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STUDIES ON CHEMICAL ELEMENTS ANALYSIS OF WOOD USING SEM-EDAX

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ABSTRACT

Wood is a highly organized material from macroscopic to micro level. Wood is a natural complex biomaterial. Analytical methods are described for the determination of major, minor, and trace elements in wood. The present study deals with micro chemical elements characterization of wood samples (*Leucaena leucocephala, Syzium Cumini, Mangifera indica L, Prosopis juliflora* and *Eucalyptus melliodora*) by energy dispersive X-ray analysis using OXFORDLINK-ISIS EDX fitted to Hitachi S-520 scanning electron microscope. Variations in major and minor chemical elements are observed from one species to other. It is interesting to note that very low amount of trace elements have been observed in different wood species shows to be essential to the growth of tree.

Key wards: Wood, SEM, EDAX, Major, Micro constituents.

INTRODUCTION

Wood is an extremely versatile complex biomaterial material with a wide range of physical and mechanical properties among the many species of wood. It is also a renewable resource with an exceptional strength-to-weight ratio. Wood and wood products occupy an important place in engineering. Wood is a desirable construction material because the energy requirements of wood for producing a usable end-product are much lower than those of competitive materials, such as steel, concrete, or plastic.

The chemical composition of wood cannot be defined precisely for a given tree species or even for a given tree. Chemical composition varies with tree part (root, stem, or branch), type of wood (i. e., normal, tension, or compression) geographic location, climate, and soil conditions. Analytical data accumulated from many years of work and from many

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different laboratories have helped to define average expected values for the chemical composition of wood. Ordinary chemical analysis can distinguish between hardwoods (angiosperms) and softwoods (gymnosperrns). Unfortunately, such techniques cannot be used to identify individual tree species because of the variation within each species and the similarities among many species. Further identification is possible with detailed chemical analysis of extractives (chemotaxonomy). Chemotaxonomy is discussed fully elsewhere in the literature[1,2].

Energy dispersive X-ray spectroscopy (EDS or EDX) is an analytical tool used for the analysis of elements or chemical characterization of a sample. It is a type of spectroscopy, in which the investigation of a sample is done through interactions between electromagnetic radiation and matter, analyzing X-rays emitted by the matter in response to being hit with charged particles. Its characterization capabilities based on the principle that each element has a unique atomic structure, allowing X-rays that are characteristic of atomic structure of the element to be identified.

Rowell et al.[3] Lignin, holocellulose, cellulose, and hemicelluloses were isolated from pine wood and reaction with acetic anhydride using EDX. Chien et al.[4] analyzed the residual elements in char, the results can provide experimental data for referencing the disposal–end practices (char) of both preservative–treated woods. Nicoleta-Valentina et al.[5] analyzed effect of pollution and components of dust and morphological observations of ornamental species of the genus Magnolia using SEM and EDX. Dibdiakova et al.[6] analyzed characterization of ashes from *Pinus Sylvestries* forest biomass using the technique of EDX. They reported percentage of elements in fuel samples. Vasubabu et al.[7] analyzed macro and micro elements present in *Casuarinaceae* wood species.

The purpose of this research is to study variation of macro and micro chemical elements in wood by taking five Indian wood species such as *Leucaena leucocephala, Syzium Cumini, Mangifera indica L, Prosopis juliflora* and *Eucalyptus melliodora* qualitatively and also quantitatively by using the technique of electron dispersive X-ray spectroscopy (EDXS) at sun dried condition.

EXPERIMENTAL

Material methods

Wood specimens are taken from wood species such as *Leucaena leucocephala*, *Syzium Cumini*, *Mangifera indica L*, *Prosopis juliflora* and *Eucalyptus melliodora* at sun

dried condition were mounted on aluminum stubs using double adhesive tape, coated with gold in Vacuum evaporated Hitachi HUS – 5GB and EDX studies were carried out on OXFORDLINK-ISIS EDX fitted to Hitachi S-520 scanning electron microscope. The Spot Mode operation was used for elements suspected to be concentrated in very small regions. SEM micrograph and EDAX with the selected area of measurement was shown in Fig. 1-5. The data on elements detected and their concentrations of each species presented in Table 1.

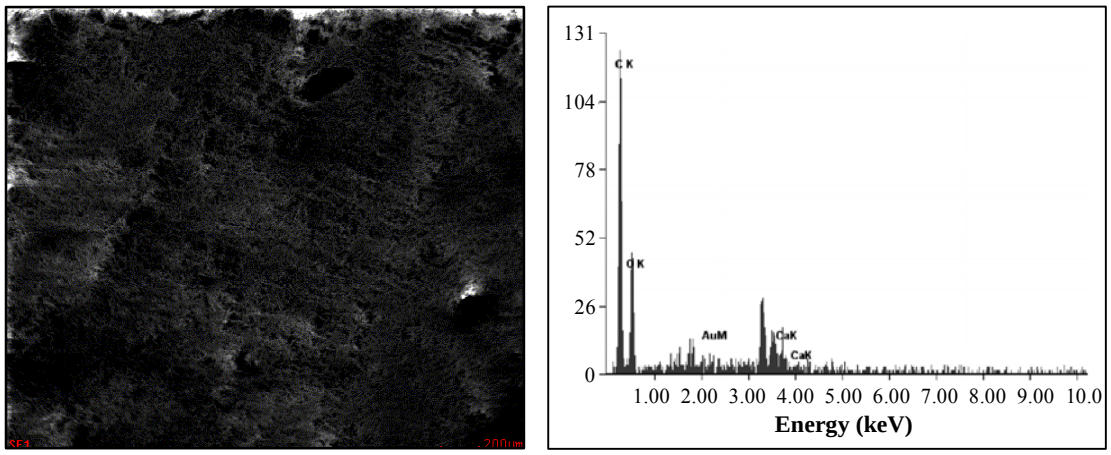

Fig. 1: SEM micrograph and EDAX spectrum of *Leucaena leucocephala* wood species

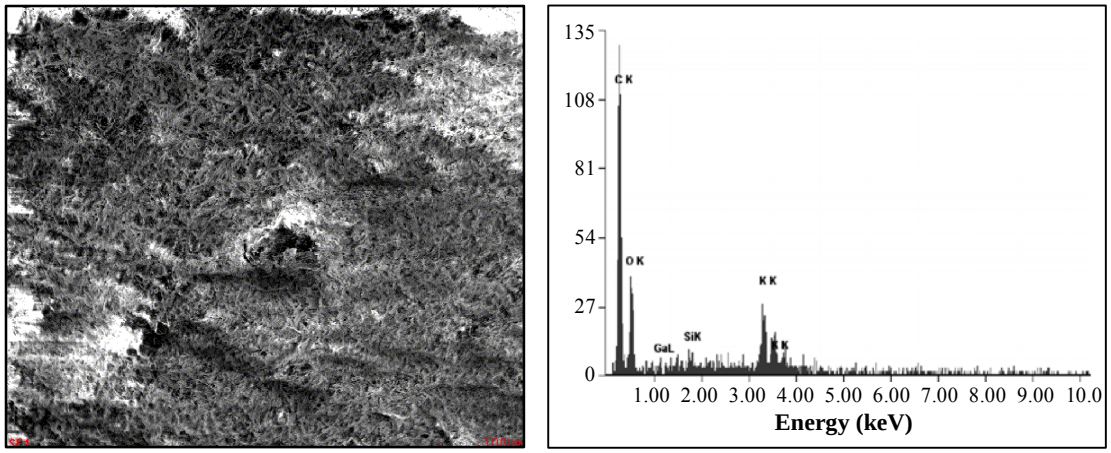

Fig. 2: SEM micrograph and EDAX spectrum of *Syzium Cumini* wood species

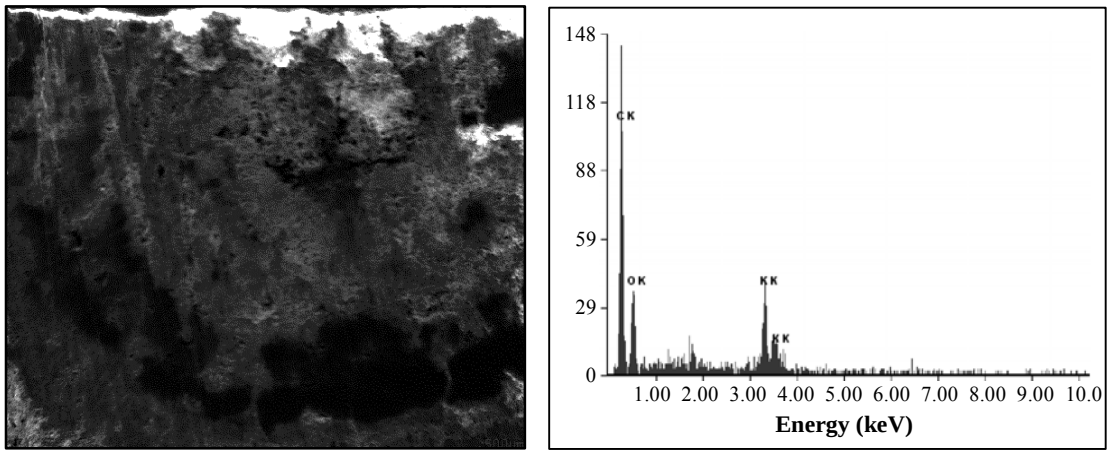

Fig. 3: SEM micrograph and EDAX spectrum of *Mangifera indica* wood species

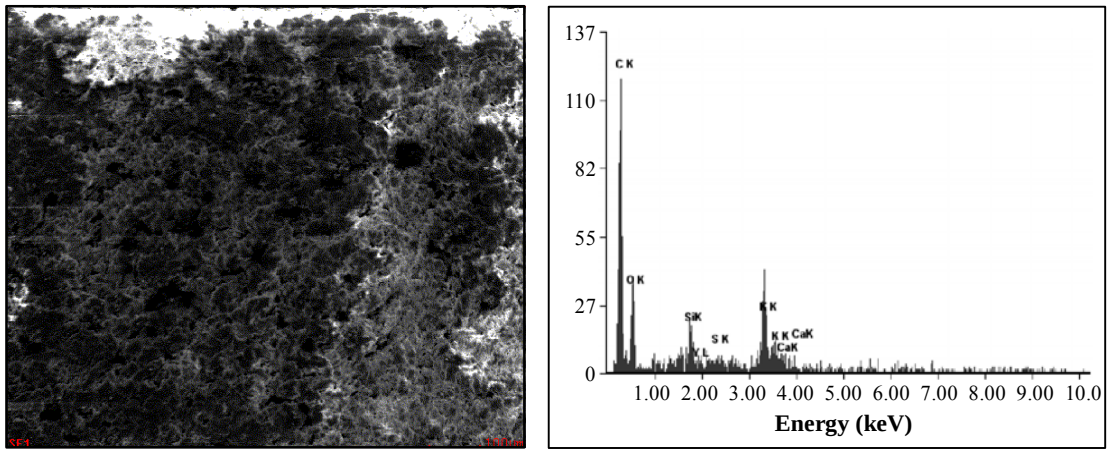

Fig. 4: SEM micrograph and EDAX spectrum of *Prosopis juliflora* wood species

Table 1: Chemical elements analysis of different wood species in weight percentage

Name of the wood species	Chemical elements with % of weight													
	C	***O***	***Na***	***Ga***	***Mg***	***Br***	***Si***	***Tl***	***Cd***	***Ca***	***YL***	***S***	***K***	***Au***
Leucaena leucocephala	61.37	32.85	----	----	----	----	----	----	----	3.01	----		----	2.77
Syzium Cumini	62.21	29.20	----	1.40	----	----	1.07	----	----	----	----	----	6.12	----

Cont…

Name of the wood species	Chemical elements with % of weight													
	CK	***OK***	***NaK***	***GaL***	***MgK***	***BrL***	***SiK***	***TlM***	***CdL***	***CaK***	***YL***	***SK***	***KK***	***Au***
Mangifera indica L	61.54	29.97	----	----	----	----	----	----	----	----	----	----	8.49	----
Prosopis juliflora	61.71	26.06	----	----	----	----	2.10	----	----	1.40	0.73	0.75	7.25	----
Eucalyptus melliodora	51.62	24.63	0.98	1.16	1.10	3.96	7.25	3.26	2.04	4.00	----	----	----	----

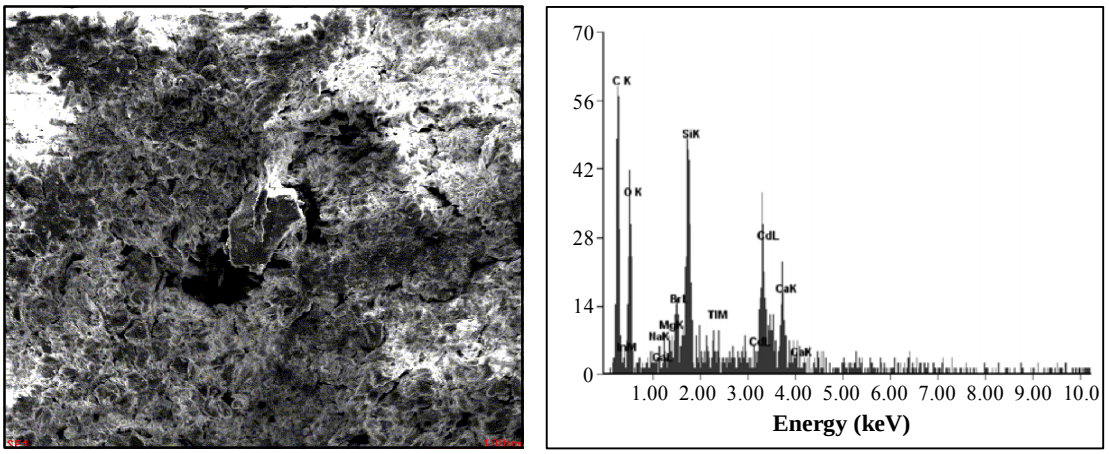

Fig. 5: SEM micrograph and EDAX spectrum of *Eucalyptus melliodora* wood

RESULTS AND DISCUSSION

Table 1 reports the data on 14 different chemical elements present in different wood species are determined by employing energy dispersive x-ray analysis. The elements are C, O, Na, Ga, Mg, Br, Si Tl Cd, Ca, Yl S, K and Au. These elements are detected from five wood species such as *Leucaena leucocephala, Syzium Cumini, Mangifera indica L, Prosopis juliflora* and *Eucalyptus melliodora.* The concentration of the elements is in weight percentage. It can be noted that the distribution of the elements is not uniform. It means that molecular composition within the specimen is highly inhomogeneous. The composition all elements analyzed C and O in general, are found to be more in quantity, while other elements are less. The percentage of C is more i.e. 51% to 62%. Oxygen is the second highest quantity within range 24% to 32%. Silicon (Si) and Potassium (K) are found in good amount, but not detected at all selected points. The other elements Na, Ga, Mg, Br, Tl Cd,

Ca, Yl S, and Au are in traces, but not found in some areas of the samples and most of the cases their signal level is even lower than the background noise. The variations in chemical elements from one species to other is in different amounts suggest structural variations of woods. The study of identification of trace elements in wood gives better understanding of physical properties of wood for engineering applications.

The EDAX analysis suggests the presence of C and O relatively in large quantity might be concerned with fiber-heart wood. Further, the inorganic content of different amounts may understand growth of tree and its physical properties.

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