

## A NEW PETRIFIED WOOD *MILLETIOXYLON SINDHIENSIS SP. NOV.* (FABACEAE) FROM THANOBOLA KHAN, SINDH, PAKISTAN

NOOR-UL-AIN SOOMRO<sup>1\*</sup>, BASIR AHMED ARAIN<sup>1</sup>, TAHIR RAJPUT<sup>2</sup>  
AND SYEDA SALEHA HASSANEY<sup>1</sup>

<sup>1</sup>Institute of Plant Sciences, University of Sindh, Jamshoro, Sindh, Pakistan

<sup>2</sup>Preston University, 15 Bangalore Town Main Shahrah-e-Faisal, Karachi, Sindh, Pakistan

\*Corresponding author's email: noorulainsoomro1@gmail.com

### Abstract

A petrified fossil wood collected from Manchar Formation of Miocene age exposed in Thanobola Khan Sindh Pakistan is described as a new fossil wood species belonging to family Fabaceae. Thin sections of fossil wood were prepared by standard ground thin section techniques. All xylotomical attributes revealed from the microscopic studies were used to compare with modern wood and already reported fossil woods. The sample was found comparable with family Fabaceae and with genus *Mellitita* in respect of character of small sized vessels, banded Parenchyma and uniseriate xylem rays. The new taxon is described as *Mellitioxylon sindhiensis sp.nov.* the specific epithet refers to the Sindh province of Pakistan from where fossil wood was collected.

**Key Words:** *Milletioxylon sindhiensis* Fabaceae, Petrified wood, Manchar Formation Thanobola Khan

### Introduction

Fossil floras from the Pakistan play an important role in understanding the palaeoecology and biodiversity of forests that existed during the Tertiary period. Moreover, these plant records are crucial for studies of biogeography trends. The area occupied by the "Petrified Forest" from Pakistan, was studied over the last half centuries by many Paleontologists starting with the report of Blanford, (1879). From the province of Punjab Pakistan 3 species of petrified wood *Ougeniaoxylon chinjiensis* Soomro *et al.*, (2014) *Albizziioxylon chinjiensis* Soomro *et al.*, (2016), *Dichrosteaohyoxyton chinjiensis* Soomro *et al.*, (2016) were reported while from the province of Balochistan species of

*Terminalioxylon Sulaimanense* and *Terminalioxylon. Burmense* Franceschi *et al.*, (2008) were reported. A large number of fossil woods were reported from Sindh by many authors including *Myristicoxylon ranikotensis* Rajput *et al.*, (1985). *Siderinium pitensis* Ahmed *et al.*, (1991) *Terminalioxylon* from Ranikot Fort Area Ahmed *et al.*, (1993) *Euphorioxylon thanobolnsis* Ahmed *et al.*, (2007) *Anogeissoxylon rehmannens* Ahmed *et al.*, (2007) and the recent one is *Andrioxylon thanobolansis* Khan *et al.*, (2016).

The present work deals with the description, identification and comparison of a Miocene wood collected from Thanobola Khan, Jamshoro, Sindh, Pakistan. (Lat. 25° 19' 55" N. Long. 67° 55' 26" E). (Manchar Formation)



Fig 1. Showing the fossiliferous locality of Thanobola Khan

## Material and Method

The sample of Miocene wood (TB 03) was collected from Thana Bola Khan, district Jamshoro, Sindh Pakistan. The sample measures 30 cm in length, 8 cm in width. It is brown in color and strongly silicified. Nine different thin sections were prepared by ground thin section techniques Weatherhead (1938) the transverse, tangential and radial planes. All the samples were carefully examine with the help of Light and Steriozome Microscope for photography Ortholux Microscope was used at the Paleobotany lab. Institute of Plant Sciences, University of Sindh, Jamshoro. The xylotomical attribute such as vessel size and grouping, distribution of parenchyma, ray size and their distribution, were used in the identification of family, genus and in some cases, species. In general for the anatomical description of fossil woods most of the terms used are from Barefoot & Hankins, (1982), Easu, (1959), Fahn, (1969) Metcalfe & Chalk, (1950).

## Anatomical Description

**Millettioxylon sindhiensis:** Noor-ul-Ain Soomro, Basir Ahmad Arain, Tahir Rajput & Syed Saliha Hassaney sp.nov.

**Diagnosis:** Wood diffuse porous. Growth ring boundaries are not seen, vessels are small to medium, mostly medium. 70% of vessels are solitary some are in radial multiple of 2-3, tangential diameter 80-260 $\mu$ m radial diameter 100-260 $\mu$ m tylosis not observed, 5-9mm<sup>2</sup>, circular to oval, Vessel membrane truncate, length 170-275 $\mu$ m in length perforation simple inter vessel pits alternate, vestured and small sized about 5-6  $\mu$ m in diameter with circular apertures. Parenchyma banded, bands completely closing the vessels, Vessels are wavy in nature about 4-7 per mm. Xylem rays mostly uniseriate, rarely 2 or 3 seriate found. 10-15 cells high in height, 8-10 per mm homogeneous ray tissue consist of procumbent cells. Fibers medium 24-30  $\mu$ m in diameter, thick walled Non septate.

**Holotype:** The specimen No.TB 03 The material TB. 03 (Fig. 2) silicified wood was collected from Thano Bola Khan, district Jamshoro, Sindh Pakistan.

Horizon: Manchar Formation

Age: Miocene.

## Morphological description

The specimens consist of a well preserved piece of petrified wood, 30 cm in length and 8 cm in diameter. Light brown in color

**Cross section:** Wood diffuse porous, growth rings not clearly seen, vessels small to large mostly medium, vessels solitary about 70 % some in radial multiple of 2-3, tangential diameter 80-260  $\mu$ m radial diameter 100-260 $\mu$ m evenly distributed about 5-9 mm<sup>2</sup>, tylosis absent, parenchyma banded bands often touching the vessels and running in regular concentric lines alternating with the

fibers bands; bands wavy in nature, about 4-7 per vessels per sq mm; Fibers are mostly thick walled and non septate (Figs. 3-5)

**Tangential section:** Vessel element: length of 280-460  $\mu$ m in length, Vessels are evenly distributed, Xylem rays are fine mostly uniseriate, rarely 2-3 seriate, 8-28 $\mu$ m wide, 3-20 cells or 80-360  $\mu$ m high, 9-11 per mm, usually steroid ray tissue homogenous to weakly hetrogenous, rays are homocellular to weakly hetrocellular and consist of procumbent cells 8-14 $\mu$ m in height. Perforation simple, intervessel pits alternate, vestured small sized, about 4-5 $\mu$ m in diameter. Fibers are thick walled and non septate, (Figs. 6-9)

**Radial longitudinal section:** Vessels segments elongated, length of the vessels member ranges from 275-450  $\mu$ m simple perforation Intervessel pits alternate, small sized 4-5 $\mu$ m in diameter

Axial parenchyma cells are found baands of 3-8 cells wide. Vessels are often present in between banded parenchyma

Rays are uniseriate (2-3 seriate very rarely) 3- 20 cells high tangential height quite variable 80-360 $\mu$ m 150-320 $\mu$ m. storied and non-storied rays appearing in the same specimens. Most ray cells are procumbent, afew body ray cells procumbent with 1 row of upright cell or square marginal cells are observed. Fibers are thick wall and non septate. (Figs.10-12).

**Comparison with modern wood:** The anatomical characters such as vessels are mostly medium, solitary as well as multiple of 2-3, banded parenchyma 1-2 seriate xylem rays, ripple marks due to storied arrangement of vessels members are seen in a few Leguminous wood. In this family the above feature are known to occur in the woods of *Bauhinia* Linn., *Craibia* Harms & Dunn., *Cynometra* Linn., *Dialium* Linn., *Millettia* Wight & Arn., *Pongama* Vent., *Erythrina Lonchopus*, *Dalbergia*., etc. Metcalfe & Chalk, (1950).

Out of these above genus the *Lonchopus* and *Erythrina* can be easily separated from the present fossils in having broader parenchyma bands and xylem rays. Some species of *Bauhinia* shows resemblance with the anatomical characters of a fossil wood under investigation but also differ quite markedly in usually different in vessel size having irregular bands of aliform to confluent parenchyma, parenchyma is non storied. Similarly, *Cynometra* can be differentiated from the present fossil wood in having crowded vessels and distinctly heterocellular xylem rays consisting of 1-2 marginal rows of upright cells.

*Dalbergia can* and *D. fusca* show similarities with our fossil wood in having parenchyma bands and ripple marks. However, the closer examination revealed that the parenchyma bands are thinner than the fossil under investigation Fossil wood under investigation shows closest resemblance with the living species of *Millettia* in all respect of xylotomical characters (Figs. 4 & 13). About 150 species distributed in the tropical and subtropical regions of the world; represented by 2 exotic species in Pakistan, Ali, (1977).

### Comparison with reported fossil wood

So far reported species of *Millettioxylon* are known as *Millettioxylon bengalensis* Ghosh & Roy (1979a), *Millettioxylon embergeri* Lemoigne (1978), *Millettioxylon pongamiensis* Prakash (1975) *Millettioxylon palaeopulchra* Lakhanpal *et al.*, (1978), *Millettioxylon indicum* Awasthi (1967).

In *Millettioxylon bengalensis* vessels are mostly small sized, parenchyma bands are up to 3 cells width. Xylem rays consist of procumbent cells with one or two heterogenous upright cells. Fossil wood under investigation have mostly medium size vessels. Vessels are completely covered by parenchyma cells. Xylem rays are made up of procumbent cells with slightly heterogenous.

*Millettioxylon embergeri* can be differentiated from our fossil wood by having vesicentric parenchyma and larger rays 4-10 seriate rays

*Millettioxylon pongamiensis* is, *Millettioxylon palaeopulchra* shows close resemblance with fossil wood in question but can be separated due to differences in size of vessels and ray cells, In *Millettioxylon palaeopulchra* xylem rays are commonly 4 seriate.



Fig. 2. Macrophotograph of holotype of the fossil wood TB.03

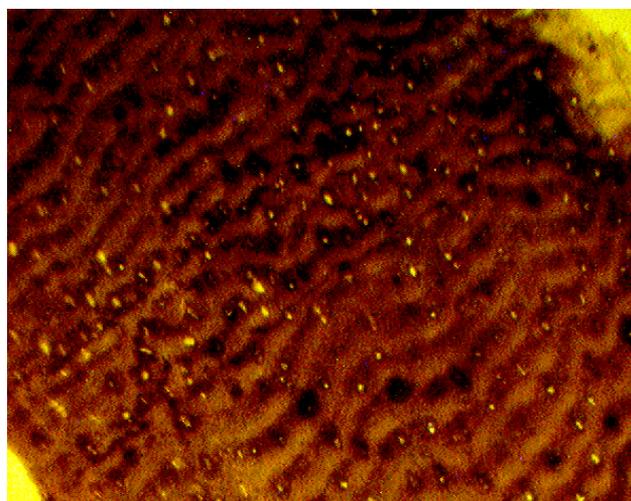


Fig. 3. Cross section showing general distribution of vessels and parenchyma. X30

Vessels are medium to large in *Millettioxylon indicum* density of vessels are also different from the fossil wood under investigation

Hence the fossil wood was given new name *Millettioxylon sindhiensis* specific epithet refer from where the fossil wood collected (Sindh Province) (Table 1).

### Discussion and Conclusion

The genus *Millettia* Wight & Arn. consists of approximately 323 species in the world and about 150 species in the tropical to subtropical regions of Asia and America (Ogata *et al.*, 2008) *Millettia* spp. are often found in mixed deciduous forest (Santisuk, 2006). The paleoeco system of Thanobola Khan was dominated by mixed deciduous with other ever green plants previously reported from the Sindh regions. Diffuse porous wood of *Millettia* confirm the tropical type of climate at the locality of Thanobola Khan. The occurrence of fossil wood from the area of Thanobola Khan indicates the presence of alluvial soil.

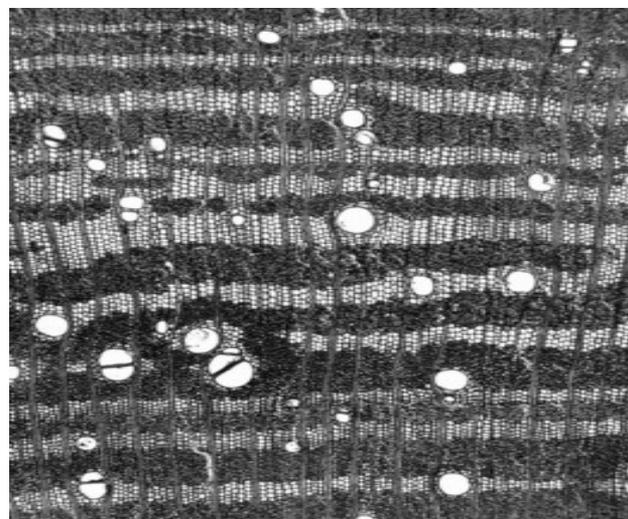


Fig. 4. *Millettia atropurpurea* Cross section showing shape, size, and distribution of vessels similar to those of Fossil (Photograph taken from inside wood)

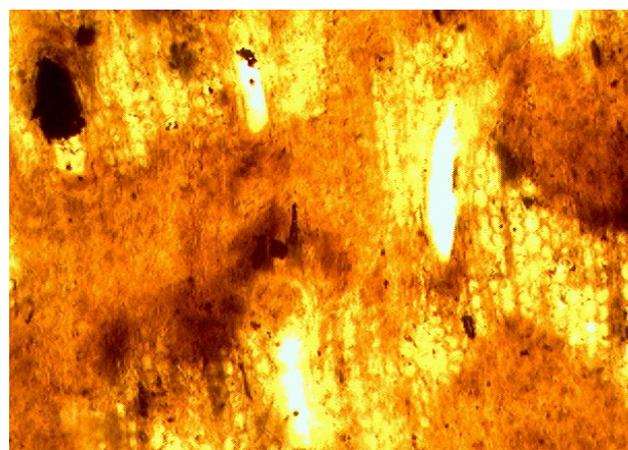


Fig. 5. Cross section showing solitary and multiple vessels with aliform to confluent parenchyma and xylem rays. X 200

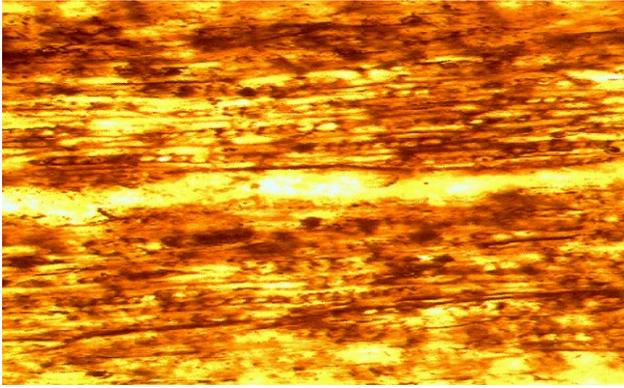


Fig. 6. Tangential longitudinal section showing distribution of xylem rays X40



Fig. 10. Radial longitudinal section show Pits on wall of the vessels X200

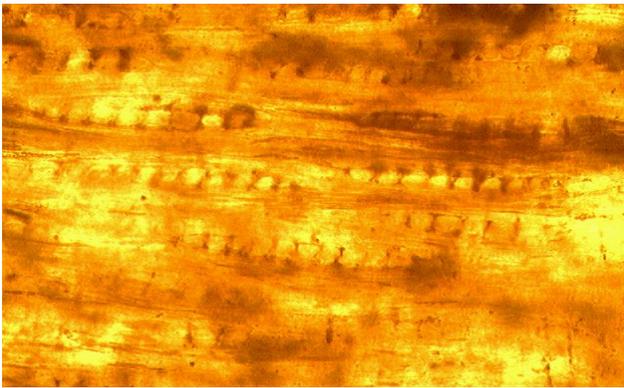


Fig. 7. Tangential longitudinal section showing distribution of xylem rays X100

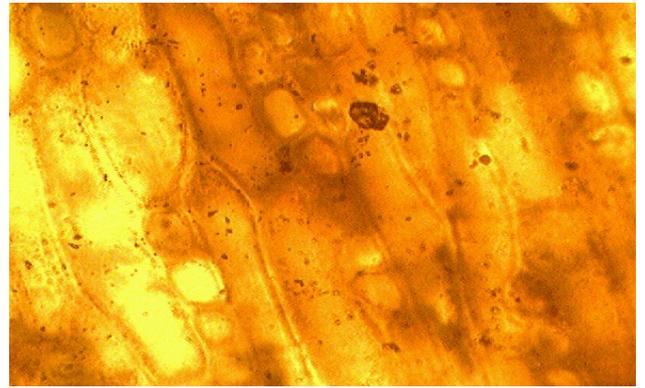


Fig. 11. Radial longitudinal section showing storied arrangement of cells X400

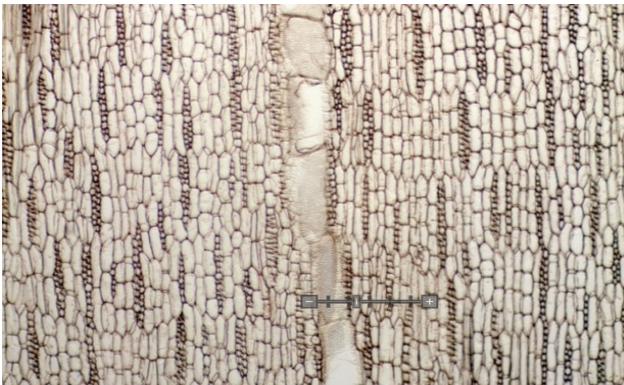


Fig. 8. *Millettia atropurpurea* (living wood) tangential longitudinal section showing rays similar to fossil wood.

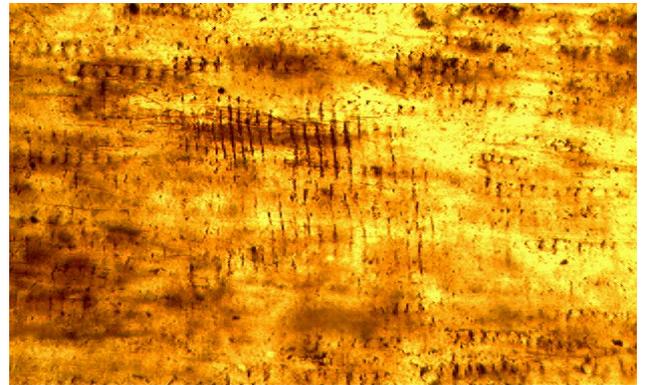


Fig. 12. *Millettia atropurpurea* Radial longitudinal section showing general arrangement of fibers and rays

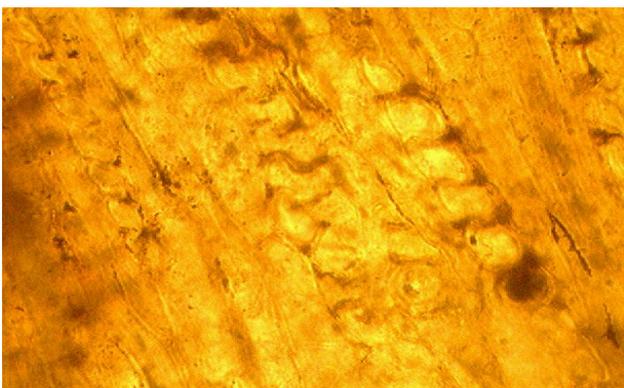


Fig. 9. Another view of Tangential longitudinal section showing distribution of xylem rays X200

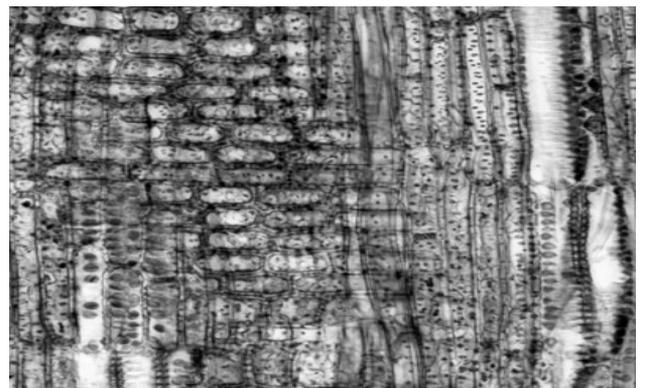


Fig. 13. Radial longitudinal section with Intervessel pits similar to the fossil wood ([www.insidewood.com](http://www.insidewood.com))

Table 1. Comparison of fossils related to genus *Milletioxylon*

Species	Wood	Vessels	Parenchyma	Xylem	Fibres
<i>Milletioxylon bengalensis</i> Ghosh & Roy. 1979	diffuse-porous	Vessels small size 5-20 per sq.mm. t.d. 50-100µm r.d. 47-120 µm, Intervessel pits alternate, small,	Axial parenchyma in narrow bands or lines up to three cells wide Body ray cells procumbent with one row of upright and / or square marginal cells 12/mm.	Xylem rays are mostly uniseriate with steroid cells 4-	Non septate
<i>Milletioxylon embergeri</i> Lemoigne 1978.	diffuse porous	Vessels are medium in size Intervessel pits are alternate	Axial Parenchyma vesicentric , Axial parenchyma in narrow bands or lines up to three cells wide	Larger rays commonly 4 - 10 seriate made up of all procumbent cells	Nonseptate
<i>Milletioxylon pongamiensis</i> Prakash 1975	diffuse porous	Vessels small to medium, rarely very small, t.d. 60-145µm, r.d. 28-140µm solitary and in radial multiples of 2-3 round to oval, evenly distributed, 7-15 per sq. mm perforation simple; intervessel pits bordered, alternate	Parenchyma paratracheal banded, bands regular, continuous, alternating with fibre bands, 3-6 cells wide	Xylem rays 8-10 per mm, mostly biseriate, uniseriate and triseriate rare, storied, made up of procumbent cells only.	Non Septate
<i>Milletioxylon palaeopulchra</i> Lakhanpal, Prakash & Awasthi 1978	Diffuse Porous	Vessels medium to large. More than 200 µm mostly in radial multiple of 2-3 rarely solitary 5-20 per sq.mm	Axial parenchyma in narrow bands or lines up to three cells wide	Xylem rays are 2-4 seriate consist of all procumbent cells 4-12 per/mm	Non-septate
<i>Milletioxylon indicum</i> Awasthi 1979	Diffuse porous	Vessels small to large, mostly medium Solitary or in radial multiples of 2-4. 3-6 vessels per sq.mm. Intervessel pits alternate bordered vested	Parenchyma in regular concentric bands alternating with fibre bands of more or less the same width bands are 3-8 cells width.	Xylem rays fine 1-3 seriate mostly 2 very rarely 3 seriate 11-14 rays per mm.	Non septate
<i>Milletioxylon Sindhiensis</i> Sp. Nov.	Diffuse Porous	Vessels are small to medium, mostly medium. Vessels 70% solitary some are in radial multiple of 2-3, t.d. 80-260 µm radial diameter 100-260µm 5-9 per sq.mm. Intervessel pits are alternate vested.	Parenchyma banded, bands completely closing the vessels, Vessels are wavy in nature	. Xylem rays mostly uniseriate, rarely 2 or 3 seriate found, 8-10 per mm homogenous ray tissue consist of procumbent cells with weakly heterogeneous cells	Non septate

## Reference

- Ahmed, B., C.R. Arain and K.M. Khan. 1993. Two new species of *Terminalioxylon* from Ranikot Fort Area, district Dadu, Sindh, Pakistan. *Sindh Uni. Res. Jour. (Sci. Ser.)*, 23: 27-41.
- Ahmed, B., M.T.M. Rajput, and N. Soomro. 2007a. *Anogeisoxylon rehmannens* sp. nov. A new fossil species of family Combretaceae from Rehman Dhoro Dist. Jamshoro, Sindh, Pakistan. *Pak. J. Bot.*, 39: 2337-2344.
- Ahmed, B., M.T.M. Rajput, N.S. Jilani and N. Soomro. 2007b. *Euphorioxylon thanobolnsis* sp. nov. A new species of fossil wood family Sapindaceae fo Thanobolakhan Dist. Jamshoro, Sindh, Pakistan. *Pak. J. Bot.*, 39: 2317-2325.
- Ahmed, B., T. Rajput and K.M. Khan. 1991. *Siderinium pitensis* sp. nov. A new species of silicified fossil wood from Tertiary deposits of Sind, Pakistan. *Pak. J. Bot.*, 23(2): 236-242.
- Ahmed, B., T. Rajput and K.M. Khan. 1991c. *Siderinium pitensis* sp. nov. A new species of silicified fossil dicot wood from tertiary deposits of Sindh, Pakistan. *Pak. J. Bot.*, 23: 236-242.
- Ali, S.I. 1977. *Flora of West Pakistan*, Papilionaceae No.100. Department of Botany, University of Karachi, Karachi, Pakistan.
- Awasthi, N. 1967 *Millettioxylon indicum* Awasthi from the cuddalore series of South India. *The Palaeobotanist*, 22: 47-50.
- Barefoot, A.C. and F.W. Hankins. 1982. Identification of modern and Tertiary woods. Clarendon press, London.
- Blanford, W.T. 1879. On the geology of western Sindh. Ind. Geol. Survey. Mem. Volume 10, part 1, Calcuta, India. pp. 1-196.
- de Franceschi, D., C. Hoorn and P.O. Antoine. 2008. Floral data from the mid-Cenozoic of central Pakistan. *Review of Palaeobotany and Palynology*, 150(1-4): 115-129.
- Esau, K. 1959. *Anatomy of Seed Plant*. John Wiley. pp. 109-113.
- Fahn, A. 1969. Plant Anatomy. *Pergaman*, pp. 320-322.
- Ghosh, P.K. and S.K. Roy. 1979a. A new species of *Millettia* from the Tertiary of West Bengal, India. *Curr. Sci.*, 48: 165-166.
- Khan, S.A., B.A. Arain, M.T.M. Rajput and S.S. Hasseney. 2016. *Andiroxylon thanobolensis* sp. nov. a new species of fossil wood of family Fabaceae from Manchar formation exposed near Thanobola Khan, district Jamshoro, Sindh, Pakistan. *Pak. J. Bot.*, 48(1): 249-253.
- Lakhanpal, R.N., U. Prakash and N. Awasthi. 1978. 1981. Some more dicotyledonous woods from the Tertiary of Deomali, Arunachal Pradesh, India. *The Palaeobotanist*, 27: 232-252.
- Lemoigne, Y. 1978. Flores Tertiares de la Haute Vallee de l'Omo (Ethiopie). *Palaeontographica*, 165: 80-157.
- Metcalf, C.R. and L. Chalk. 1950. Anatomy of the Dicotyledones. Vol. I & 2, Oxford press. Oxford.
- Ogata, K. Fujjii, T.H. Abr and P. Bass. 2008. Identification of the Timbers of Southeast Asia and the Western Pacific. Japan Kaiseisha Press.
- Prakash, U. 1973-1975. Fossil woods from the Lower Siwalik beds of Himachal Pradesh, India. *The Palaeobotanist*, 22: 192-210.
- Rajput, M.T.M., S.S. Tahir K.M. Khan. 1985. *Myristicoxylon ranikotensis* sp. nov. A silicified dicot wood from Ranikot fort area, District Dadu, Sindh, Pakistan. *Pak. J. Bot.*, 17(2): 247-252.
- Santisuk, T. 2006. Forest of Thailand. The Forest Herbaium, National Park, wildlife and plant conversation Department.
- Soomro, N., B.A. Arain and M.T.M. Rajput. 2014. *Ougenioxylon chinjiensis* sp. nov., a new fossil species of the family Leguminosae from Chinji Formation Salt Range, Punjab Pakistan. *Am. J. Plant Sci.*, 5: 3745-3751.
- Soomro, N., B.A. Arain and M.T.M. Rajput. 2016 *Albizzioxylon chinjiensis* sp. nov., a new fossil species of the family Leguminosae from Chinji formation salt range, Punjab Pakistan, *Int. J. Geomate*, 11(28): 2838-2843.
- Soomro, N., J.U. Mangi, R.J. Abdul, N.S. Jillani, B.A. Arain and M.T.M. Rajput. 2016. *Dichrostachyoxylon chinjiensis* sp. nov., A new fossil species of the family Fabaceae from Chinji Formation, Salt Range, Punjab, Pakistan, *Sindh Univ. Res. J. (Sci. Ser.)* Vol. 48(4): 803-808.
- Weatherhead, A.V. 1938. The preparation of micro-sections of rocks. Watson Microscope record, London. Pp. 43.

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