Effect of Tree portion and Distance from Pith on the Physical Properties of Batai (*Paraserianthes falcataria)*

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Abstract

This study was conducted on the Paraserianthes falcataria (batai), to determine its basic properties and effects of tree portion and distance from pith. Three 8-year-old batai were obtained from the Forest Plantation at Dong Hwa Fiberboard, Merbok Kedah. Discs of 20mm thick were cut from bottom (30 cm above ground), middle (50% of clear bole height) and top (80% of clear bole height). From each portion samples (20mm x 20mm x 20mm) were according to three sections namely near bark, middle and near pith. The basic properties determined carried out according to the Technical Association of the Pulp and paper Industry Standard (TAPPI). Result shows the specific gravity of batai ranges from 0.15 to 0.31. It decreases with tree portion and increases with distance from pith. While the green moisture content of batai ranges from 280% to 550%. It increases from bottom to top portion and decreases from near pith to near bark.

Keywords: *Paraserianthes falcataria, height portion, specific gravity, distance from pith, moisture content.*

INTRODUCTION

Wood supply now depends on the forest, at the insistence of the environmental requirements the forest harvesting rates have reduced. When minimized, the problem of raw material supplies facing shortage. Although wood is a renewable resource, but it took a long time to replanting. Now days, fast growing species is a famous plantation in many countries. Recently, through the research and development in several years indicated that fast growing species become a potential as raw material for wood based product. Batai scientific name is *Paraserianthes falcataria* (L.) Nielsen (syn. *Albizia falcataria* (L.) Fosberg) belonging to the subfamily Mimosoidae of the family Leguminoceae. According to (Wahyudi *et al.* 2000; Sumiasri *et al.* 2006; Ogata *et al.* 2008), it is an important plantation tree species in Indonesia and tropical countries and it is fast growing tree.

The importance of knowing the physical properties of wood is reflected by the end-use of the materials itself (Jamaludin, 1999). Moisture content affects the properties of wood and also influences the dimensional stability and these are generally associated with toughness, density, strength, working properties and durability (Panshin and De Zeeuw, 1970; Hamdan and Abd. Latif, 1992). Moisture affects the behavior of wood in a number of very critical ways (Findlay, 1975). Therefore, specific gravity also predicts such characteristics as hardness, ease of machining and nailing resistance (Bruce, 2000). Specific gravity has an important influence on the strength of wood (Findlay, 1975). The objective of the study was to determine the physical properties of batai. The study also determines the effects of tree portion and distance from pith on the physical properties.

MATERIALS AND METHODS

Field procedure

Batai trees were harvested from the Forest Plantation at Dong Hwa Fiberboard, Merbok Kedah. The age of the trees was 8 year old. At the experimental area, breast height diameters of batai were measured for every tree. After the trees were cut down, from each tree cross-sectional discs of approximately 5 cm in thickness were taken at three height levels: bottom (30 cm above ground), middle (50% of clear bole height) and top (80% of clear bole height). Each disc was mark with the tree number and height level. The discs were immediately wrap with aluminum foil and kept in air-tight plastic bags to reduce the loss of moisture. All the wrap discs were placed in cold room (about 4^0C) upon arrival at the University Teknologi Mara (UiTM) Jengka, Pahang until further processing.

Sampling for specific gravity analysis

The three batai Trees were cut for this experiment. Samples taken from different high level there were top, middle and bottom in disc shape. The discs were cut into cubes size approximately 2 cm x 2 cm x 2 cm for specific gravity and moisture content with of measurement. The samples for each disc were divided into Three zones namely near bark, middle, and near pith. A total of 12 sample pieces were obtained for each disc.

Specific gravity and Moisture content

The weight measurements were carried out at green and oven-dry conditions. The specific gravity was determined when cubes were immersed in water until they were fully swollen. These cubes were placed in oven for 24 hours at 105 ± 2°C until constant weight is obtained. Testing of physical properties were conducted in accordance with TAPPI T2557 cm – 2002: Sampling and preparing wood analysis. The specific gravity and moisture content were calculated with the following formula:

$$\text{Specific gravity} = \frac{\text{Weight of oven dry sample}}{\text{Weight of water displacement}} \qquad 1$$

$$\text{Moisture content}(\%) = \frac{\text{Air dry weight - Oven dry weight (g)}}{\text{Oven dry weight (g)}} \times 100\% \qquad 2$$

RESULTS AND DISCUSSIONS

Physical Properties

Table 1 shows the specific gravity of batai decreases with tree portion from bottom and increases with distance from pith. The highest value specific gravity (0.31) was observed from sample near bark at the bottom portion and the lowest density (0.15) was at the top portion near pith sample. While the green moisture content of batai it decreased with tree portion and distance from pith. Sample near pith at top portion has higher value of moisture

content (502 %) while sample near bark at bottom portion show lower moisture content (241 %).

Table 1: Physical properties of Batai according to Tree Portion and Distance

Portion	Distance	SG	MC (%)
Top	NP	0.15	501.51
	Inter	0.23	355.97
	NB	0.25	296.71
	Mean	0.21	384.76
Middle	NP	0.16	458.96
	Inter	0.24	338.36
	NB	0.25	318.81
	Mean	0.22	372.04
Bottom	NP	0.21	372.92
	Inter	0.31	242.89
	NB	0.31	241.37
	Mean	0.28	285.72

Note: NP – Near Pith, Inter- intermediate, NB – Near Bark, SG – Specific Gravity, MC – Moisture Content

Effect of Height Portion

Figure 1and Figure 2 shows the effects of specific gravity and moisture content towards tree portion. The specific gravity of batai was observed to decrease from bottom to top while the moisture content increases with tree portion. However, the correlation analysis (Table 2) show that the decrease in specific gravity has a negative correlation (r = -0.457ns) and the increases in moisture content was significant (r = 0.384*). According to (Zziwa, A., et al, 2006), the specific gravity of the wood varied significantly from species to species and different parts of tree. Fibers are particularly important to determine of specific gravity, if the fibers are thick-walled and show small lumina, then the total air space relatively small and the specific gravity tends to be high (Panshin and De Zeeuw, 1970). Reported by Mitchell and Denne (1997) for Sitka spruce, the specific gravity decreased with increasing height in the tree due to the thicker walls of fibers in mature wood in the butt. Specific gravity is also major determinant of maximum moisture content, lumen volume decreases as specific gravity increases, so maximum moisture content also decreases because there is less room available for free water (Anonymous, 1999).

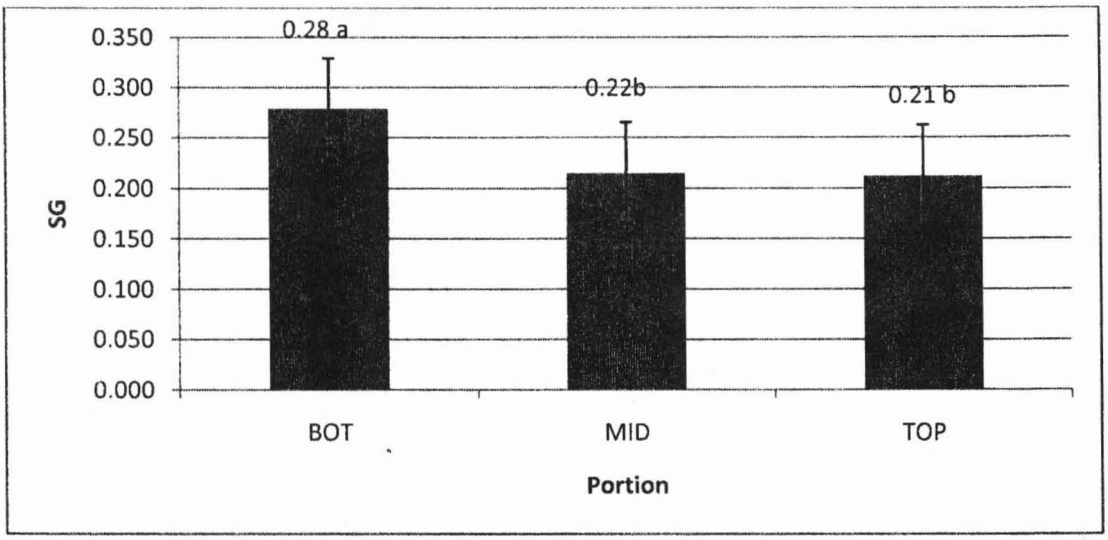

Figure 1: Effect of SG towards its tree portion

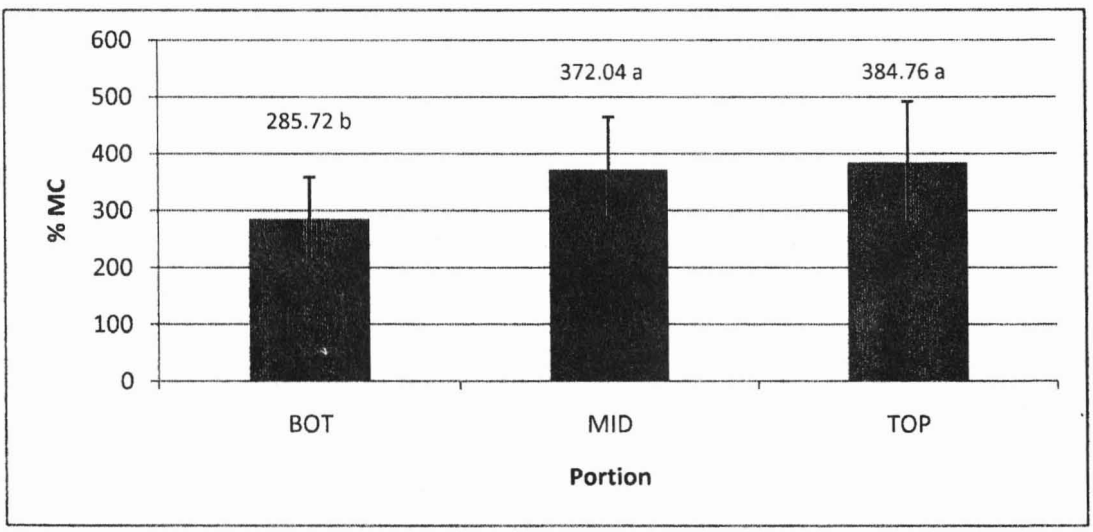

Figure 2: Effect of MC towards its tree portion

Effects of Distance from the Pith

Figure 3and Figure 4 showed that the specific gravity was to observe increase from near pith to near bark while moisture content decreases from near pith to near bark. The correlations analyses according to distance were given in (Table 2). The increase in specific gravity was shown to be significant (r = 0.653**) and for moisture content, its decrease towards near bark was negatively correlated (r = -0.617**). In general terms, the increasing of specific gravity depends either increasing wall thickness of fiber from pith to bark or increasing percentage of fibers with little change in wall thickness (Panshin and De Zeeuw, 1970). Ishiguri et al.(2007) reported that the specific gravity of batai showed an almost constant

value up to 10 cm from the pith and then increased toward the bark. Decreasing in moisture content with increasing distance from the near pith due to the sapwood is thus not enough mature to transformed into heartwood. Sapwood contains both living and dead cells and functions primarily in the storage of food, and its also handles transport of water or sap (Anonymous, 1999). The other factors are (1) tree age, (2) growth condition, (3) genetic and (4) types of soil which can influence the moisture content (Haygreen and Bowyer, 1996).

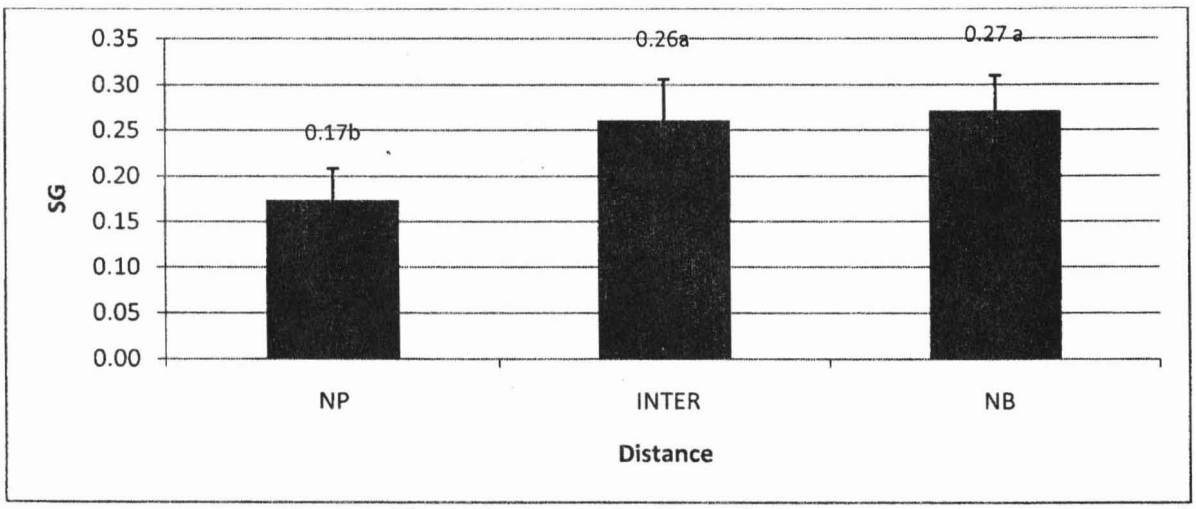

Figure 3: Effect of SG towards its tree distance

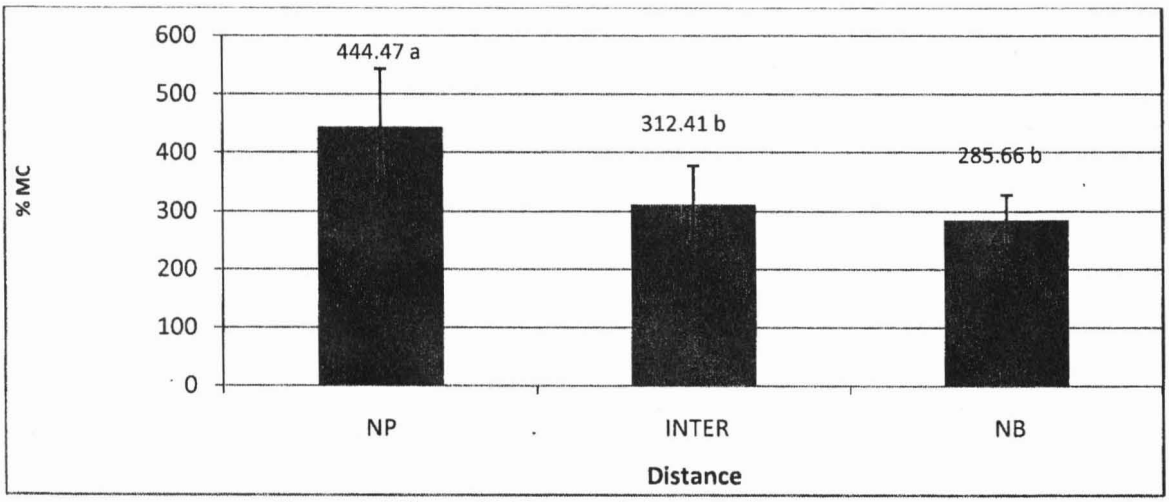

Figure 4: Effect of MC towards its tree distance

Table 2: Table of correlations analysis of the effects of height portion and distance from pith on the initial moisture content and specific gravity

Source		SG	MC (%)
Portion			
	Pearson Correlation	-0.457**	0.384**
	Sig. (2-tailed)	0.000	0.000
	N	108	108
Distance			
	Pearson Correlation	0.653**	-0.617**
	Sig. (2-tailed)	0.000	0.000
	N	108	108

Note: ** Correlation is significant at the 0.01 level

CONCLUSION

Result shows the specific gravity of batai ranges from 0.15 to 0.31. It decreases with tree portion and increases with distance from pith. While the green moisture content of batai ranges from 280% to 550%. It increases from bottom to top portion and decreases from near pith to near bark. These result suggest batai has a strong potential uses for be for veneer production, low density wood composite, handicrafts and also artificial limbs.

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