SOME PHYSICAL AND MECHANICAL PROPERTIES OF TURKISH HAZELNUT (CORYLUS COLURNA L.) WOOD

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Abstract: The aim of this study was to determine some of the physical and mechanical properties of Turkish hazelnut (CorlyluscolurnaL.) wood. Hazelnut is an endemic species in Turkey and the trees used for the study were taken from the Pınarbaşı District of Kastamonu Province. As a result of experiments carried out to evaluate the physical properties, it was found that the values of dry and air dry density were 0.636 gr/cm³ and 0.672 gr/cm³, radial, tangential and longitudinal swelling values were 4.60%, 7.48% and 0.41%, radial, tangential and longitudinal shrinkage values were 5.11%, 8.49% and 0.59%, respectively. According to the related standards, the mechanical properties of bending strength (98.5 N/mm²), modulus of elasticity in bending (8273.4 N/mm²), compressive strength parallel to the grain (50.09 N/mm²), dynamic bending strength (impact strength) (0.71 kN/cm), tensile strength perpendicular to the grain (5.09 N/mm²), and hardness values of cross, radial and transverse sections (72.55 N/mm², 47.32 N/mm², 46.13 N/mm², respectively) were also determined.

Keywords: TURKISH HAZELNUT, CORYLUS COLURNA, MECHANICAL PROPERTIES, PHYSICAL PROPERTIES

1. Introduction

Turkish hazelnut (Corlyluscolurna L.), one of the endemic species in Turkey, has a smooth stem and can reach 80 cm in diameter and 15-20 m in height. Some trees in Kale Forest District of Bolu Regional Forest Headquarters have attained a diameter of 1 m and height of 30-35 m. ¹, and trees growing in graveyards and at the edges of fields in Merkeşler village in Bolu Province were measured at more than 80 cm in diameter. This tree species is rarely used in the timber industry because its technological properties are not well known. Turkish hazelnut grows naturally in western Anatolia (Kazdağı/Bolu, Kastamonu and Yenice/Karabük) and eastern Anatolia (Rize and Trabzon). ¹ It can grow at an altitude of 1600 m in Yığılca/Düzce, Köşebek Forest/Nalihan, Kastamonu between Azdavay and Cide and on Gavur Mountain in Tosya, and in Amasya on Sana Mountain. It is found at 1160 m in Ayancık, Çingen Konağı and Zindan/Sinop, and at 800 m in Mihalıççık, Çatacık Forest/Eskişehir. Turkish hazelnut trees are most commonly located in the northwest of the country at a vertical distribution of between 800-1700 m, in small groups or individually, together with other species such as oak, beech, maple and fir. ² The wood of this species is red in color and well-polished is used for the manufacture of furniture. ³

Forest villagers in the mid and western Black Sea region have made use of Turkish hazelnut for the production of wooden souvenir items and furniture. When assessing the possibility of utilizing tree species in terms of suitable areas of the forest products industry, it is very important to determine the chemical, physical, mechanical, drying, machining and conservation properties of those tree species. At present, only the anatomical properties of the Turkish hazelnut tree have been investigated for this purpose. This study is very important because the technological properties of this tree species have not been previously determined. Accordingly, Turkish hazelnut has been underutilized in the forest product industry. Depending upon the development of increased industrial applications, this tree could be more widely cultivated. Nonetheless, to begin with, the wood properties of the Turkish hazelnut must be determined. The aim of this research was to investigate the physical and mechanical properties of Turkish hazelnut and to interpret the results with regard to possible industrial utilization.

2. Materials and Methods

In order to examine the distribution areas of Turkish hazelnut, sample trees belonging to this protected species were taken from Pınarbaşı District in Kastamonu Province. An official description of the study area is given in Table 1.

In order to determine the physical properties, a total of 32 sections, 15cm in length, were taken from each sample tree at heights of 0.30m, 1.30m, 2.30m, 4.30m, 6.30m, 8.30m and 10.30m. A total of five sample logs, 1.5 m in length, were taken from each sample tree for mechanical testing, according to TS 2470 standard.

The physical properties of oven and air dry density (TS 2472, 1976), radial, tangential (TS 4083, 1976) and volumetric (TS 4085, 1983) shrinkage, and radial, tangential (TS 4084, 1976) and volumetric (TS 4086, 1983) swelling were investigated. The mechanical properties of bending strength (TS 2474, 1976), modulus of elasticity in bending (TS 2478, 1976), tensile strength perpendicular to the grain (TS 2477, 1976), impact bending strength (TS 2476, 1976), compressive strength parallel to the grain (TS 2595, 1977) and Janka hardness (TS 2479, 1976) of Turkish hazelnut wood were also examined.

First, sections obtained from the sample trees were cut and left under a covered outdoor area until the fiber saturation point was
reached. The specimens for physical tests were then prepared according to standards. A total of 400 specimens for density and 50 specimens for each of the other physical tests were prepared. All samples used for the physical and mechanical tests were acclimatized according to TS 642 ISO 554 (1997) to attain the air dry state (12%). The section parts used for physical test specimens are shown in Figure 1.

![Fig 1: Timber used to prepare the mechanical test specimens.](image)

The timber sections used for mechanical test specimens are shown in Figure 2.

![Fig 2: Timber used to prepare the mechanical test specimens.](image)

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The bending strength, modulus of elasticity (MOE), compression strength parallel to the grain, impact bending strength, tension strength perpendicular to grain, and hardness values were determined. After the mechanical tests, the moisture content of each specimen was measured and the values of samples having different air dry moisture content were converted to 12% values.

3. Results and discussion

The density and sorption values of Turkish hazelnut are given in Table 3.

![Table 3: Density and sorption values of Turkish hazelnut wood.](table)

The mechanical values of Turkish hazelnut are given in Table 4.

![Table 4: Mechanical values of Turkish hazelnut wood.](table)

The density test results of Turkish hazelnut along with the values of other broad-leaved native species in Turkey are given in Table 5.

![Table 5: Density values of some Turkish wood species.](table)

As seen in Table 5, except for alder, poplar, and lime tree, the density values of Turkish hazelnut are similar to those of other broad-leaved tree species. Turkish hazelnut has medium density according to the classification values presented by Bozkurt and Erdin (1990). The shrinkage test results of Turkish hazelnut and other broad-leaved native species in Turkey are given in Table 6.

![Table 6: Shrinkage values of some Turkish wood species.](table)
shrinking’. The ratio of tangential and radial shrinkage is 1.62, which is only slightly lower than the general mean ratio of 1.65. The difference between tangential and radial shrinkage is 2.88%. With a value greater than 2.5, as in this case, the deformation risk increases during the wood drying.20

The swelling test results of Turkish hazelnut and other broad-leaved native species in Turkey are given in Table 7.21-24

Table 7: Swelling values of some Turkish wood species.

<table>
<thead>
<tr>
<th>Species</th>
<th>Radial (N/mm²)</th>
<th>Tangential (N/mm²)</th>
<th>Longitudinal (N/mm²)</th>
<th>Volumetric (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beech</td>
<td>98.5</td>
<td>112</td>
<td>77</td>
<td>120</td>
</tr>
<tr>
<td>Oak</td>
<td>130</td>
<td>82</td>
<td>900</td>
<td>13400</td>
</tr>
<tr>
<td>Maple</td>
<td>50.1</td>
<td>57</td>
<td>50</td>
<td>65</td>
</tr>
<tr>
<td>Poplar</td>
<td>46.1</td>
<td>56.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mechanical test results of Turkish hazelnut and some other broad-leaved native species in Turkey are given in Table 8.17

Table 8: A comparison of mechanical test results of some Turkish wood species.

<table>
<thead>
<tr>
<th>Mechanical properties</th>
<th>Turkish Hazelnut</th>
<th>Beech</th>
<th>Chestnut</th>
<th>Ash</th>
<th>Oak</th>
<th>Hornbeam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bending strength</td>
<td>98.5</td>
<td>112</td>
<td>77</td>
<td>120</td>
<td>108</td>
<td>160</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>8273.4</td>
<td>130</td>
<td>82</td>
<td>900</td>
<td>13400</td>
<td>11056</td>
</tr>
<tr>
<td>Impact bending</td>
<td>0.71</td>
<td>0.9</td>
<td>0.57</td>
<td>0.65</td>
<td>0.78</td>
<td>0.8</td>
</tr>
<tr>
<td>Compression strength (N/mm²)</td>
<td>50.1</td>
<td>37</td>
<td>50</td>
<td>52</td>
<td>65</td>
<td>82</td>
</tr>
<tr>
<td>Tension perpendicular (N/mm²)</td>
<td>5.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swelling</td>
<td>72.5</td>
<td></td>
<td>78</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The bending strength of Turkish hazelnut is moderate. But its MOE is low. In other words, under a certain load it shows more deformation (bending). Its compression strength is also moderate. It exhibits high impact bending, and for this reason it can be employed where high impact performance is needed. At the same time, Turkish hazelnut wood can be considered for applications that require bending properties, because it has a relatively high impact bending strength comparable to that of beech, oak, ash, elm and maple. Turkish hazelnut displays high hardness parallel to the grain. The same point is also true for hardness perpendicular to the grain.

4. Conclusion

Because of its high hardness value, Turkish hazelnut wood can be used for parquet flooring, and it is also suitable for the production of sports equipment, machine parts, tool handles, stairs, furniture and other wooden structures, especially in areas exposed to shock. In addition, as its bending properties are considered to be appropriate for certain applications, further bending tests must be performed to investigate these possibilities; however, the chemical, anatomical, drying and machining properties should also be taken into account.

5. References

16. TS 642 ISO 554, 1997. Standard atmospheres for conditioning and/or testing; Specifications