

COMPARATIVE WOOD ANATOMY OF *MORUS ALBA* AND *MORUS NIGRA* GROWN IN SWAT, KHYBER PAKHTUNKHWA

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ABSTRACT

The present research was conducted under development research to study anatomical properties of *Morus alba* and *Morus nigra* wood grown in Swat valley, Khyber Pakhtunkhwa in order to observe variations in structural features and evaluate technological properties to improve the quality the wood species for better utilization. Permanent slides of cross, radial and tangential sections of each wood species were prepared, observed under the microscope and data were collected for the frequency and dimensional measurement of different wood elements/ structures in each wood species. On the basis of results, it was found that *Morus alba* wood may be comparatively stronger and have better seasoning and preservation behavior. Moreover, *Morus alba* wood may be more resistant to deteriorating agents in comparison to *Morus nigra*. Further, the wood of both the species may also be suitable for pulp and paper making.

INTRODUCTION

Morus, a genus in the family Moraceae, comprises 10–16 species of deciduous trees commonly known as mulberries, growing wild and under cultivation in many temperate world regions (Suttie, 2012). The trees can be monoecious or dioecious (Zhengyi *et al.*, 2014). Ter Welle *et al.*, 1986 studied anatomical features of all genera of the family Moraceae.

In Pakistan *Morus alba* is commonly known as Chitta Toot distributed in Swat, Hazara, Kashmir and Murree (Arshad *et al.*, 2010). The tree is of medium sized, deciduous, 9 to 15 m tall with a diameters of 0.6 to 0.8 m. The wood is of straight, medium coarse uneven texture with yellowish to yellowish white sapwood and bright heartwood which may change yellowish brown to dull brown with age (Sheikh, 1993).

Morus nigra locally known as Kata Toot is cultivated and grows wild throughout the country. The tree is deciduous growing 12m tall by 15 m broad. (Arshad *et al.*, 2010; Elham *et al.*, 2010). The wood is lustrous when first exposed becoming dull with age, without characteristic odor or taste, straight grained and medium coarse and somewhat uneven textured. The Sapwood white to yellowish white, the heartwood bright yellowish to golden brown at first, changing to dark color after sometimes.

The current study has been carried out with the objective to collect the anatomical data of *Morus alba* and *Morus nigra* grown in the prevailing climatic

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conditions of Swat in order to observe variations, evaluate their technological properties and predict utilization other than the conventional.

MATERIALS AND METHODS

To carry out the research work, the wood material in logs form were collected from Swat, Khyber Pakhtunkhwa. Discs of about two inches in thickness were cut and standard blocks of 1x1x2 cm were prepared from each log. Permanent slides of cross, radial and tangential sections of all the wood samples were prepared by standard laboratory procedures and observed under microscope for various structural features. To measure the fiber length, a small portion of wood from each sample was macerated in Schulze's mixture (20% Nitric acid and Potassium chlorate) to separate the fibers (Anon., 1974). Data were collected for the frequency and dimensional measurements of different wood elements/structures in each wood sample by the process of micrometry (Guay, 2013) and analyzed for statistical variables for each feature in each sample.

RESULTS AND DISCUSSION

Structure of *Morus alba* Wood

The wood is ring porous, growth rings are distinct and fairly conspicuous with the naked eye, 1-5 per inch. The vessels very variable in size, open or occluded with tylosis; the springwood vessels large to medium sized, solitary and in radial rows of 2-3 forming a belt of porous tissue at the beginning of the ring 4-6 pores wide and frequent on both sides 9-14 per mm² and the largest one are 240-265 μ in diameter. Summerwood vessels medium sized to small or very small with nests of 3-15 the smallest 20-30μ in diameter. The parenchyma is para-tracheal, paratracheal-zonate and meta-tracheal in cambiform rows of 2-8 cells along the grain with maximum diameter 35-50μ. The fibers are non-libriform to semi-libriform, very fine, non-septate, 385-1300μ long, 17-23 μ in diameter and 2-3μ in wall-thickness. Heterogeneous rays are of two sorts, the larger 4-8 seriate and 70-80μ wide upto 40 cells and 700μ plus in height and narrow rays much less numerous, 1-3 seriate, 1-6 cells and upto 170μ in height.

Structure of *Morus nigra* Wood

The wood is ring porous, growth ring boundaries are distinct. The vessels are mostly multiples (sometimes solitary) in radial direction of 2-6 cells in earlywood and sometimes in cluster groups of 2-7 (rarely more than 7) in latewood. The average number of vessels is 136 (83-305) per mm² in the earlywood and 141 (104-187) per mm² in the latewood; average diameter is 97 (75-129) μm in the earlywood, and 70 (45-134) μm in the latewood. The fibers

are libriform and non-septate with average length of 1.07 mm (0.56-1.49), 17-23 μ in diameter and 2-3 μ in wall-thickness. The Axial parenchyma is diffuse, paratracheal axial parenchyma is found in vasicentric form, axial parenchyma in marginal bands and aliform parenchyma are present. Rays are found in range of 11-38 per mm²; both uniseriate and multiseriate; homo-cellular rays mostly consist of procumbent cells; rays are sometimes hetero-cellular with a few square cells; rays are about 316 μ m in height and 1-9 in numbers.

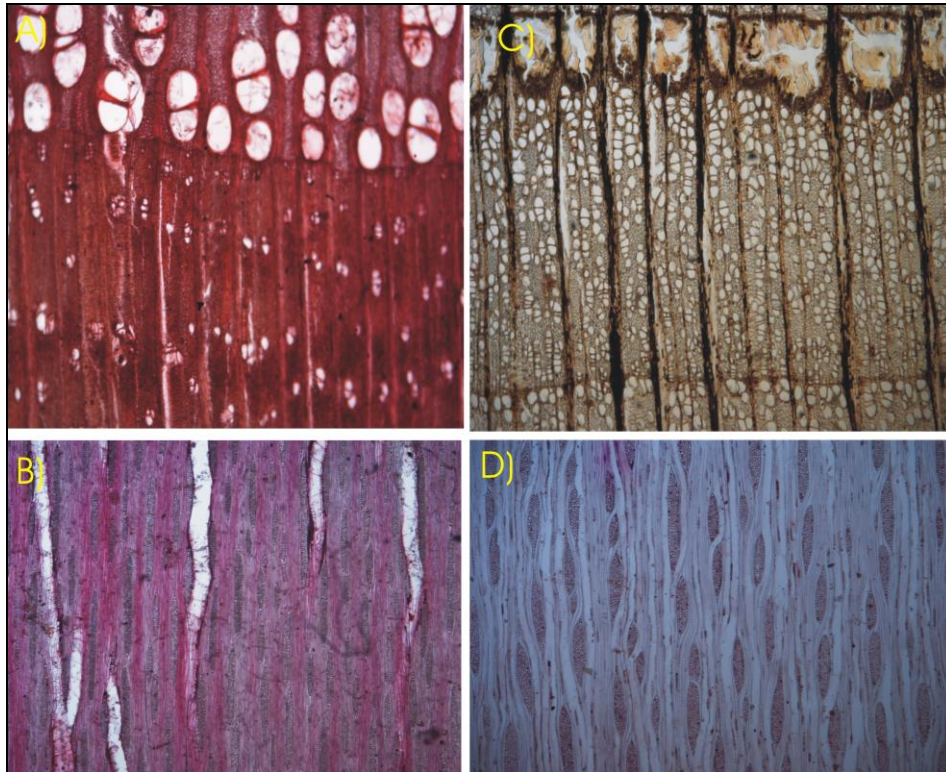


Fig.1. Cross and Tangential Section View of *Morus alba* (A&B) and *Morus nigra* (C&D) grown in Swat Valley, Pakistan

Comparison of Anatomical Data

Results given in table 1 showed that fibers of *Morus alba* wood are 0.72-1.40 mm long, 9.7-23.51 μ in diameter and have 1.84-3.94 μ thick walls. The vessel 5-11 EW and 4-42 LW/mm² in number and 216-439 μ EW and 71-264 μ LW in diameter. The wood rays are 1-2/mm in cross section and 5-10/mm² in tangential section. The largest wood rays are 774.49 μ (75 cells) in height and 82.65 μ (8 cells) in width.

In *Morus nigra*, the fibers are found 0.56-1.49 mm long, 10.31-20.86 μ in diameter and have 1.51-4.21 μ wall-thickness. The vessels were calculated 83-305 EW and 104-187/mm² in number and 75.10-129.31 μ EW and 45.69-134.35 μ LW μ in diameter. The wood rays are 4-5.83 /mm in cross section and 11.29-38.22/mm² in tangential section. The largest wood rays are 815.24 μ (62 cells) in height and in 102.03 μ (9 cells) width.

Table 1. Frequency and Dimensional Measurement of Different wood elements in *Morus alba* and *Morus nigra* Grown in Swat, Khyber Pakhtunkhwa

Anatomical Parameters	Units	<i>Morus alba</i>			<i>Morus nigra</i>		
		Averages value	Standard deviation (\pm)	Co-efficient of variation (%)	Averages value	Standard deviation (\pm)	Co-efficient of variation (%)
Fiber length	(mm)	1.14	0.22	19.48	1.07	0.18	17.21
Fiber diameter	(μ)	22.97	4.02	17.52	15.89	2.73	17.20
Fiber wall-thickness	(μ)	3.72	0.58	15.84	2.75	0.57	20.89
Fiber lumen width	(μ)	15.53	-	-	10.39	-	-
Runkel ratio	-	0.48	-	-	0.52	-	-
Frequency of vessels	No. of vessels/mm ²	EW	2.51	16.92	E.W	38.15	27.87
		LW	31.82	25.33	L.W	24.48	17.35
Vessels diameter	(μ)	299.81	68.19	22.73	97.60	10.87	11.14
		52.05	12.45	23.93	70.44	14.06	19.97
Rays frequency	No. of rays/mm ²	9.03	1.79	19.90	23.42	6.01	25.67
Rays frequency	No. of rays/mm	2.90	-	-	4.60	-	-
Height of ray	(μ)	531.69	213.52	40.15	316.18	208.88	66.06
No. of cells in ray height	-	51.90	35.03	67.49	24.86	17.23	69.33
Width of ray	(μ)	69.42	16.27	23.43	46.13	29.52	64
No. of cells in ray width	-	5.34	2.11	39.60	4.30	2.50	58.16

E. W-earlywood

L. W-latewood

Comparison of anatomical characteristics represented that *Morus alba* wood has comparatively longer fibers with wider diameter, lumen width and of less wall-thickness as compared to *Morus nigra* which indicated that this species may be better in strength than *Morus nigra*. Further, the Runkel ratio value of fibers also reflected its suitability for the manufacturing of pulp and paper products. Although *Morus nigra* has higher frequency of vessels per mm² in both earlywood and latewood portion but *Morus alba* has wider vessel diameter of EW vessel which represented that the seasoning and preservation behavior of this species may be better than the *Morus nigra*. Ray frequency i.e. Number of rays/mm² in tangential-section and Number of rays/mm in cross-section was found less in *Morus alba* as compared to *Morus nigra* that further pointed out its better resistant property against wood deteriorating agent as compared to *Morus nigra*.

CONCLUSION

Based on the results, it can be concluded that, *Morus alba* wood may be stronger than *Morus nigra* and could behave better during seasoning and preservation processes. In addition, *Morus alba* wood is more resistant to wood decaying agents as compared to *Morus nigra*. Moreover, both wood species have also utilization potential for pulp and paper manufacture.

REFERENCES

- Anon., 1974. The Preparation of Wood for Microscopic Examination. TIL 52. Building Research Advisory Service; Building research Station Garston, Watford WD27 Jr.
- Arshad, M. A., M. A. Khan, A. Mushtaq, M. Munir, M. Zafar, S. Sultan, Z. Mishwani, and Zahid Ullah, 2014. Ethnobotanical and taxonomical screening of Genus *Morus* for Wild Edible Fruits Used by the Inhabitants of Lesser Himalayas-Pakistan. J. Med. Plant Res. Vol.8 (25) 2014. pp. 889-898.
- Guay, R., 2013. WinCELL 2013 for wood cell analysis. Regent Instruments Inc., Quebec City, Quebec, Canada.
- Suttie, J. M., 2012. *Morus alba* L. Plant Production and Protection. Food and Agricultural Organization (FAO) of the United Nations. Retrieved 20 October 2012.
- Zhengyi Wu, Zhe-Kun Zhou and Michael G. Gilbert, 2014. "Flora of China". Retrieved 21 July.

Sheikh, M. I. 1993. Trees of Pakistan. Pakistan Forest Institute, Peshawar. Page: 85.

Elham, K., Kambiz, P. and S. Mahdi, 2010. Wood Anatomical Structure of *Morus alba* L. and *Morus nigra* L., native to Iran. Not. Sci. Biol. 2 (4) 2010, 129-132.

Ter Welle, B. J. H., J. Koek-Noorman and S. M. C. Topper. 1986. The systematic wood anatomy of the *Moraceae* (*Urticales*) V. Genera of the tribe *Moreae* without urticaceous stamens. IAWA Bulletin 7:175-193.