

# Acoustic Properties of Selected Tropical Wood Species

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**Abstract** Acoustic properties such as specific dynamic Young's modulus ( $E'/\gamma$ ), internal friction ( $Q^{-1}$ ) and acoustic conversion efficiency (ACE) of wood are important properties frequently examined by researchers. Vibration technique is one of the non-destructive evaluation techniques used as an alternative method for measuring the acoustic properties of wood. The objectives of this study are to determine acoustic properties of selected low density tropical wood species namely *Endospermum Diadenum*, *Cratogeomys Arborescens*, *Dyera Polyphylla*, *Macaranga Gigantea*, *Commersonia Bartramia* and *Alstonia Pneumatophora* and their suitability for making violin and guitar (acoustic instruments). The acoustic properties were determined by using free-free flexural vibration method. The results show that there are significant and good relationship between  $\log Q^{-1}/(E'/\gamma)$  and  $\log E'/\gamma$  with negative gradient for each and overall wood species studied. The  $P$ -value of regression equation is less than 0.01 whereas the coefficient of determination ( $r^2$ ) is in the range of 0.565 to 0.894. The mean value of  $E'/\gamma$ ,  $Q^{-1}$  and ACE of wood species studied are in the range of  $1.69 \times 10^{10}$  Pa to  $2.73 \times 10^{10}$  Pa, 0.017 to 0.035 and  $1.50 \times 10^7$  to  $3.56 \times 10^7$  respectively. Based on the mean value of  $E'/\gamma$ , *Endospermum Diadenum*, *Cratogeomys Arborescens*, *Macaranga Gigantea* and *Dyera Polyphylla* are preferred for making all component of violin and guitar except for the top plate of violin. *Commersonia Bartramia* is preferred for making the back plate of violin and

guitar, whereas *Alstonia Pneumatophora* is only preferred for making the back plate of violin.

**Keywords** Acoustic properties · Tropical wood species · Low density

## 1 Introduction

Acoustic properties such as specific dynamic Young's modulus ( $E'/\gamma$ ), internal friction ( $Q^{-1}$ ) and acoustic conversion efficiency (ACE) of wood are important properties which are frequently examined by researchers. Vibration technique is one of the non-destructive evaluation techniques used as an alternative method for measuring the acoustic properties of wood. Generally tropical Malaysian woods are used as material for building construction, bridge construction, furniture, matchstick, chop stick, stationery and paper. Tropical woods are also used for manufacturing traditional musical instrument such as Sapeh, Gendang, Rebana, Beduk and Tar [2]. However the determination of suitability of tropical wood species for making musical instruments is conducted dominantly based on trial and error or experience of manufacturer. Therefore the tropical wood species that have been selected by manufacturer in making musical instrument are very limited such as *Intsia Palembanica* (Merbau) and *Artocarpus Champeden Spreng.* (Cempedak), although there are a lot of other wood species available in Malaysia [2]. The determination of suitable wood for manufacturing musical instrument is scientifically done based on the acoustic properties of wood. Since then, studies have been conducted on acoustic properties of substitute woods and woods that have been used for manufacturing musical instruments. However only a few tropical wood species have been used so far; such as *Dialium* species and *Agathis Booneensis* [2–7]. Thus the

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