CHEMICAL COMPOSITION IN *Eusideroxylon zwageri* & *potoxylon melagangai* WOOD

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2003

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ABSTRACT

This study was performed to determine and to compare chemical composition between two different species of tropical hardwoods from the family Lauraceae. The species used were *Eusideroxylon zwageri* and *Potoxylon* melagangai, taken from natural stand. *Potoxylon melagangai* was taken from two localities, which were from Mulu, Miri and Suai, Bintulu in Sarawak. Heartwood was the part of the wood to be examined in the chemical analysis and the samples were in the form of wood meals that retained in the 180μm-sized sieve. Chemical compositions determined were cold-water solubility, hot-water solubility, ethanol-acetone solubility, alkali solubility, content of lignin, holocellulose, alpha-cellulose, ash and silica. The results showed that all of the chemical constituents for both species were significantly different at significant level of 95% except for alpha-cellulose, ash and silica, which were not significantly different at a significant level of 95%.

Keywords: *Eusideroxylon zwageri*; *Potoxylon melagangai*; wood; chemical composition.

ABSTRAK

Kajian ini telah dijalankan untuk menentukan dan membandingkan komposisi kimia di antara dua spesies kayu keras tropika yang berlainan dari famili Lauraceae. Spesies yang digunakan adalah Eusideroxylon zwageri dan Potoxylon melagangai, diambil dari dirian semulajadi. Potoxylon melagangai diambil dari dua lokasi iaitu dari Mulu, Miri dan Suai, Bintulu di Sarawak. Kayu teras merupakan bahagian yang diuji dalam analisis kimia dan sample-sampel tersebut adalah dalam bentuk serbuk kayu yang tertinggal dalam pengayak bersaiz 180μm. Komposisi kimia yang telah ditentukan adalah keterlarutan air sejuk, keterlarutant air panas, keterlarutan etanol-aseton, keterlarutan alkali, kandungan lignin, holoselulosa, alfa-selulosa, abu dan silika. Keputusan yang telah diperolehi menunjukkan kesemua kandungan kimia bagi kedua-dua spesies adalah berbeza secara signifikan pada tahap signifikan 95% kecuali bagi alfa-selulosa, abu dan silika yang tidak berbeza secara signifikan pada tahap signifikan 95%.

Kata kunci: *Eusideroxylon zwageri; Potoxylon melagangai; kayu; komposisi kimia.*

INTRODUCTION

Eusideroxylon zwageri (locally known as Belian) and *Potoxylon melagangai* (locally known as Malagangai) are the hardwood trees native to Borneo and Sumatera, belongs to the family of Lauraceae. Browne (1955) stated that *E. zwageri* is a lowland forest species, and is rare above an altitude of 1500 feet. It generally occurs on sandy soils of tertiary origin, on clay-loam soils or on sandy silt-loam soils (Soerinegara & Lemmens, 1994). *E. zwageri* can be recognized as a hard, heavy brown wood, with conspicuous, broken lines of soft tissue joining up several pores and containing oil dots (Browne, 1955). The density of the heavy hardwood is more than 880kg/m^3 with 15% moisture content. Oldfield *et al.* (1998) showed that it is included in the list of threatened tree species. This is because *E. zwageri* wood is very hard and heavy that made it one of the heaviest and most durable timbers of South-East Asia. *E. zwageri* has been agreed to have its own extreme durability (Browne, 1955). *E. zwageri* contents of toxic in their tissue such as alkaloid and other substances that provides imperviousness to insect attack also contribute to durability of the wood. Therefore, it is resistant to termite attack and wood-rotting fungi (Soerinegara & Lemmens, 1994).

Oldfield *et al.* (1998) stated that *E. zwageri* is very important and has become one of the heaviest and most durable timbers in Sarawak. *E. zwageri* is used in marine constructions for making pilings, wharfs, docks, sluices, dams and materials such as keels, ribs and decking in ships. In heavy construction, it is used to build bridges, power line poles, masts, piles and house posts. *E. zwageri* is also important to make frame, board, for heavy duty flooring, floodgates, road pavement and foundations, railway sleepers, fencing, printing blocks, vehicle bodies, sleds for log skidding, furniture, chopsticks, blowpipes, poles in pepper cultivation and survey pegs. Among the Dayak in Borneo, it is also used for the traditional longhouses and roof shingles which are reported to last 50 years to more than a century (Soerinegara & Lemmens, 1994).

P. melagangai is characteristic of primary lowland evergreen forest, mainly mixed dipterocarp forest and it is especially found on sandy-clayey alluvial soils in riverine forest and adjacent hills including limestone hills, up to 300m altitudes. Teo (1978) stated that *P. melagangai* is a popular substitute for the more durable *E. zwageri* used for heavy construction, boat building, posts, paddles, fences, pepper posts and shingles and it yields a medium weight to heavy hardwood with a density of 525-920 kg/m^3 at 15% moisture content.

All woods are composed of cellulose, hemicelluloses and lignin (Walker, 1993). Cellulose is the major constituent as a polymer of glucose. It makes up approximately 50% of cellulose as the main structural and chemical constituent of most plant tissues and fibers. Cellulose gives timber its high tensile strength. Hemicelluloses are polymeric units built up from simple sugar molecules such as pentose sugars (five-carbon sugars), L-arabinose and D-xylose, and the hexose sugars, D-glucose, D-mannose and D-galactose. Hemicellulose fraction that is contained in the short-chain material dissolves and it can be divided into β- and γ-cellulose. The amount, structure and composition of hemicelluloses vary between genera and species (Walker, 1993). The hemicelluloses are structurally related to cellulose so one would expect their chemical reactions to be comparable, although the hemicelluloses are generally more reactive (Harris, 1975).

Lignin is a kind of acid-insoluble that is filtered off after the hidrolisation and solubilization of the carbohydrates in wood and pulp using sulfuric acid. Content of lignin contributes to the hardness, bleachability and other pulp properties such as colour of the wood. Lignin that is occurs between cells serves as a binding agent to hold the cells together. Those that is occurs within cell walls is very intimately associated with cellulose and hemicellulose that gives rigidity to the cell. Haygreen and Bowyer (1996) mentioned that lignin is also credited with reducing dimensional change with moisture content fluctuation and has been said to add to woods toxicity, thus making it resistant to decay- and insect-attack.

Extractives include tannins and other polyphenolics, colouring matter, essential oils, fats, resins, waxes, gums and starches which contribute to its colour, odour, taste, decay resistance, hygroscopicity and flammability. Wood extractives is used to describe the numerous compounds which can be extracted from wood using solvents such as water, alcohol, acetone, benzene and ether (Hillis, 1962). Free silica may include in pure inorganic salts, other than salts of organic acids, which are belong to inorganic extractive. On burning, inorganic extractives form ash. Ash content and composition varies on basis of species, locality or provenance, growing condition and season (Negi, 1997).

Some of the natural resistance of woody tissues to the biological agencies is due to the natural resistance of woody tissues to the characteristics of the principal cell wall constituents. However, the main reason for the natural durability of some species of wood is the presence of toxic substances in the heartwood (Panshin & Zeeuw, 1980). They also stated that the superior durability of some woods, including those of light density, is traceable directly to the presence of toxic ingredients in sufficient quantities to inhibit deterioration. *E. zwageri* is economically important and *P. melagangai* substituting it especially in areas where the latter is not readily available. Therefore, objectives of this study are to determine and to compare the chemical constituents of *E. zwageri* and *P. melagangai*. Knowledge of the chemical composition of these two woods will help to further understanding of their properties and behaviour.

MATERIALS AND METHODS

The materials used in the experiments were wood (heartwood) blocks of *E. zwageri* and *P. melagangai*, 1: 2 ethanol-acetone, 1% sodium hydroxide, 10% acetic acid, 72% sulphuric acid, sodium chlorite, acetone, 17.5% sodium hydroxide, 8.3% sodium hydroxide, 2N acetic acid, 69% nitric acid, distilled water, hot-plate, soxhlet apparatus, water-bath, oven, furnace, refrigerator, desiccator, vacuum pump, electric heating mantle, fume hood and evaporator. *E. zwageri* and *P. melagangai* were taken from natural stand. The natural stand of *P. melagangai* was taken from two localities. One of them is located near Sungai Besari in Suai, Bintulu, Sarawak. The bole was curved with 42cm diameter breast height and 18m heights. It can be found at the edge of the Sungai Besari that is located in a destroyed and easy-to-flood riverine forest. The soil is blackish in colour, humid and fertile silt. Another natural stand of *P. melagangai* is located at Sungai Melinau (N 04° 08′ 13.0″ and E 14° 53′ 17.1″) in Mulu, Miri, Sarawak. The tree trunk is curved and unpleasant in appearance with 50cm DBH and 20m heights. It was found 70m from the main river in mountainous region characterized with reddish yellow silt.

Wood Meal Preparation

Wood (heartwood) blocks of the samples were obtained from the wood disc (Figure 1). Wood blocks of *E. zwageri* and *P. melagangai* were manually chipped into small pieces and ground-milled with a disk mill grinder to obtain wood meal. Wood meal retained on the mesh size BS180μm was used for chemical analysis. All the experiments were carried out in duplicates except for determination of moisture contents, cold-water solubility, ethanol-acetone solubility and determination of ash contents (in triplicates).

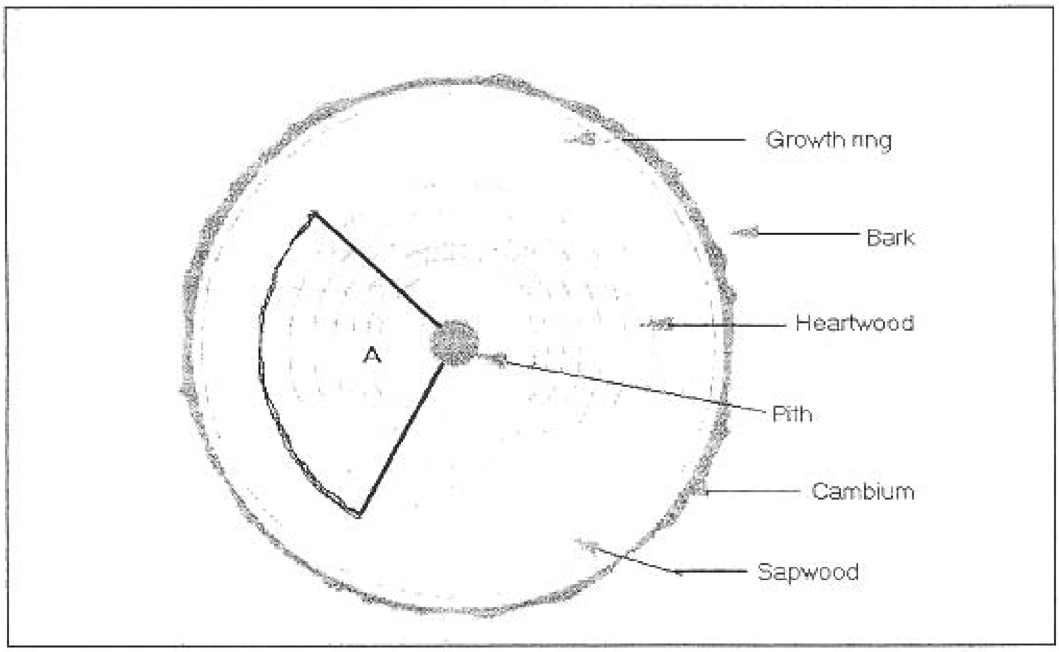

Figure 1: Cross section of the wood disc. (A) is the part where the wood blocks were obtained.