PROPERTIES AND UTILIZATION POTENTIAL OF COMMON ASH (*FRAXINUS EXCELSIOR*)

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ABSTRACT

Various Technological properties of common Ash (*Fraxinus excelsior*) present at northern areas of Pakistan, especially Neelum valley, were determined to find out better utilization by standard laboratory methods. Permanent slides of cross, radial and tangential sections of the wood were prepared to determine anatomical properties of the wood through microscopic observations. The wood samples were prepared and tested as per international standard to determine physical and mechanical properties of wood. The thick walled and long fibers were observed which showed its better strength. The wood may be less durable or non- durable, however, chemical preservation can be made easily to enhance its durability. Seasoning may also be done easily if due care is provided. After that the determined results have been compared with shisham wood (*Dalbergia sissoo*). It can be used as alternate of shisham wood in manufacturing work after some processing is carried out carefully. Its also recommended for a number of uses due to its better strength figures.

INTRODUCTION

Natural range of common Ash covers most of Europe. In Asia it is found in much elevation right from 1800–2200m. It demand a variety of soil types. However, it is highly furnished in rich soil. It like the calcareous nature soil (Alfas Pliura and Myriam Heurtz, 2003).

In Pakistan it is found in natural forest and also cultivated on private land in northern western hilly area up to 1825m elevation (Mustafa, 2006).

It is fairly fast growing, at early stage (upto 50 years) of age, large in size, deep rooted, broadleaved, deciduous with spreading branches formed round or doomed shaped fairly open crown of green foliage. It grows to high of 25-35m (rarely upto 40m) with long, straight and clean bole between 2m to 3m (rarely 3.5-4m) in girth,

The wood is straight grained and somewhat course textured. It is tough and elastic timber and is reasonable durable. It is moderately easy to work, though its uneven texture may cause trouble in surfacing by the machine planer. The wood bends very well and turns satisfactorily (Titmuss, 1965).

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Common Ash timber is used mainly for tool handles and for sports equipment such as hockey sticks and oars handles. It has distinction between sapwood (yellow or grayish white) and heart wood (grayish white to light brown) making it very valuable for furniture, veneer and flooring. Ash bark and leaves are astringent and leaves are used in modern herbal medicine for their laxative properties (Alfas Pliura and Myriam Heurtz, 2003).

A study has been carried out to evaluate the various technological properties of common Ash with a view to find out its better utilization and recommend its suitability as an alternate of shisham wood a conventional commercial timber.

MATERIAL AND METHODS

The required defect free wood material of common Ash (sum) was collected from Neelum Valley of Azad Jammu and Kashmir and transported to PFI, Peshawar.

A disc of about 10cm in thickness was cut from and face of butt log and then required blocks were separated from the disc to determine the anatomical properties of wood. After that permanent slides of cross, radial and tangential sections were prepared by standard laboratory procedure from each such block. (Anon, 1971) and observed under the microscope for various structure features and data were collected for the following microscopic features.

- Frequency of vessels per unit area
- Diameter of vessels
- Frequency of wood rays per mm in crows section.
- Frequency of wood rays per mm square in tangential section.
- Number of cells along ray height.
- Number of cells along ray width.
- Height of ray in microns.
- Width of ray in microns.
- Fiber diameter.
- Fiber wall thickness.

A small portion in the form of chips of wood was macerated in the mixture of 20% Nitric acid and Potassium chlorate (Wallis, 1965) to separate the fiber and observe the fiber length in each sample. The date collected for each microscopic features were analyzed for statistical variables such as mean value, standard deviation and co-efficient for each anatomical feature and presented in the form of table.

A disc of 7cm in thickness was separated from log to determine moisture content, density and shrinkage so standard samples were made. Remaining research materials were used for the examination of strength properties.

Mechanical properties were determined from butt end log after its conversion. Half the materials in the form of planks were staked in seasoning shed to attain equilibrium moisture contents. The planks to be tested in both conditions (green and air dried) were converted into strips of 2cm thickness and the following sizes were prepared from each plank according to international standard.

Wood Property	Specimen Size
Static bending	30 cm × 2 cm × 2 cm Impact
bending	30 cm × 2 cm × 2 cm
Compression parallel to grain	6 cm × 2 cm × 2 cm Tensile
strength perpendicular to grain	7 cm × 2 cm × 2 cm
Cleavage	4.5 cm × 2 cm × 2 cm
Hardness	10 cm × 2 cm × 2 cm

After preparation of test samples, the strength properties were determined both in green and air dry condition. All the test were performed on "Universal Wood Testing Machine Amsler" with a total loading capacity of 4,000 kg by ensuring defect free specimens.

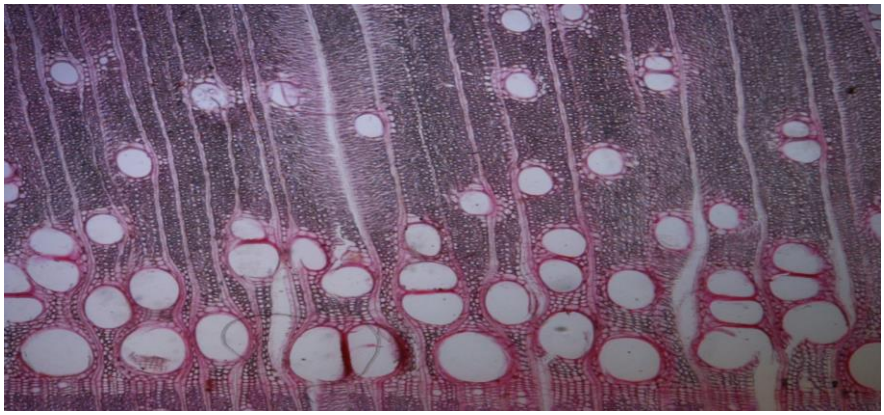
RESULT AND DISCUSSION

General Characteristics

The observed colour of sapwood was yellowish or grayish white and the colour of heartwood was grayish white to light grown. It showed somewhat course textured and may finish to smooth surface. It was found tough and elastic timber which may be the sign of durability. The wood was observed moderately hard and heavy, straight grained and may be easy to saw and work.

Anatomical Properties

Growth rings are distinct and well defined owing to large size of early wood vessels.



Photograph showing early wood Vessels are larger in diameter than late wood vessels

The wood is ring porous in natural. Vessels are circular to oval in shape are observed. Vessels are observed in large to medium size (variable in size). Vessels diameter was recorded 207 (Avg.) in early wood vessels and 59 in late wood vessels and vessels frequency was recorded as 6/mm^2 (Avg.) in early wood were as late wood it was observed 7/mm^2 (Avg.). The wood are observed larger in size and higher in frequency was determined as 33/mm^2 (Avg.) in tangential section and 5/mm^2 (Avg.) in cross section. There were 11 cells (236) in height and 1-2 cells (24) in width. The fiber were found medium thick-walled longer in size and rounded in form. The fiber were 1.26/mm (Avg.) long, 18.67 (Avg.) in diameter and their walls were determined as 3.01 (Avg.) in thickness.

On the basis of average values as given in table 1 reveal that the fibers are longer and medium thick walled and the wood may be better in strength and can be used for manufacturing various products. The wood may be less durable or somewhat non durable because of larger in size and higher in frequency of wood rays, whoever, it can be easily preserved with chemicals as the early wood vessels are larger in diameter which may ease seasoning process of wood if due care be provided. Due to wide lumened fibers it can also be used in pulp and paper manufacturing and can produce better properties in paper.

Table 1. Anatomical properties of *Fraxinus excelsior*

S. No	Microscopic features	Unit	Average	Standard Deviation (α)±	Coefficient of Variance (%)
1	Fiber length	mm	1.26	0.24	19.04
2	Fiber diameter	µ	18.67	1.7304	9.2
3	Fiber Wall thickness	µ	3.01	0.2467	.8.19
4	Fiber lumen width	µ	12.65	-	-
5	Vessel frequency	/mm^2	E.W 6 L.W7	1.6493 0.90	27.333 12.85
6	Vessel diameter	µ	E.W 207 L.W 59	2.7127 1.1457	1.3 1.946
7	Height of ray	µ	236.	3.469	1.46
8	Height of ray	Cell	11	3.469	31.45
9	Width of ray	µ	24	0.5060	2.10
10	Width of ray	Cell	1-2	-	-
11	No. of rays in tangential section	/mm^2	33	4.4350	13.33
12.	No. of rays in cross section	/mm^2	5	1.02	20.4

Physical Properties

The average moisture content of the log was determined as to percent.

Table 2. Physical properties of "*Fraxinus excelsior"*

S.No	Property	Average value
1	Specific gravity	0.657
2	Basic Density	0.5610
3	Green density	0.84
4	Longitudinal shrinkage:	
	From Green to oven-dry %	10
5	Radial shrinkage:	
	From Green to oven-dry %	5
6	Volumetric shrinkage	15

Its air dry density was calculated as 657 Kg/cm^3 whereas' basic density (Ratio of oven dry weight to green volume) was determined as 561. The timber need to be seasoned at the level of moisture contents 122% before utilization. The maximum radial shrinkage was 5% and maximum tangential shrinkage was 10%. The shrinkage along longitudinal direction was not

recorded and assumed as negligible. Results of these properties are given in table 2.

Keeping view the above physical properties of common Ash wood it has been classified as medium dense wood, stronger in nature and moderately heavy in weight so may be used in manufacturing of various products but may not be used in mega construction work.

Mechanical Properties

Specimens of common Ash wood were tested/examined both in green and oven dry condition for various mechanical properties. Wood tested in green condition has minimum strength as compare to the wood tested in air dried/oven dried condition.

In air dried condition results given in table 4 showed that it has an excellent average value of Modulus of rupture (MOR) (1214kg/cm^2) and modules of elasticity (87320kg/cm^2). The crushing strength parallel to grain 541kg/cm^2 has been determined which indicates its strongness when used especially in athletic, sports goods, tool handles, cross arms and etc. Cleavage was calculated as 30Kg/cm which mean the wood has better nail and screw holding capability. Similarly the wood has higher value of shear stress parallel to grains (168kg/cm^2). The side and end hardness were 655kg and 811Kg respectively so it can be used against knives of lathe or other machine.

Table 3. Strength properties in green condition of *Fraxinus excelsior*

S.No	Property	Unit	Average	Standard Deviation (α)±	Coefficient Variance (%)
1	Modulus of rupture	Kg/cm^2	1744	38.93	2.11
2	Modulus of elasticity	Kg/cm^2	77407	17.44	0.022
3	Max. Crushing strength parallel to grain	Kg/cm^2	245	44.68	18.23
4	Cleavage	Kg/cm	27	3.80	14.17
5	Tension strength parallel to	Kg/cm^2	23.41	5.16	22.06
6	Impact bending	/4cm^2			
7	Hardness	Kg			
	Side grain		506	30.082	5.94
	End grain		495	35.45	7.1629

Table 4. Strength properties of "*Fraxinus excelsior*" in Air-dry condition

S.No	Property	Unit	Average	Standard Deviation (α)±	Coefficient of Variance (%)
1	Modulus of rupture	Kg/cm^2	1214	27.22	2.24
2	Modulus of elasticity	Kg/cm^2	87320	15.55	0.017
3	Max. Crushing strength parallel to grain	Kg/cm^2	541	34.60	6,39
4	Cleavage	Kg/cm	30	4.44	13.4
5	Max. Shearing strength parallel to grain	Kg/cm^2	168	19.28	11.47
6	Impact bending	/4cm^2			
7	Hardness	Kg			
	Side grain		655	27.13	4.14
	End grain		811	23.45	2.89

Comparison of tested mechanical properties of common Ash wood with Shisham wood

Pakistan has meager resources of commercial timber like Shisham. However the demand of conventional timber has become manifold owing to heavy consumption but not paid proper attention toward production. For high class furniture and cabinet work, the shisham is still now considered as best one wood. It is also used in good constructional work like house building, flouring, carpentry, joinery work etc. In addition to these uses it is widely used for other purposes as well and now a day it is also liable to susceptible to alarming disease named Shisham Dieback. Due to its over utilization there is heavy pressure on it. Demand does not meet by its scarce supply. So keeping in view these circumstances it is very necessary to use the alternate commercial wood to meet the demand. In order to solve this problem, the tested common Ash wood was to compare with Shisham wood.

Comparison of all technological properties of common Ash wood with Shisham wood enabled us to give final recommendation for better end uses. The timber value obtained from different mechanical tests performed at wood anatomy and mechanics laboratories with regard to common Ash wood was found potentially significant. So it has been identified that it can be used as an alternate of traditionally used Shisham Timber and also it will help to overcome pressure on it. It was the main objective of the study and comparison was found highly remarkable and marvelous. Evaluated tests are provided in table 5.

Table 5. Comparison of wood properties of Common Ash and Shisham at 12% moisture content

S.No	Property	Common Ash	Shisham
1	Modulus of Rupture (Kg/cm^2)	1214	1120
2	Modulus of Elasticity(Kg/cm^2)	87320	85790
3	Max. compression strength parallel to grain(Kg/cm^2)	541	560
4	Side grain (Kg)	655	650
5	End grain (Kg)	811	800
6	Cleavage (Kg/cm)	30	22
7	Impact bending(m-kg)	2.80	1.79

Comparative analysis of the result given in the table has made it clear that the wood of Common Ash was superior to Shisham regarding MOR and MOE. Although maximum compression parallel to grain is far better in common ash comparative to Shisham. Value of side and end grain hardness was also found greater in Common Ash than Shisham wood. Cleavage was found highly remarkable in common ash timber which has proved suitability to be use as an alternate of Shisham commercial timber specie.

CONCLUSION

Fibers are medium thick walled and longer in size so; it is classified as better in strength. Early wood vessels are larger in size and lower in frequency may not only ease the process of seasoning but also easily treated with preservative to enhance the durability of wood.

Due to larger in size and higher in frequency of wood rays make it less durable/non durable for its open use/outside from the buildings or any premises (when used in open air/direct sunlight)

Different Physico-mechanical properties reveal that it is stronger than shisham wood and it has considerable potential to be used as alternate/ substitute of shisham for making furniture, cabinet work, sports goods, packing cases, tool handles, cross arms, joinery work, agriculture implements, walking sticks, Bedsteads, Carving, Carpentry work, turnery article, flooring, paving etc.

Common Ash wood is easy to work on machine or by hand. Its high value of hardness makes the timer suitable for different machinery operation without its failure.

However, one drawback is that it may not be used in mega constructional work because it is medium dense wood.

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