

Species Identification of Wood Coffins in Chosun Dynasty Period Excavated in Andong Area^{*1}

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ABSTRACT

Three wood coffins of Chosun Dynasty period buried about 450 years ago were excavated in the sound condition in Andong area in the early 1998. The proprietors of wood coffins were grandparents, Mr. Myoung Jong Lee and Mrs. Mun, and their grandson, Mr. Eung Tae Lee, and the social standing of their family was known to belong to the nobility in those days by the clan genealogy.

All the wood coffins investigated through light microscopy had same anatomical characteristics as follows: abrupt to somewhat abrupt tracheid transition from earlywood to latewood; normal longitudinal and horizontal resin canals with thin-walled epithelium; tylosoids in resin canals; bordered pits frequently in 1 row on radial walls of tracheids; 1 or 2 window-like pits per cross-field; uniseriate and fusiform rays; heterogeneous rays composed of body ray parenchyma cells and marginal ray tracheids or homogeneous rays composed of only ray tracheids; dentate ray tracheids; occasional trabeculae traversing tracheids in radial direction. Based on these microscopic characteristics, all the wood coffins were identified to be Korean red pine (*Pinus densiflora*) or Korean black pine (*Pinus thunbergii*).

Korean black pine growing naturally in coastal area might not be probable because the site of excavation, Andong area, was mountainous and inland area of Korea. Thus, Korean red pine was thought to be the possible species for the wood coffins because of its natural distribution through the Korean Peninsula and the easy availability.

Key words: Wood coffins, Chosun Dynasty period, anatomical characteristics, species identification, *Pinus densiflora*

INTRODUCTION

In the early 1998, three wood coffins of Chosun Dynasty period buried about 450 years ago were excavated in Andong area in southern part of Korea. At the time of excavation, the sites were replete with water like bog and the wood coffins

containing mummies were unearthed in the green and sound condition. By the clan genealogy, the proprietors of wood coffins were grandparents, Mr. Myoung Jong Lee and Mrs. Mun, and their grandson, Mr. Eung Tae Lee, and the social standing of their family was known to belong to the nobility in those days. Korean Broadcasting

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System (KBS) sent me the blocks from wood coffins of grandparents and grandson for the identification of wood species and the reason of their decay resistance. This paper presents the identification of wood species which used in making coffins for the nobility of Chosun Dynasty period.

MATERIALS AND METHODS

Wood blocks were subdivided into small cubes of ca. 1 cm³ size in laboratory with hand saw. They are softened in water in an autoclave, followed by immediate storage in a mixture of equal volumes of glycerine, ethyl alcohol, and water till sectioning (Berlyn & Miksche 1976). Transverse, radial, and tangential sections of 20 to 30 μm thickness were cut with a sliding microtome and permanent slides were prepared after staining with safranin, dehydration in ethyl alcohol and xylene series, and mounting with Canada balsam (Japan Wood Research Society 1985). The observation and photomicrography were made in the prepared permanent slides by the aid of Axioskop routine microscope with attachment camera, Carl Zeiss, Germany.

RESULTS AND DISCUSSION

Microscopic Characteristics

All the wood coffins investigated shared common anatomical characteristics as follows (Fig. 1 - 6): abrupt to somewhat abrupt tracheid transition from earlywood to latewood; normal longitudinal and horizontal resin canals with thin-walled epithelium; tylosoids in resin canals; bordered pits frequently in 1 row on radial walls of tracheid; 1 or 2 window-like pits per cross-field; uniseriate and fusiform rays; heterogeneous rays composed of body ray parenchyma cells and marginal ray tracheids or occasionally small

homogeneous rays composed of only ray tracheids; dentate ray tracheids; occasional trabeculae traversing tracheids in radial direction.

Based on the above microscopic anatomical characteristics and the description by Lee and Eom (1987), the species was identified to be Korean red pine (*Pinus densiflora*) or black pine (*Pinus thunbergii*) as follows:

Identification Key

1. Normal resin canal present 2
2. Spiral thickening present in tracheid
.....*Pseudotsuga*
2. Spiral thickening absent in tracheid 3
3. Epithelial cell thick-walled 4
3. Epithelial cell thin-walled 5
4. Bordered pits in 1 row on radial walls
of tracheid and cross-field pit piceoid
.....*Picea*
4. Bordered pits in 1 to 2 rows on radial walls
of tracheid and cross-field pit cupressoid
or piceoid*Larix*
5. Cross-field pit window-like 6
5. Cross-field pit pinoid
..... Hard pines exclusive of *Pinus*
densiflora and *P. thunbergii*
6. Ray tracheid wall smooth Soft pines
6. Ray tracheid wall dentate
.....*Pinus densiflora* or *P. thunbergii*

Species of Wood Coffins

All the wood coffins were thought to be made of Korean red pine or black pine heartwood due to frequent occurrence of tylosoids which develops as a part of heartwood formation (Panshin and de Zeeuw 1980).

Since Korean black pine (*Pinus thunbergii*) growing naturally in coastal area, this species might not be probable because the site of excavation, Andong area, was mountainous and inland area. Thus, the Korean red pine (*Pinus densiflora*) was thought to be the possible species for the wood coffins because of its

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Fig. 1. Microscopic wood structure of grandfather's coffin showing somewhat abrupt tracheid transition from earlywood to latewood and normal longitudinal resin canals with tylosoid (arrow) in cross surface. Fig. 2 and 3. Microscopic wood structure with window-like cross-field pits (arrow) and dentate ray tracheids (arrowhead) in radial surface. -Fig. 2: grandfather's coffin. -Fig. 3: grandson's coffin. --Fig. 4. Microscopic wood structure of grandmother's coffins showing trabeculae (arrow) in radial surface. Scale bars = 100 μ m.

natural distribution through the Korean Peninsula and the easy acquisition.

Two types of hard pines grows in the Korean Peninsula. In general, Korean red pine vertically grows 1300 m or below in altitude and horizontally through the Peninsula except northern

highlands. Mature tree attains a diameter of 150 to 180 cm and a height of 30 m, and is used for building construction, furniture, coffin, implement, carving, and pulpwood. Korean black pine, however, grows along coastline and naturally distributes up to Namyang, Kyounggi-do in the

Fig. 5 and 6. Microscopic wood structure showing uniseriate (arrow) and fusiform rays with normal horizontal resin canal (arrowhead) in tangential surface. -Fig.5: grandfather's coffin. -Fig. 6. grandfather's coffin. Scale bars = 200 μ m

west coast and Wooljin, Kyongsangbuk-do in the east coast. Mature tree attains a diameter of 100 to 200 cm and a height of 28 to 30 m, and has the same uses as Korean red pine (Lee 1982; Lee and Eom 1984; Kim 1994).

In the Chosun Dynasty period, Korean red pine was generally used for building construction, battleship and cargo ship construction, etc. Especially, the heartwood of Korean red pine called 'Whangchangmok (黃腸木)' in the Korean language was mainly used in making coffins for the King and Royal Family. Thus, a lot of good Korean red pine forests were managed and protected under the supervision of nation as the indispensable raw materials in the production of wide wood panels for the Royal House (Park 1992, 1993, 1996). The proprietors of wood coffins were known to belong to the noble family in those days, and thus the use of wood panels of Korean red pine for the dead's coffin in the noble family might be quite within the bounds of possibility. In addition, the fact that Korean red pine was used as the private coffins

of the middle stage was reported (Park *et al.* 1993). Thus, the common wood species for making coffins might be Korean red pine in the Chosun Dynasty period.

The wood coffins were not treated with finishes such as Korean traditional natural *Rhus* lacquer but were excavated in the sound and green condition from the sites filled with water. Sound preservation of wood coffins under the ground for a long time may be attributed to the factors of moisture and air because Korean red pine itself is rated as resistant to heartwood decay, especially in water (Lee 1997; Shimaji and Itoh 1982) and very high moisture content may deprive wood decaying fungi of needed air or oxygen. This kind of example can be found in the wood protected by storage in water (Tsoumis 1991; Fengel 1991).

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