New Crops with Potential to Produce Essential Oil with High Linalool Content Helping Preserve Rosewood – An Endangered Amazon Species

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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.

INTRODUCTION

Rosewood is the English name of *Aniba rosaeodora*, a species of the Lauraceae family occurring all over the Amazon region (Guenther, 1949), mostly in the middle Amazon River (Carneiro Filho, 2000). The essential oil extracted from its trunk, due the high content of linalool, has a pleasant aroma and the industry uses it in expensive and well known perfumes (Guenther, 1948).

Rosewood wood was used since the beginning of the South America colonial history by the European carpentry and furniture industry. By the end of 18th century, its aromatic properties started to be explored. By 1924, some steam distilleries started to operate in the Amazon region to extract essential oil (Guenther, 1948). The distillation process consists of transforming the whole trunk into chips and/distilling them with steam and/condensing the steam in a heat changer to recover the essential oil. As the price of the essential oil is very attractive, approximately US \$80.00 kg $^{-1}$ (Vial-Debas, 2000), trees of any age or trunk diameter are indiscriminately cut even in the deep forest, and its natural propagation is seriously compromised. For this reason, the species is in danger, despite many restrictive regulations aimed at its conservation. Despite laws to regulate, sustainable exploration and replanting of the legally harvested individuals (SUDAM, 1971; Vial-Debas, 2000), the species is still being exploited and is vanishing in much of its natural habitat. Artificial propagation has a low rate of success and aggravates the problem (Sampaio, 1989; Mitja & Lescure, 2000).

Looking ahead to the preservation of the rosewood tree, *(Aniba rosaeodora*) this work analyzed five different species that produce essential oils containing a reasonable linalool content, that can act as alternative producers of essential oil rich in linalool and to reduce the predatory exploitation of the tree. By attempting to produce the essential oil in large enough quantities to reduce the price to a level that will discourage predatory

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harvesting and distillation of the oil as well as providing and additional cash croup to small farmers in the production of an alternative source of natural linalool.

MATERIALS AND METHODS

The essential rosewood oil that was used as control was bought in the Amazon open market from a regular distillery. Alternative species were cultivated in soil at the Agronomic Institute Experimental Farm in Campinas, Brazil (22^0 54' S, 47^0 05' W, 674 m above sea level). The species cultivated were: coriander (*Coriandrum sativum* L.), linaloe (*Bursera delpechiana*), bitter orange (*Citrus aurantium* subspécie *amara* L.), orange (*Citrus spp.*), laurel (*Laurus nobilis* L.), camphor (*Cinnamomum camphora* Sieb.), cinnamom (*Cinnamomum verum* L.), chamomile (*Matricaria chamomilla* L.), sage (*Salvia sclarea* L.), lavander (*Lavendula officinalis* Chaix et Villars) and basil (*Ocimum basilicum* L.). Those species were selected for their essential oil yields and linalool content (Table 1).

The oil was extracted by steam distillation according to the method described by Guenther (1948), after 50 minutes in a modified Moritz apparatus (Costa, 1975). The essential oil composition was analyzed using a GC-MS (Shimadzu model QP5000) equipped with J & W Scientific DB-1 fused silica capillary column (30 m X 0.25 mm X 0.25 μm); column temperature program: 40 °C (5min) – 100 °C, 3°C min^{-1}, 100 °C - 200°C, 10 °C min^{-1}. The electron impact technique (70 eV) was used. Analysis conditions of the 1 μL sample were: injector and detector at 250 ºC and 230 ºC, respectively, He as the carrier gas, with a flow rate of 1.7 ml min^{-1}, split 1/15. The identification of the chemical constituents was based on comparison of the mass spectra of the substances with the GC-MS data banks and that of the literature (McLafferty & Stauffer, 1989).

RESULTS

The essential oil extracted from the cultivated plants and its linalool content was compared with the composition of rosewood extracted in Amazon and used as control (Table 2).

Some essential oil of plants studied in this work that did not produce, or it was not possible to detect, significant quantities of linalool, even though they were sighted in the literature references (Table 3). Although chromatograph analysis detected essential oil components up to 0.01 %, only concentrations above 2 % are shown in both tables.

DISCUSSION

Five species produced essential oil with significant linalool content: camphor, laurel, basil, citrus and linaloe, with 56.15, 43.57, 30.73, 22.40 and 17.5 % respectively. The ease of cultivation and the essential oil yield make citrus, basil, and laurel good species for further research, there by permitting the possibility o isolating an economic substitution for the essential oil extracted from rose wood.

Linaloe, the species well known to be rich in linalool, since earlier times, produces an essential oil extracted from the branches with only 17 % concentration of linalool according to our tests. High content of neril acetate (70 %) a compound that produces "pleasant notes" (a term used in the perfume industry to classify certain pleasant aromas) in relation to its essential oil. Nevertheless, the slow growing rate and difficult propagation of the tree make it difficult and expensive to use as an alternative. The same can be said about laurel and camphor. Our findings did not concur with Massada (1976) and Vilal-Debas (2000) whose findings showed 85 % of linalool in the same plants from Japan, essential oil of camphor cultivated in Brazil under different conditions produced 56 % of the oil.

Citrus are a good source of linalool. The Brazilian juice industry produces essential oil as a byproduct from the fruit peels at very low prices, but theirs is poor in linalool. The essential oil extracted from the leaves of the two *Citrus* species studied in this work, shows that a great variability should be expected and further research should be developed as the large areas of citrus cultivation in Brazil offers a potential worth looking at.

Besides species variability, other factors such as soil fertility and plant nutrition are just as important in the production of high quality of essential oil. (Maia et al., 2001) and should be studied in this case. *O. basilicum* has agronomic advantages, due its ease in cultivation, propagation, and short growing seasons from planting to harvest that clearly makes it a potential alternative for rosewood oil, due its high content of linalool (31 %.)

New technologies for extraction, as super critical fluids, would be essential in the production of linalool from species other than rosewood, due its precision in extracting only the wanted substance at low temperatures. The combination of the new extraction technology along with alternative crops, could make it possible to have other less endangered sources of essential oil rich in linalool, with good high quality, and able to substitute the rosewood as the main source of essential oil, not to mention the economic advantages and the introduction of a new more environmentally friendly system, slowing down the current predatory exploration.

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Literature Cited

Carnero Filho, A. 2000. Os principais produtos extrativistas e suas áreas de produção. A floresta em jogo – O extrativismo na Amazônia Central. São Paulo: UNESP, p.91-97.

Costa, A.F. 1975.Métodos que isolam as essências por destilação aquosa. In: Costa, A.F. Farmacognosia. 3.ed. Lisboa: Fundação Calouste Gulbenkian, cap.3, p.436-440.

Finnemore, H. 1926. The essential oils. London: Ernest Benn, 880p.

Guenther, E. 1948. The essential oils: history - origin in plants production - analysis. Vol 1. New York: D. Van Nostrand, 427 p.

Guenther, E. 1949. The essential oils: individual essential oil of the plant families Vol 3. New York: D. van Nostrand, 777 p.

Guenther, E. 1952. The essential oils: individual essential oil of the plant families. Vol 5. New York: D. van Nostrand,. 507 p.

Maia, N.B., Bovi, O.A., Marques, M.O.M., Granja, N.P. and Carmello, Q.A.C. 2001. Essential oil production and quality of *Mentha arvensis* L. grown in nutrient solutions. In: international Symposium on Growing Media and Hydroponics. Acta Hort., v.548.

Massada, Y. Analysis of essential oils by gas chromatography and mass spectrometry.

New York: John Wiley & Sons, 1976. 334.

McLafferty, D.B. and Stauffer, D.B. 1989. The Wiley/NBS Registry of mass spectral data. Vol. 1-7, Wiley, New York.

Mitja, D. and Lescure, J.P. 2000. Madeira para perfume: qual será o destino do pau-rosa? A floresta em jogo – O extrativismo na Amazônia Central. São Paulo: UNESP, p.99-107.

Sampaio, P.T.B., Parente, R.C.P. and Noda, H. 1989. Enraizamento de estacas de material juvenil de pau-rosa (*Aniba roseadora* Duck - Lauraceae). Acta Amazônica. v.19. p.391-400.

SUDAM 1971. O extrativismo do pau-rosa. Belém: Assessoria de programação e coordenação – Divisão de documentação. Ministério do Interior, 40p.

Vial-Debas, C. 2000. Da tora ao linalol: uma interface econômica-ecológica. A floresta em jogo – O extrativismo na Amazônia Central. São Paulo: UNESP, p.183-190.

Tables

Table 1. Essential oil yield and linalool content of the species studied, according to the literature.

Species	**Reference**	**Oil (%)**	**Linalool (%)**
Rosewood	Guenther (1948) / Massada (1976)	0.7 –1.2	83- 87
Coriander	Massada (1976) / Vial-Debas (2000)	0.4 – 1.1	60 - 70
Linaloe	Finnemore (1926) / Guenther (1948)	0.6 – 1.0	60 -70
Orange	Finnemore (1926) / Massada (1976)		22
Laurel	Finnemore (1926) / Massada (1976)	0.5	
Camphor	Guenther (1948) / Vial-Debas (2000)		85
Cinnamom	Massada (1977) / Vial-Debas (2000)	0.1 – 0.2	23
Chamomile	Massada (1997) / Guenther (1952)	0.3 – 1.0	
Sage	Massada (1976)	0.1 – 0.2	32
Lavander	Massada (1976) / Guenther (1949)	0.05 – 0.10	28 - 46
Basil	Massada (1976) / Guenther (1949)	0.01 – 0.08	

Table 2. Main components of essential oils of species with potential to produce linalool, cultivated in Campinas, Brazil.

	Species					
	rosewood	linaloe	citrus spp	laurel	camphor	basil
Substance	(%)					
Linalool	86.08	17.45	22.40	43.57	56.15	30.73
Linlool Oxide <Cis>	2.95					
Linlool Oxide <Trans>	2.81					
δ-Elemene				3.18		
α-Fenchene				3.22		
β-Mircene			2.73			
α-Terpenyl Acetate				4.70		
α-Terpineol	2.29	5.71				
1,8-Cineole					5.89	6.61
Butyl Acetate			6.47			
Camphor					28.26	
Canfene				8.78		
Cariofilene						18.83
Citronellal			6.75			
Dl-Limonene			2.81			
Eugenol				2.67		
Metil Eugenol				4.45		
Naftalene						8.58
Neril Acetate		68.11				
Sabinene			28.70	2.83		
Trans-β-Ocinene			5.09			

Table 3. Essential oil composition of species shown in Table 1 that did not produce linalool in the study.

	Species						
	coriander (seeds)	coriander (leaves)	bitter orange	sage	cinnamon	chamomile	lavender
Substance	(%)						
α-Bisabolol Oxide A						56.47	
α-Bisabolol Oxide B						9.39	
β-Fanesene						4.91	
α-Felandrene							5.67
δ-Gurjunene				4.27			
α-Humulene				2.38			
β-Mircene							3.60
α-Pinene				5.27			
1,8-Cineole				3.22			28.30
1-Decanal		4.79					
2-Nonanal		24.12					
3-Carene					3.09		
Butyl Acetate	17.96						
Camphor	3.14			25.76			28.02
Canfene				2.91			
Cinaldeide					16.63		
Cis-Thujone				41.74			
Decanal		28.71					
Dodecanal	2.67	4.20					
Eugenol					58.77		
Isoborneol							9.94
Isoeugenol Acetate					10.22		
Lavandulyl Isobutyrate	3.46						
Neril Acetate			74.51				
Nonane		2.42					
Terpinolene	65.55						
Trans-2-Dodecanal		11.35					
Trans-2-Nonanal		3.57					
Trans-2-Undecanal		3.54					
Trans-Thujone				5.80			