

# Evaluating mukau wood

Looking at the properties of *Melia volkensii*, compared to mahogany, teak and mvule

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**M***elia volkensii* is an indigenous tree species in the plant family *Meliaceae*. Its common names include mukau (Kamba / Mbeere / Embu / Meru), mpenda bure (Swahili), kirumbutu (Taita) and boba (Somali). *Melia* grows naturally in the semi-arid zones of Ethiopia, Somalia, Tanzania and Kenya.

The species is common in deciduous bushland in association with Acacia-Commiphora vegetation in agro-ecological Zones IV - V (arid and semi-arid). In Kenya, the species grows mostly in Mbeere, Tharaka, Mutomo, Kitui, Mwingi, Makueni and Taita Taveta. In these areas, the tree is managed as remnants of natural stands, woodlots, scattered trees on cropland and homestead compounds.

The tree grows to a height of 15 metres, has a rounded crown and low hanging branches. It has grey and fairly smooth bark. The leaves are compound with many leaflets. The flowers are white in dense panicles. The fruits are green ovals, about 4cm long, which turn yellow when ripe.

The timber is pale reddish-brown, resembling mahogany, and is highly valued for a variety of uses. It is suitable for furniture/joinery and interior panelling.

*Melia* has been exploited heavily over the

last decade, owing to a shortage of alternative hardwood species. The Kenya Forestry Research Institute (KEFRI) has led the way in developing propagation, establishment and management techniques for *Melia* since the 1990s.

Through on-station and on-farm research, several techniques of establishing and managing the tree have been realised. As a result, tree growers are now striving to grow *Melia* as a plantation species.

## Comparison with other well known species

In Table 1, we compare *Melia* to mahogany (*Khaya* species), teak (*Tectona grandis*) and mvule (*Milicia excelsa*), all well-known species.

## Density

Density is defined as a tree's mass per unit volume measured at particular moisture content. *Melia* is a moderately heavy species with an average density of 620 kg/m<sup>3</sup>. This compares well with the three species mentioned above and all are classified as moderately heavy (densities ranging between 580 and 810 kg/m<sup>3</sup>).

## Heartwood and sapwood colour

The predominant colour of the heartwood and sapwood of *Melia* after drying is pale-red and pale brown respectively. The colour of *Melia* timber is very close to that of mahogany.

## Texture and grain

Texture describes the relative size of vessels in the wood. It affects the resistance of the timber to abrasion, and to some extent, the quality of the machined and polished surface finish. The texture of *Melia* is coarse which means it has large and widely spaced vessels, which are visible to the naked eye. *Melia*'s texture is the same as that of mahogany, teak and mvule.

The grain is the alignment of cells relative to the axis of the tree or the longitudinal edge of an individual piece of sawn timber. The grain of *Melia* is straight; so is that of mahogany and teak timber.

## Mechanical properties

The mechanical properties of wood are an expression of its behaviour under applied forces. *Melia* timber has superior mechanical wood properties and is comparable with mahogany, teak and mvule (Table 2).

## Bending strength (modulus of rupture - MOR)

This shows the highest stresses in the outermost fibres of the wood when the beam breaks under a load. The bending strength of *Melia* is relatively high, and thus it is classified as a strong timber. The other three species are equally strong as they range from moderately strong (mahogany) to very strong (teak and mvule).

Table 1: Some physical properties of mukau (*Melia volkensii*), mahogany (*Khaya* spp), teak (*Tectona grandis*) and mvule (*Milicia excelsa*)

Property	<i>Melia</i>	Mahogany	Teak	Mvule
Average density (kg/m <sup>3</sup> )-[air dry]	620 (Moderately heavy)	685 (Moderately heavy)	650 (Moderately heavy)	675 (Moderately heavy)
Heartwood and sapwood colour	Pale brown sapwood to pale red heartwood	Pale brown sapwood to pinkish brown to deep red heartwood	Light golden with dark markings	Yellow-white sapwood to yellow to deep golden-brown heartwood
Texture and grain	Coarse textured with straight grains	Coarse textured with straight or interlocked grains	Uneven coarse textured with straight grains	Coarse textured with interlocked and wavy grains

Table 2: Some mechanical properties of mukau (*Melia volkensii*), mahogany (*Khaya* spp), teak (*Tectona grandis*) and mvule (*Milicia excelsa*)

Property	<i>Melia</i>	Mahogany	Teak	Mvule
Bending strength (MOR) [N/mm <sup>2</sup> ]	74 – 96	50 – 110	81 – 196	75 – 156
Bending stiffness (MOE) [KN/mm <sup>2</sup> ]	5.8 – 9.2	7.8 – 10.3	7.6 – 17.5	8.3 – 13.0
Crushing strength [N/mm <sup>2</sup> ]	42 – 56	24 – 53	34 – 70	42 – 65
Shear strength (parallel to grain) [N/mm <sup>2</sup> ]	14 – 18	8 – 14	5 – 16	5 – 14
Hardness [N/mm <sup>2</sup> ]	3.5 – 5.1	3.4 – 5.7	3.8 – 4.8	4.8 – 6.1

KN = Kilo Newton

N = Newton: a unit to measure force applied per area.

Table 3: Some seasoning and wood working properties of mukau (*Melia volkensii*), mahogany (*Khaya spp*), teak (*Tectona grandis*) and mvule (*Milicia excelsa*)

Property	Mukau	Mahogany	Teak	Mvule
Shrinkage rates	Low	Moderate	Low	Moderate
Movement in service	Small once the wood is dry	Fairly stable once dry	Stable with low movement values	Small once the wood is dry
Machining	Easy to saw and work	Easy to work	Easy to saw and work	Saws easily
Seasoning/drying characteristics	Seasons well without degrade	Seasons well	Seasons well without degrade	Seasons well with little degrade of minor end checks
Durability	Durable and extremely termite and decay resistant	Moderately durable but susceptible to termites and pinhole borers	Durable - decay and termite resistant. Moderately resistant to marine borers and powder post beetles.	Heartwood is durable and resistant to decay but not immune to termites. Sapwood is susceptible to attack by beetles-borers
Uses	<ul style="list-style-type: none"> <li>• Furniture /joinery</li> <li>• Panelling</li> <li>• Framing</li> <li>• Floor parquets</li> <li>• Poles</li> </ul>	<ul style="list-style-type: none"> <li>• Furniture /joinery</li> <li>• Ship and boat-building</li> <li>• Veneer /panelling</li> <li>• Floor parquets</li> <li>• Framing</li> </ul>	<ul style="list-style-type: none"> <li>• Ship and boat-building</li> <li>• Veneer</li> <li>• Furniture</li> <li>• Carvings</li> <li>• Exterior construction</li> </ul>	<ul style="list-style-type: none"> <li>• Veneer /panelling</li> <li>• Furniture /joinery</li> <li>• Floor parquets</li> <li>• Boat-building</li> <li>• Framing</li> </ul>

### Bending stiffness (modulus of elasticity - MOE)

This expresses the linear relationship between stress and strain within the elastic range of a material, providing an indication of stiffness. It is important in determining the reflection of a beam under load. The bending stiffness of *Melia* is generally low compared to the three other species, meaning it is not suited to heavy engineering work.

### Crushing strength

This is the maximum compressive strength of the specimen, parallel to the grain and is important for columns and chair legs. The crushing strength for *Melia* is high, at the range of 42 – 56 N/mm<sup>2</sup>.

### Shear strength (parallel to the grain)

This is the measure of the resistance of the timber to shearing/splitting/tearing. The shear strength for *Melia* is high at a range of between 14 – 18 N/mm<sup>2</sup>.

### Hardness

This represents the resistance of the wood to wear and abrasion, which is a useful property in assessing the suitability of a timber for flooring. *Melia* has a range of 3.5 – 5.1 N/mm<sup>2</sup> and is thus rated as a soft to moderately hard timber. The moderate hardness makes the species suitable, just like mahogany and mvule, for making floor parquets.

### Seasoning

The seasoning (drying) rate with which a timber can be dried is determined by kiln settings or ambient climatic conditions and board thickness. The rate at which a particular timber species dries is principally determined by its density, anatomical characteristics and the degree to which drying can be accomplished to 12 per cent moisture content, with acceptable levels of degrade if present. *Melia* was found to dry well without degrade.

### Wood-working properties

Machining is the ease or difficulty with which a timber can be machined. *Melia* is generally easy to machine and work with. It gives good finishing (the general quality of a finished surface) and takes polish well. The grain orientation gives this species an eye-catching feature, which can be exploited for woodcarvings and furniture-making. This property of *Melia* is also generally noted in the other species it is compared with.

*Melia* timber has low shrinkage rates and movement in service is small (Table 3). This aspect makes the species suitable for flooring and furniture. The rates of shrinkage of mahogany, teak and mvule are moderate to low and these species too, are fairly stable in service.

### Natural durability

Natural durability refers explicitly to the resistance of the timber to fungal degradation and insect attack. The principal factor conferring resistance to biological attack is the presence of extractives in the heartwood. Generally, *Melia* timber is classified as durable and extremely termite and decay resistant (15-25 years) when in contact with the ground in the tropics. This makes the species suitable for external use.

### Conclusions

KEFRI's Timber Bulletin (No. 1) entitled "Strength Groups of Kenyan Grown Major Commercial Timbers" has grouped 49 species into four strength groups – S1 to S4 in order of decreasing strength properties (very strong, strong, moderate and weak). These four categories reflect the common uses of timber in Kenya, i.e., heavy engineering, general structural construction (housing), furniture manufacturing and light construction.

Based on the MOR and MOE values, *Melia* can be grouped S3 to S2 (moderate to strong). This means the timber from this species can be used in general construction and for furniture. It has also been noted that *Melia* has small movement in service, making it very stable while in use. Its low rates of shrinkage also make it suitable for construction and flooring. Its decay and termite resistance qualities make this species suitable for general construction such as housing.

*Melia* timber compares favourably with mahogany, teak and mvule; the colour of *Melia* is very close to that of mahogany; the grain of *Melia* is straight just like that of mahogany and teak timber. The uses of *Melia* are generally similar to those of the three species it has been compared with.

Table 4: Comparison of Kenyan prices of the four species discussed

Species	Cost (Ksh/board foot)	Cost (Euro/m <sup>3</sup> )	Location
Mukau	130-150	500-578	Kibwezi, Kitui, Mwingi
Mahogany	150	578	Nairobi (from DRC)
Teak	200	770	Nairobi
Mvule	180	693	Nairobi (from DRC)

(A board foot is one foot by 1 foot by one inch, or 0.002360 m<sup>3</sup>. One euro is equivalent to Ksh 110).

Note: The export price of *Khaya ivorensis* (African mahogany) timber from Ghana, kiln dried, FOB is 643 Euro/m<sup>3</sup> (ITTO Vol 17, No 4, 16-28 Feb 2013).

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