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Characterization of Activated Carbon prepared from *Achyranthes aspera* Linn. by X-ray fluorescence spectroscopy (XRF)

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ABSTRACT

The Achyranthes aspera Linn. belongs to family Amaranthaceae. This plant is locally available as a weed and naturally abundant agricultural waste. Activated carbon has been prepared from Achyranthes aspera by chemical treatment. Activated carbon has many applications. The activated carbon is excellent and versatile adsorbent as reported in literature. Elements present in the material play an important role during adsorption and various reaction, as catalyst. Therefore, the analysis of elements is required. A modern technique, X-ray fluorescence spectroscopy (XRF) is used to determine quantitatively presence of elements. It is one of the most powerful and quick multi-elemental analysis with high sensitivity has been used. The present work includes quantitative determination of various elements from the activated carbon. The data shows presence of fifty elements in varying concentration.

Keywords: *Achyranthes aspera*, Activated carbon, XRF, Multielements.

INTRODUCTION

The plant *Achyranthes aspera* Linn. belongs to the family Amaranthaceae. It is an annual stiff erect herb, growing up to 1 m height [1]. Stems are square, leaves elliptic ovate or broadly rhombate. The plant is widespread in the world as a weed, in Baluchistan, Ceylon, Tropical Asia, Africa, Australia and America [2]. It is distributed throughout the India as a weed on wasteland and roadside [3]. *A.aspera* Linn., which is a locally available as a weed and naturally abundant agricultural waste [4].

Activated carbon has many applications [5-9]. It is used as an adsorbent for purification of effluents, air and many chemical products [10]. It can be employed for separation of organic molecules from plant extracts. Activated carbon is used in gas purification, gold purification, metal extraction, water purification, medicine, sewage treatment, air filters, as an efficient catalyst and many other applications[11]. Porous carbon containing several types of inorganic impregnate such as Al, Mn, Zn, Fe, Ca etc. have been prepared for specific applications in air pollution control [11]. Therefore, the main objective of this study is quantitative determination of various elements from activated carbon prepared from *Achyranthes aspera* stem by X-ray fluorescence spectroscopy. The results are compared with the raw material data, which is already reported [12].

MATERIALS AND METHODS

The plant material was collected from the Purander district of Pune, Maharashtra, India. It was authenticated form Botanical survey of India, Pune, Maharashtra, India. The air shade dried and pulverized stem material of *A. aspera* was used. The raw material (100g) was charged with

Table-1

Sr. No	Elements	ppm	%
1	Sodium	26280	2.628
2	Sulphur	15880	1.588
3	Silicon	4647	0.4647
4	Calcium	3649	0.3649
5	Chlorine	1177	0.1177
6	Aluminum	645	0.0645
7	Iron	362.1	0.03621
8	Potassium	146.1	0.01461
9	Titanium	82	0.0082
10	Zinc	48.2	0.00482
11	Magnesium	< 34	< 0.0034
12	Tin	19.1	0.00191
13	Tellurium	17.5	0.00175
14	Copper	16.7	0.00167
15	Antimony	14.4	0.00144
16	Manganese	12	0.0012
17	Iodine	10.2	0.00102
18	Vanadium	< 7.9	< 0.00079
19	Nickel	7.7	0.00077
20	Bromine	7.1	0.00071
21	Phosphorus	< 6.9	< 0.00069
22	Cobalt	< 6.3	< 0.00063
23	Erbium	< 5.1	< 0.00051
24	Strontium	5	0.0005
25	Chromium	4.9	0.00049
26	Cesium	< 4.0	< 0.0004
27	Lead	3.9	0.00039
28	Yttrium	2.2	0.00022
29	Silver	< 2.2	< 0.00022
30	Cadmium	< 2.0	< 0.0002
31	Barium	< 2.0	< 0.0002
32	Lanthanum	< 2.0	< 0.0002
33	Cerium	< 2.0	< 0.0002
34	Ytterbium	< 2.0	< 0.0002
35	Molybdenum	1.7	0.00017
36	Thorium	1.3	0.00013
37	Zirconium	1.1	0.00011
38	Tantalum	< 1.0	< 0.0001
39	Tungsten	< 1.0	< 0.0001
40	Thallium	< 1.0	< 0.0001
41	Bismuth	< 1.0	< 0.0001
42	Hafnium	0.9	0.00009
43	Rubidium	0.7	0.00007
44	Uranium	0.7	0.00007
45	Mercury	0.6	0.00006
46	Gallium	< 0.5	< 0.00005
47	Germanium	< 0.5	< 0.00005
48	Arsenic	< 0.5	< 0.00005
49	Selenium	< 0.5	< 0.00005
50	Niobium	< 0.4	< 0.00004

A. R. grade concentrated $H_2 SO_4$ (35 ml), which was charred and kept in an oven at 120^0C for six hours for complete carbonization. The carbonized material was washed with distilled water to get it free from acid and dried at 110^0C for six hours. The dried material was grounded and sieved to get uniform size (63 mesh). This activated carbon, put for elemental analysis by using X-ray fluorescence spectroscopy. The total fifty elements were detected. They were

composed of macro elements, microelements, transition metals and heavy elements. The details are reported (**Table-1**)

RESULTS AND DISCUSSION

The result represents, presence of various elements in different amount. It contains

Five major macro elements : Na, S, Si, Ca, Cl.
Nineteen microelements (trace elements) : Al, K, Mg, I, Br, P, Ga, Ge, Se, Rb, Sr, Zr, Cs, Ba, La, Er, Yb, Tl, Th.
Seventeen Transition metals : Cr,Co,Ni,Cu,Zn, Mn,Fe, Ti, V, Y, Nb, Mo, Hf,Ta,W, Ag,Cd.
Nine heavy elements : As, Sn,Sb,Te, Ce,Hg,Pb,Bi,U.

The raw material showed the presence of following elements in different amount as reported earlier.
Five major macro elements : K, Ca, Mg, Cl, P.
Nineteen microelements (trace elements) : Na, S, Si, Al, I, Br, Ga, Ge, Se, Rb, Sr, Zr, Cs, Ba, La, Er, Yb, Tl, Th.
Seventeen Transition metals : Cr,Co,Ni,Cu,Zn, Mn,Fe, Ti, V, Y, Nb, Mo, Hf,Ta,W, Ag,Cd,
Nine heavy elements : As, Sn,Sb,Te, Ce,Hg,Pb,Bi,U.

The data indicates variation in elemental concentrations in both samples, which may attributed to adsorption study. The elements play an important role in the field of catalysis. The transition metals and their compounds, are used as catalyst because of their ability to change oxidation state or in the case of the metals, to adsorb other substances on their surface as catalyst. Transition metals are often used to catalyze redox reactions for example, in the Haber process, finely divided iron serves as a catalyst for the synthesis of ammonia from nitrogen and hydrogen while the Raney nickel is used for hydrogenation. Many catalytic processes, especially those used in organic synthesis, require transition metals which include Palladium, Platinum, Nickel, Cobalt, Zinc etc. The prepared activated carbon contain various concentration of transition metals which may be useful in the catalytic processes and during adsorption. Therefore, in the present study the elemental analysis of this activated carbon is useful in the field adsorption and catalysis.

CONCLUSION

Activated carbon prepared from *Achyranthes aspera* can be used as a new, low-cost, locally available and eco-friendly adsorbent or catalyst.

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