Medicinal Plants of Bangladesh with Anti Blood Pressure Potential – A PIXE Analysis

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Abstract— High blood pressure is a common disease around the whole world. Stress, obese, lack of physical activity, older age, genetics, healthy food and soda are the main cause of blood pressure. Heart disease, stroke, kidney diseases may in the risk due to high blood pressure. Naturally occurring medicinal plants and herbs have hypotensive or antihypertensive potential. In this regards, some medicinal herbs and spices samples were collected from various places in Bangladesh. The samples were irradisted by 3 MV Van de Graaff Accelerator at Atomic Energy Centre, Dhaka (AECD) using Proton Induced X-ray Emission (PIXE) technique. The elements that were found to be present in these samples are: P (223 to 760), K (10537 to 47007), Ca (11239 to 50507), Mn (22 to 1128), Fe (202 to 918), Cu (7 to 63) and Zn (26 to 135) ppm. High blood pressure can be controlled by maintaining a proper lifestyle and healthy balanced diet.

Index Terms — DAN32, High Blood Pressure, IBA Technique, MAESTRO, PIXE

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1. INTRODUCTION

Blood pressure is a measurement of the force against the walls of arteries as the heart pumps blood through the body. When the blood pressure is 140/90 mmHg or above, most of the time is known as High blood pressure (hypertension). Stroke, heart attack, heart failure, kidney diseases are the risk of high blood pressure. Most of the time, high blood pressure can be controlled with medicine. But every medicine has some side effects. Another important way to control high blood pressure is to change lifestyle such as minimize weight, stop smoking, exercising and taking healthy diet, including potassium and fiber.

Since ancient times, plants have been an exemplary source of medicine [1]. Herbs and spices can also manage blood pressure of food. For this purposes seven medicinal herbs and spices such as Cardamom, Oregano, Garlic, Cinnamon, Olives, Onions and Hawthorn samples were collected from various places in Bangladesh. Garlic used widely as a flavor in cooking. It has also been used as a medicine throughout ancient and modern history to prevent and treat a wide range of conditions and diseases [2]. It contains allicin, a substance which has antibacterial, antioxidant, lipid lowering and anti-hypertension properties. Cinnamon is a powerful spice which has been used medicinally around the world for thousands of years. Cinnamon reduces the most common risk factors for heart disease, including high cholesterol levels, high triglyceride levels and high blood pressure [3].

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Oil made from olives is used to reduce blood pressure. When free radicals oxidize cholesterol, blood vessels are damaged and fat builds up in arteries, possibly leading to a heart attack. The antioxidant nutrients in black olives impede this oxidation of cholesterol, thereby helping to prevent heart disease [4].

Oregano contains the compound carvacrol which has been proven to be effective against blood pressure. Hawthorn has been traditionally used to treat high blood pressure. Cardamom can improve antioxidant status while breaking down blood clots without significantly altering blood lipids and fibrinogen levels [5]. The present research work has been performed successfully in Accelerator Facilities laboratory using proton beam of 2.2 MeV and experimental setup with associated software for sample irradiation and data accumulation.

2. MATERIALS AND METHOD

2.1 Sample Collection and preparation

Samples of medicinal herbs and spices were collected from different locations of Bangladesh and were prepared at the Accelerator Facilities Division of Atomic Energy Center, Dhaka. The local name, scientific name and parts used for analysis of the studied samples are given in table -1.

TABLE1
Medicinal plants and herbs with their name and parts used

Sample Name	Scientific Name	Part used
Cardamom	*Elettaria cardamomum*	Seeds
Oregano	*Origanum vulgare*	Leaves
Garlic	*Allium sativum*	Bulb
Cinnamon	*Cinnamomum verum*	Bark
Olives	*Olea europaea*	Fruit
Onions	*Allium cepa*	Bulb
Hawthorn	*Terminallia chebula Retz.*	Fruits

The collected samples were washed with distilled water; labeled and dried in an oven at a temperature of 60^0 C for about 10 days

to make the samples water free. After cooling the samples to the room temperature in a dessicator, the weights were taken. The process of heating, cooling and weighing was repeated until a constant weight is shown by the balance which is a confirmation of zero water content. The dried weighted samples were then grinded in a grinder and made into pellets with a pellet maker. In this experiment we have made the pellets of diameter 0.7 mm at 120-130 kg/cm^2 pressure [6], [7]. These pellets were used as the targets for irradiation.

2.2 Method of Analysis

The experiments were done with 2.2 MeV proton beam with beam current of 10 nA produced from the 3 MV Van de Graaff Accelerators at AECD. In PIXE, the characteristic X-rays emitted from the sample were detected using a 30 mm^2 Si(Li) detector (Model: SL30165) and associated electronic setup. The X-ray detector is positioned in one side of the chamber wall horizontally, creating an angle of 45° to the sample normal. The beam itself enters at 0° to the sample normal. The count rate was reduced using a 170 μm thick Mylar absorber. The PIXE analysis provides high Z elements such as S, Cl, K, Ca, Fe, Cu, Zn, Ga, Br, Ru, Pb etc. and gives the accurate concentration of the most of the elements present in the samples with high accuracy [8]. MAESTRO software was used to save the X-ray emission spectrum and for analyzing PIXE spectra GUPIX with DAN32 interfacing software were used. The X-ray spectrum of CuS thin standards obtained from 3 MV Van de Graaff Accelerator is shown in Fig. 1.
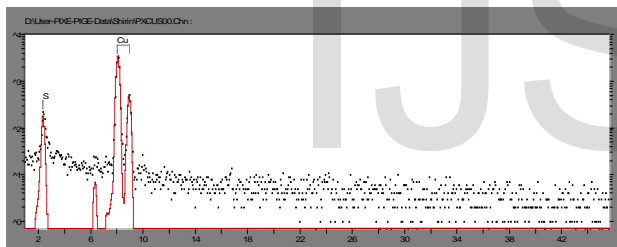

Fig. 1 : X-ray spectrum of CuS
(X-axis: Energy (keV); Y-axis: Count/Sec)

3. RESULTS AND DISCUSSION

The elemental concentration (in ppm) of medicinal herbs and spices are given in table 2. The elements determine in varying concentrations include: Phosphorous, Potassium, Calcium, Manganese, Iron, Copper and Zinc.

TABLE 2:
Elemental concentration (ppm) of Medicinal Herbs and Spices using PIXE

Element	Elettaria cardamo mum	Origanum vulgare	Allium sativum	Cinnam omum verum	Olea europaea	Allium cepa	Terminallia chebula Retz.
P	223	365	704	227	400	316	760
K	47007	25305	13131	10537	30689	36409	18279
Ca	11239	41238	2264	32097	22114	2560	50507
Mn	1128	177	22	433	33	352	349
Fe	414	510	307	918	382	202	806
Cu	--	63	29	--	7	13	60
Zn	135	53	166	--	--	26	216

Potassium and Calcium were present at the major elements of all samples. Table 2 shows that *Elettaria cardamomum* contains the highest amount of K (47007 ppm) and *Cinnamomum verum* contains the lowest amount of it (10537 ppm). K helps in regulation of the water balance of the body [9] and crucial to heart function [10]. K can lessen the effects of Na on blood pressure. Taking K simultaneously with Na, blood pressure can be reduced [11]. Ca plays a very important role in human body. Calcium is essential especially for bones and it makes the teeth and bones strong as well as healthy. Fig. 2 shows the X-ray spectrum of Terminallia chebula Retz.
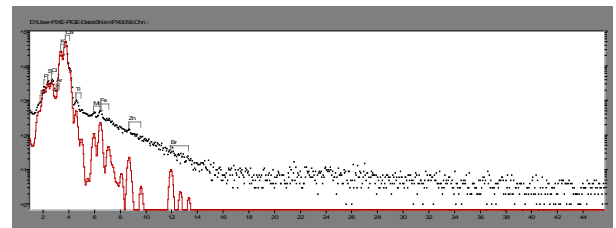

Fig. 2 : X-ray spectrum of Terminallia chebula Retz.
(X-axis: Energy (keV); Y-axis: Count/Sec)

Copper and zinc absorption is closely related. If large amounts of copper are present, then zinc and vitamin C is reduced in the body, and vice versa. Copper is required in the formation of hemoglobin, red blood cells as well as bones. A lack of copper may also lead to increase blood fat levels.

Manganese can control the blood sugar levels in our body and help prevent diabetes. Manganese can normalize the synthesis and secretion of insulin in the blood to control the level of sugar. The average concentrations of Iron are found to be 506 ppm as shown in Fig. 3. Iron is an essential component of the hemoglobin of the blood and active in maintaining in healthy immune system [12].
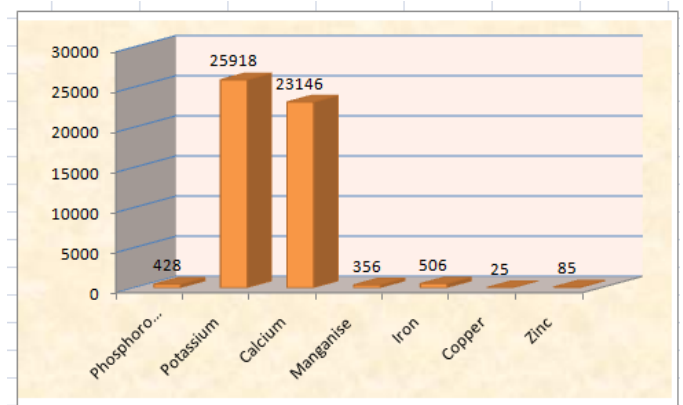

Fig. 3 : Graphical presentation of average elemental concentration in ppm of studied samples

4. CONCLUSION

Seven medicinal herbs and spices collected from various places in Bangladesh were investigated elementally using Ion Beam Analysis Technique- PIXE. The elements to be present in the measured sample were: P, K, Ca, Mn, Fe, Zn and Cu. It is found that most of these samples have sufficient amount of K, Fe and Mn to reduce blood pressure as well as boost body's health. Naturally grown herbs have low calorie content which increase the medicinal value of food and also used for lowering blood

pressure. Lifestyle can play an important role in treating high blood pressure. By controlling blood pressure successfully with a healthy lifestyle, medication may be avoided, delay or reduced.

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