ISSN(Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2015

Structural Characterization and Physical Properties of Syzygium cumini Flowering Plant

Mohamed A. Siddig[*,1], Abdelgadir E. Abdelgadir[2], Abdelrahman A. Elbadawi[3], Eltayeb M. Mustafa[1], Anwar A. Mussa[4]

Associate Professor, Department of Physics, Faculty of Science and Technology, Alneelain University, Khartoum, Sudan[1]

Associate Professor, Department of Environmental Science, Faculty of Science and Technology, Alneelain University, Khartoum, Sudan[2]

Assistant Professor, Department of Physics, Faculty of Science and Technology, Alneelain University, Khartoum, Sudan[3]

Postgraduate, Department of Physics, Faculty of Science and Technology, Alneelain University, Khartoum, Sudan[4]

ABSTRACT: In this study, the flowering plant of syzygium cumini was used. X-ray fluorescence (XRF) and X-ray diffraction (XRD) were used to investigate the structure of the leaves and barks of syzygium cumini. The XRD results were indicated that the structures of both leaves and bark were amorphous. The XRF results indicated that both leaves and barks contained Potassium (K), Calcium (Ca), (Ti), and Magnesium (Mn), Iron (Fe), Copper (Cu), Zinc (Zn), Zernike (As), Lead (Pb), Barium (Br), Strontium (Sr). The optical properties of syzygium cumini were carried out using Fourier Transformation infrared spectroscopy (FTIR) and Ultra violet spectroscopy (UV). The FTIR spectra showed a broad and strong absorption band in the range (685-1638) cm^{-1}, and these absorptions were assigned to the different stretching vibrations. The absorption for bark and leave was found to be 2.45 and 2.52 a u, while the wave length was found to be 277.4 and 277.5 nm, respectively. The energy band gap is calculated and found to be 5.017 and 4.67 eV, for bark and leave, respectively.

KEYWORDS: Energy band gap, physical properties, syzygium cumini, Sudan , X-ray fluorescence (XRF).

I. INTRODUCTION

A greater knowledge of the physical properties of plants is important to future applications, as well as for improvements in product development with the currently available technology [1].

Traditionally the jambul fruits, leaves, seeds, and bark are all used in ayurvedic medicine. The bark contains tannins and carbohydrates, accounting for its long-term use as an astringent to combat ailments like dysentery [2-5]. A glycoside in the seed, jamboline, is considered to have antidiabetic properties [6,7]. Older French research shows that the seeds have a significant hypoglycemic effect in diabetic rabbits [8,9]. Jamun fruit seeds and pulp have been reported to serve various purposes in diabetic patients, such as lowering blood glucose levels and delaying diabetic complications including neuropa- thy and cataracts . Jamun is most often recognized as an adjuvant therapy in type-2 diabetes. This has been traced not only to its anthocyanin-rich, dark-purple fleshy pulp, but also to its seeds, which have been most studied for their antidiabetic principles [10-12].

All parts of the jambolan can be used medicinally and it has a long tradition in alternative medicine. The plant has been viewed as an antidiabetic plant since it became commercially available several decades ago. From all over the word, the fruits have been used for a wide variety of ailments, including cough, diabetes, dysentery, inflammation and

ISSN(Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2015

ringworm [13-15]. It is also an ancient medicinal plant with an illustrious medical history and has been the subject of classical reviews for over 100 years [16-21].

The aim of this work is to investigate the structural and the physical properties of the bark and leaves of syzygium cumini. The structure of the leaves and the barks was determined using x-ray diffraction (XRD. The existence of the elements in the samples were investigated using X-ray fluoresces device (XRF) and the following elements were found; Potasium (K), Calcium (Ca), Titanium (Ti), Magnesium (Mn), Iron (Fe), Copper (Cu), Zinc (Zn), Lead (Pb), Zernike (As), Barium (Br) and Strontium (Sr). Fourier transformation infrared (FTIR) device was used in order to determine the chemical bonds, while the UV-VIS spectroscopy was used to determine the absorption for bark and leave, respectively.

II. EXPERIMENTAL

2.1 SAMPLE PREPARATION

The plant leaves and bark Syzygium sample were collected during 2014 season as natural exudates of jampol trees from Khartoum, Sudan. The soil in this location is Sandy clay. The syzygium was dried at room temperature and kept in plastic containers for analysis. Sample was made powder using mortar in order to perform XRD. To prepare sample for FTIR test a small amount about one gram of potassium bromide KBr3 was mixed with the sample and compressed in order to make a suitable capsule for FTIR device.

2.2 Equipment's and measurements

The XRF was performed using Cd-109 XRF spectrometer system. The XRD analysis was carried out to confirm the purity of the synthesize materials using Shimadzu 6000 X-ray diffractometer with Cu-Kα radiation of a wavelength of λ= 1.5406 Å source.

FTIR measurements were performed using (Mattson, model 960m0016) spectra, while, the absorption of solution with different concentration was calculated using UV min 1240 spectrometer Shimadzy.

III. RESULTS AND DISCUSSION

3.1 X-RAY DIFFRACTION RESULTS

The structure of prepared samples is confirmed by XRD patterns. Figure 1 displays the typical XRD spectra for the leave of syzygium. The sample showed one strong peak with intensity 145 a. u. The XRD indicated that structures are of amorphous type.

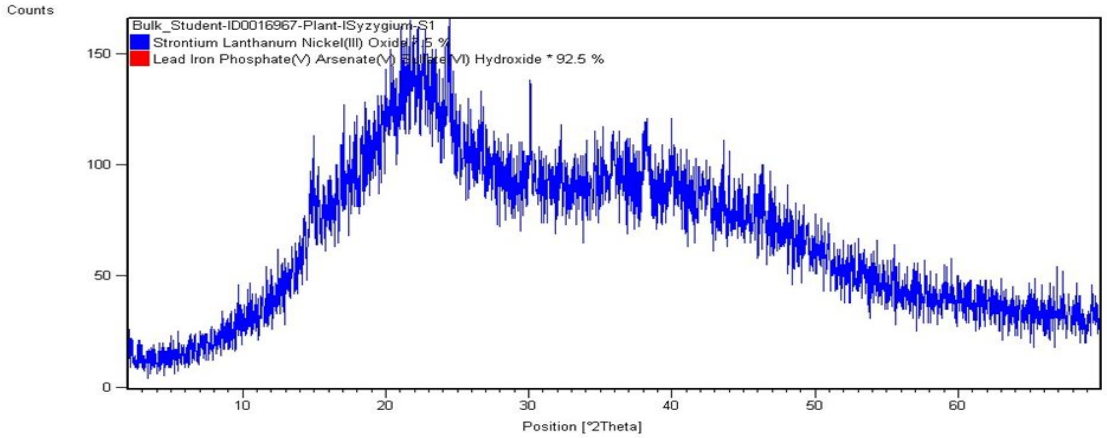

Figure1: XRD patterns of Syzygium cumini flower plant

ISSN(Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2015

3.2 X-Ray Fluorescence Analysis

X-Ray Fluorescence data allowed the researchers to observe the elements present in the sample. Each element gives an XRF signal at a unique energy level characteristic of that element.

The XRF is performed in one gram of powder of Syzygium plant. The structural characterizations and the results obtained for bark and leave samples are shown in table 1 and table 2, respectively. The XRF results are indicated that both bark and leave are contained Potassium (K), Calcium (Ca), (Ti), and Magnesium (Mn), Iron (Fe), Copper (Cu), Zinc (Zn), Zernike (As), Lead (Pb), Barium (Br), and Strontium (Sr). Althsough, the concentrations are found to be different for elements of different parts of Syzygium. In both case of bark and leave Potassium (K) is found to have highest concentration, while Lead (Pb) is the least. Table 3 shows a comparison between concentrations of different elements exist in bark and leave of Syzygium.

Table 1: The structural parameters of bark

Element	E (KEV)	INT(C/S)	S	T	CONC(FRAC)	ERROR
K	3.312	0.461	1.38E+04	0.0566	2.84E-03	2.30E-03
Ca	3.690	1.258	2.44E+04	0.0728	3.42E-03	2.75E-03
Ti	4.508	0.045	8.60E+04	0.1187	2.10E-05	LDL
Mn	5.895	0.127	1.83E+05	0.2422	1.37E-05	1.12E-05
Fe	6.400	1.537	2.02E+05	0.2955	1.23E-04	9.94E-05
Cu	8.041	1.096	4.80E+06	0.4648	2.36E-06	1.90E-06
Zn	8.631	0.110	4.26E+05	0.5185	2.39E-06	1.98E-06
As	10.532	0.075	7.44E+05	0.6543	7.42E-07	LDL
Pb	10.540	0.286	5.20E+06	0.6547	4.06E-07	3.28E-07
Br	11.907	0.113	7.79E+05	0.7216	9.71E-07	8.03E-07
Sr	14.142	5.269	1.11E+06	0.7937	2.90E-05	2.33E-05

Table 2: The structural parameters of leave

Element	E[KEV]	INT[C/S]	S	T	CONC[FRAC]	ERROR
K	3.312	0.461	1.38E+04	0.0566	2.84E-03	2.30E-03
Ca	3.690	1.258	2.44E+04	0.0728	3.42E-03	2.75E-03
Ti	4.508	0.045	8.60E+04	0.1187	2.10E-05	-DLD -
Mn	5.895	0.127	1.83E+05	0.2422	1.37E-05	1.12E-05
Fe	6.400	1.537	2.02E+05	0.2955	1.23E-04	9.94E-05
Cu	8.041	1.096	4.80E+06	0.4648	2.36E-06	1.90E-06
Zn	8.631	0.110	4.26E+05	0.5185	2.39E-06	1.98E-06
As	10.532	0.075	7.44E+05	0.6543	7.42E-07	-DLD -
Pb	10.540	0.286	5.20E+06	0.6547	4.06E-07	3.28E-07
Br	11.907	0.113	7.79E+05	0.7216	9.71E-07	8.03E-07
Sr	14.142	5.269	1.11E+06	0.7937	2.90E-05	2.33E-05

Table 3: comparison of elements concentration of bark and leaves

Element	Concentration (%)	
	Bark	Leaves
K	1.69E-01	2.84E-01
Ca	4.44E-01	3.42E-01
Ti	2.54E-03	2.10E-03
Mn	1.03E-03	1.37E-03
Fe	6.83E-03	1.23E-02
Cu	2.71E-04	2.36E-04

ISSN(Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2015

Zn	5.89E-04	2.39E-04
As	9.76E-05	7.42E-05
Pb	3.47E-05	4.06E-05
Br	2.93E-04	9.71E-05
Sr	6.01E-03	2.90E-03

3.3 FTIR Analysis

An infrared spectrum represents a fingerprint of a sample with absorption peaks which correspond to the frequencies of vibrations between the bonds of the atoms making up the material. Because each different material is a unique combination of atoms, no two compounds produce the exact same infrared spectrum. Therefore, infrared spectroscopy can result in a positive identification (qualitative analysis) of every different kind of material. In addition, the size of the peaks in the spectrum is a direct indication of the amount of material present [1].

The FTIR was performed in powder samples of bark and leave of Syzygium. FTIR spectra are shown in figure 2 for bark. The FTIR spectra showed a broad and strong absorption band in the range 685-1638 cm^{-1}, and these absorptions are assigned to the different stretching vibrations. The analyses of FTIR spectra for the samples are presented in table 4 for bark and leave. The C-C stretching vibration is appeared at 685 cm-1. The O-H bending vibrations appeared at 1633 and 3400 cm-1. The C=O stretching are observed at 1400 cm-1.

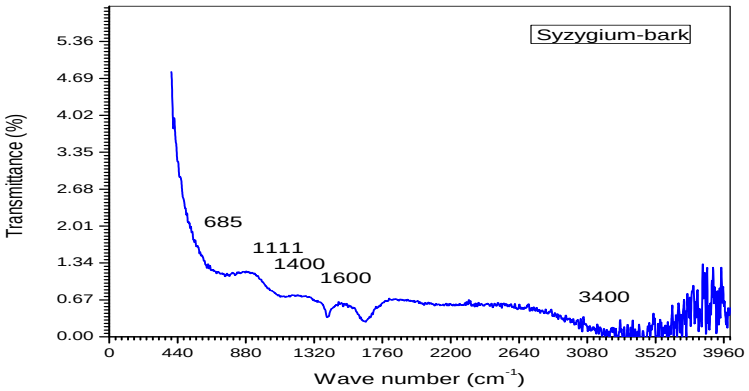

Figure 2: The FTIR spectrum for Syzygium (bark)

Table 4 The summary of characteristic of Syzygium.

Wave number	Molecular bonds	Functional group
3400	O-H	Alcohols
1638	C=C	Alkenes
1600	C=C	Benzene
1400	C=O	Carboxylic Acid
1111	C-O	Ethers
1103	C-O	Alcohols
741	C-H	Aromatic
685	C- element	Cloro alkenes

ISSN(Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2015

3.4 UV- VIS Analysis

The absorption as a function of wavelength for bark and leave of Syzygium is shown in figure 3. The absorption for bark and leave is found to be 2.45 and 2.52 a u, while the wave length is found to be 277.4 and 277.5 nm, respectively. The optical band gap energy of the materials was obtained using the following equation:

$$(\alpha h\nu) = A\left(h\nu - E_g\right)^m \qquad (1)$$

In Eq. (1) Eg, the optical band gap whereas m represents the nature of the transition band gap, constant A is an energy-independent constant, (hv) is energy of photon [22]. Assuming direct band gap transition for the samples, m was assigned a value of 1/2. To evaluate a precise value for the optical band gap, we plotted $(\alpha\ h\nu)^2$ versus energy ($h\nu$) for bark figure 4. The optical band gap is determined by extrapolating the linear portion of the plot to $(\alpha\ h\nu)^2 = 0$ and is found to be 5.017 for and 4.67 eV for bark and leave, respectively.

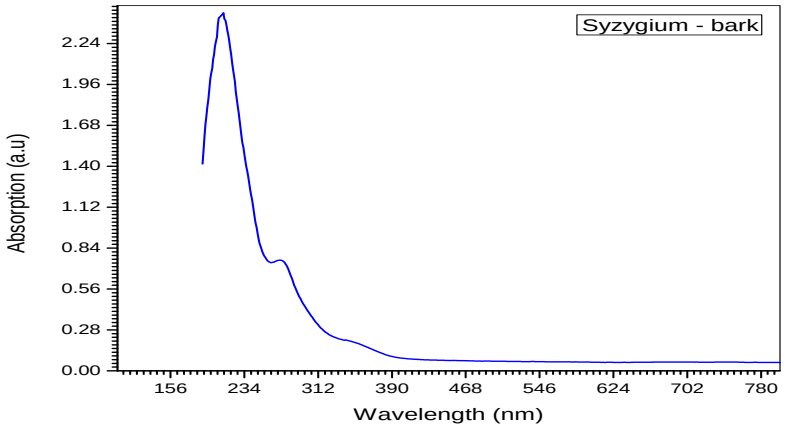

Figure 3: Absorption as a function of wavelength for Syzygium (bark)

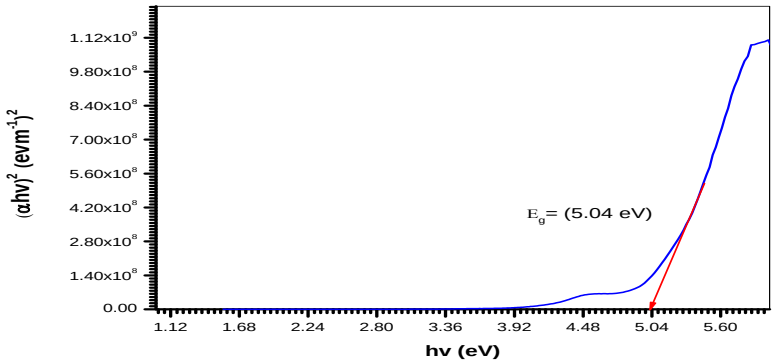

Figure 4: Optical band gap of bark calculated using Tauc Plot method and are found to be 5.01 eV

ISSN(Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2015

IV. CONCLUSION

Structure and physical properties of leaves and barks of Syzygium were investigated. XRD results indicated that the samples are amorphous. The XRF showed that Syzygium contained the following elements; Potassium (K), Calcium (Ca), Titanium (Ti), Magnesium (Mn), Iron (Fe), Copper (Cu), Zinc (Zn), Zernike (As), Lead (Pb), Barium (Br), and Strontium (Sr). The concentration of elements was different for the samples of leaves and barks. FTIR results proved that the both bark and leave samples were similar in terms of bonds and groups. The energy band gap is calculated and found to be 5.017 and 4.67 eV for bark and leave, respectively.

REFERENCES

[1] Nisreen A.Eltahir, M. A. Siddig, A. A. Siddig, Hajir Adam, structure and physical properties of flowering plants of the genus hibiscus, Sudan Medical Monitor, Vol.8 No.3 2013, pp 135-139
[2] Munsell H., L. , L. Williams, Guild, C. Troescher, G. Nightingale and R. Harris, "Composition of Food Plants of Central America," Food Research, Vol. 14, No. 2, 1949, pp. 144-164.
[3] Baliga, M., P. Bhat and B. Baliga, "Photochemistry, Traditional Uses and Pharmacology of Eugenia jambolana Lam. (Black Plum): A Review," Food Research International, Vol. 44, No. 7, 2011, pp. 1776-1789.
[4] Namasivayam R. , B. Ramachandrani and M. Deecaraman, "Effect of Aqueous Extract of Syzygium cumini Pulp on Antioxidant Defense System in Streptozotocin Induced Diabetic Rats," International Journal of Post Harvest Technology, Vol. 7, 2008, pp. 137-145.
[5] Chaudhuri N., A. Pal and S. Gomes, "Anti-Inflammatory and Related Action of Syzygium cumini Seed Extract," Phototherapy Research, Vol. 4, No. 2, 1990, pp. 5-10.
[6] Reynertson K.. A. Basile and M. J. Kennelly, "Antioxidant Potential of Seven Mystaceous Fruits," Ethnobotany Research and Applications, Vol. 3, 2005, pp. 25-35
[7] Prince P. and M. Venon, "Effect of Syzigium cumini in Plasma Antioxidants on Alloxan-Induced Diabetes in Rats," Journal of Clinical Biochemistry and Nutrition, Vol. 25, No. 2, 1998, pp. 81-86.
[8] Sepaha G. and S. Bose "Clinical Observations on the Antidiabetic Properties of Pterocarpus marsupium and Eugenia jambolana," Journal of the Indian Medical As- sociation, Vol. 27, 1956, pp. 388-391.
[9] Helmstadter L. ,"Syzygium cumini Skeels (Myrtaceae) Against Diabetes: 125 Years of Research," Pharmazie, Vol. 63, No. 2, 2008, pp. 91-101.
[10] Giri J., Sathidevi T. and Dushyanth N., "Effect of Jamun Seed Extract on Alloxan Induced Diabetes in Rats," Journal of the Diabetic Association of India, Vol. 25, 1985, pp. 115-119.
[11] Jain S. K., "Dictonary of Indian Folk Medicine and Eth- nobotany," Deep Publications Paschimvihar, New Delhi, 1991.
[12] Damasceno D. C. ,. Volpato G. T and. Calderon I. D, "Study of Averrhoa carambola and Eugenia jambolana Extracts Purchased from Manipulation Drug Store on the Experimental Diabetes," Revista Brasileira de Toxicologia, Vol. 15, 2002, pp. 9-14.
[13] Ravi K. , S. Rajasekaran and S. Subramanian, "Hypogly- cemic Effect of Eugenia jambolana Seed Kernels on Streptozotocin-Induced Diabetes in Rats," Pharmaceuti- cal Biology, Vol. 41, No. 8, 2003, pp. 598-603.
[14] Sharma S. B , A. Nasir and K. M. Prabhu, "Antihyper- glycemic Effect of the Fruit-Pulp of Eugenia jambolana in Experimental Diabetes Mellitus," Journal of Ethno- pharmacology, Vol. 104, 2006, pp. 367-373.
[15] Ravi K. , B. Ramachandran and S. Subramanian, "Protective Effect of Eugenia jambolana Seed Kernel on Tissue Antioxidants in Streptozotocin-Induced Diabetic Rats," Biological & Pharmaceutical Bulletin, Vol. 27, No. 8, 2009, pp. 1212-1217.
[16] Vikrant V. , J. K. Grover and N. Tandon, "Treatment with Extracts of Momordica Charantia and Eugenia Jambolana Prevents Hyperglycemia and Hyperinsulinemia in Fructosefed Rats," Journal of Ethnopharmacology, Vol. 76, No. 2, 2001, pp. 139-143.
[17] Srivastava Y. , H. Venkatakrishna-Bhatt and O. P. Gupta, "Hypoglycemia Induced by Syzygium cumini Linn Seeds in Diabetes Mellitus," Asiam Medical Journal, Vol. 26, No. 7, 1983, pp. 489-491.
[18] Gami Bharat and Parabia MH. Pharmacognostic Evaluation of Bark and Seeds of Mimusops elengi l. International Journal of Pharmacy and Pharmaceutical Sciences.; Vol.2 No.4, 2010, 110-113.
[19] Shaukat Mahmud, Shareef H, Ahmad M, Gouhar S and Rrizwani GH. Pharmacognostic studies on fresh mature leaves of Holoptelea integrifolia (roxb) planch. Pak J Bot. Vol.42, No.6, 2010; 3705-3708.
[20] Patel SS. Morphology and Pharmacology of Passiflora edulis. Journal of Herbal medicine and Toxicology, Vol.3, No.1, 2009; 1-6.
[21] Gowri Shyamala S and Vasantha K. Phytochemical Screening and Antibacterial Activity of Syzygium cumini (L.) (Myrtaceae) Leaves Extracts. International Journal of PharmTech Research, Vol.2, 2010, 1569-1573.
[22] Lal Said Jan and Mohamed Ahmed Siddig, Synthesis, characterization and enhanced electrical properties of CTAB-directed polyaniline nanoparticles, Chinese Journal of Polymer Science, Vol. 29, 2011, pp 181-190.