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Proximate Chemical Analysis of Pulp Isolated from *Leucaena leucocephala*

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Abstract: In the present study, proximate chemical composition analysis of *Leucaena leucocephala* hard wood was carried out and results of various parameters were noted down. Ash content was found to be 2.01%, cold water soluble and hot water solubility was reported to be 3.27% and 17.42%, respectively. Solubility of plant materials in 1%NaOH was noticed 16.57% and Alcohol/Benzene solubility was noticed 3.83%. Holocellulose percentage was also estimated that is 49.71% and Pentosan percentage was 11.18% where the acid soluble lignin percentage was observed 24.26% and the acid insoluble lignin percentage was 25.35% in the sample.

Keywords: *Leucaena leucocephala*, Chemical composition, Softwoods, hardwoods.

INTRODUCTION

Wood is the dominant fiber source in the pulp and paper industry in the world which can be simply classified as softwood and hardwood. Both softwoods and hardwoods consist of four major components: cellulose, hemi-cellulose, lignin and extractives. The relative amounts of the components differ between softwoods and hardwoods and between species[1]. Wood represents organic compounds in different compositions. These organic compounds are cellulose (38-42%), Glucomannan (2-20%), Xylan (7-30%), lignin (20-30%), resins (2-6%) and other hydrocarbons (<5%). The cellulose in wood is associated with a substantial amount of lignin, hemicelluloses and other substances present in the minor quantities. However, the chemical composition present in the final product of the pulp is cellulose (72-73%), Glucomannan (2-10%), Xylan (10-30%), lignin (2-5%), resins (<1%) and other hydrocarbons (<1%). Cellulose is basically a long molecule chains formed by the monomer of glucose. Cellulose is a polysaccharide consisting of β-D-glucose units linked together by 1-4 glycosidic bonds. [2] Cellulose is a linear polymer of β-(l+4) -D-glucopyranose units in $^4C_1$ conformation. It is the biggest component in both softwood and hardwood species. The degree of polymerization (DP) of cellulose in wood is approximately 10,000. In chemical pulping and bleaching, the objective is to separate the wood fiber without seriously degrading the cellulose chain. Hemicelluloses are sugar polymer and very similar to cellulose in their make-up except that they are heterogeneous in their monosaccharide units and have a much shorter chain length. They all contain side chain or groups that lead to an amorphous structure. Each hemi-cellulose is composed of several carbohydrate monomers (arabinose, galactose, glucose, xylose and mannose joined primarily by 1-4 glycoside bonds between monomer units. The hemi-cellulose polymers are non-crystalline and can generally be solubilized by the base, but this removes the acetate side groups. The typical degree of polymerization of hemicellulose chains is about 100-200. Hemicelluloses play a very important role in pulping and bleaching processes. The principal hemi-cellulose component of hardwoods is glucuronoxylan, comprising 15-30% of wood. Glucomannan is the minor hemi-cellulose component of hardwoods, making up 1-3% of hardwoods. In recent years, *Leucaena leucocephala* (Subabul) has become more popular among farmers in the southern states also due to its ability to produce pulpwood within three to five years. On this basis, *Leucaena leucocephala* was selected as the potential pulping raw material and alternative source fibers for making the paper.

MATERIALS AND METHODS

Logs of Subabul (*Leucaena leucocephala*) obtained from the study area of Ganjbasoda, district Vidisha M.P. were brought in to laboratory for chipping, screening, drying and pulping. The chips were analyzed with respect to extracts, carbohydrate composition and lignin content proximate analysis following the different methods as mentioned in the Table (1).

Table 1: Proximate chemical analysis methods of *Leuceana leucocephala* (Hard wood).

S. No.	Parameters	Methods
1	Ash	APPITA P3M-69
2	Lignin	TMI-A1 and TMI-D4
3	Holo-cellulose	TMI-A7
4	Alcohol/Benzene Solubility	TMI-A1.
5	Pentosan	TMI-A1
6	Hot water solubility	TMI-A1
7	Cold water solubility	TMI-A1
8	N/10 Na OH Solubility	TMI-A1

RESULTS AND DISCUSSION

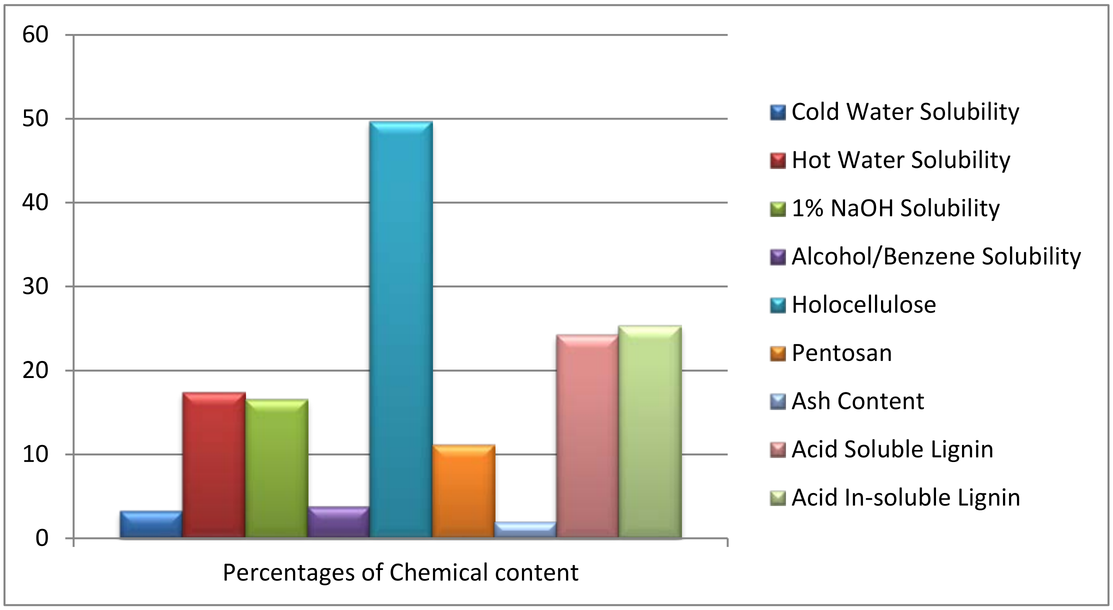
In the present study, Proximate chemical composition analysis of *Leucaena leucocephala* (Hard wood) raw material was carried out as per the methods mentioned in Table (1) and various parameters including ash content (2.01%), cold water solubility (3.27%) and hot water solubility (17.42%), solubility in 1%NaOH (16.57%) and Alcohol/Benzene, (3.83%), estimation of Holocellulose (49.71%) and Pentosan (11.18%) and acid soluble lignin (24.26%) and acid insoluble lignin content (25.35%) in sample were tested and their results were observed as shown in Table (2).

Table 2: Results of Proximate Chemical Analysis of *Leucaena leucocephala* raw materials.

S. No.	Parameters	Results (%)
1	Cold Water Solubility	03.27
2	Hot Water Solubility	17.42
3	1% NaOH Solubility	16.57
4	Alcohol/Benzene Solubility	3.83
5	Holocellulose	49.71
6	Pentosan	11.18
7	Ash Content	02.01
8	Acid Soluble Lignin	24.26
9	Acid Insoluble Lignin	25.35

Very recently, Neiva et al. [3] has reported chemical composition and kraft pulping potential of 12 eucalyptus species. Eucalyptus is among the most important short rotation hard woods planted worldwide for the pulp and paper industry. These 12 species (*Eucalyptus botryoides*, *Eucalyptus camaldulensis*, *Eucalyptus globulus*, *Eucalyptus grandis*, *Corymbia maculata*, *Eucalyptus ovata*, *Eucalyptus propinqua*, *Eucalyptus resinifera*, *Eucalyptus rudis*, *Eucalyptus saligna*, *Eucalyptus sideroxylon*, *and Eucalyptus viminalis*) were analyzed for chemical composition. Moreover, the 12 species also showed substantial differences regarding extracts (6.1–18.9%), lignin (21.6–30.8%) and holocellulose content (55.4–70.1%). Hemmasi[4] has also reported chemical composition of olive wood, including holocellulose percentage, lignin percentage, percentage yield obtained by soda, sulphite and kraft pulping. He has noticed that kraft pulp exhibited the highest holocellulose % yield, α-cellulose % yield ratios and the sulphite pulp and the soda pulp exhibited highest lignin ratios. These increased parameters increased the resistance of paper sheets of kraft pulp. Similarly, Sharma and Shukla[5] have reported the impact of cooking conditions on pulp viscosity and a Kappa number of *Leucaena leucocephala* wood for kraft pulping.

In the present study, holocellulose and pentosan estimation was noticed in the proximate chemical analysis of *Leucaena leucocephala* and it was observed that holocellulose was found to be 49.71%, pentosan was found to be 11.18% and lignin was obtained 24.26% in raw material of *Leucaena leucocephala* (Table 2, Graph 1). Similarly, Vena et al. [6] has reported extraction of cellulose, pentosan and lignin from giant bamboo prior to kraft and soda anthraquinone (additives) pulping to produce paper pulp. They have also noticed the chemical composition values of cellulose, pentosan and lignin in giant bamboo plant. These values were also found in almost similar range, i.e. cellulose content 44.4%, pentosan component 24.7% and lignin content 22%. Schall et al.[7] has also noticed the chemical composition of wheat straw and found cellulose 49.7% and lignin 21.2% ethanol benzene extracts 5.4% and ash content 9.7%. Besides this, screened yield % was found between 44-47% and rejection percentage was in between 0.1-1.7%. However, in the present study, alcohol, benzene solubility percentage was found to be 3.83% and the ash content percentage was found to be 2.01% (Table 2, Graph 1).



Graph 1: Proximate chemical content analysis percentages of *Leucaena leucocephala* raw materials.

CONCLUSION

Lastly, it can be said that the proximate chemical analysis process can be used to analyze cellulosic fibers like content and to remove lignin by white liquor for the paper pulping process.

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