Chemical Prospecting of Malaysian Dipterocarpaceae from UiTM Pahang Forest Reserve (HSUiTM Pahang)

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ABSTRACT

A great majority of the Malaysian population relies on indigenous medicinal plants for treatment of diseases. The search for the plant constituents with potential activities for medicinal purposes can be performed successfully by chemical methods and, in combination with biological evaluation. However, the pre-selection process of plants to be investigated is also one of the most important pre-requisites. In the UiTM Pahang Forest Reserve (HSUiTM), there are many plants that have not been evaluated for their potential medicinal value. This paper presents a brief review on resveratrol in dipterocarpaceae plants and their health benefits.

Keywords: *Dipterocarpaceae, health benefits, natural product, resveratrol*

Introduction

The World Health Organization (WHO) reports that more than three quarters of the world population rely upon traditional remedies for their health care. In fact, plants are the oldest friend of mankind. Not only they provide food and shelter but also serve the humanity to cure different ailments (Gilani, 2003). Malaysia is blessed with the old and rich flora in world. Malaysians have a long tradition of benefiting from the rich and beautiful flora through our traditional medicine practices. However, until today, only a few species of the well-known plants have been studied for their chemical constituents and biological activities.

UiTM Pahang Forest Reserve (HSUiTM)

UiTM Pahang Forest Reserve (HSUiTM) is about 180 km North of Kuala Lumpur in the district of Maran, Pahang. The forest covers an area of about 100 hectares and is classified as secondary forest (A. Jalil, 1998). This land was contributed by the Pahang State Government in 1985 to be used for the wood and agriculture courses. This forest is a part of Jengka reserve forest. In the past, it functioned as an economy source for the local community especially to the Orang Asli society. The vegetation of this forest is classified as forest herbs, shrubs and trees. Several research on HSUiTM have been carried out in the aspects of management forest (Muzamil et al., 2002) and natural product resources (Ainun et al., 1998). However there has been no biological study carried out on this potential forest.

Dipterocarpaceae is a large family of tropical plants, consisting of 16 genuses which are *Anisoptera, Balanocarpus, Cotylelobium, Dipterocarpus, Doona, Drybalanops, Hopea, Isoptera, Neobalanocarpus, Parashorea, Shorea, Stemonoporus, Upuna, Vateria,* and *Vatica* and it has approximately 600 species. Three main genuses are *Shorea* which has 150 species, *Hopea* with 100 species and *Dipterocarpus* with approximately 75 species. In Malaysia they are known as *Meranti, Merawan and Keruing*. The local communities have used this plant for construction materials and, lately, they have also used the plant in the plywood industry. Dipterocarpus trees produce *'minyak keruing'* which is used locally for caulking boats and for torches, medicinal and other minor purposes. Meanwhile, *Shorea* and *Hopea* produce resin for varnishes. Research on chemical constituents in Dipterocarpaceae trees have been ongoing for many years. This family of tree plant produces a wide variety of natural products, including terpenoids, flavonoids, arylpropanoids and oligomer resveratrol. Research on the chemical constituents have focused on the resinous part which is terpenoid in nature and also on sesquiterpenes. Since hopeaphenol and polyphenol compound from oligomer resveratrol have been isolated from two species of *Hopea odorata* and *Balanocarpus heimee* in early 1950, research on resveratrol have been ongoing aggressively. This is supported by many of the latter class of compounds, which form the major polyphenolic constituents showing a variety of biological activities (Hakim, 2002).

Plant Material

There are nineteen species of Dipterocarpacaeae in HSUiTM Pahang as reported by A. Jalil (1998). The list of Dipterocarpacaeace species are shown in Table 1.

Table 1: Dipterocarpacaceace Species in HSUiTM Pahang

Vernacular Name	Scientific Name		Vernacular Name	Scientific Name
Balau kumus hitam	*Shorea maxwelliana*		Meranti Kepong	*Shorea ovalis*
Damar hitam	*Shorea multiflora*		Meranti sarang punai	*Shorea parvifolia*
Damar siput	*Shorea faguetiana*		Meranti melantai	*Shorea macroptera*
Kapur	*Dryobalanop aromatica*		Meranti pa'ang	*Shorea bracteolate*
Keruing gombang	*Dipterocarpus cornutus*		Meranti tembaga	*Shorea leprosula*
Keruing mempelas	*Dipterocarpus crinitus*		Meranti nemesu	*Shorea pauciflora*
Keruin ropol	*Dipterocarpus hasseltii*		Meranti belang	*Shorea resinosa*
Keruing merah	*Diterocarpus verrucosus*		Meranti rambai daun	*Shorea acuminate*
Keruing neram	*Dipterocarpus oblingo-folius*		Resak keluang	*Vatica bella*
Resak laru	*Vatica pauciflora*			

The plant can be chosen either randomly, based on the literature or consultation with local healers. After the right material has been chosen, the plant collection must be botanically identified and voucher specimen must be placed in the local herbarium. All data regarding the collection must be observed and documented, such as climate conditions, seasons, geographical localisation, environmental conditions, etc. in order to elucidate future differences in bioactivity compared with other results found. Any plant part can be used but reference to the literature or consultation with local healers is very useful to reduce research time.

Extraction and Isolation

Oligomer resveratrol compounds are usually isolated from the bark or the stem of the plant. However, one source reported the isolation of the compound from the leaf (Dai et al., 1998). In general, most of the resveratrol are semipolar and polar, so that, the extraction of the sample tested requires the semipolar and polar solvents like acetone, chloroform, methanol etc. Usually, the samples are soaked in semipolar solvent at room temperature for one to six days. Extraction process in the same solvent is repeated in duplicate to ensure that all of the semipolar compounds are extracted. Then, the sample is soaked again in polar solvents like ethanol or methanol to extract the more polar compounds.

Crude extracts are then partitioned with ether or ethyl acetate (Oshima et al., 1993), and then purified with chromatography techniques. Sometimes, the purification involves the crystalization process to produce pure oligomer resveratrol. Lastly, for structural eluicidation, the chemist will use a variety of instrumentation such as Neutron Magnetic Resonance (NMR) spectroscopy to know the Carbon (C) and Hydrogen (H) position in the molecule and, Infra Red (IR) spectroscopy to know functional group of the compound, mass spectroscopy is carried out to show molecular and fragmentation ions that reveal the amount of oligoresveratrol unit, while X-ray diffraction is carried out to reveal the absolute molecule structure and many more.

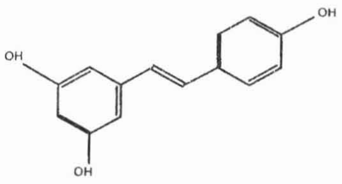
Resveratrol

Resveratrol was first isolated in 1940 as a constituents of the roots of white hellebore (*Veratrum grandiflora* O.Leos) but has been found in various plants including grapes (*Vitis vinifera*), *Vaccinum spp* such as blueberry, bilberry and cranberry, peanuts (*Arachis hypogaea*) (Aggarwal et al., 2004) and also in woody plants like Dipterocarpacaeae (Sootheswaran & Pasupathy, 1993). The first resveratrol from Dipterocarapaceae was isolated in early 1950 from *Hopea odorata* (meranti siput jantan) and *Balanocarpus heimeii* (Cengal). Resveratrol is naturally found in plants to protect them from disease, injury or fungal infection and it is called 'phytoalexins' (Sotheeswaran & Pasupathy, 1993). 'Phyto' means plant in Greek, while 'alexin' means to 'ward off' or to protect.

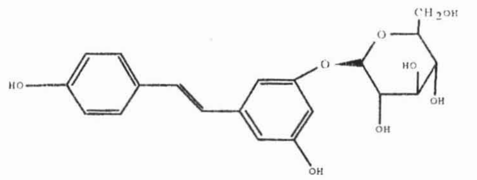
Chemistry of Resveratrol

The basic unit (monomer) of resveratrol is trans-3,5,4'-trihydroxystilbene . The resveratrol units are joined together by phenolic oxidative coupling reactions at several different active sites resulted in the formation of complicated oligoresveratrol (dimer, trimer, tetramer, heksamer and octamer) to form a resveratrol derivatives (Hakim 2002).

A. **Monomer resveratrol**

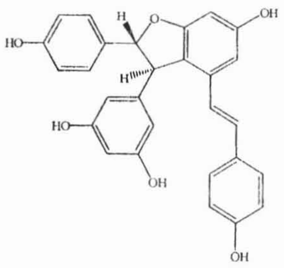


Resveratrol

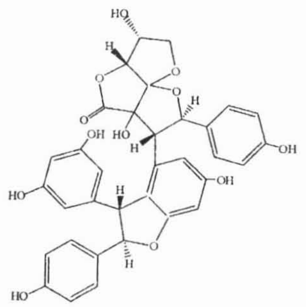


Resveratrol C-glukosida

B. **Dimer resveratrol**

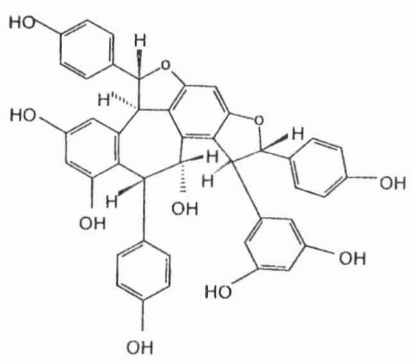


ε-viniferin

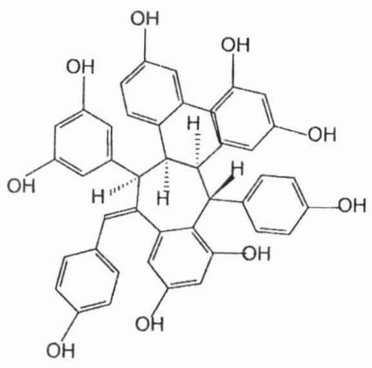


Laevifonol

C. **Trimer resveratrol**

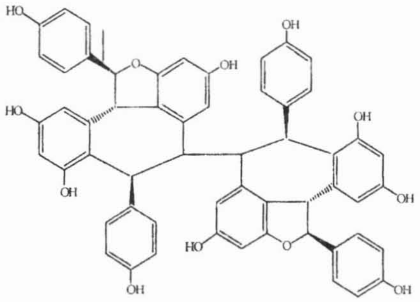


Hemsleyanol B

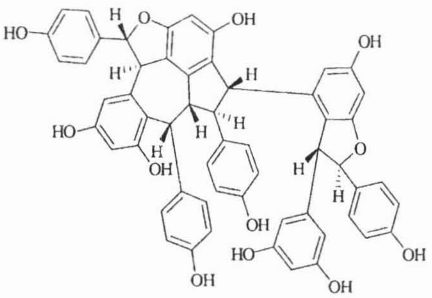


Stemonoporal A

D. **Tetramer resveratrol**



Vaticanol B



Hopeafenol

Health Benefits of Resveratrol

Cardiovascular Benefits

Studies have shown resveratrol inhibit blood clots (Kirk et al, 2000), which are known to contribute to heart attack strokes. Resveratrol has also been shown to enhance the production of nitric oxide which is a chemical that help to keep arteries relaxed, allowing for improvement in blood flow (Wallerath et al., 2002; Chen & Pace-Asciak, 1996).

Oxidative Stress

Resveratrol has been shown to act as an anti-oxidant (Ito et al., 2003). It scavenges free radials. Studies have shown that resveratrol improves diabetic neuropathy. Diabetic neuropathy is one of the most common complication affecting diabetics.

Neurodesenarative Disorders

Evidence has shown that resveratrol may be beneficial against nerve degeneration in diseases such as Huntington's, Parkinson's, Alzheimer's and stroke (Luo & Huang, 2006).

Cancer

Resveratrol has been found to increase the expression and activity of enzyme that help rid the body of potentially toxic carcinogenic compounds (Jang et al, 1997). It has also been shown to help in the fight against cancer cell that rapidly grow, by stopping them (Aggarwal et al, 2004). Furthermore, cancer cells in the body can also develop their own blood supply, which helps them to survive. However, resveratrol has been shown to stop this process (Igura et al., 2001). A number of human studies are currently underway to evaluate the role of resveratrol in cancer prevention (Anthar et al., 2007).

Inflammation

New research showing many chronic diseases is inflammation. Inflammation contributes to chronic disease such as cardiovascular disease and cancer through various mechanism.

Weight Control, Exercise Endurance, Anti-aging

Resveratrol can be effective in keeping the weight down. In middle-aged mice eating high calorie, fattening diets, resveratrol promotes a longer life span and shows increased survival similar to that of calorie restriction. The mice, fed on resveratrol kept their weight down compared to the control mice, and had doubled the running endurance Baur et al., 2006).

Conclusion

Natural product research and development has been an ongoing academic activity in Malaysia for many decades. Until recently, the level of success has been measured by the number of papers published. However, until today, very few species of the well-known plants have been studied for their chemical constituents and biological activities. This is because we do not have sufficient knowledge and experience coupled with the lack of coordination among scientists. In addition, in preparing ourselves to survive in the globalisation climate, we need to establish networks and strong collaborations among scientists, industrialists and institutions within the country and also amongst nations. Such activities and linkages will help our country to realise its vision to fortify the neutraceutical and pharmaceutical industries in Malaysia. We hope this report will be used as a platform to generate new ideas and collaborations and also to strengthen the existing ones.

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References

A. Hadi A. H. Message from the Chairman Of the Organizing Committee International Seminar & Workshop on Natural Product. *Proceedings of 19th International seminar on natural products* : Kuala Lumpur: 3

A. Jalil. (1998). Penggunaan kawasan kampus di UiTM Pahang. *Bengkel Pengurusan UiTM Cawangan Pahang.*

Ainun, J. M., Asmah, A., Mohd Supi, M., Noraishah, A. S, & Siti Zaiton , M. S. (1998). *Pengecaman tumbuhan bernilai komersial di Hutan Simpan ITM Cawangan Pahang serta penyaringan bahan-bahan sekunder.* Laporan Akhir Projek Penyelidikan Biro Penyelidikan dan Perundangan , Universiti Teknologi MARA, Shah Alam Selangor.

Aggarwal B.B, et al. (2004). Role of resrovetrol in prevention and therapy of cancer: preclinical and clinical studies. *Anticancer Res.* 24(5A): 2783-2840.

Baur et al. (2006). Resveratrol improves health and survival of mice on a high-calorine diet. *Nature*.006; 444(7117): 337-342.

Cronquist, A. (1981). *An integrated system of classification of flowering plant*: New York: Columbia University Press. pp.317-318.

Dai L. R., Hallock Y. F., Cardellina, J. H & Boyd M. R. (1998). HIV-inhibitory and cytotoxic oligostilbenoids from the leaves of Hopea maliboto. *Journal Natural Product* 61: 351-353.

Gilani U.H. (2003). *Role of medicinal plants in modern medicine*. International Seminar & Workshop on Natural Products, Kuala Lumpur.13th-16th October 2003: 33.

Hakim, E.H. (2002). Oligostilbenoids dari tumbuh-tumbuhan Dipterocarpaceae. *Bulletin of Indonesian Society Natural Product Chemistry* 2: 1-9

Ito, T., Tanaka, T., Iinuma, M., Nakaya, K., Takashi, Y., Sawa, R., Naganawa, H. & Chelladurai, V. (2003). New resveratrol oligomers in the stem bark of *Vatica pauciflora*. *Tetrahedron* 59:235-1264.

Igura K, et al. (2001). Resrevatrol and quercetin inhibit angiogenesis in vitro. *Cancer Lett.* 171 (1): 11-16.

Jang M, et al. (1977). Cancer chemopreventive activity of resveratrol, a natural product derived from grapes. *Science*. 275 (5297): 218-220.

Kirk, R. I., et al. (2000). Resveratrol decrease early signaling events in washed platelets but has little effect on platelet in whole blood. *Blood Cells Mol* Dis. 26(2): 144-150.

Luo, L. & Huang Y. M. (2006). Effects of resveratrol on the cognitive ability of Alzheimeros mice. [article in Chinese] Zhong Nan Da Xue Xue Bao Yi Xue Ban. 31 (4): 566-568.

Muzamil, M., Mazlin, K., Sarina, H. & Anuar, Y. (2002). Inventory and mapping of *Shorea* spp. In UiTm Jengka Campus Forest Reserve with Balau Kumus (Shorea laevis) as a new record. *Proceedings of Seminar on Forestry and Forest Based Industries –Socio Econiomics& Policy Isuues*: 47-55.

Oshima, Y., Kamijou, A., Ohizumi, Y., Niwa, M., Ito, J., Hisamichi, K., Takeshita, M. (1995). Tetrahedron 51, 11979-11986.

Symington, C.F. (1974). *Foresters' manual of dipterocarps*. Kuala Lumpur: Penerbit Universiti Malaya.

Wallerath T, et al. (2002). Resveratrol, a polyphenolic phytoalexin present in red wine, enhances expression and activity of endothelial nitric oxide synthase. *Circulation*. 106(13): 1652-1658.

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