

## ELEMENTAL PROFILE STUDY OF SOME CHEWING STICKS GROWN IN BANGLADESH BY PIXE TECHNIQUE

\*Md. Joynal Abedin<sup>1</sup>, Shirin Akter<sup>2</sup>, Sk. Abdul Kader Arafin<sup>3</sup>, Shirin Akter<sup>1</sup>,  
S.M. Azharul Islam<sup>4</sup> and M. Obaidur Rahman<sup>4</sup>

<sup>1</sup>Accelerator Facilities Division, <sup>2</sup>Chemistry Division

Atomic Energy Center Dhaka, Post Box: 164, Shahbag, Dhaka-1000, Bangladesh

<sup>3</sup>Dept. of Natural Sciences

Daffodil International University Dhaka-1207, Bangladesh

<sup>4</sup>Department of Physics, Jahangirnagar University

Savar, Dhaka-1342, Bangladesh

E-mails: <sup>1</sup>joynal\_afd44@yahoo.com (\*Corresponding Author) <sup>2</sup>shirinakter43@yahoo.com

shirin\_apece@yahoo.com <sup>3</sup>skak\_arafin@daffodilvarsity.edu.bd

<sup>4</sup>rahmanju83@gmail.com & smazharphyd@yahoo.com

**Abstract:** Proton Induced X-ray Emission (PIXE) is one of the most useful IBA techniques that employed for this research works to determine elements and their concentrations in some chewing sticks grown in Bangladesh. PIXE technique and [Si(Li)] detector (SI30165) we used is not capable to determine low Z ( $Z < 12$ ) elements. PIGE technique will be employed to determine F, Na, Mg, and will be explained in our next paper. Only the soft trunks of Neem, Ulot-kumbal, Jam, Joytun, Batul, Akondo, Datoi, Aam, Dadmordon, and Nishinda are used for the experiments. The elements found with their average concentration are projected in  $\mu\text{g/gm}$ ; S(1973.8), Cl(1891), K(9358.3), Ca(18287.4), Ti(71.2), Mn(370.7), Fe(276.4), Ni(17.5), Cu(28.8), Zn(46), Br(4.34), Rb(40), and Sr(50.7). Calcium keeps a significant role to enhance the qualities of bones and teeth. We are trying to establish an elemental database of chewing sticks used by the villagers that may be helpful to human being.

**Keywords:** PIXE, chewing stick, concentration, spectrum, [Si(Li)], dental.

### 1. Introduction

More than 500 medicinal plants are grown in Bangladesh those are used therapeutic purposes. Some of them are used as chewing sticks by most of the rural and even some urban people of Bangladesh. Due to the combined effect of mechanical cleaning and enhancement of salivation as well as their significant antimicrobial activity against a broad spectrum of microorganisms, chewing sticks are as effective as toothbrushes and toothpastes in maintaining oral hygiene. People use these sticks partly for the sake of tradition and partly because they are unable to afford to buy expensive modern toothpastes. The teeth of those who use them are generally strong, clean, fresh looking, and devoid of germs and caries. The

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leaves, stems and roots of the plants are also made into mixtures such as powders and pastes that are used to treat ailing teeth and as a painkiller. Due to the excellent condition of the teeth of the chewing sticks users, the results of the present study may provide useful information concerning the apparent dental value of the sticks.

In recent years the study of both major and trace elements especially in environmental ingredients has assumed increasing importance due to the global concerns for environmental degradation because the vital role they play in human health and diseases. Trace elements such as iron, copper, zinc, cobalt, etc. act as metalloenzymes and perform important metabolic functions. The objective of the present study is to estimate the concentrations of the elements present in some local chewing stick plants grown in Sarishabari local area of Jamalpur district, Bangladesh in order to help assess their impact on human health. Elements S, Cl, K, Ca, Ti, Mn, Fe, Ni, Cu, Zn, Br, Rb, and Sr are determined using PIXE technique that based on atomic fluorescence created by energetic protons and the analysis is performed by measuring the characteristic X-rays emitted from the sample [6]. PIXE is well adapted in the VDG accelerator laboratory at AECD. All the equipments and facilities needed for sample preparation to data analysis are available at VDG Laboratory [2, 7, 13].

## 2. Sampling and Sample preparation

Ten different chewing stick plant samples shown below are collected from separate locations of Sarishabari of Jamalpur district, Bangladesh. The samples are dried, made fine powder and made pellets for irradiation. The soft trunk of the sample are sliced into pieces and dried in an oven at 70°C temperatures and it took 17 days continuous running to dry fully. The dried sliced pieces are made fine powder separately. All type of precautions is taken to avoid the contamination probability. For each pellet of 7mm diameter and 1mm thick, 0.025 gm of fine powder is pressed by hydraulic pellet-Maker. The pellets are preserved in vacuum desiccators until irradiation [4, 5].

**Table 1:** Name, part and grown place of the chewing stick used for this research work.

Local Name	Scientific name	Taken parts	Place of grown
Neem	<i>Atzadiracha indica</i> A. Juss	Soft trunk	Sarishabari, Jamalpur
Ulot-kumbal	<i>Abroma angusta</i> L.	Soft trunk	Sarishabari, Jamalpur
Jam	<i>Syzygium cumini</i>	Soft trunk	Sarishabari, Jamalpur
Joytun	<i>Sesbania sesban</i> (L.) Merr.	Soft trunk	Sarishabari, Jamalpur
Batul	<i>Sapium indicum</i> Willd.	Soft trunk	Sarishabari, Jamalpur

Akondo	Calotropis procera	Soft trunk	Sarishabari, Jamalpur
Datoi	Grewia microcos	Soft trunk	Sarishabari, Jamalpur
Aam	Mangifera indica	Soft trunk	Sarishabari, Jamalpur
Dadmordon	Cassia alata	Soft trunk	Sarishabari, Jamalpur
Nishinda	Vitex trifolia	Soft trunk	Sarishabari, Jamalpur

### 3. Experiments and data acquisition

PIXE is one of the most powerful Ion Beam Analytical technique used worldwide for scientific research [3]. We have done the data acquisition using this technique. The data acquisition setup is calibrated using 2.2 MeV proton beam in the current range of 15nA. The standardization has been done using X-ray source, IAEA standard  $CuS_x$  (thin), and Apple leaves (thick). We used the [Si(Li)] detector model: SL30165 for characteristic X-ray photons detection emitted from the samples [7]. Ten numbers of chewing stick samples, two IAEA standards  $CuS_x$  (thin), an apple leave sample (thick) and a Quartz are set on the sample wheeler and positioned in the IBA scattering chamber. The samples are irradiated by 2.2 MeV proton beam and the beam current used is 15nA. 10  $\mu C$  charges are collected by the 'Faraday Cup' for each of the sample irradiation. Only 5 nA beam current used and 5  $\mu C$  charge is collected for  $CuS_x$  standard due to thin sample. All the experiments have been done in vacuum chamber. The [Si(Li)] detector SL30165 is employed for PIXE experiments and for the detection of characteristic X-rays emitted from the sample at irradiation period. The spectrum data are collected by MCB 919E with data acquisition setup using MAESTRO-32 software version 6.05. Mylar absorber of 170  $\mu m$  is used to protect the detector from damage probability due to high energetic X-rays [7, 8].

### 4. Results and discussion

The elemental concentration of 10 different chewing stick samples found by the PIXE experiments is presented in the table below.

**Table 2:** Samples and their elemental concentration projected in  $\mu g/gm$  unit.

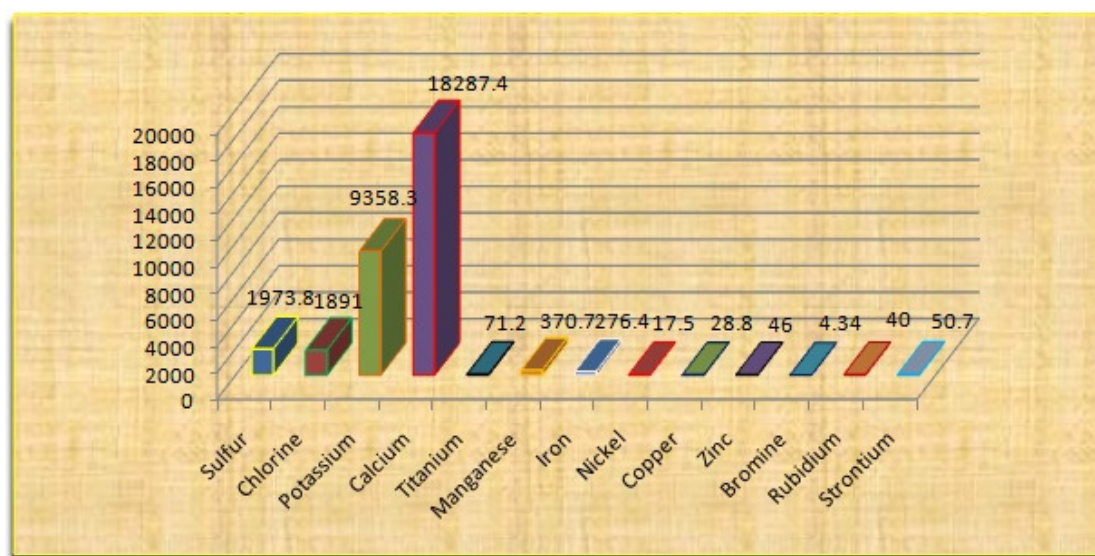
Sample	S	Cl	K	Ca	Ti	Mn	Fe	Ni	Cu	Zn	Br	Rb	Sr
Neem	1107	2047	10066	9331	49	25	123	11	19	41	3	52	BDL
U-kumbal	1533	1236	8736	17881	134	176	235	28	19	27	6.4	52	60
Jam	2013	2179	8109	15233	45	24	231	29	24	57	BDL	6	32
Joytun	1291	1050	12001	20510	39	61	223	7	33	50	BDL	55	22
Batul	2084	2543	13042	27877	81	613	412	22	24	105	6	37	64

Akondo	2930	2816	1124	13540	69	219	203	8	26	29	12	36	41
Datoi	276	2907	12648	8762	69	1432	128	36	31	64	12	73	29
Aam	2433	1478	8393	28936	134	752	493	BDL	76	60	BDL	34	76
Dadmordon	5243	1924	14475	29580	54	29	502	34	23	27	4	45	99
Nishinda	828	730	4989	11224	38	376	214	BDL	13	BDL	BDL	10	84

\* BDL=Below Detection Limit

The average concentration of Ca of these 10 chewing stick samples is 18287.4  $\mu\text{g/gm}$  and the highest among all of the other elements found. The second highest average 9358.3  $\mu\text{g/gm}$  is of K and present in all of the samples studied for this paper. The high concentration of Ca is very significant due to its capabilities of enhancing the qualities of bones and teeth.

Calcium is a hard deposit formed on the teeth by calcification of bacterial plaque. The main source of formation of calculus is from calcium salt (calcium phosphate). The perception of calcium salt is due to a local rise in pH but that the alkaline environment is created immediately around the teeth by bacteria breaking down proteins and liberating ammonium ions [1, 10, 12].



**Figure:** Graphical presentation of average elemental concentration in  $\mu\text{g/gm}$  of 10 chewing stick samples.

Iron is present in all chewing sticks and relatively high concentration. Iron is known to be an important element in the human body, for instance it is common knowledge that the iron together with hemoglobin and ferro-doxin play important roles in metabolism. Iron concentration fluctuates widely in different chewing sticks. Manganese is projected in all of the samples but relatively low concentrations. The concentrations of Ti, Ni, Cu, and Zn are relatively low and are present in all chewing stick samples studied. Their roles in protecting

and improving the qualities of human teeth are not well known even though each of them play important and useful role in the health of human teeth. The concentrations of Br, Sr, and Rb are at trace levels [1, 9]. Br is not found in all the 10 samples. Thus, this study indicates that the chewing sticks made from Neem, U-kumbal, Jam, Joytun, Batul, Akondo, Datoi, Aam, Dadmordon and Nishinda plants may play significant roles as foaming and cleansing agents that help to promote better dental health [10, 11, 12].

## 5. Conclusion

The popular chewing stick plants investigated in this study are used in Bangladesh for cleaning teeth and also for therapeutic purposes in dental health care. PIXE study provides useful data on the concentration of 13 elements in these plants. For the detection of fluoride PIGE technique will be used and explained in the next paper. K and Ca concentrations are relatively high and expected for their direct useful impact on teeth. The projected elements are normally useful to human being, but their specific and significant functions with regards to improved qualities in human teeth are not well known.

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