VOLUMETRIC COMPOSITION OF SOME PAKISTANI TIMBERS

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Abstract

Important local hardwood species were studied for the volume of various wood elements. Photomicrographs of cross section of each species were prepared under standard laboratory procedures and data was collected by wood image weighing method for the percentage of wood volume occupied by fibers, vessels, longitudinal parenchyma and wood rays in each species. Results showed that in *Acacia nilotica, Dalbergia sissoo, Fraxinus excelsior, Albizzia lebbek, A. procera, Mangifera indica, Alnus nitida, Juglans regia, Populus euphratica, Quercus incana, Platanus orientalis, Acer caesium* and *Cedrela toona*, major portion of the wood by volume was composed of fibers. In *Acacia modesta, Melia azedarach, Tamarix aphylla, Prosopis cineraria, Bombax ceiba* and *Morus alba*, greater volume of the wood was occupied by parenchymatous cells. Whereas, the wood volume occupied by vessels was found higher (44%) only in *Aesculus indica*. However, it was observed about 20% in *A. nilotica, F. excelsior, M. azedarach, P. euphratica, P. orientalis, P.cineraria, C. toona and M. alba*.

Introduction

Work has been done for the dimensional measurements and frequency of different wood elements/ structures in important Pakistani timbers but no data have been collected so far on their relative proportion in a wood which is also necessary to have thorough comprehension of any wood species and helpful to assess different technological properties, behaviour and suitability of wood for specific end uses.

Proportion of fibers relate with the density and strength properties of wood. Greater the volume of wood composed of fibers, higher may be the density and strength properties as the fibers are comparatively thick-walled cells and constitute the mechanical tissue (Desch.1983). Proportion of vessels relates with the porosity of wood because of their larger size. Higher the volume of wood occupied by vessels, more the wood may be easy to impregnate with preservatives as the vessels are the main route for the flow of preservatives (Wilkinson,1979). Furthermore, seasoning behavior of the wood may also be better as the vessels are like drain pipes and moisture can move through them lengthwise as well as sidewise (Findlay, 1962). Proportion of parenchyma and wood rays relates with the

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resistance of wood against the fungal and insect attack as they contain plant food material. Higher the percentage of wood volume occupied by parenchyma and wood rays, the less may be the resistance to insects and fungi attack. (Brown,1965; Kollamann and cote,1968).

This study was carried to collect data on the percentage of wood volume occupied by vessels, fibers, longitudinal parenchyma and wood rays in some important local hardwoods. The data will be helpful to facilitate different practices of wood processing and use.

Material and Methods

Important local hardwoods such as Babul (*Acacia nilotica*), Phulai (*Acacia modesta*), Shisham (*Dalbergia sissoo*), Ash (*Fraxinus excelsior*), Bakain (*Melia azedarach*), Kokko (*Albizzia lebbek*), Siris (*Albizzia procera*), Mango (*Mangifera indica*), Sharol (*Alnus nitida*), Walnut (*Juglans regia*), Popular (*Populus euphratica*), Farash (*Tamarix aphylla*), Oak (*Quercus incana*), Chinar (*Platanus orientalis*), Maple (*Acer caesium*), Horse chestnut (*Aesculus indica*), Jund (*Prosopis cineraria*), Toon (*Cedrela toona*), Semel (*Bombax ceiba*), and Mulberry (*Morus alba*) were selected and studied for their volumetric composition by wood image weighing method (Brown, et.al, 1949).

Permanent slides of cross sections of all the species were already available in the collecting of wood anatomy laboratory. Photomicrographs of the cross section of each species were prepared by standard procedures (Allen.1946) at sufficient higher magnification to get clear image of each wood element and structure. Weighing of each photo-micrograph was done on a sensitive balance and noted. Then at the same time by observing the image carefully, the vessels, fibers, longitudinal parenchyma and wood rays were cut separately, weighed and the percentage of wood volume occupied by each was calculated in each species with the help of following formula:

$$\frac{\text{weight of image of certain wood element}}{\text{net weight of the photomicrograph}} \times 100$$

Percentage of wood volume occupied by longitudinal parenchyma and wood rays collectively was also calculated to find out net volume of wood occupied by parenchymatous cells in each species as the wood rays are composed of transverse parenchyma.

Results and Discussion

Fibers

As shown in table, in majority of the species greater volume of wood was composed of fibers. It was observed above 50% in *J. regia*, *A. caesium*, *F. excelsior*, *A. lebbek*, *A. procera*, *M. indica*, *A. nitida* and *Q. incana*, 40 to 50% in *A. nilotica*, *D. sissoo*, *P. euphratica*, *A. indica* and *C. toona*, 30 to 40% in *A. modesta*, *P. orientalis*, *P. cineraria*, *B. ceiba* and *M. alba* whereas, in *M. azedarach* and *T. aphylla* it was less than 30%.

Vessels

The wood volume occupied by vessels was determined maximum (44%) in *A. indica*, 30 to 40% in *P. euphratica* and *P. orientalis*, 20 to 30% in *A. nilotica*, *F. excelsior*, *M. azedarach*, *A. nitida*, *P.cineraria*, *C. toona* and *M. alba* whereas, in rest of the species it was below 20%.

Longitudinal Parenchyma

Percentage of wood volume occupied by longitudinal parenchyma was found highest (36%) in *M. azedarach* and *A. modesta*, 20 to 30% in *D. sissoo*, *A. lebbek*, *P.cineraria*, *B. ceiba* and *M. alba* whereas, in other species it was lower than 20%.

Wood rays

The volume of wood composed of wood rays was observed maximum (52%) in *T. aphylla*, 20 to 30% in *M. indica*, *A. nitida*, *Q. incana*, *P. orientalis* and *M. alba* whereas, in remaining species it was less than 20%.

Percentage of wood volume occupied by longitudinal parenchyma and wood rays collectively was calculated above 50% in *T. aphylla*, *A. modesta and M. azedarach*, 40 to 50% in *P.cineraria*, *B. ceiba* and *M. alba*. 30 to 40 % in *A. nilotica*, *D. sissoo*, *A. lebbek*, *A. procera*, *M. indica* and *Q. incana*, 20 to 30% in *F. excelsior*, *A. nitida*, *P. orientalis* and *C. toona*. Whereas in rest of the species it was below 20%.

On comparison, the wood volume occupied by various wood elements within

each species, greater volume of wood composed of fibers was found in *A. nilotica, D. sissoo, F. excelsior, A. lebbek, A. procera, M. indica, A. nitida, J. regia, P.euphratica, Q. incana, P.orientalis, A. caesium* and *C. toona*. Larger wood volume occupied by parenchymatous cells was determined in *A. modesta, M. azedarach, T. aphylla, P. cineraria, B. ceiba*, and *M. alba*. Whereas, the wood volume occupied by vessels was observed higher only in *A. indica*, almost equal to that of fibers.

As the study is based on single wood specimens of different species therefore, does not cover variations due to growth rate and position in the tree.

Volumetric data on some hardwoods of Pakistan

Species	Vessels %	fibers %	Wood rays %	L.parenchyma %	L.parenchyma + wood rays %
Babul (*Acacia nilotica*)	21	50	15	14	39
Phulai (*Acacia modesta*)	10	39	15	36	51
Shisham (*Dalbergia sissoo*)	14	47	17	22	39
Ash (*Fraxinus excelsior*)	23	56	14	7	21
Bakain (*Melia azedarach*)	21	25	18	36	54
Kokko (*Albizzia lebbek*)	11	57	10	22	32
Siris (*Albizzia procera*)	8	55	18	19	37
Mango (*Mangifera indica*)	9	53	26	12	38
Sharol (*Alnus nitida*)	20	52.5	27	0.5	27.5
Walnut (*Juglans regia*)	18	63	6	13	19
Popular (*Populus euphratica*)	33	49	17	1	18
Farash (*Tamarix aphylla*)	8	27	52	13	65
Oak (*Quercus incana*)	10	58	27	5	32
Chinar (*Platanus orientalis*)	36	39	23	2	25
Maple (*Acer caesium*)	11	78	8	3	11
Horse chestnut (*Aesculus indica*)	44	43.7	12	0.3	12.3
Jund (*Prosopis specigera*)	21	37	12	30	42
Toon (*Cedrela toona*)	29	47	14	10	24
Semel (*Bombax ceiba*)	18	37	19	26	45
Mulberry (*Morus alba*)	23	34	22	21	43

Conclusions

- The wood of *A. nilotica, D. sissoo, F. excelsior, A. lebbek, A. procera, M. indica, A. nitida, J. regia, P.euphratica, Q. incana, P.orientalis, A. caesium* and *C. toona* may be higher in density and strength properties and good source of fibers.

- The wood of *A. nilotica, F. excelsior , M. azedarach, P. euphratica, P. orientalis, A. indica, P. cineraria, C. toona* and *M. alba* can behave better in seasoning and preservation than the other species.

- The wood of *A. modesta, M. azedarach, T. aphylla, P. cineraria, B. ceiba* and *M. alba* may be less durable as compared to other species.

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