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BIOCHEMICAL ACTIVITY OF BHUMI AMLA BY ELECTROCHEMICAL METHOD

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ABSTRACT

The electrochemical study of herbal xerophytic medicinal plants Bhumi Amla of Eubhorbiaceae family has been studied in vitro condition employing three pairs of electrodes in different seasons. The various electrical activities were determined by measuring their bio-electrode potential (BEP) regulating vital physiological process occurring in the living cell based on redox process. The effect of catalyst ($CuSO_4$), respiratory substrate ($C_6H_{12}O_6$) and primary salts have been studied. The BEP arose in the system due to formation of charge transfer complex, between bio-sap and electrodes. Numerous graphs were plotted between BEP and time to co-relate the results. The analyses of natural products such as chlorophylls, Carotenoides, amino acids etc have also been carried out.

KEYWORDS: Bio-sap, bio-electrode potential, oscillatory motion, photic excitation, null potential, vis-à-vis.

INTRODUCTION

Electrochemistry occupies a central position in the chemistry. The living organism follows redox process. Biological energy produced by plants using radiant energy to reduce Carbon dioxide. The BEP is an open alternative source of non conventional energy by forming bio-fuel cells[1] based on redox principle. It proliferate low cost bio-energy. Thousands years, ago the natural products have been playing a pivotal role in treating and preventing human diseases as well as providing useful materials for human and other animal kingdom. In this context, the life of all living on earth solely depends upon unlimited treasure of the almighty,

ranging from oxygen to reach and drugs to heal. Mythic logically, a tree is as good as ten sons as mentioned in epics.

A large number of herbal and xerophytic plants were used in India, China, Egypt and Greece long before B.C. by different religions. The forest in India is the principal depository of large number of medicinal and aromatic plants, which are collected for manufacturing of drugs perfumery products as well as generic medicines. The tasks of bio electrode potential of xerophytic plants have been reported by different workers[2-10] who initiated the exploitation of bio-mass energy from plants leaves. The recent survey clearly indicates that no systematic work on the electrochemical medicinal analysis has been documented till date. This prompted me to investigate the above titled topic.

EXPERIMENTAL

MATERIAL AND METHODS

All the chemicals used in the investigations are of analytical grade. In recent communication, we have reported[11,12] the electrochemical and medicinal analysis of two varieties of Bhumi Amla abbreviated as BA-1 and BA-2 respectively. Bhumi Amla medicinal plant abbreviated as BA-3 has been studied electrochemically employing three pairs of electrodes viz. Ag-Zn, C-Zn and Cu-Zn respectively. After plucking the fresh leaves and processed well before use its bio-sap are obtained and treated as an electrolyte in vitro condition. The cleaned needle types of fine electrodes of different dimensions are immersed in electrolytes which were finally connected with digital panelmeter with an accuracy of ±0.01 percent. The bio-electrode potential (BEP) of BA-3 medicinal plant has been measured electrochemically in three different seasons namely Summer (S), Rainy (R) and Winter (W) at morning (M), Noon (N), evening (E) and midnight (Nt).

RESULTS AND DISCUSSION

The phytochemical analysis was performed for the separation, extraction, purification and identification of ten amino acids as main constituents of Bhumi Amla-3 by ascending paper chromatographic method using solvents of appropriate compositions. The detection of amino acids was finally made using 0.2% ninhydrin solution in n-butanol as a locating reagent by spraying method. There are different active ingredients like lignans mainly phyllanthin and hypophyllanthin also analyzed chromatographically. Serum Glutamic Pyruvic Transaminease (SGPT) test in vitro condition was also examined by UV method in highly sophisticated modern pathological laboratory.

The BEP of the bio-sap of the system was measured and recorded in Tables: 1 to 3. The electrical activity in living cell takes place due to movement of ions causes regulation of several vital physiological processes of the plants. The study reveals under normal atmospheric condition that the injured leaf gives high potential in comparison to uninjured leaf. The electrons flow from anode to cathode by a metallic wire of two electrodes occurs due to formation of charge transfer complex. The BEP depends upon the presence of ions transpiration, photosynthesis, respiration, transport phenomena. Besides the other factors affecting the BEP are temperature, humidity, pH and age of the systems. During photic excitation due to oxidation, the free energy of the electron is converted into ATP and reduction transformed the NADP to NADPH. The study suggested coupling between electron flow and ATP synthesis may be electrochemical in nature. The difference in concentration of protons on two sides of chloroplast membrane and the resultant electrical potential arises across the membrane. Since the reducing species at the injured site indirect comes in contact with the electrode by the intact tissues remains at higher energy level called Fermi level (interface of anode), which transferred electrolyte to the electrode till thermodynamic equilibrium is achieved in the close vicinity observing null potential.

The highest observed values of BEP for Bhumi Amla (BA-3) medicinal plant in vitro condition was found in winter 956 mV at night while the values in rainy and summer are 911 mV and 938 mV with Ag-Zn pair of electrodes The observed highest value of BEP for C-Zn electrode pair in all above conditions were 944 mV (R), 922 mV (W) and 830 mV (S) at night. The minimum values were exhibited in all above conditions with Cu-Zn electrode pairs in morning in different seasons 674 mV (R), 730 mV (S) and 783 mV (W). The study indicates the midway values for C-Zn electrode pair in different seasons in comparison to remaining two electrode pairs. The various combined graphs plotted BEP Vs Time for the system BA-3 in different seasons. The results of investigation in summer for BA-3 with three pairs of electrodes ended at 108 hours at 305 K. The whole observations have been represented graphically in the plots of BEP Vs Time (Figs 1 to 3) respectively. The plot of BEP Vs. time indicates that some random peaks are obtained, showing the rushing of ions associated with oscillatory motion. Such fluctuations are also caused due to increase in temperature and surface permeability of leaf.

The Ag-Zn electrodes pair gives maximum potential. The tendency of Ag to gain the electron from bio-mass is more pronounced than Cu and others. When bio- system is suddenly killed

or deactivated it achieves the thermodynamic equilibrium and null potential is observed asymptotically under such condition. The number of tissue is very much sensitive to ambient atmosphere, The rains make the transport phenomenon highly that is responsible for higher BEP. During ionic transport, the fuel cells carry the current without any obstruction of cuticle for the free movement of ions towards the site of injury for healing process. The biomass material get dried which causes more transpiration at high temperature, that is why, BEP is lowest in summer.

The catalyst $CuSO_4$ shows deactivating effect consequently reduces the potential. The respiratory substance $C_6H_{12}O_6$ delivered more charges within duration of 108 hours. The monovalent cations and anions of (Na^+, K^+ and Cl^-) ion more rapidly enters the cell rather than divalent and trivalent ions gives highest current because they survive in the system for a long period gives vis-a-vis ionic contribution in charge transfer reaction. The Zwitter ions also responsible for flow of current. The plants cells are associated with number of fuel cells contains multilayers of oppositely charged ions between electrode and sap causes potential difference.

Table: 1[Bio-Electrode Potential of Medicinal Plant Bhumi Amla].

System : Bhumi Amla (BA-3)

Electrode pairs : Ag-Zn, C-Zn and Cu-Zn

Season : Summer

Temperature : 305 K

S. No.	Time (Hours)	Electrode pairs		
		Ag-Zn	C-Zn	Cu-Zn
		BEP (mV)	BEP (mV)	BEP (mV)
1.	0	840	750	730
2.	6	850	754	742
3.	12	901	817	750
4.	18	938	830	812
5.	24	740	650	510
6.	30	666	491	550
7.	36	780	512	291
8.	42	510	454	338
9.	48	620	396	195
10.	54	393	421	239
11.	60	444	233	146
12.	66	162	253	140
13.	72	257	190	110
14.	78	217	180	91

15.	84	232	93	67
16.	90	150	120	34
17.	96	181	87	0
18.	102	44	0	-
19.	108	0	-	-

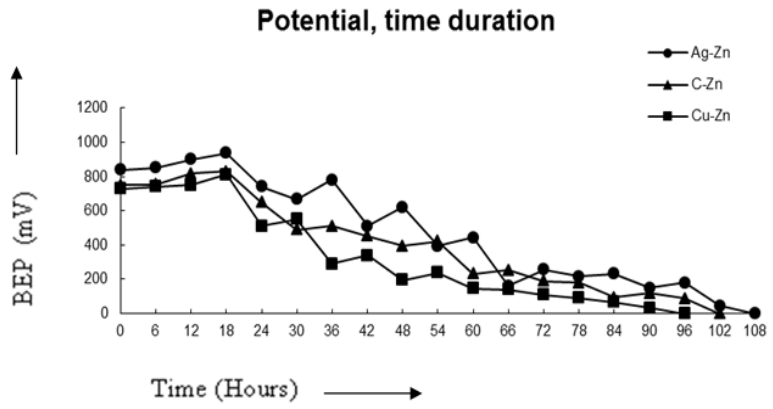

Fig. 1: Plot of BEP Vs. Time

Table: 2 [Bio-Electrode Potential of Medicinal Plant Bhumi Amla]

System : Bhumi Amla (BA-3)

Electrode pairs : Ag-Zn, C-Zn and Cu-Zn

Season : Rainy

Temperature : 299 K

S. No.	Time (Hours)	Electrode pairs		
		Ag-Zn	C-Zn	Cu-Zn
		BEP (mV)	BEP (mV)	BEP (mV)
1.	0	800	777	674
2.	6	830	780	682
3.	12	842	807	717
4.	18	911	944	768
5.	24	794	751	712
6.	30	911	840	750
7.	36	846	790	510
8.	42	922	830	560
9.	48	731	670	392
10.	54	793	712	430
11.	60	540	494	342
12.	66	597	524	290
13.	72	491	443	360
14.	78	440	500	194
15.	84	360	280	247
16.	90	380	310	111
17.	96	190	260	144
18.	102	202	270	51

19.	108	153	103	62
20.	114	162	120	0
21.	120	60	0	-
22.	126	72	-	-
23.	132	0	-	-

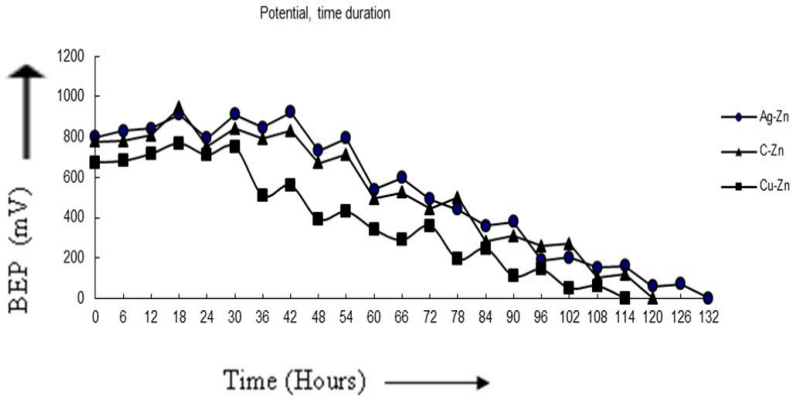

Fig. 2: Plot of BEP Vs. Time.

Table: 3 [Effect of concentration of NaCl salt on Bio-Electrode Potential of Bhumi Amla].

System : Bhumi Amla (BA-3)

[NaCl] : 1.25×10^{-3} (mol dm^{-3})

Electrode pairs : Ag-Zn, C-Zn and Cu-Zn

Season : Winter

Temperature : 287 K

S. No.	Time (Hours)	Electrode pairs		
		Ag-Zn	C-Zn	Cu-Zn
		BEP (mV)	BEP (mV)	BEP (mV)
1.	0	910	847	803
2.	6	922	851	778
3.	12	898	859	782
4.	18	854	827	712
5.	24	859	781	714
6.	30	861	705	597
7.	36	881	663	579
8.	42	887	696	451
9.	48	786	741	473
10.	54	627	658	346
11.	60	584	507	351
12.	66	571	428	253
13.	72	588	449	273
14.	78	611	488	188
15.	84	500	351	202

16.	90	363	203	106
17.	96	307	142	100
18.	102	294	156	0
19.	108	199	0	-
20.	114	0	-	-

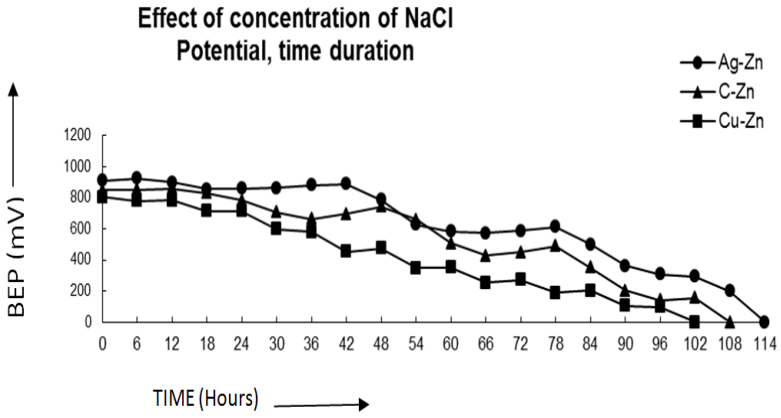

Fig. 3: Plot of BEP Vs. Time.

CONCLUSION

Summing-up of all above experimental findings, the overall observed activity of Bhumi Amla (BA-3) was found with respect to three pairs of electrode viz Ag-Zn, C-Zn and Cu-Zn in three different season's summer, rainy and winter respectively. The biochemical activity was observed in the following order:

Ag-Zn (W) > C-Zn (R) > Cu-Zn (S)

The study shows that younger cells are more metabolic process in comparison to older cells owing to less deposition of cellulo-pectic substances, consequently reduces the electrical conductivity, obstructed physiological process and thus reduces the ionic potential of the system. The rains and moisture make the transport phenomenon more pronounced which is responsible for high BEP. Overall the redox couple in the medicinal plant is good source of ionic energy. The study would be very useful in the field of drugs design and pharmacology.

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