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Wood Macroscopic and Fiber Dimensions of Pasak Bumi Root (*Eurycoma longifolia*)

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ABSTRACT
The purpose of this study was to characterize the macroscopic feature and fiber dimension of root wood of pasak bumi (*Eurycoma longifolia).* Macroscopic structures of the root wood were observed using stereoscopic microscope NIKON SMZ645 with magnification of 20-50x. Fiber cells were obtained from the maceration process using immersion in a solution of HNO3, KCLO3, alcohol 50% and distilled water. Fiber dimension measurements using the Olympus BH-2 microscope equipped with a micrometer at oculer lens. Categorization of fiber dimension follow the IAWA (International Association of Wood Anatomist) method. In macrocopically, the root wood of pasak bumi has a distinctive features, i.e. yellowish brown color with unobvious border of sapwood and heartwood, unobvious growth-ring, a distinctive wood odor, moderately fine and even in texture, and straight to occasionally wavy grain. Fiber dimensions with length 57.5 ± 12.7 μm, diameter 7.75 ± 2.22 μm, lumen diameter 2.26 ± 5025 μm, and fiber wall thickness 5.24 ± 1.25. Such indications can be used to recognize and distinguish the root wood of pasak bumi from other plant roots.

Keywords: *Wood Macroscopic, Wood Root fiber, Pasak Bumi, Eurycoma longifolia*

1. INTRODUCTION

Pasak Bumi (*Eurycoma longifolia*) is one of the many medicinal plants found in the forests of Indonesia, Malaysia, Thailand, Philippines, Vietnam, and Burma. This plant is a small tree with a height of 20 m [1]. The root part of pasak bumi is a very important medicinal plant, especially for people who used it as an alternative to the traditionally healing of diseases [2]. Pasak Bumi is efficacious as stomachics and antipyretics, amoebic dysentery, fever medications [3] sprue, weak bodies, dirty blood, healing back pain due to fatigue, increasing the vitality of the body for males as well as increasing sexual activity [4]. Due to low negative effects, the use of traditional medicine is generally considered safer than modern medicine.

Since 2003, *E. longifolia* root has become a commodity as a medicinal plant and is traded domestically and abroad. Traditional medicine industries in Java, Bali and West Nusa Tenggara average traded 2,154 kg/year and 34 tons/year. Meanwhile, Malaysia's herbal industry is massively buying *E. longifolia* from Sumatera through the black market [5].

On the other hand, people often do not recognize the pasak bumi roots' characteristics since it is difficult to distinguish them from other plants roots that are traded in the market. One way that can be used to recognize the pasak bumi roots' characteristics is the macroscopic observation either by the naked eye or by using loupe. Macroscopic wood is a common wood characteristic, including colour, odour, texture, grain, lustre, and hardness used for wood identification [6]. In this study, the macroscopic wood features are also equipped with fiber dimensions which the wood fiber obtained from the maceration process. Maceration is the separation of wood fibers from a solid by using a solvent [7].

The purpose of this study was to characterize and recognize the macroscopic features of wood and fiber dimensions of the pasak bumi roots so that they can be used as information for the identification of wood from the pasak bumi root.

2. MATERIAL AND METHOD

2.1. Root Wood Sample

The *E. longifolia* wood roots (figure 1) used in this study were from Tumbang Atie Village, Sanaman Mantikei Katingan District of Central Kalimantan Province.

Figure 1 Photograph of pasak bumi root wood

2.2. Macroscopic Features of Root Wood

The stereoscopic microscope of NIKON SMZ 645 with 10-30x magnification is used to observe macroscopic features of pasak bumi wood root sample in transverse, tangential and radial sections, such as growth-ring appearances, the wood colour of sapwood and heartwood, texture, odour, and grain as mentioned by Whe as (physical features), shape, porosity, arrangement and grouping of vessels, and ray appearances (anatomical features) [8].

2.3. The Process of Maceration and Measurement of Fiber Dimension

On fiber maceration process followed Schulze's method [9], it was used HNO_3, $KClO_3$, 50% alcohol and distilled water. About 20 or more fibers were selected and measured by Olympus BH-2 microscopy equipped ocular lens micrometre with magnifications of 100 and 400 times. Measurements were performed on length, diameter, lumen width, and fibers' wall thickness [10]. These fiber dimensions were then categorized based on IAWA classifications [6].

3. RESULT AND DISCUSSION

3.1. Macroscopic Features of Root Wood

From the observations obtained, the physical features of root wood, as shown in Table 1. The root wood samples had growth-rings unclear, wood colour yellowish brown with the boundary between sapwood and heartwood was unobvious, the texture fine and even, and had a distinctive wood odour. The grain appeared straight and occasionally wavy.

Macroscopically, vessel cells were categorized as diffuse porosity and radial arrangement patterns in transverse view (figure 2). Rays appeared on transverse view as the elongated line following the explanation of Hart [7] and Mandang and Pandit [11] that wood ray is a horizontal line originating from the outer surface (bark) toward the inner surface (pith) of stem disks (Figure 2 and 3).

Vessels in transverse sections are round in shape (figure 4), whereas in tangential and radial sections, they appeared elongated like a tube, as reported by Mandang and Pandit [11]. Grouping of the vessel is almost entirely solitary and was being surrounded by other tissues or not connected to other vessels (figure 4) following the explanation of Wheeler [12] and Vilet [13].

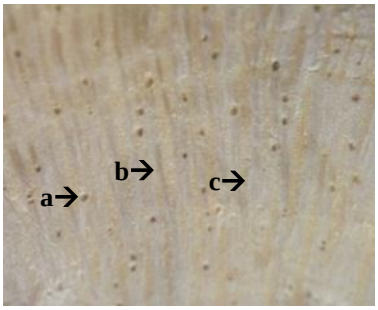

Figure 2 General view of the transverse section: a.Vessel with diffuse porosity and radial arrangement. b. Rays. c. Fibers.

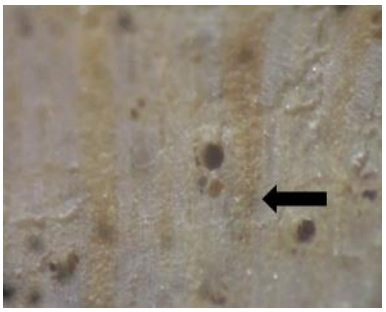

Figure 3 Transverse section: Rays feature (arrow).

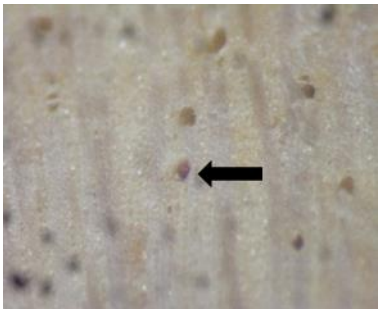

Figure 4 Transverse section: Vessel with round shape and solitary/single (arrow).

Table 1. Physical features of the wood root of *Eurycoma longifolia*

Growing ring	unobvious
Colour	yellowish-brown colour with the boundary between sapwood and heartwood is unobvious
Texture	moderately fine and even
Odor	a distinctive odor
Grain	straight and occasionally wavy

3.2. Fiber Dimension of Root Wood

The results shown in Table 2 indicated that fibers of the root wood were categorized as short fiber (57.5 ± 12.7 μm in length), small fiber (7.75 ± 2.22 μm in fiber diameter), the small lumen (5.02 ± 2.26 μm in fiber lumen width) and thin fiber (5.24 ± 1.25 μm in thickness).

Fibers of *E. longifolia* root wood were shorter and smaller than that of other plant roots; meanwhile, lumen fiber wall thickness was the same size, for instance, compared with *Jacaranda ulei* [14] and *Phlomis fruticosa* [15].

Table 2. Characteristics of fibers

Dimension of fiber	Results measurement (μm)
Fiber length	57.5 ± 12.7(short fiber)
Fiber diameter	7.75 ± 2.22(small fiber diameter)
Fiber lumen	5.02 ± 2.26(small fiber lumen)
Fiber wall thickness	5.24 ± 1.25(thin fiber walls)

4. CONCLUSIONS

Based on the results, it can be concluded that *E. longifolia* root wood could be recognized through its macroscopic characteristics in yellowish-brown wood colour with an unobvious border of sapwood and heartwood, unobvious growth-ring, a distinctive wood odour, moderately fine and even in texture, and straight to occasionally wavy grain. The fibers of *E.longifolia* root wood were categorized as short and small-fiber with a small lumen and thin cell walls.

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