

ABSTRACT

Searching of forest based wood substitute is the broad objective of this analytical study of bamboo species. The application of bamboo can reduce the most exploited timber based wood uses. The gathering of knowledge on physical, chemical and anatomical properties of bamboo helps in its appropriate uses. Such knowledge also provides scope of extension in its application from traditional to modern industrial uses. Studies on physical and mechanical properties of regularly used bamboo species have been carried out by many workers around the world but the lesser known and lesser used bamboos still needs more studies.

Studies of physico-chemical and anatomical properties of selected bamboo species of Kokrajhar district of BTAD, Assam, India has its importance because this kind of study was not carried out earlier in the district. The present study is an investigation work on the chemical, physical and anatomical properties of 6 numbers of bamboo species viz. *Bambusa garuchokua*, *B. assamica*, *B. pallida*, *Melocanna baccifera*, *B. polymorpha* and *B. bambos* growing in Kokrajhar district. For this study the sample was prepared from the uniform height of breast height diameter (BHD) which comes around 137.16 cm height portion of bamboo culm. In order to obtain more accuracy in the result, the chemical and anatomical analysis was carried out in all the three cross sectional positions, the outer, middle and inner of culm wall. The method followed for the chemical evaluation was ASTM International and test for elements was followed AOAC.

Among the studied bamboo species the *B. assamica* shows lowest average alcohol-toluene solubility content with $4.29 \pm 0.06\%$ whereas, *B. bambos* shows highest content with $5.72 \pm 0.20\%$. The result also shows the alcohol-toluene solubility content in cross sectional position within a culm with higher content in the inner position than middle and outer which followed the same pattern as described by many workers.

The result of hot water solubility content shows the *B. assamica* with lowest content of $5.54 \pm 0.03\%$ and *B. bambos* with highest content of $7.01 \pm 0.12\%$. It also

shows the highest hot water solubility content in inner position of cross sectional layer as compared to middle and outer position. Present study shows the variations of lignin content in different bamboo species. It shows that *B. garuchokua* with highest lignin content of $26.86\pm 0.81\%$ followed by *B. bambos* with $26.20\pm 0.82\%$ and *B. assamica* with lowest content of $20.44\pm 0.94\%$. This study determines the pattern of lignin content by having highest percentage in outer layer then inner and middle. The result also satisfies the relationship between fiber length and lignin content, as higher the lignin content shorter the fiber length.

This study shows the result of highest holocellulose content in the outer side of the cross section of culm wall with $79.13\pm 0.72\%$ in *B. bambos* and lowest content with $64.31\pm 0.45\%$ in *B. assamica*. The study shows the significant between species and position in holocellulose content, and followed the same pattern of having the highest holocellulose in the outer side than middle and inner side of the cross section of culm wall as studied by various workers. The *B. assamica* shows highest α -cellulose content of $46.04\pm 2.83\%$ and *B. bambos* with lowest content of $37.51\pm 0.35\%$. This result established a negative relation of holocellulose and α -cellulose content, as higher the α -cellulose content lowers the holocellulose content. The range of α -cellulose content (37.51 ± 0.35 to $46.04\pm 2.83\%$) in studied bamboo species followed the same pattern of having higher content in outer side than middle and inner as reported by many authors.

Some of the important physical parameters including moisture content (MC), specific gravity (SG), shrinkage, modulus of rupture (MOR) and modulus of elasticity (MOE) were studied. The present study shows the moisture content percentage range from 56 to 60% which is comparable to the results of previous workers found in other bamboos. Among the studied bamboo species the *B. bambos* shows the lowest percentage of moisture content with $56.2934\pm 3.02\%$ and *B. assamica* shows the highest moisture content percentage with $60.3911\pm 1.34\%$.

This study shows a reverse relation of specific gravity with moisture content. The result shows as moisture content is low the specific gravity is higher which satisfied the pattern of relation of moisture content and specific gravity described by

several workers. *B. assamica* shows lower specific gravity with $0.5735 \pm 0.01 \text{ gm/cm}^3$ and *B. bambos* shows higher specific gravity with $0.6457 \pm 0.02 \text{ gm/cm}^3$.

The result of present study on the shrinkage percentage shows differences in different species and dimension (Tangential, Radial, and Longitudinal). Among the present studied species *B. assamica* shows highest shrinkage percentage in all direction with $7.62 \pm 0.97\%$ (Radial), $5.54 \pm 0.42\%$ (Tangential), $0.27 \pm 0.06\%$ (Longitudinal) followed by *M. baccifera* with $7.41 \pm 0.12\%$ (Radial), $5.39 \pm 0.27\%$ (Tangential), $0.25 \pm 0.07\%$ (Longitudinal). *B. garuchokua* shows the lowest shrinkage percentage with $5.89 \pm 0.56\%$ (Radial), $3.11 \pm 0.40\%$ (Tangential), $0.13 \pm 0.04\%$ (Longitudinal). The results of the present study almost satisfy the statement given by different workers that, shrinkage in radial direction is almost double than tangential direction with negligible longitudinal shrinkage. This studies also shows that higher the initial moisture content (MC), higher the shrinkage percentage.

The results of the present study followed the same pattern with higher the moisture content higher the value of modulus of rupture (MOR). The results show exceptional with little differences in the value of *B. polymorpha*. The result of the present study shows that *B. bambos* and *B. garuchokua* have very close MOE (MPa) with 10361.59 ± 410.98 and 10153.91 ± 373.54 MPa respectively and MOR (MPa) with 179.06 ± 2.93 and 158.05 ± 1.60 MPa respectively. Among the studied species *B. assamica* shows the lowest MOE (MPa) and MOR (MPa) by having 6861.94 ± 114.92 and 120.04 ± 2.71 MPa respectively. The result of the present study showed that different species have different compression strength, which is supported by the description given by different workers. Among the studied bamboo species *B. garuchokua* shows highest compressive value in both the direction by having 73.85 ± 3.24 MPa (longitudinal), 30.16 ± 1.11 MPa (tangential) followed by *B. polymorpha* with 71.89 ± 3.05 MPa (longitudinal), 29.84 ± 0.94 MPa (tangential) and *B. assamica* shows the lowest compressive value in both the direction with 58.71 ± 3.36 MPa (longitudinal), 18.83 ± 2.01 MPa (tangential).

The present study shows the same pattern of fiber length characters across the culm wall position (outer, middle and inner) by having highest fiber length in middle position than inner and outer as described by several workers. The result of the present study shows the highest fiber length in *B. assamica* with 2.3850 ± 0.07 mm followed by *M. baccifera* with 2.3646 ± 0.03 mm. The *B. garuchokua* and *B. bambos* both have shown close fiber length by having 2.2912 ± 0.06 and 2.2928 ± 0.12 mm respectively.

The results of different chemical, physical and anatomical properties of studied bamboo species followed the same pattern as that of the regular used bamboos. Values of many important content is very close and comparable, hence these studied bamboos may be used for industrial purposes including papermaking, particleboards and other structural uses.