AGARWOOD RESIN PRODUCTION FROM WALLA PATTA (*GYRINOPS WALLA*): THE TREE OF THE FUTURE

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"Walla patta", scientifically known as *Gyrinops walla*, a tree which had no commercial value a few months back, suddenly came under the spot light in Sri Lanka due to frequent efforts made to smuggle it out of the country. The reason of smuggling was believed to be the resinous tissue of agarwood which is produced inside the stem of this particular tree. The agarwood resin extracted from other species has been used for centuries in the Arab region and in some Asian countries. However, it is the first time that evidence was found on the production of agarwood resin in walla patta. Agarwood resin is a highly fragrant and very valuable resin produced by certain species of the family Thymelaeaceae as a result of a self-defence mechanism. The resin is highly sought after for religious, medical, ceremonial and domestic activities by Asian Buddhists and Moslems. In addition to that, a large demand is seen for agarwood resin in Southeast Asia, Middle East and United States as a perfumery agent. The extreme value of the agarwood resin depends on the oleoresin content of the wood. For instance, first grade agarwood resin is one of the most expensive natural raw materials in the world, with prices in consumer countries ranging from a few dollars per kg for low quality material to more than US$ 30,000 per kg for top quality wood. Agarwood oil fetches similarly high prices. Agarwood resinous substance occurs mainly in the trees of the genus Aquilaria which can be found from the foothills of the Himalayas to the rain forests of Papua New Guinea. In addition, agarwood resin is produced in three other genera, i.e., Gyrinops, Aetoxylon and Gonystylis of the family Thymelaeaceae. The agarwood resin production ability of walla patta was first reported in 2012 by the author.

Irrespective of the species, the presence of agarwood resin is seen in a small percentage of trees which are growing naturally. The process of this production is the tree's response to injury where its first line of defense, formation of phloem callus tissue, is inhibited from forming over the injury. Formation of agarwood resin can mechanically be initiated by the creation of open wounds on the trunk of the tree.

It is a common practice nowadays to apply mechanical injuries on the stem and branches at regular intervals to initiate early infection.

These injuries provide ready infection sites and also pushes the tree to undergo a stress condition, which helps in spreading of the infection. This practice yields better results when there is a microbial population already built up in the soil and also when the climate is warm and humid. These cut injuries further serve as the initial sites of fungal infection.

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Agarwood resin is not a uniform product, but instead possesses different characteristics. Therefore it is classified according to various grading systems that differ according to the product in trade and country in which trading is taking place. The grade (and hence value) of agarwood resin and its derivatives such as oil is determined by a complex set of factors including: country of origin; fragrance strength and longevity; wood density; product purity; resin content; colour; and size of the form traded.

Agarwood resin has been used for medicinal purposes for thousands of years, and continues to be used in Ayurvedic, Tibetan and traditional East Asian medicine. The Sahih Muslim, which dates back to approximately the eighth century, refers to the use of the resin for the treatment of pleurisy and its use is referenced in the Ayurvedic medicinal text the *Susruta Samhita*. It is prescribed in traditional East Asian medicine to promote the flow of *qi*, relieve pain, arrest vomiting by warming the stomach, and to relieve asthma. High-grade agarwood resin powder is prescribed in Chinese medicine and is also used in the production of pharmaceutical tinctures. Furthermore, Malaysians used agarwood resin mixed with coconut oil as a liniment, and also in a boiled concoction to treat rheumatism and other body pain. It is also used as a complex ointment for smallpox and for various abdominal complaints.

The use of agarwood resin for perfumery extends back several thousands of years, and is referenced, for example, in the Old Testament several times using the term 'aloes'. Both agarwood smoke and oil are customarily used as perfume in the Middle East. In addition, the perfumes manufactured using agar oil as a base has become increasingly popular in USA and Europe.

Agarwood incense is burned to produce a pleasant aroma, its use ranging from a general perfume to an element of important religious occasions. Irregular chunks of agarwood, usually a few centimetres long and weighing 10-200 g, may be cut or broken into smaller pieces and then burned, usually in a specially made incense burner. Agarwood powder and dust cannot be burnt directly in incense holders, but can be used to make incense sticks or coils for indoor fragrance, and are used for religious purposes by Muslims, Buddhists and Hindus.

Nine species out of 15 recorded Aquilaria species *i.e., A. beccariana, A. crassna, A. filaria, A. hirta, A. khasiana, A. malaccensis, A. microcarpa, A. rostrata, and A. sinensis produce* agarwood resin. Moreover, resin production has been recorded from *Gyrinops ledermanii* and *G. versteegii* from the recorded eight species of Gyrinops. The author has identified the ability of walla patta *(Gyrinops walla)* for producing agarwood resin for the first time. In addition to that, preliminary studies have proven that the quality of the resin produced by walla patta is similar to that are available in the market produced by Aquilaria species.

Aquilaria trees are native to Asia from northern India to Vietnam and Indonesia. However, none of the species of the Aquilaria genus has been recorded in Sri Lanka. Walla patta is the only member present in Sri Lanka of the genus Gyrinops. According to the floristic records, outside the wet zone of Sri Lanka, "walla patta" had been recorded only in the extreme southwest of India, where it appeared to be very rare. Therefore it can be assumed that, walla patta occurs only in Sri Lanka at present based on the lack of information on finding this species in India.

"Walla patta" is a medium-tall tree which grows up to 15 m in height with a straight, slender trunk and a small, rounded crown. It bears a thin, brownish-grey bark which is smooth and strongly fibrous. Therefore its bark is used as a binding material by the villagers. Twigs are slender and wiry, rather shining and chestnut-brown in colour when young. Leaves are oblong and 3.0-9.0 cm x 1.2-5.0 cm with a short, rather abrupt, bluntish acumen up to 1 cm long. Petiole is short and 1-6 mm in length. Inflorescence is terminal or few flowered with umbel-like heads. Pedicels are 3-4 mm and thinly pilose. Flowers are yellowish-white and the size of the calyx tube is 4-10 mm which is narrow.

During the study carried out in identifying the agarwood resins of walla patta, the presence of those constituents were identified using gas chromatography analysis. In addition, those compounds identified in "walla patta" were compared with the commercially available agarwood resins of Aquilaria species. For that reason, chromatograms and indices obtained from authentic agarwood samples were used for confirmation of published data.

The resin contents of the samples varied from 4.4% to 10.9% with an average of 6.81%. However, since artificial resin induction had not been done and the naturally wounded areas of the selected trees were used for the present study, the pattern of the development of the tissues of the plants was not identified.

The results of the gas chromatography analysis revealed that the agarwood resins of "walla patta" contained several aroma principles commonly found in agarwood. Sesquiterpenes of guaiane and eudesmane skeleton were also present. These compounds were known to produce a characteristic camphor like aroma with woody and floral notes. In addition, several fatty acids were also found to be common between the authentic and test samples. The following table illustrates the presence and the similarity of six main agarwood resin compounds in the tested *Gyrinops walla* and *Aquilaria crassna* trees.

Compound	Retention Index		Percentage area ± Standard deviation
	G. walla	*A. crassna**	
jinkho-eremol	1641	1643	0.58 ± 0.1
selina--3,11-diene-9-one	1689	1687	2.22 ± 1.89
selina--3,11-diene-14-al	1733	1735	5.35 ± 1.62
9,11-eremophiladien-8-one	1741	1740	1.44 ± 0.74
guaia-(10),11-dien-15-ol	1766	1770	1.76 ± 0.45
oxo-agarospirol	1818	1822	0.98 ± 0.38

Agarwood oils vary in their composition between trees. According to the previous studies, over 57 major compounds have been identified. The main compounds in the resin have been revealed to be sesquiterpenes and chromone derivatives.

Various techniques are used for agarwood oil extraction such as hydro-distillation, solvent extraction, and supercritical fluid extraction. Each technique has advantages and disadvantages. The classical method that is currently used in commerce for the agarwood oil extraction is hydro-distillation. This method consumes 7-10 days and high energy for extraction. The supercritical fluid carbon dioxide extraction is known as non-flammable, non-toxic, chemically stable and a less energy consumption method. It provides some advantages over classical method, since super critical carbon dioxide has low viscosity, high diffusivity, good transport properties and gives faster extraction and high yields.

International demand for agarwood resin is increasing and over the past decade it has resulted in over-exploitation. Poaching increases tree mortality, reduces the growth rate of pre-adults and adults, and decreases the percentage of adults that reproduce. Loss of lowland forest habitats also threatens populations of these species. Agarwood resin producing species are becoming more difficult to find, as reported by collectors, non-infected trees are increasingly being felled and collection is taking place within protected areas.

This over-use of agarwood resin producing species has therefore seriously affected the natural resources of all Aquilaria species capable of producing the resin, thus making these endangered species listed in Appendix II of the Convention on Internal Trade in Endangered Species of Wild Fauna and Flora (CITES) since 2004.

Based on the results of the studies conducted on "walla patta", it can be concluded that the resin formed in "walla patta" is strongly similar to that of the commercially available agarwood resin mainly extracted from Aquilaria species. Due to this finding and the present rate of illegal harvesting, if proper action is not taken by the government, the same fate of Aquilaria can befall the "walla patta" trees naturally growing in Sri Lanka causing its extinction. However, at the same time, it is essential to establish a proper mechanism to grow this tree in homegardens and as plantations so that a new industry can be developed in line with the "green economy" concept which can significantly contribute to the poverty alleviation.

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From Atta-ur-Rahman FRS.

The exciting developments in Science and Technology are transforming the world we live in. The only constant is change. Nations that can ride this change rather than be buried in it are surging forward, leaving others behind. The change is being driven by new scientific discoveries. These are then transformed into technologies. Then through innovation and entrepreneurship they become products of daily use. This is apparent in almost every sphere of our lives: Engineering goods, household appliances communication tools, electronics. Pharmaceuticals and many other fields are evolving with increasing rapidity.

Indigenous knowledge wizardry
Captain Cook's ship the Endeavour

In the winter of 1769 the British explorer Captain James Cook received from a Polynesian priest named Tupaia an astonishing gift, namely a Map showing all the major islands of the south Pacific. Some accounts say that Tupaia sketched the map on paper; others that he described it in words. The map instantly gave Cook a far more complete picture of the South Pacific than any other European possessed. It showed every major island group in an area some 3000 miles across from Marquesas to Fiji. It matched what Cook had already seen and showed much that he had not. Cook then granted Tupaia a berth on his exploration vessel the Endeavour, in Tahiti. Soon the Polynesian priest surprised Cook and his crew by navigating to an island unknown to Cook, some 300 miles south, without ever consulting compass, chart, clock or sextant. In the weeks that followed he helped guide the Endeavour, from one archipelago to another, and amazed the sailors by pointing out on request, at any time day or night, cloudy or clear, precisely toward Tahiti.

David Dobbs in the National Geographic Magazine January 2013.

"Climbing is akin to love. It is hard to explain. We endure pain for the joy that comes with discovering ourselves and the Planet..

Cory Richards, Mountaineer and Photographer,, National Geographic Magazine January 2013.