain circumstances

Maia J. G. S., Zoghbi M. G. B. & Andrade E. H. A. (2001) *Plantas aromáticas na Amazônia e seus óleos essenciais*, Museu Paraense Emílio Goeldi: Belém, 2001.

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Margolis M. (2004) "Jungle economics: Environmentalists though they could save the rain forest and make money at the same time. They were wrong." *Newsweek International* 16.02.2004

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May P.H. & Barata E.S (2004). "Rosewood exploitation in the Brazilian Amazon: Options for sustainable production" *Economic Botany* **58**(2) pp257-265. Abstract. The authors report on ongoing work in the Brazilian Amazon to assess the current and prospective management of rosewood (*Aniba rosaeodora* Ducke) populations threatened by a half-century of predatory extraction for the valuable essential oil linalool used widely in perfumery. The report synthesizes prior research on rosewood exploitation and markets and recent research to develop new essential oil products derived from rosewood leaves and stems. The study suggests alternative rosewood production systems, to guide investment in management and certification of sustainable rosewood oil supplies. ***Cropwatch comments:*** Cropwatch extensively critiqued this paper for its many scientific errors at http://www.cropwatch.org/cropwatch6.htm

Mitja D. & Lescure J.-P. (1996) "Du bois pour da parfum : le bois de rose doit-il disparaître?" In L. Emperaire ed. *Le forêt en jeu l'extrativisme en Amazonie Centrale* UNESCO-ORSTOM, Paris pp93-102. through May & Barata (2004) above.

Morais A.A., Rezende C.M.A.M., Bulow M.V.V., Mourao J.C., Gottlieb O.R., Marx M.C., Rocha A.I. & Malgalhaes M.T. (1972) "Oleos essenciais de especies do genero *Aniba*." *Acta Amazonica*, **2**, 41-44.

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Ohashi S.T., Rosa L.S., Olivera F.A., Santana J.A. and Simons A. (1993) "A strategy for collection, conservation and utilization of genetic resources of *Aniba rosaeodora*." *Forest Ecology Managemen* 1993

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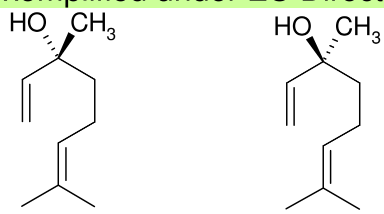
***Aniba rosaedora* – Safety Issues.**

Rosewood oil is not restricted IFRA, and was previously found non-toxic, non-irritating & non-sensitising (Opdyke (1975). Under the EFFA CoP 2008 v2, Rosewood oil is classified Xi Irritant, with associated risk phrases R(38-43-52/53). Linalol, as a mixture of the enantiomers (3R)-(-)-linalol and (3S)-(+)-linalol, occurs at 84 to 93% in unadulterated rosewood oil. Linalol ex Rosewood oil was once extensively used as a perfumery material in its own right, its odour profile being preferred to the blander synthetic version. Linalol is an alleged allergen according to EU Directive 2003/15/EC, however the experimental and clinical evidence for this is flimsy, and its status as an allergen has been disputed (Schnuch *et al*. 2007; Hostyneck & Mailbach 2008). The European Commission has recently asked the SCCP to update its opinion with respect to the notorious '26 allergens situation' as exemplified under EU Directive 2003/15/EC.



(3R)-(-)-linalol (3S)-(+)-linalol

Hostyneck J. & Mailbach H. (2008) "Allergic contact dermatitis to linalool" *Perfumer & Flavorist* May 2008, **33**, 52-56.

Opdyke D.L.J. (1975) "Rosewood Oil" *FCT*, **16**, 653. ***Cropwatch comments:*** Opdyke summarised the literature indicating that Rosewood oil was reported to have anti-convulsant activity in mice & rats, spasmolytic activity on isolated guinea pig ileum, and anti-microbial properties. It was also reported as relatively non-toxic, non-irritating and non-sensitising (!).

Schaller M, Korting H C (1995) "Allergic airborne contact dermatitis from essential oils used in aromatherapy." *Clin Fxper Dermatol* **20**(2), 143-145. ***Cropwatch comments***: A 53-year old patient with re-occurring eczema on the scalp, neck & hands which was resistent to treatment was patch tested with various essential oils. Sensitisation was found due to previous exposure to lavender jasmine & rosewood, and a diagnoisis of airborne contact dermtitis was given.

Schnuch A., Uter W., Geier J., Lessmann H., Frosch P.J. (2007) "Sensitization to 26 fragrances to be labelled according to current European regulation. Results of the IVDK and review of the literature." *Contact Dermatitis.* **57**(1),1-10.

Sköld M., Börje A., Matura M. & Karlberg A.-T. (2002) "Studies on the autoxidation and sensitizing capacity of the fragrance chemical linalool, identifying a linalool hydroperoxide." *Contact Dermatitis* **46**(5), 267-272. Abstract. Fragrances are among the most common causes of allergic contact dermatitis. The two monoterpenes linalool and d-limonene are the most frequently incorporated fragrance chemicals in scented products. Previous studies on d-limonene show that this monoterpene oxidizes on air exposure (autoxidation) and that allergenic oxidation products are formed. Due to structural similarities, linalool might also form allergenic oxidation products on air exposure. The aim of the present study was to study the autoxidation of linalool and to investigate the

sensitizing potential of linalool before and after air exposure. Linalool was oxidized for 10 weeks and gas chromatographic analyses showed that the content of linalool decreased to about 80%. The chromatograms revealed the formation of other compounds during oxidation. One of the major oxidation products was isolated and identified as 7-hydroperoxy-3,7-dimethyl-octa-1,5-diene-3-ol. This substance is, to the best of our knowledge, described for the first time. In sensitization studies in guinea pigs, linalool of high purity gave no reactions, while linalool that had been oxidized for 10 weeks sensitized the animals. It is concluded that autoxidation of linalool is essential for its sensitizing potential.

***Aniba rosaedora* – Therapeutic Effects.**

de Almeida R.N., Araújo D.A., Gonçalves J.C., Montenegro F.C., de Sousa D.P., Leite J.R., Mattei R., Benedito M.A., de Carvalho J.G., Cruz J.S. & Maia J.G. (2009) "Rosewood oil induces sedation and inhibits compound action potential in rodents." *J Ethnopharmacol.* **124**(3), 440-3. Abstract. AIM OF THE STUDY: *Aniba rosaeodora* is an aromatic plant which has been used in Brazil folk medicine due to its sedative effect. Therefore, the purpose of the present study was to evaluate the sedative effect of linalool-rich rosewood oil in mice. In addition we sought to investigate the linalool-rich oil effects on the isolated nerve using the single sucrose-gap technique. MATERIALS AND METHODS: Sedative effect was determined by measuring the potentiation of the pentobarbital-induced sleeping time. The compound action potential amplitude was evaluated as a way to detect changes in excitability of the isolated nerve. RESULTS: The results showed that administration of rosewood oil at the doses of 200 and 300 mg/kg significantly decreased latency and increased the duration of sleeping time. On the other hand, the dose of 100 mg/kg potentiated significantly the pentobarbital action decreasing pentobarbital latency time and increasing pentobarbital sleeping time. In addition, the effect of linalool-rich rosewood oil on the isolated nerve of the rat was also investigated through the single sucrose-gap technique. The amplitude of the action potential decreased almost 100% when it was incubated for 30 min at 100 microg/ml. CONCLUSIONS: From this study, it is suggested a sedative effect of linalool-rich rosewood oil that could, at least in part, be explained by the reduction in action potential amplitude that provokes a decrease in neuronal excitability.

Franchomme P. & Peneol D (1990) *l'aromathérapie excactment* pub. Jollois. ***Cropwatch comments:*** Franchomme & Peneol (1990) cite the following properties, for the oils of *A. parviflora* and *A. rosaedora* var. *amazonica*:: anti-infectious, anti-bacterial, anti-fungal, anti-viral, anti-parasitic, tonic and stimulant, suggesting use in oral & bronchial infections of adults, children and babies, vaginal candidosis, nervous depression, fatigue, and note its' non-aggressive properties towards the skin and mucous membranes. Although some 796 references are included at the end of latter authors' work, it is unclear which, if any, specifically refer to these stated therapeutic claims

Manley C H (1993) "Psychophysiological effect of odor." *Crit Rev Food Sci & Nutrition* **33** (1):57-62 ***Cropwatch comments*:** An electroencephalographic method was used by the authors to measure slow brain wave responses, the technique being known as 'contingent negative variation' (CNV). The odours of sixteen essential oils (basil, bergamot, rosewood, chamomile, clove, geranium, lemon, lemongrass, marjoram, neroli, patchouli, peppermint, rose, sage, sandalwood and valerian – botanical sources unstated) were used to create brain wave patterns. which were exclusive of any optical or aural stimulation, and also found to be independent of the level of consciousness, psychological state or degree of arousal of the subject. The stimulation of the brain by the odours of the individual oils caused changes in the magnitude of CNV; increased, decreased or unchanged CNV magnitude led to stimulant, sedative or neutral descriptive classifications for the oils.. The age, sex, national origin or race of the subjects did not appear to affect the results. The authors found that the CNV classification of the majority of the oils corresponded with their established aromatherapeutic uses.

Peana A.T., D'Aquila P.S., Chessa M.L., Moretti M.D., Serra G. & Pippia P. (2003) "(-)-Linalool produces antinociception in two experimental models of pain" *Eur J Pharmacol* **460**(1), 37-.

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***Aniba rosaedora* – Other,**

Burfield T. & Sheppard-Hanger S. (2003) "Substituting for Rosewood oil *Aniba rosaeodora* var. *amazonica* Ducke" *Aromatherapy Today* 2**6**, June 2003, pp30-37.