International Journal of Research Radicals in Multidisciplinary Fields (IJRRMF), ISSN: 2960-043X
Volume 2, Issue 2, July-December, 2023, Available online at: www.researchradicals.com

Electrochemical and Kinetic Study of Xerophytic Medicinal Plants Pongamia Pinnata

Uma Ahirwar[1], Dr. P.K. Singh[2], Sharmila Singh[3], S.S. Saket[4]

[1,2] Department of Chemistry, S.G.S. Govt. P,G. (Autonomous) College, Sidhi (M.P.)
[3,4]Department of Chemistry, Govt. Girls P.G. College Satna (M.P.)

ABSTRACT

Electrochemical study of xerophytic medicinal plants pongamia pinnata of family has been studied in vitro condition employing three pairs of electrodes in different seasons. The various electrical activities were determined by measuring their bioelectrode 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-electrode potential, oscillatory motion, photic excitation, null potential.

INTRODUCTION

The birth of chemical kinetics often is taken to have occurred. Studied the rate of inversion of sucrose**.** The ancient Indian documents[1,2], the Vedas emphasize the planting of trees for worshiping, material prosperity, fulfilment of desires and salvation ensures himself against all diseases for seven births to come. In our Epics, plants purify the atmosphere. They are also source of energy and provide sufficient natural products in the field of drugs and even the medicines to get relief from the diseases[3]. The systematic analysis of drugs used in indigenous medicine was taken up on modern scientific lives.The electrochemical kinetic study is based on charge transfer that takes place through certain bio-chemical system like photosynthesis, respiration and transport phenomenon of ions which are responsible for enhancing ionic potential[4]. Moreover the movement of ions are associated with certain electromagnetic waves[5]. The electrochemical[6,7] and kinetic[8-10] studies of bio-system have been acclaimed earlier by a number of authors. We report here the hitherto unreported results of electrochemical kinetics investigation of three varieties of pongamia pinnata is a zerophytic medicinal plants abbreviated as PP-1, PP-2 and PP-3 medicinal plants .

Experimental -All the chemicals used in the study were of standard analytical grade. The plucked leaves of pongamia pinnata is a zerophytic medicinal plants are macerated, crushed and sap is extracted as an electrolyte properly after suitable process. It is filtered and purified by distillation. Bio-emf-device (BED) is prepared conveniently by dipping the electrode pair Ag-Zn in an electrolyte obtained from the medicinal plant (PP). All the electrical measurements have been made through a digital panel meter (UNI-T, model DT 830B) having resolution of 1 mV with an accuracy of $\pm$ 0.1% as shown in circuit diagram Fig. 1.

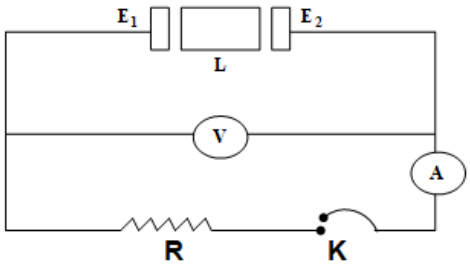

Fig.1 Circuit diagram
(E_1 and E_2 = electrodes, Ag, Zn), R = Resistance,
A = Ammeter, V = Voltmeter, L = Electrolyte (sap)

The experimental data have been recorded properly. The statistical analysis has been carried out. The rate constant was evaluated by applying integration method ($k = \frac{2.303}{t} \log a/a-x$). The chlorophylls and amino acids were identified chromatographically[11] by measuring their R_f values. The pH and conductivity of the bio-sap (electrolyte) were measured by digital pH and conductivity meters. Various activation parameters such as energy of activation (Ea), frequency factor (A) enthalpy of activation ($\Delta H^{\#}$), free energy of activation ($\Delta G^{\#}$) and entropy of activation ($\Delta S^{\#}$) were determined at different temperatures in Summer, winter and rainy seasons respectively.

MATERIALS AND METHODS

The study of electrical and electrochemical kinetic properties in system is due to the presence of ions. The medicinal plant leafs seems most suitable organ which posses a lucrative quantity of ions and give large uniform surface area of system**.** Thus for the present investigation the author has selected leaves of three varieties of medicinal plant of leguminosae family, namely pongamia pinnata abbreviated as PP-1, 2 and 3 types plants respectively. The Leaves plucks leaf from medicinal plant are macerated, crushed and sap is extracted as an electrolyte. It is filtered and purified by distillation. The electrode pairs of the size 2 x 2 cms. are dipped in the electrolyte as shown an electric circuit digram pongamia pinnata is a zerophytic medicinal plants found everywhere. This is of two types in colour red and white. It is polymorphic and polyannual distributed about 2-3 meter in length branched and is coloycal herbal plants. It contains flowers and store food in rainy season. The chemical constituents, present in plants are basic potassium chlorate, nitrate contained in root, stem, and leaves. It is widely used in treatment of cardiac, urological nephrological diseases. In addition to this it is widely used as in effective treatment of dropsy, insanity ophthalmology, asthama and leprosy

Processing Of Plant Leaf- The leaves of all three medicinal plants of the same family i.e. pongamia pinnata (pp-1), (pp-2) and (pp-3) contain sap in which food material like carbohydrate, protein, vitamin, nucleic acid, fat, etc. and metal like Zn, Na, K etc. are present.

METHODOLOGY

1. Size of leaf piece and the number of cells in the biomass is counted with the help of research microscope.
2. pH and conductivity of biomass sap have been measured with the help of digital pH meter and conduct meter.
3. Open circuit voltage has been measured several times under normal atmospheric condition during morning, noon, evening and midnight hours in rainy, winter and summer seasons only. The effect of injury by removing epidermis of leaf and the time duration of potential drop during the gradual death of plant tissues has been recorded.

Electrochemical activity in medicinal plants- The electrical activity in living cells on the other hand takes place through the movement of ions, which are charged atoms or groups of atoms such as Na^+, K^+ and Cl^- etc. The charge on the ion, whether positive or negative may vary depending on its atom or molecule. These ions are essential in regulating several vital physiological processes of plants These metal ion maintain the photo electron transport activity in plants**.** The presence of ions in the system apparently makes them physically electrolytic system. The system are capable of developing electrical potential of their own whenever necessary.

Leaf BED (Bio-emf-device) performance during morning, noon, evening, and mid night in vitro during summer, rainy and winter season. The temperature recorded during observation are as under :

S. No.	Season	Morning 06:00AM	Noon 12:00AM	Evening 06:00PM	Night 12:00PM
	Summer	35 ± 3^0C	37 ± 3^0C	36 ± 3^0C	36 ± 3^0C
	Rainy	28 ± 3^0C	28 ± 3^0C	28 ± 3^0C	28 ± 3^0C
	Winter	14 ± 4^0C	22 ± 4^0C	17 ± 4^0C	17 ± 3^0C

The study is divided into two parts viz.
Potential development on uninjured leaf as electrolyte surface during morning, noon, evening and midnight in three season summer, rainy and winter of three medicinal plants i.e. (pp-1), (pp-2) and (pp-3) with electrode pairs Ag-Zn has been recorded in Table 3.2.1(a) are as follows. The Ag-Zn combinations of electrodes are used to derive the potential development on the sap/ electrolytes of leaves system of three species of plants. These plant species are pp in three seasons summer, rainy and winter. Electrode dimension used is 2 × 2 cm.

Table : Potential development in uninjured leaf

Medicinal plant : pongamia pinnata (pp)
Season : Summer
Electrode pair : Ag-Zn

S.No.	System	Morning 06:00AM	Noon 12:00AM	Evening 06:00PM	Night 12:00PM
		OCV (mV)	OCV (mV)	OCV (mV)	OCV (mV)
	pongamia pinnata (pp-1),	1085	971	1112	1251
	pongamia pinnata(pp-2)	1047	943	1023	1151
	pongamia pinnata (pp-3)	954	881	961	1081

Chemical Analysis Of Chlorophyll And Amino-ACIDS;-
The chemical study of plant leaf was restricted to the analysis of the (a) presence of pigment molecules and (b) free amino acids. The thylakoid membranes of chloroplast contain the light absorbing pigment–chlorophyll and carotenoids. The principal function of the chlorophyll pigment is the absorption of light energy, which is subsequently transferred into various kinds of chemical energy utilized by the chloroplast for the reduction of carbon dioxide to carbohydrates. The carotenoid pigment are yellowish compounds insoluble in water and soluble in organic solvents. The function of carotenoids appear to be that of antioxidants, which keep the chloroplast membrane free of damaging concentrations of strong oxidizing materials that can readily be formed as a result of photochemical activity in the presence of oxygen. The building blocks of proteins are amino-acids.

Chlorophyll And Carotenoids-
Chloroplasts mainly contain three different pigments, two yellow pigments carotenes and Xanthophylls and two green pigments chlorophylls. The natural chlorophyll is the mixture of two different chlorophylls- chlorophyll-a and chlorophyll-b, which are found in the ratio of 3:1 in higher plants. Biologically, chlorophyll is very important natural pigment as it is responsible directly or indirectly for the synthesis of all kinds of food such as carbohydrates, fat, protein, and vitamin etc. Chlorophyll absorbs light energy and get activated, it reduces carbon dioxide forming a carbohydrate type molecule with the evolution of oxygen during photo synthesis

RESULTS AND DISCUSSION

The problem entitled “Electro-chemical and kinetic study of medicinal plants namely pp abbreviated as pp-1, pp-2, and pp-3 respectively, with the three pair of electrodes viz. Cu-Zn, C-Zn, and Ag-Zn have been investigated for three different seasons summer (S) rainy (R) and Winter (W) in morning, noon, evening and night under uninjured and injured conditions. The detail of experimental results so obtained clearly indicate that there is much difference between the activities of these medicinal plants which have been discussed in two pairs:

1. Electro-chemical study of medicinal plants, and
2. Kinetic study

Electro-chemical study of medicinal plants
The open circuit voltage (OCV) values of leaf BED’s for three combination of electrodes viz. Cu-Zn, C-Zn, and Ag-Zn have been measured several times under normal atmospheric condition to study the electrode effect on the uninjured and injured leaves. During the study, it has been found that injured leaf gives high voltage in comparison to uninjured leaf. The origin of electrode potential depends upon the availability of ions. The potential development also depends upon the permeability of surface cuticle of the leaf.

BED parameters in uninjured and injured leaves have been recorded at different periods morning (06: AM), noon (12:00 AM), evening (06:00 PM) and midnight (12:00 PM) during summer, rainy and winter seasons respectively.

Kinetic Study of Medicinal Plants-

The kinetic study of medicinal plants have been carried out for all the three medicinal pongamia pinnata plants viz. pp-1, pp-2, and pp-3 with Ag-Zn electrode pairs. Various activation parameters such as temperature coefficient, energy of activation, frequency factor, enthalpy of activation, free energy of action and entropy of activation are evaluated from the data obtained experimentally for three different seasons respectively.

In order to study the kinetics of each medicinal plants, many typical studies were carriedout. The plot of graphs of system between log a/ (a-x), OCV vs. time and log (a-x) vs. time clearly indicates that the redox process follow the first-order kinetics and the order falls from one to zero for pp-1 and pp-2 and as one to two for pp-3. When bio-potential goes on decreasing. The rate constant of different medicinal plants have been calculated for three seasons (S, R and W) graphically by selecting their peak's values using integration method.

CONCLUSION

The oxidation process entirely depends upon the detachment of electrons from the tissues present in sap. The study directly or indirectly support the electrochemical study of medicinal plants on the basis of following results:

1. At equilibrium, the rate of injury is found as the rate of healing.
2. The minimum value of rate constant 'k' is found at the first peaks of all the system during oxidation, but when the reduction process is on it shows gradual increase.
3. The kinetics of the tissues present in the sap is due to the presence of some fuel cells carrying transport ions in the system. They are responsible for generating BEP.

REFERENCES

[1]. **Mukhopadhayaya, G. N.:** History of India Medicine" Calcutta University, (1923).
[2]. **Chopra, R.N., Nayar, S.L. and Chopra, I.C.:** Glossary of Indian Medicinal Plants, CSIR Publication, New Delhi (1956).
[3]. **Balkrishna, A.:** Mystery of Ayurvedic Herb Divya, Publication, Edn. I, New Delhi (2008).
[4]. **Shephered, V.A.:** Curr. Sci (India), 77, 189, (1999).
[5]. **Bose, J.C.:** The Nervous Mechanism of Plants, Longmans, Green and Co., London (1926).
[6]. **Jain, K.M., Bhatnagar, S.P. and Hundet, A.:** Proc. 6th Bio-energy convention Madurai (1991).
[7]. **Gangwal, M.L., Vardhan, D.K., Sharma, Arti, Patidar, Pankaj and Kushwah, R.:** Res. J. Chem. Environ. 2(4), (1998).
[8]. **Singh, P.K., Agrawal, R., Khan, M.U., Nigam, S.K. and Khan, Shahnaz:** Asian J. Chem. 19, 213, (2007).
[9]. **Saket, S.S. and Dwivedi, H.P.:** Proc. 47th Annual convention of Chemists and International conference on Recent Advances in chemical science, Raipur (2010).
[10]. **Sarabhai, P., Khan, M.U.:** A.M.S.E. J. Chem. France No. 06386 (2C), (2007).