Physical Properties and Potential of Medicinal Plants of Marsegu Wood (*Nauclea Orientalis L*)

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Abstract. *Marsegu* wood (*Nauclea Orientalis L*) is a type of wood that grows and spread throughout Indonesia, as well as in the Maluku province, especially in Buru regency. This study aimed to determine horizontal position of the bark, middle and pith to the physical properties and chemical components of *Marsegu* wood. The results showed that the horizontal position that the moisture content field experience variation from the bark part to the pith while density tends to experience the increase of the pith to the middle section. The shrinkage wood in the field position show that reduction tends to rise from the bark to pith and the most considerable in the tangential direction. The chemical compounds contained in *Marsegu* wood in the three parts of the stem, namely base, middle and end showed that there were terpenoids due to the type of triterpenoids, essential oils of phenol groups of simple phenol types, phenolic acids, tannins and flavonoids.

Keywords: Physical properties, potential, Medicinal plants, Marsegu wood, Nauclea orientalis

1. INTRODUCTION

Wood is a material that is often used in building construction. Some reasons that have resulted in wood being preferred for construction materials compared to steel or other materials are that wood is not easily broken if it is exposed to vibration loads due to the earthquake and does not experience corrosion. Initially, forest products in the form of wood were obtained from natural forests that were able to produce millions of cubic meters of wood.

Recognizing wood materials with the purpose of being used is essential, both for entrepreneurs engaged in the wood industry and for other wood users. Every type of wood use requires some specific requirements (Dumanauw, 2007). Wood is the central element that significantly determines the quality of furniture products and other woodcraft, so the categories of physical properties of wood, wood mechanical properties, wood class, wood life, and substances which contains wood is a wood feasibility quality (Nila and Sri, 2013). On the other hand, wood has reasonably high variability in one tree. The nature of the tree part of the base will be different from the nature of the middle and the end, for this reason, it is necessary to test the properties of wood both physical properties and chemical compounds contained in the base, middle, and end of the wood can be used according to its ability. Newly cut wood includes a number of water, the amount of which varies between 40 to 100%, depending on the type and position of the wood in the tree trunk (Basri, 2001).

*Marsegu* Wood (*Nauclea orientalis*) is a type of wood that grows and spreads throughout Indonesia as well as in the Maluku region, especially in Buru district and spread almost to the majority of the Buru district, *Marsegu* wood or often called yellow wood by hunting communities although very much in the area, however,
the use of *marsegu* wood is not used as a multi-purpose timber, but this wood is only used by the community as raw material for firewood and also as raw material for the manufacture of eucalyptus oil refining kettle.

This study aims to determine the effect of wood position (base, center, and tip) in the tree and the field of observation (tangential, radial) and the position of the outer, middle and pith tree trunks on the physical properties and wood chemical compounds of *Marsegu*.

2. **METHOD**

2.1. **Time and Place of Research**

This research will be carried out at the MIPA Laboratory, Tarbiyah and Teacher Training Faculty at IAIN Ambon, and Chemistry Laboratory at Hasanuddin University Makassar.

2.2. **Tools and Materials**

The tools used in the research are cut saw/chainsaw for cutting and splitting trees, measuring tape to measure tree length and diameter, calipers, ovens, analytical scales, desiccators, to find out the wood chemical compounds of *Marsegu*. The analysis was carried out using the GCMS-Pyrolysis method with the ShimadzuPyr-GCMS QP2010 chromatography, while the primary material in this study was the main ingredient of one *Marsegu* wood (*N. orientalis* L.) *Marsegu* wood sample used obtained from community plantations. The tree aged is ± seven years with a diameter of 35 cm and a branch-free height of ± 8m.

2.3. **Procedure**

2.3.1. **Raw Material Preparation**

One *marsegu* tree (*N. orientalis* L.) was taken in the village of Wamlana which was obtained from community gardens, felled at an altitude of 15 cm from the ground, then cut into three parts, namely the base, centre and end of the sample taken in the field outside, inside, laying out like the pattern in Figure 1. For each test, *Marsegu* wood pieces are then wrapped in aluminum foil to avoid further evaporation so that the physical condition of fresh wood can be maintained, then cut to become a test sample according to the nature and purpose of the test.

![Figure 1](image-url)  
*Figure 1.* The pattern of distribution of sample tree trunks (a) and Log cutting patterns (b) where: 1 = Example of tangential direction shrinkage test (1 cm x 1 cm x 5 cm), 2 = Example of radial direction shrinkage test (1 cm x 1 cm x 5 cm), 3 = Example of test for moisture content, density and specific gravity (2 cm x 2 cm x 2 cm)
b. Test samples and physical and chemical properties testing

Test samples and dimensions, examples of moisture content and specific gravity refer to British Standard Number 373 1957 and according to the procedure described by Kamasudirdja, et al., 1974 referenced by Savitri, 2014, with the following sizes

1. Testing physical properties

Wood moisture content and wood density

The first step is to cut the sample of wood that will measure the moisture content with a size of 2 x 2 x 2 cm. The sample is then weighed and then oven at 1030 ± 20°C to its weight, the same is done for specific gravity, after reaching a constant weight calculated by mass volume. Moisture content and wood density are then calculated based on the equation below.

\[ KA \% = \frac{BB - BKT}{BKT} \times 100\% \]
\[ \rho (g/cm^3) = \frac{BB}{V_{vol}} \times 100\% \]  

Where: \( KA \) = Moisture content (%), \( \rho \) = Density (g/cm³), BB = Initial Weight (g), BKT = Furnace Dry Weight (g).

2. Depreciation

Depreciation measured includes volumetric, radial, and tangential shrinkage. Measurement of this dimension is carried out using calipers, in both parts the wood is marked and measured in dimensions so that the next measurement process is carried out in the same position. For the determination of the percentage of wood shrinkage, the first time taken is a sample of wet wood with a size of 1 x 1 x 5 cm, then the volume is determined. The sample is then oven heated at a temperature of 1030 ± 20°C until the weight is constant and then the dry sample is pre-determined. Depreciation for each wood area is then calculated based on the equation:

\[ \text{Penyusutan} \% = \frac{D_{i1} - D_{i2}}{D_{i1}} \times 100\% \]

Where: \( D_{i1} \) is the dimension of the initial width, \( D_{i2} \) is the dimension of the final width, I is tangential and radial

3. Analysis of chemical compounds

Analysis of chemical compounds to determine the chemical components of wood *Marsegu*. The analysis was carried out using the GCMS-Pyrolysis method with ShimadzuPry-GCMS QP2010 chromatography using a column of quartz capillaries coated with polyamide deposits. This tool works at 400 OC for 1 hour, injection temperature of 280 OC, detector temperature of 280 OC, and initial temperature of column 50 OC with an increase of 15 OC per minute to 280 OC. Identification of compounds was carried out by matching mass spectrum data along with ion fragmentation of an extracted compound with data contained in the 7th WILEY database (Sari et al. 2011 referred to by Uar, 2014).

4. Analysis of data

Data analysis of physical properties in this study was carried out with a simple descriptive analysis to determine the average value using Microsoft Excel 2007 statistical data. To find out the effect of wood position and the observation field, a two-factorial complete randomized design with factor A is a variation of wood position, and factor B is a variation of the field of observation. Deuteronomy is done three times.
3. RESULTS AND DISCUSSION

3.1. Moisture content and wood density

The results of the study showed three radial positions; the Moisture content varied from the bark to the pith (near the pith). Variation in Moisture content starting from the bark part of (78.70%), to the middle part of (102.31%), then to the pith section of (99.67%). (Figure 2), while the density of marsegu wood (*N. Orientalis*) is seen in the horizontal position, the frequency of marsegu wood tends to increase from pith down to the middle. This can be understood because wood near the heart wood is usually soft, which means the cell walls are thin and less dense, the space between cells is large and the tissue is high, so the density of wood near the heart is low. Basically the thickness of wood in the most upper horizontal posotion starts from the course of the outer part of the pith (Panshin and Zeeuw 1980 referred to in Uar, 2014). Research Uar et al. 2015; Uar 2016) in *N. Orientalis* and Jabon species also experience variations in the horizontal position from the bark to the pith. This variation that is not too far away is also indicated by a statistical test on the 95% confidence interval that is not significant or not significantly different. While the results of statistical tests for wood density showed no significant or not significantly different at 95% confidence interval.

![Figure 2. Moisture content (◊), and density (□) sample tree trunk from the bark to pith](image)

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Marsoem 1999 was referred to by Manuhuwa, 2007, stating that many types of wood in Indonesia have high Moisture content near pith, including acacia mangium, acacia auri, teak, and several other species. The decreasing Moisture content will also affect the density of wood. Differences that are not too far from each part are indicated by the results of the statistical test at the 95 percent confidence interval, which is not significant.

Factors that are thought to affect the ability of wood to absorb or excrete water from their wood cells are the structure of the wood constituent cells and the external content and presence or absence of tylosis (Wang et al. 2003 referred to by Indahsuary et al. 2014). Meanwhile, Haygreenet *et al.* (2003), states that biomass (weight of dry wood material) at the base is greater than the middle and end. In the xylem section, water is generally more than half the total weight, meaning that the importance of water in fresh wood is typically equal to or greater than the biomass.

In different seasons the Moisture content will also be changed because it is influenced by the season, which in the rainy season the Moisture content will be higher compared to the dry season. Many factors affect these variations such as the place of growth, climate, geographical location and the species itself. Differences in the Moisture content of the results that are not too different are assumed to be the transition of seasons. Manuhuwa (2007), states that the season is very influential on the level of fresh water, in the rainy season the Moisture content will be higher than in the dry season. The density of a type of wood depends on the amount of wood material arranged, its cell cavity, the number of pores, the Moisture content contained in it and its extractive substances. At the end is composed of tissue that is still young, where physiologically the tissue is still functioning actively so that the cell wall. The weight of wood is also influenced by the amount of pore in the wood. The more pores in the wood, the lighter and the less wood that has fewer pores, the wood will be more substantial.
3.2. Wood Depreciation

Depreciation is the result of water loss in the wood below the point of saturation of fiber. Development is the result of adding wood moisture content. The shrinkage of wood dimensions is not the same in all three directions (radial, tangential, and longitudinal). Longitudinal direction shrinkage is often overlooked because the percentage is usually between 0.1-0.2% and less than 4%. Tangential direction shrinkage is more significant than radial reduction with a factor between 1 to 3 compared to 1. The cause is the presence of radius tissue, tight radial walls, the dominance of summer wood in the tangential direction, and the difference in the number of cell walls radially opposed tangential (Haygreen, 2003). The dimensions of wood will be stable; the wood will be durable when the Moisture content is above the saturation point of the fiber and will change its dimensions when water loss is below that point (Bowyer et al., 2007). Depletion of cell walls occurs when bound water molecules break away from cellulose and hemicellulose molecules.

The results of the study of shrinkage in the field position show that reduction tends to rise from the bark to pith and the most considerable in the tangential direction. This is in line with the opinion of Penshin and Zeeuw (1980) referenced by Basri and Rulliaty (2008) adding that the density in the Radial / Tangential direction rises from the outside to the inner wood in a non-uniform direction. The low frequency in the outer wood is possible because in this section there are only a few extractive substances. While according to Tobing 1976 in the Sutomo 2013, the low value of longitudinal shrinkage is due to the majority of the direction of microfibrils in the cell wall layer almost parallel to the cell axis, while the tangential shrinkage which is twice the radial shrinkage is due to the presence of finger resistance.

The drying process is a way to reduce the Moisture content in wood, the dimensions of wood can be reduced or shrunk by decreasing the wood Moisture content. Depreciation of the aspects of wood starts to be taken into account after the wood reaches 30% moisture content (moisture content. The point saturates the fiber) because it is above that value usually. Shrinkage is minimal, so it is ignored. The stability of wood dimensions is shown by the ratio of wood shrinkage to its tangential direction towards its radial (T / R). Typically wood with a T / R value below two dimensions is more stable during drying. Shrinkage is the release of water from wood until it is below the saturation point of fiber, wood shrinkage occurs generally in the longitudinal direction of 0.1 to 0.2%, radial direction of 2.1 to 8.5%, then tangential direction 4.3 to 14%, this condition consists of water free and bound water (Dumanauw 1982 referred to by Kailola 2006).

![Figure 3. Histogram of shrinkage from the bark, middle, and pith](image)

Table 1 results show that the average shrinkage increases from the bark to pith, so that wood shrinkage tends to be high at the pith of both the radial direction and tangential. Tangential shrinkage increases from the pith and
decreases at the bark. It is presumably because the average test sample in the tangential direction uses sapwood compared to the porch wood. The higher the shrinkage of eating the more significant the Moisture content that comes out and the accuracy will be even more significant, this is due to the release of water in the cavity so that the release or discharge of water from the cell cavity will cause shrinkage which affects the density of wood. The more wood content in the cell wall, which means the thicker the cell wall is, the higher the specific gravity (Haygreen et al. 2003).

Table 1. Depreciation rates in field positions

|                | Bark     | Middle    | Pith    | Bark     | Middle    | Pith    |
|----------------|----------|-----------|---------|----------|-----------|---------|
| Rattan         | 3.310    | 3.858     | 5.018   | 4.987    | 5.438     | 5.340   |
| Sd             | 2.365    | 1.906     | 2.191   | 2.7169   | 3.168     | 1.673   |
| CV             | 5.594    | 3.632     | 4.802   | 7.381    | 10.0388   | 2.798   |
| Min            | 1.555    | 2.539     | 2.491   | 2.444    | 2.063     | 3.975   |
| Max            | 6.0      | 6.043     | 6.389   | 7.849    | 8.349     | 7.206   |

Sd= standard deviation, Cv= Coefficient variation, Max= maximum value, Min= minimum

Kailola's research, 2006, in some superior types of Tobelo wood also showed a shrinkage rate in the tangential direction greater than radial shrinkage at the base of the stem position. This is in accordance with the opinion of Haygreen and Bowyer (1993) referenced by Kailola (2006) who said that the amount of shrinkage is generally proportional to the amount of water released from the cell wall. It means that species or parts of wood that have a high density must shrink more per percent change in Moisture content compared to species or parts of wood that have a lower density. The results of the diversity analysis showed that the interactions between the two treatments were not significant or not significantly different. It means that between the radial position and the tangential position influence each other against fresh volume density. According to Prawiroatmodjo (2001), between the density and fresh Moisture content, there is a strong negative relationship, where increases and types of wood will cause a decrease in the fresh Moisture content of wood and vice versa.

3.3. Wood Chemical Compounds

Chemical compounds commonly found in Nauclea spp start from the leaves of tree trunks, and roots which consist of terpenoid compounds namely essential oils and carotenoid triterpenoids, saponins, alkaloid compounds, phenol simple phenols, phenolic acids, tannins, flavonoids, terpenoids of triterpenoid types, crucial oils of phenol compounds from phenol compounds are simple (Prastika, 2014; Asmiyanti et al, 2014; Tuhuteru et al, 2014).

The identification results of chemical compounds in Marsegu wood species on three stem sections namely middle, base and end showed that there were terpenoids due to the type of triterpenoids, essential oils of phenol groups of simple phenol types, phenolic acids, tannins, and flavonoids. Shows that in the marsegu logs there are compounds from the terpenoid group, essential oils of phenol compounds of simple phenol types, phenolic acids, tannins. While the Aisya 2012 study showed that secondary metabolic compounds contained in N. Orientalis Lmampu as a disease control bacteria. One of the compounds found in marsegu wood, namely terpenoid compounds is a compound that functions as a flea remover and anti-tumor (Early, 2018). The secondary metabolic compounds found in N. Orientalis L are antioxidants. In addition, the wood from the Rubiaceae family is mostly antioxidants derived from secondary metabolic compounds contained in the wood (Saefudin et al., 2016). So that it can be assumed that wood plants of this species and family have the potential as medicinal plants ranging from leaves, stems, and roots. Secondary metabolic compounds commonly found in plants are alkaloids, flavonoids, steroids, saponins, terpenoids and tannins (Harborne 1987 referred to by Ergina et al., 2014).

Mustainichie et al. (2013), stated that secondary metabolic substances are very widely used, among them in the field of pharmacology as antioxidants, antibiotics, anti-cancer, anti-blood sugar, which are carcinogenic inhibitors, and secondary metabolites can also be used as anti-pest control agents. Environmentally friendly
Samsudin and Kahirudin, 2008). Secondary metabolic compounds are alkaloids, terpenoids, flavonoids, steroids, and others. Flavonoid compounds that have been successfully isolated from sharing plants are known to have interesting biological activities that are toxic to cancer cells which can inhibit histamine release, anti-fungal, and anti-bacterial (Mulyani et al., 2013). Meanwhile, terpenoid compounds can be used as antimicrobials that are environmentally friendly (Saxena and Kalra, 2011).

Secondary metabolites are small molecules that are specific (not all organisms contain similar compounds), each compound has a different function or role. In general, secondary metabolic compounds function to defend themselves or maintain their existence in the environment they are in (2008), states that metabolic secondary is a biomolecule that can be used as lead compounds in the discovery and development of new drugs.

In addition to the chemical compounds contained in the Marsegu logs, there are also chemical components of wood which are also critical components in the wood. The chemical elements of wood consist of carbohydrates, cellulose, lignin, and extractive substances. The research of Wibisonoet al, 2018 shows that the chemical components of wood from N. Orientalis L have a relatively high level of holocellulose. The high level of holocellulose shows that the wood can be used for other forest product industries as pulp and paper.

4. CONCLUSION

The moisture content of the horizontal position of the field experience variation. The moisture content depends on the season, which is when logging, while the density of wood in the horizontal position shows the highest frequency starting from the middle, pith and decreasing at the bark.

Depreciation wood the horizontal position shows that the greatest shrinkage in the tangential plane compred to the radial plane.

The chemical compounds contained in Marsegu wood on the three parts of the stem, namely the base, midd and tip show that there are terpenoid compounds due to the type of triterpenoids, essential oils of phenol groups of simple phenol types, phenolic acids, tannins and flavonoids and potentially as medicinal plants.

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