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Research Articles

ELECTROCHEMICAL MEDICINAL ANALYSIS OF BHUMI AMLA

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ABSTRACT

The electrochemical study of two varieties of herbal xerophytic medicinal plants Bhumi Amla of Eubhorbiaceae family in vitro condition using three pairs of electrodes in different seasons have been carried out. The phytochemical analysis included measurement of bio-electrode potential (BEP) regulating various electrical activity and physiological process occurring in the leaving 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 development of BEP occurs in the system, due to formation of charge transfer complex, between bio-mass and electrodes. Various graphs related to the investigation were plotted. The chromatographic analysis of chlorophyll and amino acids was discussed.

Key words: Bio-mass, bio-electrode potential, creation, vital, exploitation.

INTRODUCTION

In electrochemistry, transformation of chemical energy into electrical energy occurs due to interaction between electrode and electrolytes of the system. Electrochemistry holds central position in the study of chemistry. The living organism is chemically reacting system on the continuous redox for plants proliferate by using radiant energy to reduce CO_2. The living biological system generates bio-electricity[1] through enzyme reaction working on redox principle. The medicinal plants are capable of forming charge transfer complex[2].

For thousands of years, natural products have played a pivotal role throughout the world in treating and preventing human diseases and providing materials useful for human body and animals. From the very first moment of his creation, man has utilized environment around him for his survival. In this context, all life forms on earth depend upon unlimited treasure of the almighty, ranging from oxygen to reach and drugs to heal.

"One who plants a tree along with any of these trees, Kshirika, Dadali, Draksha Piyala, Panas etc, ensures himself against all diseases for seven births to come. A large number of herbal and aromatic plants were used in India, China, Egypt, and Greece long before the beginning of the Christian era. Among ancient civilizations, India has been known to be rich depository of medicinal plants. The forest in India is the principal depository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products used as generic medicines. However, the recent survey of literature pertaining to the electrochemical study has so far been reported by earlier workers.

Three decade ago Jain et al. [3-7] reported the work on the exploitation of bio-mass energy from bio-system. Sarabhai et al.[8] , Agrawal et al.[9], Saket et al.[10] Swami et al.[11] and Bunker[12-13] extended similar type of work on medicinal plants, who reported the production of bio-mass energy containing amino acid which are capable of forming charge transfer complexes due to formation of Zwitter ions between the electrode and electrolyte of the bio system. The recent survey clearly reveals that no systematic work on the electrochemical probe has been documented till date. This prompted me to investigate the titled topic.

EXPERIMENTAL

Material and Methods

All the reagents and solvents used in this investigation were of standard grade. The two varieties of the Bhumi Amla abbreviated as BA-1 and BA-2 have been studied electrochemically employing three pairs of electrodes viz. Ag-Zn, C-Zn and Cu-Zn in three different season respectively. The bio-mass treated as an electrolyte was obtained for the

study after plucking the fresh leaves and processed well before use. The cleaned and needle types fine undertaken electrodes were dipped in the electrolyte which were finally connected with digital panelmeter with an accuracy of ± 0.1 percent. The BEP of BA-1 and BA-2 medicinal plants have 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 chemical analysis of medicinal plant BA-1 and BA-2 for chlorophyll-a and chlorophyll-b was carried out by measuring their Rf values chromatographically. Almost a similar phytochemical analysis was performed for the separation, extraction, purification and identification of ten amino acid namely alanine, aspartic acid, cystein, glutamic acid, glycine, histidine, leucine lysine, threonine and valine as a main constituents of Bhumi Amla by ascending paper chromatographic method using solvents of appropriate compositions. The detection of amino acid was finally made using 0.1% ninhydrin solution in n-butanol as a locating reagent by spraying.

The medicinal plants under investigation for active ingredients were subjected to analysis for different phytoconstituents such as lignans mainly phyllanthin and hypophyllanthin chromatographically. The spectral analysis of Serum Glutamic Pyruvic Transaminease (SGPT) for two patients was spectrophotometrically examined by UV method in a highly sophisticated modern pathological centre.

Other physical parameters such as pH, surface tension, viscosity and electrophoresis were also determined for the system. The BEP of the sap of the system in vitro condition was measured and recorded in Tables: 1 to 3. The whole observations have been illustrated graphically in the plots made between BEP and time. (Figs 1, 2 and 3 respectively)

During photic excitation[14] **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[15] in direct 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[16] is achieved in the close vicinity that dependence on the number of cell present. The electrical activities will then stop and null potential is observed. The property of entire living cell is to maintain an unusual distribution of ions between inside and outside of the cell created a potential difference in the two areas.

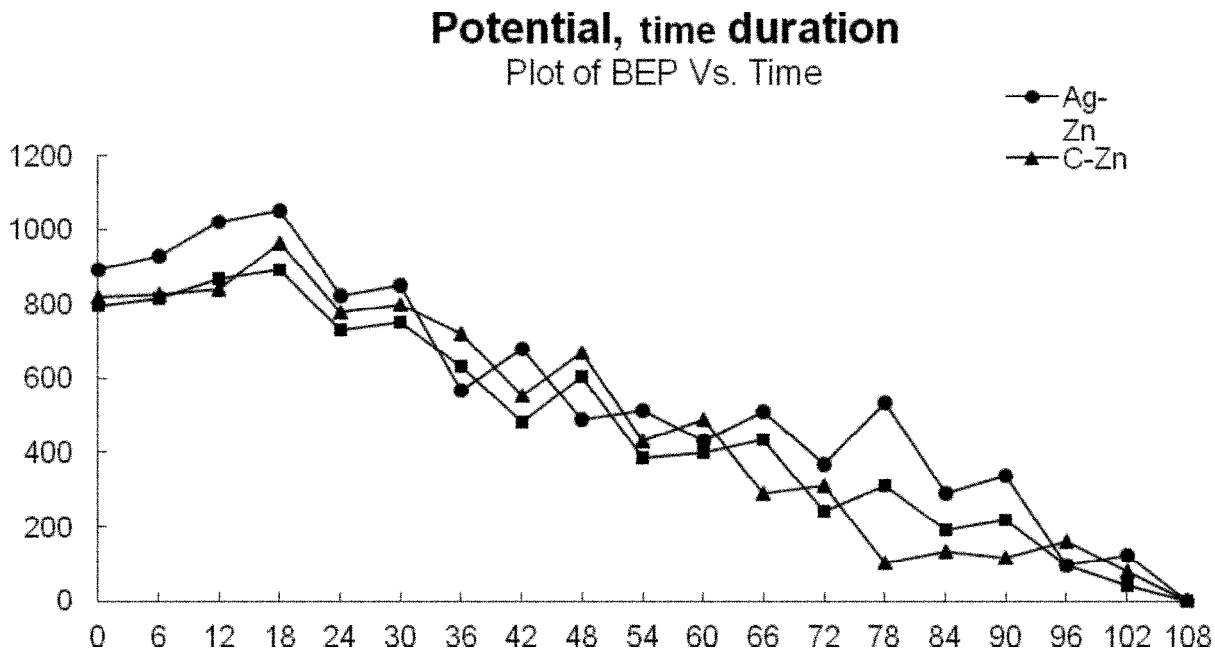

Fig. 1
System : Bhumi Amla (BA-1)
Season : Summer
Temperature : 305 K

The highest observed values of BEP for BA-1 medicinal plant in vitro condition was found in winter 1077 mV at night while the values in rainy and summer are 1003 and 1052 mV with Ag-Zn pair of electrodes and minimum values were exhibited in all above conditions with Cu-Zn electrode pairs in morning in different seasons 939 mV (W), 784 mV (R) and 796 mV (S). The study reveals the midway values for C-Zn electrode pair in different

seasons in comparison to remaining two electrode pairs. Exactly similar trends in values of BEP were determined for BA-2 medicinal plant under same circumstances in winter 983 mV (W), 901 mV (R), 963 mV (S) with Ag-Zn electrode pair, as is oblivious from the various combined graphs plotted BEP Vs. Time for the system BA-1 and BA-2 in different seasons. The results of study in summer for BA-1 using three pairs of electrodes ended at 108 hours at 305 K. The plot of BEP Vs. time indicates that some random peaks are obtained, showing the rushing of ions due to associated oscillatory motion. Such fluctuations are also caused due to increase in temperature and surface permeability of leaf. The development of maximum potential in Ag-Zn pair of electrode for BA-1 is due to electron interface contribute along with the electrons donated from redox reaction . During ionic transport, the fuel cells carry the current without any obstruction of cuticle for the free movement of ions towards the site of injuiry for healing process. The effect over potential drainage was also seen which has to fight for survival of life activities as supply of water is cut of in vitro condition. The biomass material get dried which causes more transpiration at high temperature that is why, BEP is lowest in summer.

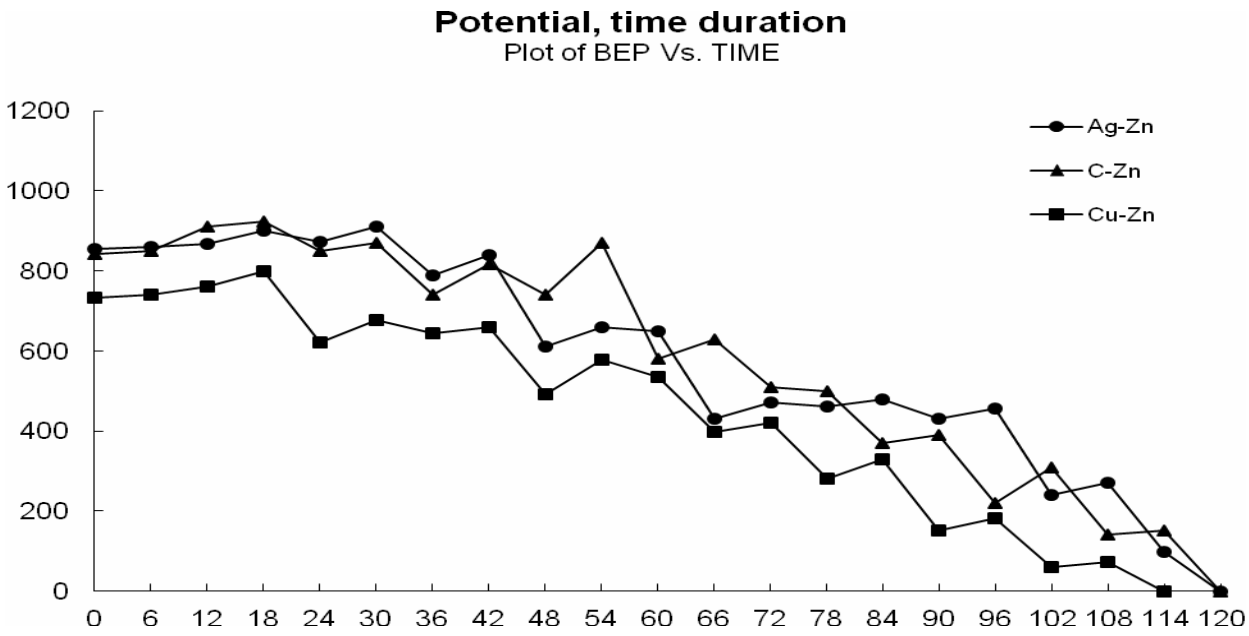

Fig. 2

System : Bhumi Amla (BA-2)
Season : Rainy
Temperature : 299 K

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The deactivating effect was shown by catalyst $CuSO_4$ consequently reduces the potential where as glucose acts as a respiratory substance delivered moe 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 produced from building block of protein present in the bio-mass obey redox process and solely responsible for flow of current. The plants cells are associated with number of fuel cells contains multilayer's of oppositely charged ions between electrode and sap causes potential difference.

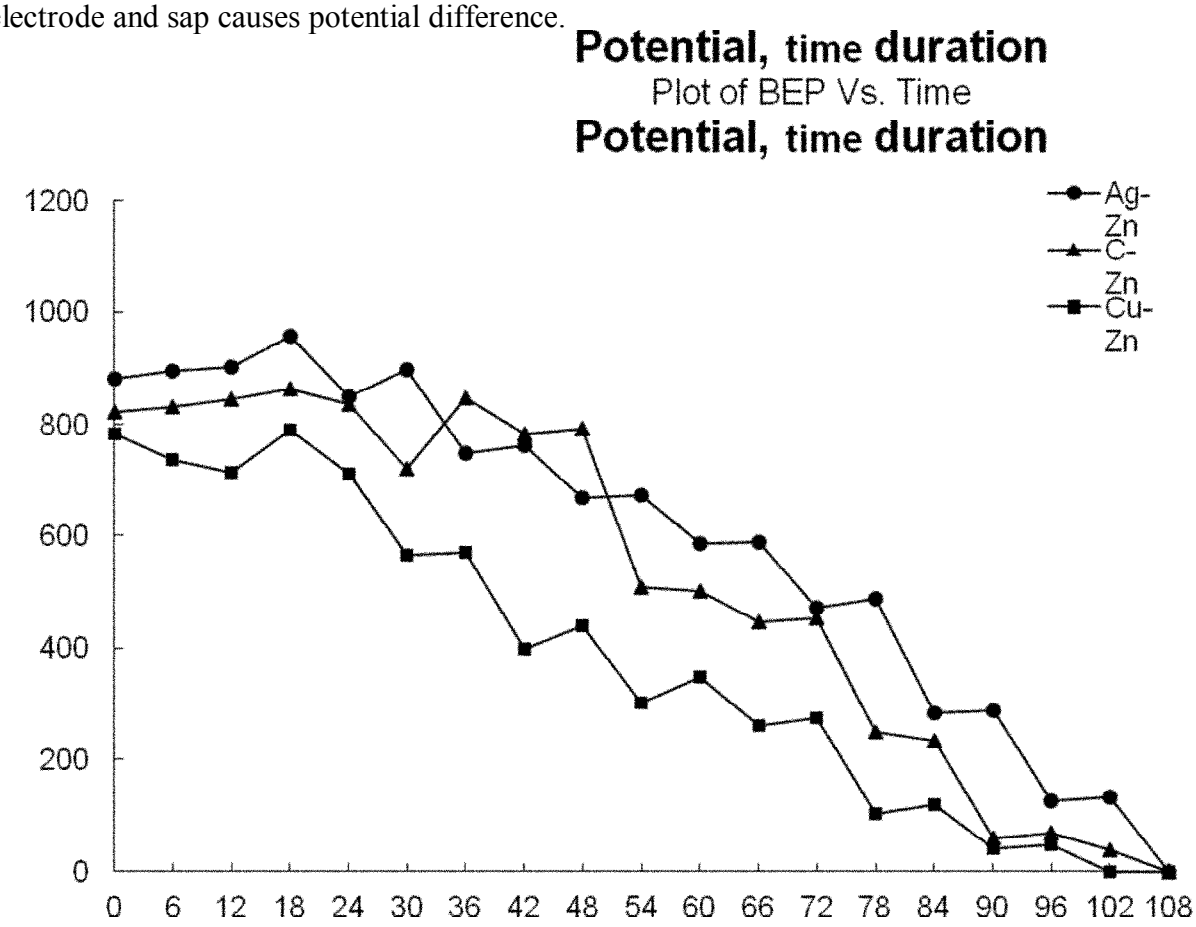

Fig. 3

System : Bhumi Amla (BA-2)
Season : Winter
Temperature : 287 K

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Summing-up of all above experimental findings, the overall observed activity was found among the two verities of Bhumi Amla probed in terms of BEP using Ag-Zn electrode pairs as in comparison to C-Zn and Cu-Zn electrode pairs in the following order:

BA1 (W) > BA2 (W)

Table: 1

Potential time duration of medicinal plant Bhumi Amla

System : Bhumi Amla (BA-1)
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	891	821	796
2.	6	930	827	817
3.	12	1020	839	866
4.	18	1052	963	890
5.	24	823	780	732
6.	30	850	800	750
7.	36	566	719	632
8.	42	680	555	480
9.	48	488	670	603
10.	54	511	430	387
11.	60	430	490	400
12.	66	510	290	433
13.	72	370	311	243
14.	78	534	103	312
15.	84	290	134	193
16.	90	340	117	219
17.	96	97	160	97
18.	102	122	80	40
19.	108	0	0	0

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Table: 2

Potential time duration of medicinal plant Bhumi Amla

System : Bhumi Amla (BA-2)
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	855	842	733
2.	6	860	850	741
3.	12	867	911	762
4.	18	901	924	798
5.	24	872	850	621
6.	30	910	871	678
7.	36	790	741	644
8.	42	840	816	660
9.	48	611	740	492
10.	54	660	870	578
11.	60	650	580	535
12.	66	430	630	397
13.	72	472	510	421
14.	78	462	500	280
15.	84	480	370	330
16.	90	430	390	151
17.	96	455	220	182
18.	102	240	310	61
19.	108	270	140	72
20	114	98	151	0
21	120	0	0	

Table: 3

Potential time duration of medicinal plant Bhumi Amla

System : Bhumi Amla (BA-2)
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	895	850	824
2.	6	917	874	831
3.	12	929	850	840
4.	18	983	891	921
5.	24	910	848	704
6.	30	932	859	711
7.	36	822	751	598
8.	42	849	762	627
9.	48	698	608	554
10.	54	719	614	562
11.	60	592	311	454
12.	66	607	340	466
13.	72	454	250	294
14.	78	465	261	312
15.	84	393	200	102
16.	90	312	207	116
17.	96	116	53	30
18.	102	133	20	52
19.	108	0	0	0

It has been observed that younger cells shows occurrence of 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 reduce the ionic potential of the system. The moisture may probably results in enormous reduction of internal resistance. The BEP dependence upon the presence of ions transpiration, photosynthesis, respiration transport phenomenon etc. Overall the redox couples in the medicinal plant are good source of ionic energy.

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