ISSN No:-2456-2165

Bio Battery from Waste Leather Based Collagen, Carbon Nanoparticles and Natural Electrolyte

A. Nelson
Assistant professor, Department of Biochemistry, Sengunthar Arts and Science College, Tiruchengode

Dr A. K. Vidya
Associate Professor, Department of Biochemistry, Kongu Arts and Science College Erode

S. Inbasekaran
Department of Bio product, Biological Materials Pilot Plant, CSIR-CLRI Adyar, Chennai

Abstract:- Bio battery, an innovative alternate natural energy source that utilize nanoparticles from plants to facilitate electricity, over the years, plants have been used as valuable sources of natural products for maintaining animal and human welfare and health. In the present study, the electrolyte paste from waste leather (animal skin) and plant extract for maintaining the electricity generation of bio battery. To analyze and assess the performance, enhancement in term of voltage, current, power caused by the modified electrolyte. As a result the iron content when estimated in Maringa oleifera lam and electrolyte paste in acidic [6.2 to 6.8 Ph.] range and voltage are tabulated. The future benefits of bio electrical energy can also be used for rural electrification of 50 to 75 houses, based on the size and application.

Keywords:- *Electrolyte paste, Plant extract, Bio Battery, Waste leather.*

I. INTRODUCTION

Leather from animal skin that has been preserved by tanning. The tanning process alters the collagen (microscopic proteins that give skin its structure & elasticity). It has the micro-fibers holding the collagen together so that they separate and toughen. This also creates leather's characteristic softness and flexibility. Goat hides make thin, fine-grained leather that's excellent for garments and other value added bio products. After skinning, the hide undergoes the following steps to become leather. The making of leather undergoes to fleshing, de haring, raw hide, tanning, and finishing. In India, there are about 3000 tanneries processing around 600 million kgs of raw skin and hide per annum, generating around 50 MLD of liquid waste and 305 million kgs of solid waste. It is reported that about 140-200 kg of fleshing, which are putrescible by nature, are generated for every tonne of leather processed.

II. METHODS

- *Materials Required*

Waste Skins are collected from the leather processing industry. The collagen extracted from goat, cow, buffalo skins had been used in this study.
Moringaoleifera lam – 10g, Digital Multimeter, Conducting nanoparticles.
AA Battery parts such as anode, cathode. Zinc and copper plates, Conductivity gel, Poly ethylene glycol.

- *Extraction and purification of collagen*

Waste animal leather
↓
Fibrizer machine
↓
Dilute sulphuric acid dissolved (24hrs)
↓
Water washed 2 or 3 times
↓
Filtered (collagen material colourless)
↓
Add polyethylene glycol 1 to 5%
↓
Add conductivity gel
↓
Corbannano particles 1 to 10mg
↓
Add silver ink (conductivity ink)

Flow chart 1:- for Electrolyte Paste Making

- *Preparation of plant extracts (moringaoleifera lam)*

2.0gms of weighed dried powder was treated with 12ml of concentration HNO_3 and boiled till brown fumes ceased. After cooling 2ml of double distilled water was added and 4ml of H_2O_2 to decompose the organic layer. Further it was heated till effervescence ceased and later on after cooling the step was repeated later on after cooling distilled water was added to the solution and boiled this was used for estimation.

- *Preparation of reagents for iron estimation:*

KSCN (Pottasiumthiosyanate: 19.4gms of KSCN was diluted to 100ml distilled water. FAS (Ferrous ammonium sulphate):0.215gms of FAS was dissolved in small amount of H_2SO_4 and then diluted to 250ml in distilled water.

- *Procedure for Iron Estimation:*

Dilute the standard FAS solution and *moringaoleifera lam* extract. Into a series of test tubes pipette out 2.0 to 10 ml of the working standard DNA solution corresponding to µg values 1.72 to 8.6. 3.0 ml of the ample was pipette out. 3.0 ml of the given unknown solution was taken. Made up the volume in all the tubes series of 20, 18, 16, 14, and 12, 10, 17 with distilled water. Set up a blank along with the working standard. Added 5.0 ml of Nitric acid solution and potassium thio cyanide to each tube. Read the absorption of yellow colour at 470nm against the blank. A standard graph as drawn by taking the concentration of iron and on X axis

ISSN No:-2456-2165

and optical density on Y axis. From the graph the amount of iron present in the unknown solution was calculated.

➢ *Kirchhoff's Laws*
- The junction rule
- The closed loop rule

➢ *Junction Rule*

At any node (junction) in an electrical circuit, the sum of currents flowing into that node is equal to the sum of currents flowing out of that node, or: The algebraic sum of currents in a network of conductors meeting at a point is zero".

The sum of currents entering the junction are thus equal to the sum of currents leaving. This implies that the current is conserved (no loss of current).

$$\sum Iin = \sum Iout$$

Close Loop Rule

The principles of conservation of energy imply that the directed sum of the electrical potential differences (voltage) around any closed circuit is zero.

$$\sum \Delta Vcloseloop = 0$$

Total Internal Resistance

r = V2 –V1/ I2 – I1

III. RESULTS

➢ *Iron Content in Moringa oleifera*

Since Iron is considered to be a good conductor of electricity compared to other metals like lead, an attempt was made to use the plant extract from *Moringa oleifera*, which contain rich source of iron for producing bio batteries to balance the internal resistance. In our study, the iron content when estimated in *Moringa oleifera lam* was found to be 7.15 % per gram.

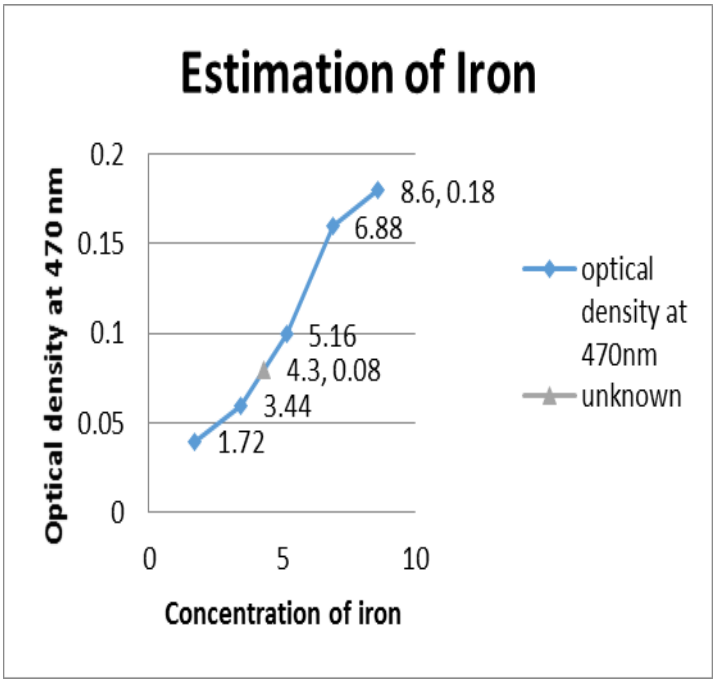

Fig 1:- Estimation of iron from *Moringaoleiferalam*

➢ *Measuring of DC voltage in electrolyte paste by using Digital Multimeter*

The electricity produced: voltage of 13500mV,for 80 well cells and the current in the range of 25-75 micro A, per cell, 1.2 A for 80 cells, Total internal resistance 2.8 Ω for button like well cell under no load condition. DC voltage for ½ litter electrolytes with 5gms electrolyte paste (voltage in DC volte)

S	Cell1	Cell2	Cell3	Cell4	Cell5	Cell6	Cell7	Cell8	Cell9	Cell10
1	526mv	568mv	516mv	553mv	544mv	552mv	466mv	529mv	476mv	485mv
Total internal resistance of each battery : 2.8 Ohms										

Table1: Series connectivity of Batteries

➢ *pH stabilisation*

It has been observed that the pH of the extracts that formulated the electrolyte paste is acidic ranging between 1-6. It was important to mention here that the generated electricity was higher in the plant extract with higher degree of acidity.

➢ *Characterization using Thermal Analysis Thermo Gravimetric Analysis (TGA)*

In the TGA weight loss of materials with increase temperature is monitored and noticed.

In the present study, the electrolyte powder weight loss is measured for analysis. Thermo gram of control collagen shows single step weight loss from 59 to 213°C and around 96% weight loss is observed. This loss may be due to the decomposition of protein, CO, CO_2 and H_2O molecules. The final residue was found to be 58.2

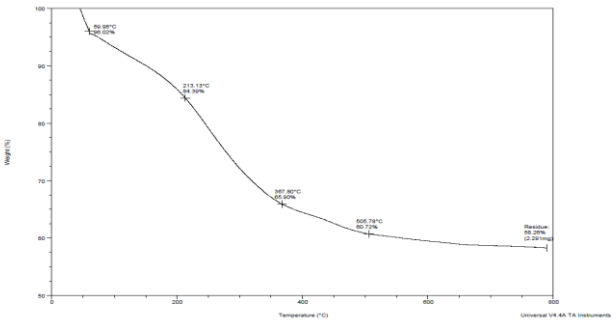

Fig 2:- A. DSC analysis in electrolyte sample

ISSN No:-2456-2165

➢ *Differential Scanning Calorimetric (DSC)*

The denaturation temperature of electrolyte powder films is determined from DSC curve and is found to be 112.80°C. The DCS results indicate that the denaturation temperature (Td) of collagen is 112.80°C.

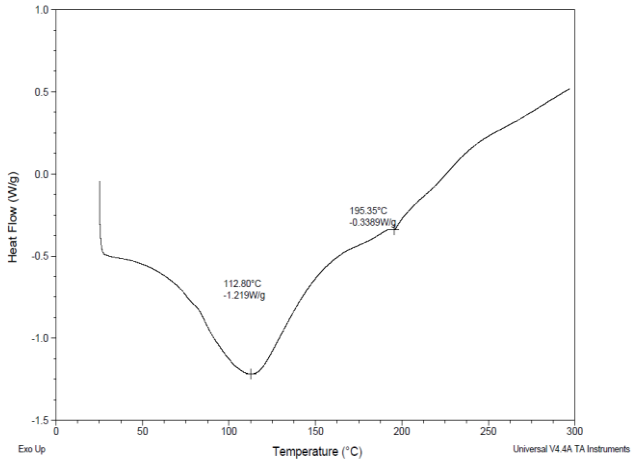

Fig 3:- C. DSC analysis in electrolyte sample

In our study, the iron content when estimated in *Moringa oleifera lam* was found to be 7.15 % per gram. It has been observed that the pH of the extracts that formulated the electrolyte paste is acidic ranging between 1-6. The electricity produced: voltage of 13500mV, per 80 cells and the current in the range of 25-75 micro A, per cell, 1.2 A ,Total current in 80 cells, resistance in the range 10 to 11MΩ.

IV. DISCUSSION

Leather of animal skin that has been preserved by tanning. The tanning process alters the collagen (microscopic protein that give skin its structure & elasticity) in the hide so that it doesn't decay or rot. It removes the micro-fibers holding the collagen together so that they separate and toughen. This also creates leather's characteristic softness and flexibility.

In the present study, aqueous extracts of *Moringa oleifera* lam and tannery fleshing were used for electrolytes in bio-voltaic cells. Conducting material made of silver ink or paste, nanoparticles with the bio material is used for the production of electricity.

The collagen extracted from waste animal (goat, cow, and buffalo) skin had been used in this study. For this the waste animal skin leather is subjected to chemical and Physical methods to obtain the collagen paste. To the collagen paste, Polyethylene glycol, Carbon nano materials from plant and Conductivity gel are added to form the electrolyte paste. Thus, the present investigation is a process for the generation of eco-friendly bioelectricity, comprising of supplementing *Moringa Oleifera* powder to the tannery fleshings with 15.0-30.0%w/w of polyethylene glycol,10.0-15.0%w/w of carbon materials The Bioelectrolyte paste with a pH 1.0-5.0 is poured into a 80 well plate, each well is setup at a conventional electrodes (cathode-zinc thin pin and anode-copper thin pin) immersed in the mixture and connected both serially and parallel for the production of electricity. Similarly the bio-voltaic cells were connected in parallel arrangement and the generated voltage and current were measured. It has been observed that, maximum 1.30V electricity was detected. Previous studies have reported a maximum of 26.74mV was generated in parallel connection in case of star fruit extract.

ACKNOWLEDGMENT

It was like a dream that come true for me to get a chance to work at central leather research institute, Chennai. I would like to thank all staff members of the department of biochemistry, for their support.

REFERENCES

[1]. VELUSAMY et al., 'Power Generation from Plant Extracts'.
[2]. [Dias et al 2000].'Studies on Ionic Liquid BasedMagnesium Ion Conducting GelPolymer Electrolytes'.
[3]. Impedance and conductance testing by CD technologies.com,
[4]. 'The development of electrolytes in aluminium electrolytic capacitor for automative and high temperature application'. Zonglidou carts Europe conference, Helsinki, finland 20-23 oct.
[5]. KhairulBahiyahMdisa et al., 'Studies on Sodium Ion Conducting Gel Polymer Electrolytes' Key Engineering Materials Vols. 594-595 (2014) pp 786-792 (2014) Trans Tech Publications.
[6]. 'Conductivity theory and practice', radio meter analytical book.
[7]. 'General Descriptions of Aluminum Electrolytic Capacitors'TECHNICAL NOTES CAT.8101E-1 NICHICON CORPORATION.
[8]. G. C. Stevens1 et al.,'Ethno-medicinal and culinary uses of *Moringaoleifera*Lam'. in NigeriaJournal of Medicinal Plants Research Vol. 7(13), pp. 799-804, 3 April, 2013.
[9]. ' Battery internal resistance' version 1.1.0 December 2005.
[10]. Gerhard Fritz, et al.,'Electrosteric Stabilization of Colloidal Dispersions' Langmuir 2002, 18, 6381-6390. Received December 13, 2001. In Final Form: April 22, 2002.