

Crystallinity and PIXE Analysis of Stem of *Ichnocarpus frutescens*

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Abstract. The stem of *Ichnocarpus frutescens*(*IF*) is considered to be an important drug in indigenous system of medicine and also well known as a ayurvedic plant.. It is considered as an important medicinal plant that belongs to the family of [Apocyanaceae](#). The aim of present study is to identify the multi elements present in the stem through the Proton Induced X-ray emission (PIXE) and crystallinity property through XRD . The medicinally important various metal and non-metal elements of the *IF* stem are investigated using PIXE technique. The result shows that the stem contains multi elements like Si, S, P, Cl, K, Ca, Ti, V, Mn, Fe, Cu and Zn , where each element or mineral plays a number of different functions and generally non toxic in nature. The findings shows that stem of *IF* can be used for the treatments of various diseases such as cholera, cough, fever, skin trouble, jaundice, measles, and headaches, loss of sensation, demulcent, syphilis and purification of bloods. .So far as our knowledge is concerned, there is no report of PIXE and XRD of stem of *IF* plants. Therefore, the study is important, encouraging and confirming the possibilities of *IF* as an ayurvedic plant for treatment of various diseases because of the presence of various pharmaceutical complexes. These complexes are condensed system of various elements present in the *IF* stem.

Keywords: XRD, PIXE, *Ichnocarpus frutescens*. Medicinal plants..

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1. Introduction

In the current world billion of people uses herbal medicines for their health .In Tribal sector people are using natural occurring various medicinal plant for treatment of various diseases and solve their health problem[1]. Medicinal plants are also known to contain trace element which play vital role as structural and functional components of metallo protein and enzymes in the living cells. Each

mineral plays a number of different functions in the body. The most important pathway of metals to transport into human is from soil to plant and from plant to human. *Ichnocarpus frutescens* is a several meter long climbing plant that belongs to the family of Apocyanaceae. It is generally considered as an important valuable ayurvedic and fiber plant that is available throughout India, Asia, China and Australia. Its local name in Odisha, India is Suan Nai. The whole part of *IF* like stem, root, flower and leaf have various medicinal properties and can be used for treatments of various diseases like fever, skin trouble, loss of sensation, purification of bloods, demulcent, dog bite, diabetes, stone in a bladder and jaundice etc[2]. The leaves paste is applied on cuts to stop bleeding and boiled with oil used for curing headaches and fevers [2]. Stems look like reddish brown in nature and is used in treatment of fevers [3]. Scanty of literature about *IF* plants have been reported but so far as our knowledge is concerned, there is no report on PIXE and XRD of stem of *IF* plants. The main advantage of this plant is very long natural fiber of several meter which can replace synthetic fiber. These are non-hazardous, low CO₂ emission, bio degradable, eco-friendly, high water resistance, high strength, friendly processing, high electrical resistance, good thermal properties and can be recycled with very low production cost. The stem of this plant can be used as suitable reinforcement for preparing of green composites. Keeping the above aspects in view, stem of *IF* plant are characterized by PIXE and XRD analysis.

Proton induced X-ray Emission (PIXE) is a non destructive multi-elemental analysis technique. This technique takes a major role for identification of trace and minor elements of plants and biological system of any form like pallet, thin film, powder, fiber, fluid, semi-solid etc. Also liquid and gaseous samples are analysed through this technique which is limited to atomic number (Z)>12. The existence of different valuable elements in the stem of *IF* plant confirmed its curative properties and usefulness of the plant in general and physical (structural and mechanical) properties of the solid in particular. Different researchers published series of paper on the medicinal properties of *IF* plants. In 2011 VS.Joshi et.al[2] investigated root of *IF* plants to study the pharmacognostic characteristics of the plant material and reported that the roots possess demulcent, tonic, diaphoretic and diuretic properties. Root powder is administered with milk as blood purifier for diabetes, stone in bladder etc. Element and functional group analysis of *IF* plants material was reported in 2012 by S.Thangarajan,et.al. They found elements like calcium, magnesium, silicon, chloride, potassium, and carbon and functional groups like amino acids, amides,

amines, carboxylic acid, carbonyl compounds, organic hydrocarbons are present[3]. In 2015 C. Kumarappan, et.al. investigated taking root, leaf and flower of *IF* plant and observed that those are used for treatment of various diseases like demulcent, syphilis, loss of sensation and hemiplegia, headaches fevers, wounds between fingerstonic, diaphoretic, diuretic, dyspepsia and skin troubles [4].

2. Material and Methods

The stem of *Ichnocarpus frutescens* were collected from local forest area and washed with water to remove dust and impurities. The stem of the plant was dried at 50°C in vacuum oven for 30 minutes and crushed into powder form. Powder form of *IF* stem and graphite was mixed together to form a pallet with wt ratio 1:1 .The presence graphite made the sample conducting . This pallet was kept inside the vacuum chamber and exposed to 3MeV proton beam. This was carried out using 3 MV Tandem Pelletron Accelerator (9SDH-2, National Electrostatic Corporation, USA) available at Ion Beam Laboratory, Institute of Physics, Bhubaneswar, Odisha, India. The X-ray diffraction pattern of the samples was obtained from Bragg's angle 10° to 80° at room temperature of 26°C by using WXR/SHIMADZU/JAPAN at a scanning speed of 10°/minute.

3. Results and Discussion

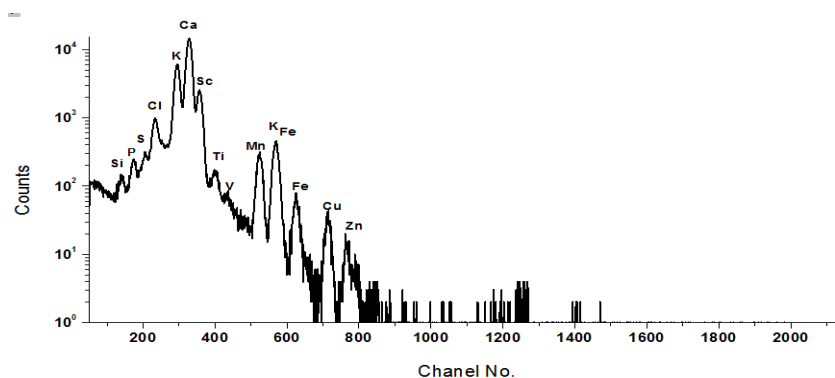


Fig. 1. PIXE spectrum of *IF* stem

The elemental analysis obtained by PIXE technique plays an important role in the metabolism. The important elements of medicinal plants possess different curative capability for human diseases. Figure1 shows that the stem contains

multi elements such as Si, S, P, Cl, K, Ca, Ti, V, Mn, Fe, Cu and Zn , each having different medicinal properties and generally non toxic in nature . The findings agreed with the result published in 2012 by S.Thangarajan, et.al [3]. The findings revealed that the stem of *IF* can be used for the treatments of various diseases such as Cholera, Cough, fevers, skin trouble, jaundice, measles, and headaches, loss of sensation, demulcent, syphilis and purification of bloods.

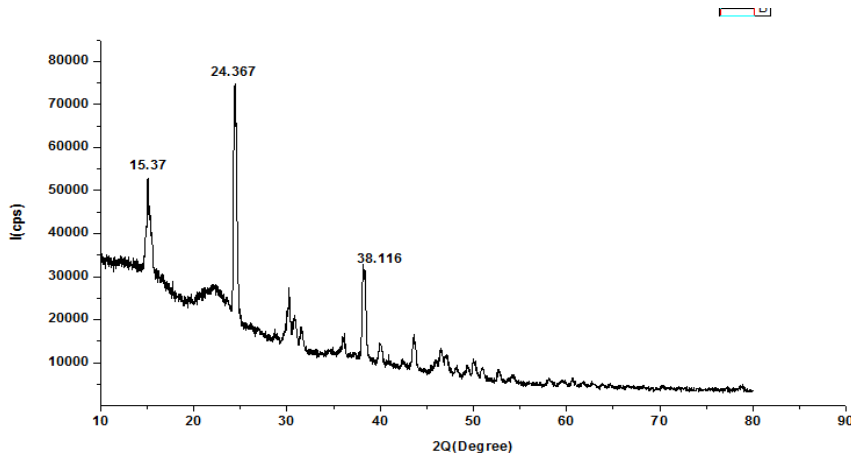


FIG. 2. XRD pattern of *IF* stem

The figure 2 gives the XRD patterns of the stem of *IF* plant. It shows intense peaks at 15.37° and 22.367°. The presence of these two peaks confirm that the stem is fibrous in nature containing cellulose. The peak at 15.37° corresponds to amorphous cellulose or cellulose II of [101] crystallographic plane and the peak at 24.367° correspond to crystalline cellulose [cellulose I] of [002] crystallographic plane[6]. *IF* stems are partly crystalline and partly amorphous in nature. The amount of crystalline cellulose or cellulose I in the total cellulose is expressed by X-ray crystallinity index as defined by equation

$$I_C(\%) = \frac{I - I_{am}}{I} \times 100$$

. I and I_{am} denote the intensity of 002 crystalline plane and intensity of the 101 amorphous phase respectively. The crystallinity index was found to be 21%.

4. Conclusion

Medicinal plant contains different elements which play a vital role as structural and functional components of metal protein and enzymes in living cells. Each element or mineral functions in different ways in the body. The findings from PIXE spectrum reveals presence of different metal and non metal elements like Si, P, S, Cl, K, Ca, Ti, V, Mn, Fe, Cu, Zn etc which are considered as various pharmaceutical complexes responsible for various medicinal properties of IF stem. The result shows that Ca and K concentration is high as compared to other in the stem of IF fiber. Ca and K are essential for bone, teeth and muscle development. XRD analysis shows that the stem of IF plant also contains cellulose and is fibrous in nature. The presence of cellulose fibers in the stem can be explored in the use of the stem of IF plant as reinforcement in polymer composites.

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