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Characteristics of Cells from Five Exotic Bamboos after Drywood Termites *Incisitermes minor* (Hagen) Attack

Karakteristik Sel dari Lima Bambu Exotic setelah Rayap Kayu Kering Incisitermes minor (Hagen) Serangan

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Abstract

This study examined the relationship between and the characteristics of five bamboos exotic in the cell walls. For this purpose, the bamboosexotic from Indonesia were separated into cells after drywood termites *Incisitermes minor* (Hagen) attack. SEM observations revealed that bamboos cells. Moreover, SEM analysis showed that the cellulose isolated from parenchyma cells. These results suggest that all the cellulose microfibrils in five bamboos different characteristics of cell function after drywood termite attack.

Abstrak

Penelitian ini menguji hubungan antara karakteristik dan lima bambu eksotis di dinding sel. Untuk tujuan ini, bamboosexotic dari Indonesia dipisahkan ke dalam sel setelah rayap Drywood Incisitermes minor (Hagen) serangan. Pengamatan SEM menunjukkan bahwa sel-sel bambu. Selain itu, analisis SEM menunjukkan bahwa selulosa yang diisolasi dari sel parenkim. Hasil ini menunjukkan bahwa semua brils fi selulosa mikro di lima bambu karakteristik yang berbeda dari fungsi sel setelah serangan Rayap Kayu Kering.

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INTRODUCTION

Bamboo is one of the fast growing planet in the world,and also is one of the fast-growing forest plants in tropicaland subtropical regions.Naturally, superior physical properties are required from the cell walls. In the case of wood cell walls, the aggregates of crystalline cellulose microfibrils behave as a rigid frame work and are embedded in softmatrix substances such as hemicelluloses and lign in with atight interface. Such structural features in wood cell walls are analogous to the requirements for composites to be stiff and tough (Fratzl et al. 2004); consequently, stress can transfer efficiently from the matrix to the microfibril aggregates. Therefore, the high rigidity of cellulose microfibrils in the cell walls of tracheids is crucial. However, not all types of plant cells need constant mechanical support like tracheids do. In this study, we have attempted to shed some light on this question by focusing on the characteristics of the cellulose microfibril aggregates.

We have chosen five bamboo for this purpose because the bamboo culm has many parenchymacells and fiber cells in vascular bundle sheaths, whose functions are distinctly different. Bamboos samples were separated into single cells by the removal of lignin, and then sieved into fiber and parenchyma cells. The microfibril aggregates from each cell were isolated and their morphological and physical properties were compared. In recent studies (Abe et al. 2007; Abe and Yano 2009; Iwamoto et al. 2008), we have been trying to isolate cellulose nanofibers from wood using a simple mechanical treatment. The obtained nanofibers were approximately 15 nm in width and at least a few micrometers in length, and corresponded to cellulose microfibril aggregates in wood cell walls (Fahle ́n and Salme ́n 2005; Donaldson 2007).

Cellulose is part of bamboo considered an almost inexhaustible source of raw material in the increasing demand forenvironmentally friendly and biocompatible products. The excellent mechanical properties,remarkable reinforcing capability, low density, thermal stability, and environmental benefits ofcellulose have attracted scientists' interest in utilizing cellulosic fibers to develop environmentallyfriendly composite materials (Khalil *et al.* 2012; Jawaid *et al*. 2014)

Decay of wood by soft rot fungi mainly occurs in the thick cell walls of thelatewood and a cavity is formed in the middle layer of the secondary cell wall.Soft rot fungal decay also occurs in the cell wall of the cell lumen. Decay of thesecondary wall is usually widespread while that of middle lamella is quiteinsignificant by comparison

METHODS

Scanning Electron Microscope (SEM)

The microscopic appearance of five bamboos sample was examined with a scanning electron microscope (Leo Supra, 50 VP, Carl Ziess, SMT, Germany, SEM) using small samples of 1 to 2 mm thickness. Specimens were sputter-coated with gold to a thickness of ca. 10 nm in order to prevent charging during the examination. An accelerating voltage of 15 kV was used to collect the SEM images. The transverse section of thickness 1 μm were cut using a Sorvall Ultra microtome (MT 500) with a glass and diamond knife. For anatomical characterization and lignin distribution determination, embedded samples were stained with 1% toluidine blue and were viewed under a polarized microscope (Olympus Bx50) for transverse and longitudinal section.

RESULTS AND DISCUSSION

SEM observations

The morphologies of the purified cell wall after drywood termites *Incisitermes minor* (Hagen) attack(Fig. 1a-f). SEM images showedthe similar appearance of parenchyma cells. Sclerenchyma sheaths surround the xylem and ploem, and are known to be principal supporting tissues within the vascular bundles (Grosser and Liese 1971). The microstructures are different in five exotic bamboos after drywood termites consumtion. The size of vascular bundles in both species increas from outer through the middle to the inner position and this type of anatomical property is well reporded (Wahab *et al*. 2010).

The fiber walls of many monocotyledons were characterized by successive lignification, as cell walls of many fibers thicken with increase in age (Li *et al*. 2007). The high lignin content of the cell wall of bamboo fiber contributes to its high heating value and its structural rigidity, with the latter making it a valuable building material.

The analysis of the control *Pinus densiflora* (1f) shows that wall cell are very damage when compared that another bamboos. The bamboos test of *Gigantochloaatter* (1b) and *Bambusavulgaris* (1c) are more damage when compared that *Gigantochloaapus* (1a), *Gigantochloa atrolviolascea* (1e) and *Dendrocalamus asper* (1d). The bamboos test of *Gigantochloaapus* (1a) and *Gigantochloa atrolviolascea* (1e) when compared that *Dendrocalamus asper* (1d).

The results of microscopic analysis of the bamboos test shows that the pores of the *Dendrocalamus asper* (1d)no longer intact indicate damage to the cell walls of the bamboo is very large when compared to the bamboo control (1f). When the bamboos are still a tree, there are parts of cells called "Pits" serves to transport liquid resin acids, monoterpenes, fatty acids, and other extractive substances. That is compounds serve to protect the wood from organisms eg termites, beetles, fungi and others. After becoming dry wood, the cell that is often called Pits has the potential to be bothered organisms. This is due to the decreasing fluid containing substances eksraktif crop protection contained in the Pits (Mai *et al*. 2004).

Bamboo have a polylaminated structure in which narrow and wide layersare repeated (Cho, *et al.* 2008; Liese 1987). Examination withan optical microscope showed that there were differences in decay between thelayers. Decay of the bamboo fibres near parenchyma cells was more advancedthan that of bamboo fibres near vessels. Cavities were found in bamboo fibresand the presence of granulates showed that they were

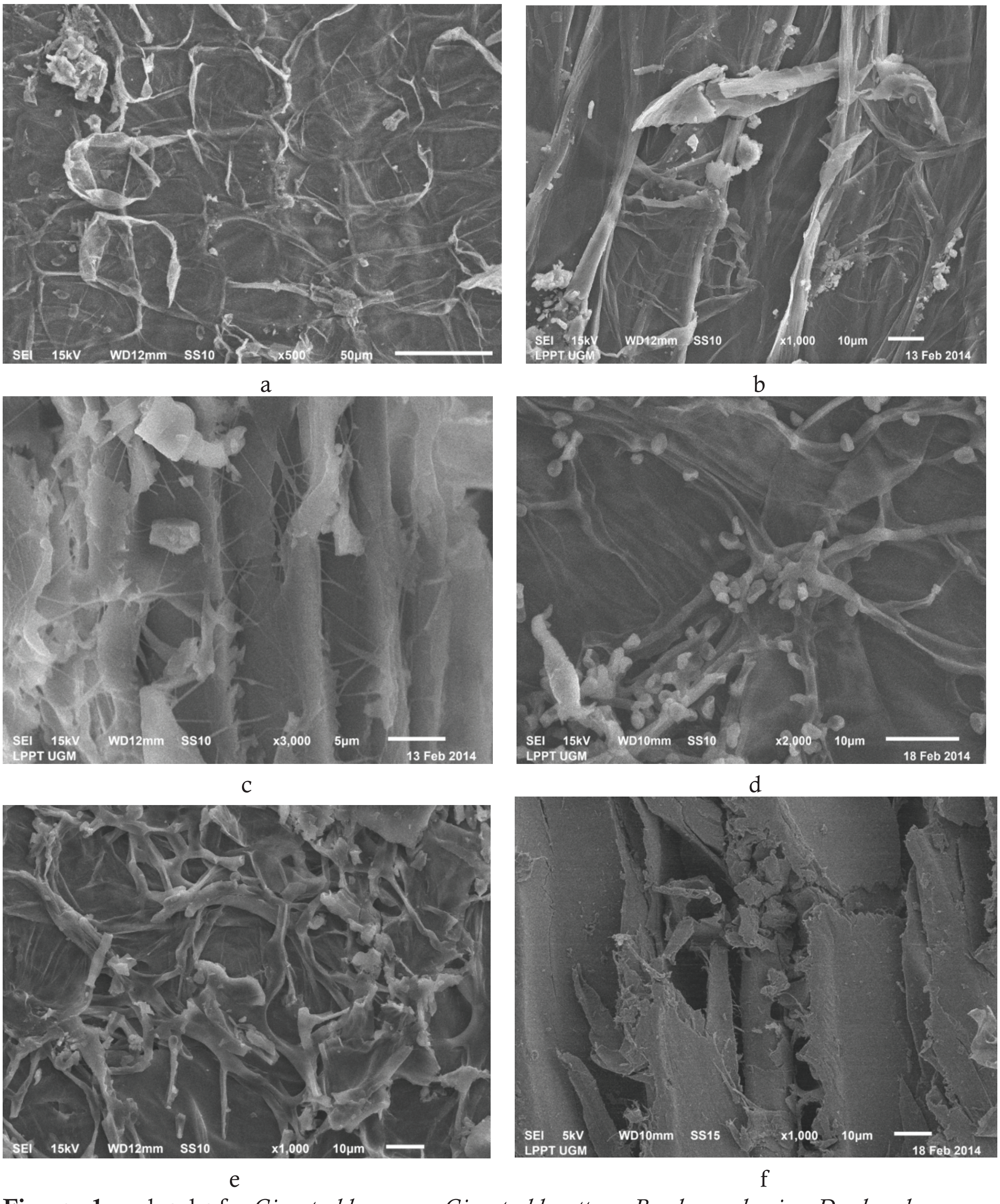

Figure 1. a,b,c,d,e,f. *Gigantochloaapus*, *Gigantochloaatter*, *Bambusavulgaris*, *Dendrocalamus asper*, *Gigantochloa atrolviolascea* and *Pinus densiflora.*

attacked by drywood termites *Incisitermes minor* Hagen.

Chemical and microbiological attack on wood has the biggest impact onthe cellulose and hemicellulose components. These polysaccharide componentsare more easily degraded than the polyphenolic lignins, leading to significantdecreases in the polysaccharide content and a corresponding relative increase inthe amount of lignin retained in waterlogged wood (Hedges 1990;Hoffmann and Jones 1990; Kim 1993; Kim, *et al.* 1990).

Cellulose is part of cell particularly valuable in determining the mechanical properties of the micro aggregates in cell walls. Considering the very similarα-cellulose contents in both the cell types, these results suggest that the cellulose microfibrils synthesized in fiber and parenchyma cell walls exhibit much the same cellulose crystallinity in the dry state (Iwamoto et al. 2007).

CONCLUSION

The bamboos hardness decreaseof bamboos andchanges of nature andchemical compositionfrom bamboos causedamage to thecell wallsof bamboos couldincrease thetermitespreferencesThe results of SEM observations analysis showed that the *Dendrocalamus asper*is the best bamboo when compared than another bamboos test for material building

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