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Utilization of Eha (*Cartanopsis buruana Miq*) based on it's Wood Anatomical Structure and Fiber Dimension

Author's Details:

[(1)]**Zakiah Uslinawaty,** [(2)]**Niken Pujirahayu,** [(3)]**Nurhayati Hadjar**, [(4)]**Nurnaningsih Hamzah,** [(5)]**Abigael kabe,** [(6)]**Musdalifah Buddini** [(1)(2)(3)(4)(5)] Faculty of Forestry and Environmental Science Universitas Halu Oleo, Kendari, 93232, Southeast Sulawesi, Indonesia.Tel:+ 62-81245849917 Fax:+62-4013193935

[*]For correspondence: zakiahuslinawati@gmail.com

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Abstract

Eha (Cartanopsis Buruana Miq) is one of the many species scattered in the forest of Southeast Sulawesi, which until now has been not much exploited by a community. This research is aimed at optimizing the use of Eha (Cartanopsis buruana Miq) based on anatomical structure and dimension of fibers. This research was conducted in the laboratory of the Forestry Department, Faculty of Haluoleo University. This research methodology is a nested experimental design (variation vertical position) with four repetitions. Observed variables in the study include a vessel (diameter, number of the vessel, contents of cells and perforation field), the rays (height, width, number cell rays, and the cell types), fiber (length, lumen diameter, and fiber thickness). The results showed that Eha (Cartanopsis buruana Miq) has incredible small vessel diameter (1.73 µm), the number of a vessel is rather sparse (5.85 per mm^2) in radial section. The wood vessels are solitary, the perforation field type is medium/ simple, and there is no tylosis. Rays of height average are outstanding short (302.222 µm). The average width of the rays, including the width (136.042 µm), the number of rays per mm is quite significant (8.817). Fiber dimensional quality of Eha (Cartanopsis buruana Miq) is categorized into the third class in terms of the value of wood fiber as raw materials for pulp and paper. Therefore, Eha (Cartanopsis buruana Miq) is more suitable for the construction material of the house, bridge, plank, pole, as well as ribs and is good to be shingles.

Keyword: *Eha (Cartanopsis buruana Miq); vessel; rays; fiber dimension*

Introduction

Woods that commonly used are those that result from high-level plants, trees through their cell activities. Because of the natural metabolism result, wood, which is produced, will have uniquely different characteristics and models, although they come from the same type. The characters and models are inherent in the anatomical structure of the forming cells (Bodig and Jayne 1982; Bowyer et al., 2003). Therefore, in the utilization of wood, the type of the woods and its characteristics need to be understood by all related stakeholders including the practitioners in the wood technology industry, government, museum and researchers particularly those who focus on botany, ecology, anthropology, and especially forestry researchers (Rowel, 2005). Some research on anatomy wood has been conducted by Santos et al., (2013) at wood anatomy of Myrtaceae, Boura et al., (2011) at wood anatomy of the *Mascarena dombeyoideae*, Gasson et al., (2010) at wood anatomy of the *Dalbergia nigra*, Serdar et al., (2008) at wood anatomy of *Fluggea Anatolia.*

One of the woods that dominate the forest in Southeast Sulawesi but is not really common in use is Eha (*Cartanopsis buruana Miq*). Some of the studies on the index of domination show that Eha (*Cartanopsis buruana Miq*) is a wood type that is very dominant and has the highest important index value (INP). For instance, a study conducted by Ridwan, 2013 reveals that the important index value point of Eha (*Cartanopsis buruana Miq*) is 130,14 % and the density is 360 ind/ ha. This value enlightens the potential of Eha (*Cartanopsis buruana Miq*) that exists in Southeast Sulawesi.

Even though it is very potential, unfortunately, Eha (*Cartanopsis buruana Miq*) has not been commonly utilized by the community due to the insufficiency of information, especially about the basic characters of Eha (*Cartanopsis buruana Miq*). Indeed, these basic characters are important to be recognized for the appropriate use. According to Wahyudi (2013), the relation between anatomy structure and characteristics, the use and the manufacturing process of the wood are very significant. The characteristics of the wood are influenced by the anatomy structure and inherent in the structure of the forming cells. Furthermore, the whole character of the wood simultaneously will determine the function and or the use of the wood while manufacturing a process that will be applied will depend on the anatomical structure of the wood. Therefore, in order to optimize the utilization, it needs research on anatomy structure and the fiber dimension of the Eha (*Cartanopsis buruana Miq*).
This study is aimed at finding the anatomy structure and fiber dimension of Eha (*Cartanopsis buruana Miq*) that result in a recommendation on the utilization and manufacturing of the Eha (*Cartanopsis buruana Miq*).

Material And Methods

Location and Time of the Study

The researchers took Eha (*Cartanopsis buruana Miq*) that exists in Taman Hutan Raya Nipa-Nipa for the tryout sample. Then, it was observed at the Laboratory of Forestry Department at Environmental Science and Forestry Faculty, Halu Oleo University.

Material and Equipment

The materials used in this study were one Eha (*Cartanopsis buruana Miq*) that has a diameter ± 34 cm (dbh) with height ± 20 m. Furthermore, chemical materials that needed were glacial acetate acid (CH_3COOH), peroxide hydrogen (H_2O_2), dye (safranin 2%), glycerin and xylene.
In addition, there were some laboratory tools and field tools used. First, field tools that include saw machine, meter tape, meter, plastic pocket, stationery, label, and digital camera while laboratory tools used were microtome, microscope, test tube, filter paper, electric warmer, plastic funnel, master plate, small paintbrush.

A procedure of the Study

The sample was taken from each tree that differs into three height levels of stems (base, middle, and tip). Cutting the base was taken approximately 5 cm from the former cutting rootstock, the tip approximately 5 cm from the bottom part of the first branch, and the middle sample was taken from the middle part, between the base and the tip. Then the thickness of each of these was taken approximately 10 cm in order to observe the anatomy characteristics of Eha (*Cartanopsis buruana Miq*). The observation was carried in order to identify fiber dimension including length, diameter, lumen diameter, and the thickness of fiber walls. On the other hand, the observation on the dimension of the vessels found out its length and its diameter.
In observing the fiber, the researchers carried out the preparation of maceration using a mixed liquid of 60 % acetate acid and 30 % peroxide hydrogen with comparison volume 50: 50 (Rulliaty, 2004). Data analysis on the anatomy structure, fiber dimension, and its descendants was done using Nested Experimental Design (vertical position of the tree trunk) with four times of repetition.

RESULTS

Microscopic Structure of the Wood

The observation and measurement of anatomy cells, including pore cells, radius, and parenchyma of Eha (*Castanopsis buruana Miq*) are presented in Table 1.
Table 1. Characteristics of the vessel of Eha (*Castanopsis buruana Miq*)

Vertical Direction	**Vessel Diameter (μ)**	**Total of vessel**	**Distribution of vessel**	**Substance of vessel**	**Perforation**
Bottom	190.83	5.8	Solitary	Empty	medium

Middle	164.00	5.6	radial line
Upper	164.17	5.9	
Average	173	5.85	

The observation result (Table 2) shows that the average value of the height of the Eha (*Cartanopsis buruana Miq*) radius is 302.222 µm categorized into very short. The average radius width is 136.042 µm including the width with frequency, or total ray is 8.817 per mm categorized into quite significant. Type ray on radial field of Eha (*Castanopsis buruana Miq*) is homo-cellular, while on the tangential field the radius is composed of uniseriate and aggregate.

Table 2. Characteristics of Rays of Eha (*Castanopsis buruana Miq*)

NO	Characteristics	Size	Remarks
1	Ray type		Homocellular (radial), unseriate and Anggregate (Tangential)
2	Height of Average Ray (µm)	302.222	Very short
3	Widht of Average Ray (µm)	136.042	wide
4	Amount of Average Ray (per mm)	8.817	Quite significant

The result of the calculation of the average value of fiber dimension and its derivative value is presented in table 3:

Table 3. Average Fiber Dimension and Derivative Value of Eha (*Castanopsis buruana Miq*)

Fiber dimension and Derivation	Average Value of the Observation Result
Length of fiber (µm)	1188.70
Fiber diameter (µm)	20.50
The diameter of the lumen (µm)	6.97
The thickness of fiber walls (µm)	6.78
Runkel ratio	0.34

The observation result shows that generally, the vessel is round, it does not contain tylosis, the distribution of vessel is solitary and lined radial, it has arranged cells and systemic vessel, and the perforation field is medium. The vessel arrangement of Eha wood is similar to *Castanopsis acuminatissima*, *Castanopsis argentea* (ITTO, 2002) and Palele wood (Castanopsis Javanica; Husein, 2004). However, the total of the vessel of Eha wood is higher (5.85/ mm^2) than Palele wood (2.73/ mm^2). While *Castanopsis Argentea* has the total of vessel least than 6/ mm^2 and *Castanopsis Aciuminatissima* has the range of vessel between 5-20/mm^2

Based on the vessel number, the total of the vessel of Eha (*Castanopsis buruana Miq*) can be categorized into sparse (classification given by Mandang and Pandit, 1997 in Kurniawan 2001). According to this classification, the diameter size of 173 µ categorized small. The amount of vessel diameter and vessel number will influence specific weight, stability, and dimension. Size of vessel diameter is a factor that influences the drying rate, the bigger the vessel diameter, the faster the drying process occurred (Panzhin and Zeuw, 1961). In relation to this statement, Shimpson, 1991 in Moya 2012 points out that wood shrinkage is influenced by the thickness of the cell walls, diameter, and vessel frequency. Moreover, the vessel diameter also determines wood texture. In line with this statement, Wahyudi (2013) states that the smooth and or the roughness of the wood are determined by the size of a diameter of the cells which form the wood (vessels for hardwood and tracheid sells for a conifer). If these cells are small, the wood texture will be smooth, but if these cells are big, the texture of the wood will be rough. According to Panshin, et al.,(1969), smooth and roughness of the wood surface are very useful to determine the appropriateness of wood product, which in the manufacturing processes, it uses gluten and finishing materials.

The analysis result on the variety of vertical position of the rod shows the average value of vessel diameter statistically are as follows: on the base part (190. 83 µm) tend to be higher than the middle part (164.00 µm) and the tip part (167.17 µm). On the other hand, the average of pore number is: the tip part (5.9500 per mm^2), tend to be higher than the base part (5.8167 mm^2), and the middle part (5. 6500 per mm^2). It is predicted that the amount of the average value of vessel diameter on these parts is influenced by water and food, which are first absorbed to be distributed, so it has a bigger diameter. In relation to this, Bowyer (2003) reveals that the differences between cell types both in dimension and number occur in the trees including in the base part, middle, and tip. They have a different proportion of mature cells depend on the development of tree growth.

The value of height, width, frequency or amount of ray will influence the characteristic of strength/ mechanic of the wood, drying, and also shrinkage. This is in line with the research conducted by Moya (2012), which shows that there is a correlation between the dimension of ray frequency and the amount of pore toward wood drying defect. A significant amount of ray will minimize the shrinkage process. Tangential shrinkage is bigger than radial shrinkage. It is influenced by some of the anatomy characters of the wood, including ray cells, the dense node on radial walls, and amount of membrane cells radially and tangentially. Variations in the shrinkage of the sampling tests that are different from the same species are caused by three factors, as follows: 1) Size and shape of cutting. This influences fiber orientation in pieces and the uniformity of water content. 2) Sample density, in which the higher the density, the more the tendency of shrinkage. 3) The drying rate of the sampling test. Under the fast-drying condition, an internal tension occurred due to the difference in shrinkage (Haygreen and Bowyer, 2003). In order to avoid the shrinkage and or defects arising after manufacturing, the wood should be put into the drying process until it is dried well before the wood is manufactured.

Regarding Eha (*Castanopsis buruana Miq*) that is observed in this research, the analysis result on the variety of vertical position of a rod can be described as follows. First, the average value of the ray height of the base part is 305. 50 µm tend to be higher than the middle part (288.00 µm) and the tip part (304.83 µm). Second, the average width of the radius of the middle part is 21.083 µm, tend to be higher than the base part (17. 833 µm) and the tip part (20.333 µm). Third, the amount of ray of the base part is 9.0833 per mm) tend to be higher than the middle part (8.8333 per mm) and the tip part (8.6500 per mm). The increase might be caused by ray cells that are produced from the initial cleavage of rays in the cambium. The result of cell cleavage that got insufficient foods or too small sometimes fail to divide again (become mature cells as xylem or phloem) or will get small and become initial ray (Bowyer et al., 2003).

Comprehensively, the total value of fiber of Eha (*Castanopsis buruana Miq*) is 175. It means that the quality of Eha (*Castanopsis buruana Miq*) can be categorized into class III based on requirements and value of wood fiber as raw materials of pulp and paper (Anonymous, 1976 in Kurniawan, 2001). This shows that Eha (*Cartanopsis buruana Miq*) is not very appropriate to be used for raw materials of pulp and paper.

3.2. Recommendation for Manufacturing

Based on the anatomy structure and fiber dimension, Eha (*Castanopsis buruana Miq*) is not very appropriate to be used for raw material of pulp and paper. However, Eha (*Castanopsis buruana Miq*) can be used for construction materials such as sills, roof frames, and furniture products. These products need drying process so the woods can be stronger and remain longer. With vessel structure and fiber walls which are thick, Eha (*Castanopsis buruana Miq*) needs a drying process, with temperature, starting from lower and then simultaneously higher (Basri *et al.*, 2009).

Conclusion

Eha (*Castanopsis buruana Miq*) has a quite smooth structure as a result of the average diameter of its pore that categorized into small and the amount of its radius is sparse. The result of calculation on fiber dimension of variety and vertical position of rod shows that Eha (*Castanopsis buruana Miq*) has a total score of fiber 175 (class III). It means that Eha

(*Castanopsis buruana Miq*) is not very appropriate to be used for the raw material of pulp and paper. In other words, Eha (*Castanopsis buruana Miq*) is more suitable for raw materials of construction for a house, bridge, board, pole, and the ribs due to its smooth structure.

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