

Wood microscopic characteristics of Nathani and its common adulteration thitsi Kyu Kyu Thin¹ and Kyaw Win Maung²

Abstract

Nathani (*Pterocarpus santalinus* L.) is well known and high valuable raw materials in Myanmar traditional medicine. Its heart wood is used for preparation of various herbal medicines and especially it is one of the major ingredients for tonic medicine called thwe sae in Myanmar. The scarcity and high price of this wood lead to adulterate with analogous woods. The common adulteration is found to be the wood of Thitsi (*Melanorrhoea usitata* Wall.) because woods of Nathani and Thitsi are difficult to distinguish in macroscopic characteristics. The authenticated wood samples of both species were provided from wood anatomy section, Forest research institute, Yezin, Myanmar. To examine the microscopic characteristics the wood samples were prepared as microslides and observed the microscopic characteristics under Meji biological microscope. The microscopic characteristics are quite different in the seriate of banded axial parenchyma, ray seriate and orientation, cell inclusions. The most outstanding characteristics of Nathani are storied and exclusively uniseriate rays and long chain crystals in axial parenchyma. These characters are the identity and the key characteristics of Nathani to distinguish its adulteration in market.

Keywords: *Pterocarpus santalinus* L., Nathani, *Melanorrhoea usitata* Wall., Thitsi, microscopic characteristics

Introduction

Pterocarpus santalinus L. belonging to family Fabaceae is an endemic and endangered species confined to India (Pullaiah, Balasu bramanya & Anuradha 2019 and Giriraj et al 2014). The heartwood of the species is one of the most valuable timbers in the world (Xiangnan 2011) because the wood is historically used as red colorant for fish processing in Europe and highly priced as classic furniture and households in Japan and China (Vedavathy 2004). According to SaraPPdamma et al (2016) it is widely used for the treatment of various ailments due to its extensive medicinal properties. In Myanmar this wood is used for preparation of various herbal medicines especially tonic medicine called thwe sae and is known as Nathani. In the herbal medicine market Nathani is often found to be adulterated with analogous woods. The wood of *Melanorrhoea usitata* Wall. (Thitsi) belonging to family Anacardiaceae is mostly used as adulteration because the macroscopic characteristics of wood of both species are difficult to be distinguished. The macroscopic characteristics such as color, weight, grain and texture is very similar to each other. However, microscopic characteristics of wood of two species are totally different because those are belonged to two different families. The microscopic characteristics of woods are studied and highlighted as the key characteristics to distinguish Nathani and Thitsi in this paper. The objectives of this research are to investigate the microscopic characteristics of Nathani and Thitsi, to identify the key microscopic characteristics in distinguishing these two species and to identify the most outstanding and reliable microscopic characteristics of Nathani in distinguishing Nathani and its adulteration.

Materials and method

The specimens of two species in this research were taken from authenticated wood sample of wood anatomical section of Forest Research Institute.

Only heartwood portion as small wood blocks (1 cm x 1 cm x 2 cm) were prepared for microslides preparation in the three sections such as transverse section, tangential longitudinal section and radial longitudinal sections. These blocks were boiled in water for 30 hours and immersed in equal volume of 50% alcohol and 50% glycerin for five days to be softened. These sample blocks were cut 20-25 μ m in thickness by sliding microtome. To prepare the permanent microslide, these sections were fixed with ferric ammonium sulphate and haematoxylin 15 seconds respectively. These sections were stained with safranin for overnight and then dehydrated with serial 50%, 70%, 90%, 95% of ethyl alcohol and two changes of xylene. Then sections were cleaned with clove oil and mounted with Canada balsam. These

microslides were observed under light microscope and measured and photomicrographed by using Meji biological microscope model: MT 4300H attached with camera and computer. To examine the anatomical features all wood elements were stained with safranin into solution of glycerine and 50% ethyl alcohol. In this study, the terminology used for microscopic description was as given by Chattaway (1932) and Wheeler, Bass and Gasson (1939).

Results and Discussion

Macroscopic characteristic of Nathani

Sapwood whitish brown; heartwood dark purple; odor and taste not distinct; straight grain; fine to coarse texture; hard.

Microscopic characteristics of Nathani

Diffuse porous, pores solitary to pore multiple of 2–3, mostly solitary, tyloses absent in vessel; rays heterogeneous, exclusively uniseriate, storied; gum deposits, crystals and silica bodies absent in ray cells; fiber non-septate, axial parenchyma abundant, banded apotracheal and paratracheal parenchyma containing 1–4 seriate, gum deposites, crystals present and silica bodies absent in axial parenchyma.



Fig 1. *Pterocarpus santalinus* L.(Nathani) A. Rift swan wood showing natural color; B. Transverse section of wood showing vessel pore distribution and uniseriate to tetraseriate narrow banded axial parenchyma

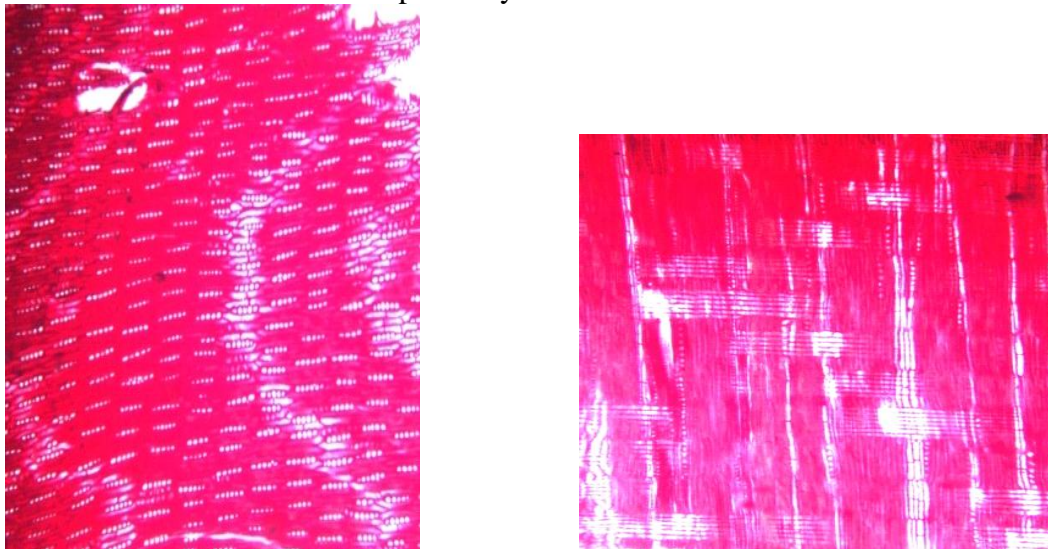


Fig 1. *Pterocarpus santalinus* L. (Nathani) C. Tangential Longitudinal Section showing storied uniseriate rays; D. Radial Longitudinal Section showing homogeneous ray and crystals in axial parenchyma

Macroscopic characteristic of Thitsi

Sapwood whitish brown, heartwood dark purple; odor and taste not distinct; straight grain; fine to coarse texture; hard.

Microscopic characteristics of Thitsi

Diffuse porous, pores solitary to pore multiple of 2–6, mostly 2, tyloses present in vessel; rays heterogeneous, 1-3 seriate; gum deposits abundant, crystals and silica bodies absent in ray cells; fiber non-septate; axial parenchyma abundant, banded apotracheal and paratracheal parenchyma, gum deposits abundant, crystals and silica bodies absent in axial parenchyma.

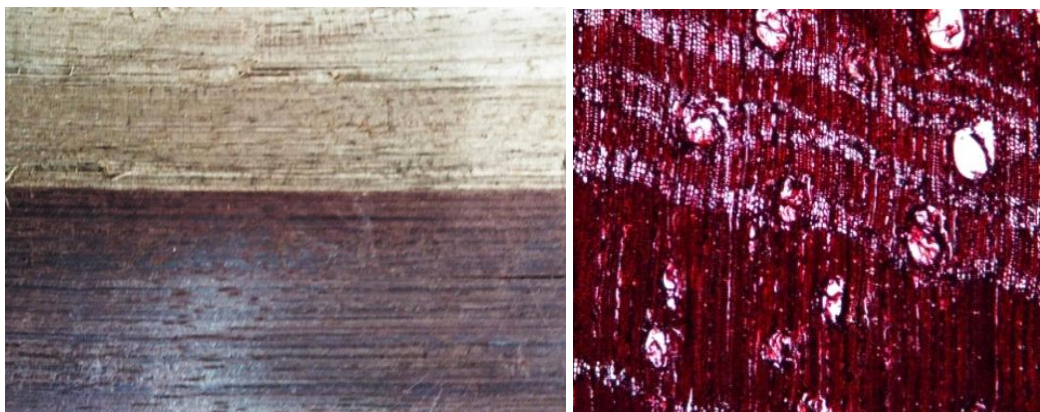


Fig 2. *Melanorrhoea usitata* Wall. (Thitsi) A. Rift swan wood showing natural color; B. Transverse section of wood showing vessel pore distribution, tetraseriate to multiseriate broad banded axial parenchyma and tyloses in vessel pores

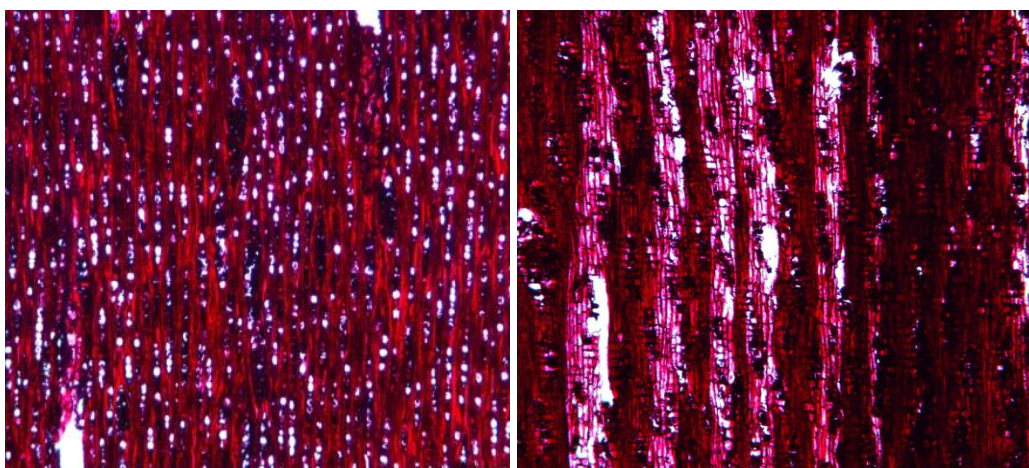


Fig 2. *Melanorrhoea usitata* Wall. (Thitsi) C. Tangential Longitudinal Section showing uniseriate and triseriate rays containing colored gum deposits; D. Radial Longitudinal Section showing heterogeneous rays, gum deposits in fibers and rays parenchyma and broad banded axial parenchyma and fibers occluding with abundant gum deposits

The wood of two species possesses similar macroscopic characteristics such as texture, hardness, grain. Although the woods are slightly different in color, these differences can be easily changed by staining. Therefore it is difficult to distinguish Nathani and Thitsi based on macroscopic characteristics of wood. However microscopic characteristics of the woods are quite different.

When the three sections of wood slide in 15–20 µm thickness are examined under microscope the most of solitary pores and most of pore multiples are found in Nathani and Thitsi respectively. Their seriate of rays are different. The rays are exclusively uniseriate in Nathani and uniseriate to triseriate in Thitsi. Moreover, the rays are storied in Nathani but not storied in Thitsi. The pattern of axial parenchyma is banded in both species but the cell seriates lead to different width of axial parenchyma bands. In Nathani axial parenchyma are narrow bands with uniseriate to tetraseriate. Most of axial parenchyma bands of Nathani is uniseriate. In Thitsi axial parenchyma is broad band contain tetraseriate to multiseriate. The cell inclusions such as tyloses, crystal and gum deposits is one of distinguishing characteristics. Tyloses is formed by outgrowth of vessel wall and thus these are found in vessel pores.

The vessel pores of Thitsi are found to be occluded by tyloses. In Nathani the vessel pores are empty. In Thitsi gum deposits are found in fiber, rays parenchyma and axial parenchyma. Especially, gum deposits are abundant in fibers. Moreover the resin ducts are found in Thitsi. Crystals are not found in any cells of Thitsi but the axial parenchyma of Nathani contains crystals.

Conclusion

There are many woody species used as adulteration of Nathani in traditional medicine market in Myanmar. Among them, Thitsi is the most common species used as adulteration of Nathani. When the microscopic characteristics are examined under microscope, it is found that the characteristics of vessel grouping, rays seriate and orientation, seriate of banded parenchyma, different types of cell inclusions and the cell types containing cell inclusions is totally different in Nathani and Thitsi. The most outstanding and reliable microscopic characteristics of Nathani are uniseriate to tetraseriate banded axial parenchyma, storied uniseriate rays and crystals in axial parenchyma to distinguish Nathani from its adulteration.

References

- Bulle Saradamma, Hymavathi Reddyvari, Varadacharyulu Nallanchakravarthula 2012. Species distribution models: ecological explanation and prediction of an endemic and endangered plant species (*Pterocarpus santalinus* L.f.), Current Science vol.102(8) 25
- Bulle Saradamma, Hymavathi Reddyvari, Varadacharyulu Nallanchakravarthula 2016. Therapeutic Potential of *Pterocarpus santalinus* L.: An Update.
- Giriraj A., G. Shilpa, C. Sudhakar Reddy, S. Sudhakar, C. Beierkuhnlein and M.S.R. Murthy 2014. Mapping the geographical distribution of *Pterocarpus santalinus* L.f. (Fabaceae) – an endemic and threatened plant species using ecological niche modeling. Conference paper, Research Gate.
- Pullaiah, T., S.Balasubramanya and M. Anuradha 2019. Red Sanders: Silviculture and conservation. Springer nature Switzerland.
- Bulle Saradamma, Hymavathi Reddyvari, Varadacharyulu Nallanchakravarthula 2016. Therapeutic Potential of *Pterocarpus santalinus* L.: An Update. Pharmacognosy review vol. 10(19) 43–49
- Vedavathy 2004. Cultivation of red sanders for international trades. Natural product Radiace vol.3(2)
- Xiangnan 2011. The rare red sandal wood. China Daily USA.