J. Biol. Chem. Chron. **2017**, **3**(*2*), 24-27
ISSN (Print): 2454 – 7468
ISSN (Online): 2454 - 7476
www.eresearchco/jbcc/

Scanning Electron Microscopic Studies of Extracted Cellulose from Wheat Straw of Himachal Pradesh

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(Received 11 Oct, 2017; Accepted 16 Nov, 2017; Published 21 Nov, 2017)

ABSTRACT: We utilize agricultural raw materials, wheat straw for the extraction of cellulose because wheat is grown-up in most of regions in India. Cellulose has been extracted, from wheat straw of different districts of Himachal Pradesh by TAPPI method, T-203-cm-99. The size and morphology of extracted celluloses were characterized by using the Scanning Electron Microscope (SEM). In SEM the structures of extracted celluloses are displayed with their sizes and diameters on the micrometer scale. SEM micrographs of the Standard Cellulose (SC) (Cellulose powder pract, Central Drug House (p) Ltd. New Delhi) is compared with extracted celluloses of different samples and analyzes on scale 10 µm. SEM micrographs obtained from different samples of extracted celluloses displayed that distribution of fiber diameters ranging from 17 to 20 µm. The micrographs of extracted celluloses show that the particles diameters are smaller than 20 µm. Celluloses obtained from wheat straw shown more homogeneity in particles size compared with SC.

Keywords: Cellulose; Wheat straw; Morphology; SEM; TAPPI and Micrographs.

INTRODUCTION: Natural fibers are abundantly present in hardwood and softwood plants, e.g. wood, grasses, reeds, stalks, woody vegetation, sisal, jute, sugarcane, bamboo, rice straw, wheat straw etc.[1,2,3,4&5] Generally wood is more costly than non-wood. Wood is the essential origin of cellulose for manufacturing paper. Likewise with the enlargement of paper ventures in the nation, pulp containing plants are being utilized to a assessable level.[24 & 30] Wood is difficult to transport yet issues with non-wood plants are gathering, stockpiling and high flaming remains content.[22] The main source for pulp and paper industry at this time is agricultural waste because of overproduction of agricultural crops, abundance and cost effectiveness.[22 & 24]Agricultural waste materials are much focused in few years for the making of materials like paper, paperboard etc.[6 & 22] Agricultural raw materials are the intermediate quality products with cheap rates such as rice straw and wheat straw.[7-8] Wheat straw is the agricultural raw materials attained from different parts of wheat plant like stem, leaves etc. It is serving as an excellent fibrous material to recycle into quality paper in many parts of the globe[24]. The yearly production of wheat straw was above than 600 million in whole world but its major part was burnt causing pollution and many health problems. Wheat straw was easily available and renewable product.[9, 10 & 11] Besides giving a source of an additional income for farmers, it was also used in application like medicines, cosmetics, soil fertility, basket making etc.[12] Wheat straw can be utilized as support materials for various polymers.[4&5] Wheat Straw is rich in cellulosic fibers, hemicelluloses, proteins, lignin and ash.[22 & 25]

Cellulose rich materials were utilized as a composite materials which are formed by a strengthening of natural fibers.[15-16] Cellulose have utilized in paper and additional complex materials in textile industry, cosmetics and medical fields.[20-21] The aim of this study is to characterize the extracted celluloses from different sampling sites by Scanning Electron Microscopy (SEM).

MATERIAL AND METHODS:

Sampling sites: Wheat straw was taken from local agricultural areas of Himachal Pradesh viz. from four different districts such as Bilaspur (BLP), Hamirpur (HMR), Kangra (KNG) and Mandi (MND), India.

Reasons for sampling like very less use other than animal feeding and not managed properly. After drying in sunlight, it was ground and sieved under mesh screens. Wheat straw was dried in oven at 105ºC for 3hrs and stored at room temperature in air tight container.[22, 28 &29]

Extraction of Cellulose: Celluloses were extracted from wheat straw of Bilaspur (CBLP), Hamirpur (CHMR), Kangra (CKNG) and Mandi (CMND) by TAPPI method, T-203-cm-99.[23] 5gm holocellulose was prepared from oven dry dust which is obtained from wheat straw. It was treated with 30ml of 17.5 percent NaOH at 20°C. After standing for 5mins duration with 10ml portions with steady rousing, the sample mixture is macerated with flattened glass rod. After 30mins, 75ml of uncontaminated water was added at 20°C with stirring and then the material was acceptable to place for 30mins 100ml of pure water at 20°C was added again and the contents were kept for 30mins more in contact with alkali. The remains was filtered and then soaked in 8.3% NaOH for few minutes and drained by suction. The residue was rinse with 250ml of pure water and saturated in 2N acetic acid for 5mins. In conclusion mixture was rinse with 400ml of pure water and dehydrated in oven at 105±1ºC. The alpha-cellulose content was determined on oven dry basis as:

$$\text{Percentage of alpha cellulose content} = \frac{w \times 100}{W}$$

Where; w = weight in gram of residue
W = weight in gram of holocellulose taken for test.

Characterization of extracted Cellulose: The diameters and sizes of extracted celluloses of different sampling sites were examined by using Hitachi S-4300 SEM. Images were taken at 5kV accelerating voltage. The extracted celluloses was deposited on the electron microscope frame, activated at an acceleration voltage at 5kV with SE2 mode and observed. To avoid burning the samples, a low acceleration voltage of 5kV was used along with minimum examination times. Caution must be exercised in evaluating the SEM data as any single micrograph or even a large number of micrographs of a single sample. To obtain a statistical sampling of even a small sample requires a very large number of micrographs. SEM analysis of extracted celluloses and standard cellulose (SC) (Cellulose powder pract, Central Drug House (p) Ltd. New Delhi) are compared with each other by their diameters and sizes.

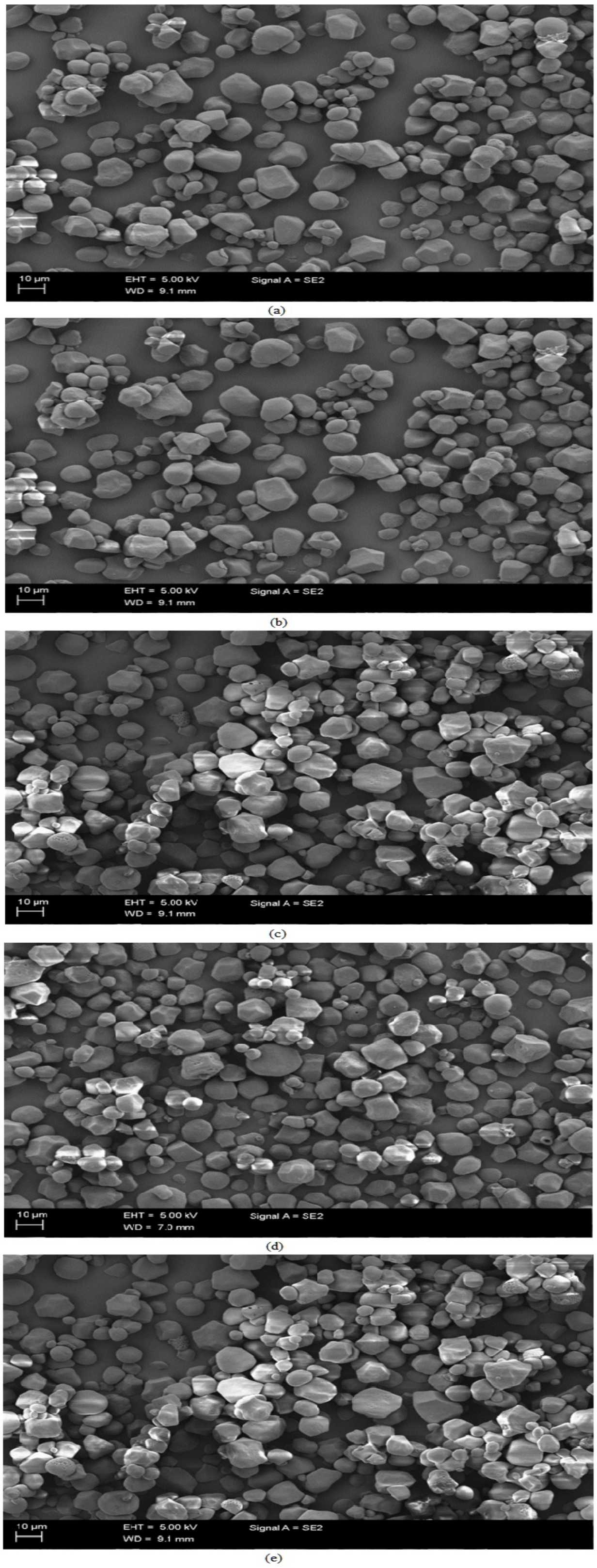

Figure 1: SEM of (a) Standard Cellulose and extracted cellulose from (b) Bilaspur (CBLP), (c) Hamirpur (CHMR), (d) Kangra (CKNG) and (e) Mandi (CMND).

RESULTS AND DISCUSSION: The structural and chemical changes of extracted celluloses were studied by SEM. SEM is used to generate high resolution micrographs of shapes of objects to show that spatial variations in sizes of particles and chemical composition. Figure 1(a-e) shows SEM micrographs of the SC and extracted celluloses such as CBLP, CHMR, CKNG and CMND and are compared at scales 10µm. SEM micrographs of SC and extracted celluloses morphological structures were similar. SEM micrographs revealed that division of extracted celluloses and SC sizes and diameters ranging from18-25 & 17 to 20 µm. SC particles size is 25 µm and the particle size of extracted celluloses (CBLP, CHMR, CKNG and CMND) are 25, 18.57, 18.57, 20 µm respectively. The diameter SC is 18.56 µm and the diameter of extracted cellulose (CBLP, CHMR, CKNG and CMND) is 17.14, 18.57, 20, 18.46 µm respectively. The microfibrils are broken separately into smaller sizes (18–25 µm) before distribution. Particles size and diameters of extracted celluloses shown more equivalence with SC micrographs.

CONCLUSION: In this study, cellulose has been extracted from wheat straw through TAPPI method. The extracted celluloses size and properties were characterized by SEM micrograph. The micrographs are useful in providing a qualitative assessment of the mechanical structure and quality of extracted celluloses. The results shown that the diameter of different samples of extracted celluloses is within the range between 17-20 µm with the length of few micron sizes. The micrographs of extracted celluloses shown that the particles diameters are smaller than 25 µm. SC particle size is 25 µm and the particle sizes of extracted celluloses (CBLP, CHMR, CKNG and CMND) were shown in micrograph 25, 18.57, 18.57, 20 µm respectively. The diameter of SC is 18.56 µm and the diameter of extracted celluloses (CBLP, CHMR, CKNG and CMND) is 17.14, 18.57, 20, 18.46 µm respectively. The results indicate that the extracted celluloses from wheat straw fiber can be useful in preparation of different cellulose derivatives.

ACKNOWLEDGEMENTS: This research was supported by Career Point University, Hamirpur to provide financial help to carry out the work. We thank our supervisor from Career Point University, Hamirpur who provided insight and expertise that greatly assisted the research.

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