

Investigating the Properties of “Acacia Nilotica” as a Species with Capability of Utilization in Furniture Industry

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Abstract

“Acacia Nilotica” is a tropical tree with rapid growth and ten-year period of yield which can grow extensively in the seashores of southern Iran. Its wood has many uses including fixing sand dune, feeding livestock, pharmacology, fuel as coal, resin and tannins, timber, traverses, ship building, woodturning, engraving, furniture and etc. because of its extensive use and the distinctive role of its anatomy in terms of its strength, we investigate its specific properties such as binding, adherence, nail working, screw tightening and etc. We first prepare transverse, radial and tangential samples from the wood following IAWA standard. The results showed that its xylem is sporadic with average diameter 122 micron. It has 4.5 rays in transverse section and 12.45 xylems per mm². In its tangential cross section, its spindle-like rays have following properties: average cells across the spindle 3.18, average cells in the length of the spindle 17.28, average width of ray 36.43 micron and average length of ray 218.86 micron. It also has mutual punctuation on the xylem wall. Spiral thickness and Librium form fiber are observable in this cross section.

Keywords: *Acacia Nilotica, xylem, wood ray, fiber, sporadic xylem, sustainable development.*

1. Introduction

Furniture is a valuable human property with many uses such as those used for sitting, eating, sleeping and for placing things on and etc. it is a long time when furniture was started to be designed and used that is when furniture craftsmanship began (more than 3000 years ago) (Ebrahimi 2008). Furniture is designed based on three principles: 1. Aesthetic considerations 2. Function 3. Applications Aesthetics refers partly to the color and design of wood. Its function relates to the design of joints and parts as well as wood robustness (Ebrahimi 2008). Trees grew with different properties in the world and with definite aesthetic uses and functions including as furniture. Beech wood is often used for furniture in Iran. However, it is suggested that Acacia Nilotica species which grows in hot and wet sites in Sothern Iran is used for furniture.

Diverse applications of a wood species depend on its macroscopic and microscopic properties. Cellular arrangement in a growth area of a tree and its change in

another area impacts significantly on wood mechanical properties specifically in transverse direction. Information about the relationship between healthy wood anatomy and its behavior is used to describe other properties of the constituents (Badig and Jin translated by Ebrahimi 2000). Therefore, microscopic properties of Acacia Nilotica help us to understand its fiber structure and wood science and applications. The microscopic and macroscopic information of Acacia Nilotica is not available in Persian language so the author intended to study them in Dashteyari Region, Chahbehar, Sistan and Balochestaan Province, Iran.

2. Wood science and habitat of Acacia Nilotica

Acacia Nilotica is a multipurpose tree with extensive distribution from Egypt to Mauritania and South Africa in Africa and from East Asia to India, Pakistan and Iran in Asia. It is a fast growing tree in Sudan-seashore of Africa (Karin 2005). Acacia Nilotica is a tall tree (6-8 meters high) with compound leaves, tiny leaflets, yellow and fragrant round flowers, sharp thorns, ball-like crown, stem in form of legume which flourishes in spring and autumn (Sabeti 2003). It grows in semi arid, hot and wet regions such as the Persian Gulf, Oman Sea and in Boushehr Province, Hormozgan Province and Sistan and Baluchestan Province (Chahbehar, Iranshahr and Nikshahre) as well as in deep loam soils. Acacia Nilotica plantation was started from 1984 in Chahbehar and Dashteyari. The plantation area in 1996 was 140 hectares (Mahmoudi Taleghani 1998). The plantation area for Acacia Nilotica and other species of Acacia in Hormozgan in 2002 was 1230 hectares (Najafi; Nayereh Shabankareh 2002). Acacia Nilotica is locally called kert (Bandarabbas), Chesh (Chahbehar) and selm (between Lar and Bandarabbas).



Figure1. Natural distribution of Acacia Nilotica around the world (Orwa et al 2009)

Acacia nilotica (family Leguminosae, subfamily Mimosoideae) grows to 15-18 m in height and 2-3 m in diameter. The bark is generally slaty green in young trees or nearly black in mature trees with deep longitudinal fissures exposing the inner grey-pinkish slash, exuding a reddish low quality gum. The leaves are bipinnate, pinnae 3-10 pairs, 1.3- 3.8 cm long, leaflets 10-20 pairs, and 2-5mm long. Thin, straight, light grey spines present in axillary pairs, usually 3-12 pairs, 5-7.5 cm long in young trees, and mature trees commonly without thorns. Flowers in globulous heads, 1.2-1.5 cm in diameter of a bright golden yellow colour, born either axillary or whorly on peduncles 2-3 cm long located at the end of branches. Pods 7-15 cm long, green and tomentose when immature and greenish black when mature, indehiscent, deeply constricted between the seed giving a necklace appearance. Seeds 8-12 per pod, compressed, ovoid, dark brown shining with hard testa (Bargali et al 2009).

Specific gravity of *Acacia Nilotica* wood is 0.67-0.68 g/cm³ and it is regarded as a weight wood. It is used in ship building, fodder, pharmacology, coal with 4950-4800 kcal/kg for external wood and internal wood respectively (Webb et al 1984; Nair and Latt 1997). Its wood is hard and coarse and resistant against termite and water proof so it is desirable for train traverses, handle for tools.

Antifungal efficacy of *Acacia nilotica* and chemopreventive and antimutagenic activity of its leaf extract, have been reported recently (Rehman et al 2011). *Acacia nilotica* have many drug and medical properties, The bark, root, gum, leaves and flowers have found use for skin diseases, Collection of Plant Material: The leaves of *Acacia diarrhoea*, dysentery, cough, diabetes, eczema, wound nilotica collected from T M Palayam, Coimbatore. healing, burning sensation and as an astringent, demulcent, anti-asthmatic(Hemamalini, Jithesh and Nirmala 2013). for example: An infusion made of the bark of *acacia nilotica* tree or the gum can either be used in decoction or in syrup as an effective medicine for diarrhea. The bark of

Acacia nilotica (booni) tree is useful in the treatment of eczema (Rajvaidhya et al. 2012).

Its wood is also desirable for engraving and woodturning and still is used for shipbuilding and furniture. Its legume protein content is more than 15%. Its skin and legume are used mainly to produce strap. Its tannins content varies 12%-20%. It is probably the earliest source of Arabic resin (Bargali et al 2009). This species wood is used in shipbuilding. Its leaf and fruit are used as fodder. These trees are very valuable for restoring arid lands and for fixing sand dune. In the past, *Acacia Nilotica* wood was cut illegally and the timber was delivered to neighboring countries and there it was used for building large ships but later it was prevented severely by Natural Source Offices in sea shore provinces. A lot of measures have been performed for improving and restoring this national treasure.

3. Material and Methods

3.1. Geographical properties of location for sampling

Sistan and Balochestan Province extends 187502 km², that is, 11.5% of whole country total area. This province is in southeast and near the coasts of Oman Sea. The climate in its south part is hot and wet. Dashtyari Plain is in the north of Chahbehar between coasts of Oman Sea and Ghasreghand Mountain Ranges. Other weather parameters are: yearly average precipitation 115.1mm, average minimum temperature 15.8°C, average maximum temperature 32.9°C, average annual temperature 27.2°C, precipitation period 12 days with no freezing (Koneshlou 1999).

3.2. Tissue Sampling: 30 years old trees near Chahbehar were sampled with two iterations. The sampled trees with no growth defects were dissected at the middle and the samples were prepared from the diameter of dissected area.

3.2. Sample Preparation process

The samples were prepared in wood workshop having dimension of 10x8x8 mm in three directions (transverse, radial and tangential). The samples were dissected microscopically using Microtome system. The samples were washed, stained and prepared based on Parsapajoh Method on slides (Parsapajoh and Grober 2002).

4. Results

4.1. Anatomic study of *Acacia Nilotica*

Cross section: Microscopic study of *Acacia Nilotica* showed that its external wood color is reddish brown and its internal wood color is from cream to bright yellow. *Acacia Nilotica* is diffuse porous wood with distinct annual growth rings and a lot of rays. In cross section vessel elements are observed as pores and rays are seen in groups with 1-5 rows. Also fibers and parenchyma cells are observed in this section but there difference is more thickness in fibers cell walls. The Parenchyma cells are placed around the xylem and attached to it and are observed in two forms: (1). Resembles paratracheal confluent arrangement, (2). Vascentric parenchyma. In this section, abundant parenchyma cells and punctated or linear interlaced inclined parts in summer zone of wood are observed. The average diameter of vascular system in transverse section in 100 iterations was 122.04, average numbers of rays in transverse mode was 4.55 per mm and average numbers of xylem was 12.45 per mm.

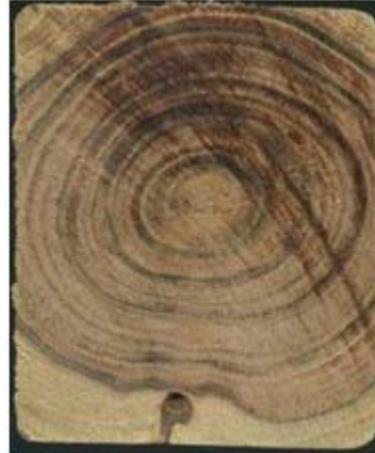


Figure3. Macroscopic diagram of *Acacia Nilotica* cross section

Radial Section: Radial section is section that perpendicular to annual growth rings. Rays are as rows perpendicular to tree axis. Axial parenchyma is as lines in longitudinal axis direction of tree as seen in the radial section and the fibers are tracheid fibers. The punctuation on the wall of xylem is mutual. Spiral thickness and Libriform fibers are observed in this section.

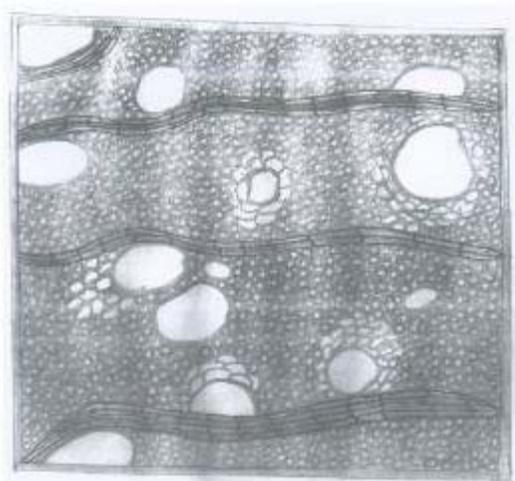


Figure2. Microscopic diagram of *Acacia Nilotica* cross section

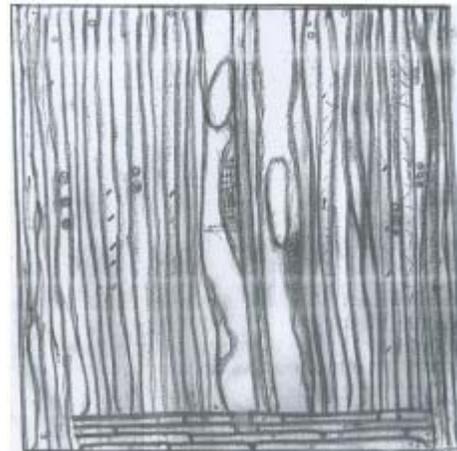


Figure4. Microscopic diagram of *Acacia Nilotica* radial section



Figure5. Macroscopic diagram of Acacia Nilotica radial section



Figure7. Macroscopic diagram of Acacia Nilotica tangential section

Tangential Section: this section is made in tangential form over growth rings. Coherent rays are observed in form of spindles with different length and width. In fact, the holes are inner diameter of rays. Parenchyma and fiber cells are observable but parenchyma cells differ in terms of their transverse wall and fiber cells are in form of taper and narrow spindles. Vascular system is torn. Average width of ray is 36.43 micron and its length on average is 218.86 micron.



Figure6. Microscopic diagram of Acacia Nilotica tangential section

5. Conclusions

Acacia Nilotica is a species with sporadic vascular system, in reddish brown color, semi weight with flat and regular fibers and easy mechanical and finishing properties so it is appropriate for shipbuilding, furniture and wood decorations.

In cross section there are ray in 1-5 rows, fiber and parenchyma. Parenchyma system is around and attached to vascular system in two forms: (1). Rare oriented vascular bundles, (2). Circular vascular system. In this section, abundant parenchyma cells and punctated or linear interlaced inclined parts in summer zone of wood are observed.

The average diameter of vascular system in transverse section was 122.04, average numbers of rays in transverse mode was 4.55 per mm and average numbers of xylem was 12.45 per mm.

In radial section, there are tracheate fibers. The punctuation on the wall of xylem is mutual. Spiral thickness and fibers are in Librium form in this section.

In tangential section, Coherent rays are observed in form of spindles with different length and width. Parenchyma and fiber cells are observed. Vascular system is torn. Average width of ray is 36.43 micron and its length on average is 218.86 micron.

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