International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 5 Issue 10, October - 2021, Pages: 6-9

Compact Setup for Standoff Laser Induced Breakdown Spectroscopy of Dates Fruits ((Barakawi)

[1]Aldesogi Omer Hamed, [2]Abeer Osman, [3]Arwa Abdoalazeez, [4]Amel Abdoalazeez,

[5]Omaima. E. Elnaiem, [6] M. A. Allhgabo .Belal and [7]Abdalsakhi, S. M.
[1,5,6] Kordofan University - faculty of Science - Department of Physics-Sudan
[2,3,4,7] Alneenlen University – faculty of Science and Technology- Department of Laser and Renewable Energy - Sudan

Abstract: *In this paper, we apply Laser Induced Breakdown Spectroscopy (LIBS) technique for high resolution spectrochemical analysis of dates fruits (Barakawi) sample collected from north Sudan location (Dongola), and its main characteristic stands in the use nitrogen laser 337.1nm pulse duration 10 ns pulse energies (100, 200) mJ . The Results were obtained by utilizing the characteristic plasma emission lines of different elements that have been confirmed (Pr, Co, Th, W, Fe, Na, Cu, Cr, Xe, Si, C, Ar, Sc, Np, Cr, Fe and Ba). Most of this elements are important for the human body.*

Keywords: Laser-induced-breakdown- Spectroscopy- Dates fruits – Barakawi- Heavy Elements- Human Body.

1. Introduction

Laser-induced breakdown spectroscopy (LIBS) is a method of atomic emission spectroscopy (AES) that uses a laser-generated plasma as the hot vaporization, atomization, and excitation source. Because the plasma is formed by focused optical radiation, the method has many advantages over conventional. In its basic form, a LIBS measurement is carried out by forming laser plasma on or in the sample and then collecting and spectrally analyzing the plasma light. Qualitative and quantitative analyses are carried out by monitoring emission line positions and intensities [1, 2, 3, 4, and 5]. In recent years, laser based technologies became important or even dominant in industrial applications such as welding or cutting. Further possibilities of processing, innovation, and advancement of laser material treatments are still in progress and very challenging. Laser-based analysis, spectroscopy, or metrology are well known and established methods [6].A plasma is an ionized gas. When a solid is heated sufficiently that the thermal motion of the atoms break the crystal lattice structure apart, usually a liquid is formed. When a liquid is heated enough that atoms vaporize off the surface faster than they recon dense, a gas is formed [7].there are three important parameters of plasma: degree of ionization χ depends on the physical parameters, namely density and temperature, which characterize the thermodynamically equilibrium of the plasma.

$$\chi = \frac{n_i}{n_o} + n_i = \frac{n_i}{n_{tot}} \quad (1)$$

Another important characteristic is the property of quasi-neutrality.

$$D\lambda = \sqrt{\frac{KT}{4\pi e 2 n_0}} \quad (2)$$

The plasma frequency, [8]

$$\omega_p^2 = ne^2/\epsilon_0 m \quad (3)$$

Date palm is the main fruit crop in arid and semiarid regions, particularly in the arid regions of western Asia and North Africa. The palm tree is well adapted to desert environments that are characterized by extreme temperatures and water shortage, both in quality and quantity, due to scarcity of rainfall, Date, the fruit of date palm, can be considered as an ideal food that provides a wide range of essential nutrients with many potential health benefits [9]. Dates contain high levels of selenium, copper, potassium, and magnesium, moderate concentrations of manganese, iron, phosphorus, and calcium and small quantities of boron [10], date fruit varieties were rich in soluble sugars, which varied from 35.57 (Smiti variety) to 77.88 g/100 g fresh weight (FW) (Korkobbi variety). Several minerals were also present in the following order; K, Ca, P, Mg, Na, Fe, Cu, Zn and Mn.[11]

2. Experimental

The samples used in this experiment is dates fruits (Barakawi) which collected from north Sudan (Dongola). A Q-switched Nitrogen laser was used at the fundamental wavelength (337.3 nm). Repetition rate of (1Hz) is use for laser-produced plasma. The output pulse duration is (10 ns) and the pulse energy (100 and 200) mJ. A schematic diagram of experimental set-up is shown in Figure (1). The target holder was fixed at 45° direction in order to ensure that the plasma emission is right-angled with respect to the diagnostic tools. The laser is focus on the sample by a quartz lens of convex quartz lens (f =10 cm) and mirror (7.4×4.7cm). Ocean optic Spectrophotometer Detector (model USB2000) was used to detect the photons which were produced by laser produced plasma, wavelength in the range of (400-1150) nm. At last Computer with ocean optic software and origin 9 program device was used. Then the emitted spectra was collected using optical fiber which was connected to USB 2000 spectrometer and recorded the data of LIBS sample spectrum ,and analyzed this data using the national institute of standards and technology (NIST database).

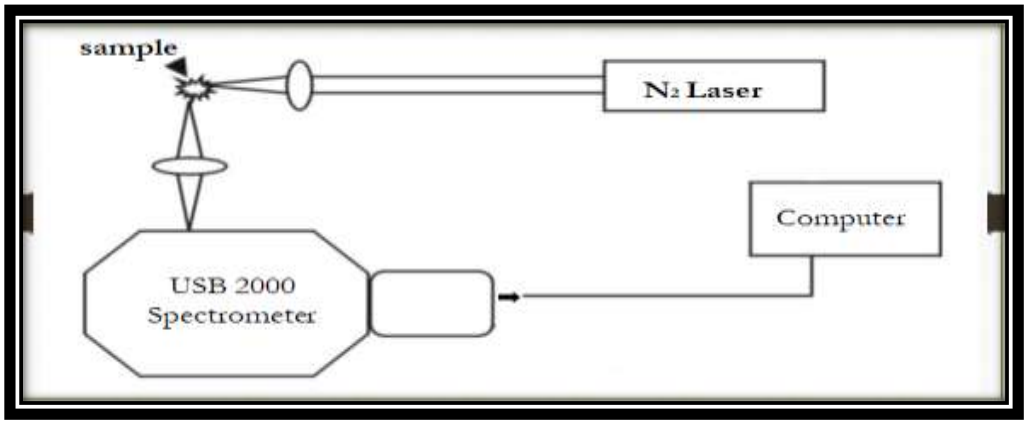

Figure (1) Layout of Laser-induced breakdown spectroscopy (LIBS) experimental setup.

3. Results

Results of the present work include the measurement the emission spectra for the **(**Barakawi) sample irradiation by (100 and 200) mJ that show in fig (2) and (3) and tableting in table (1) and table (2).

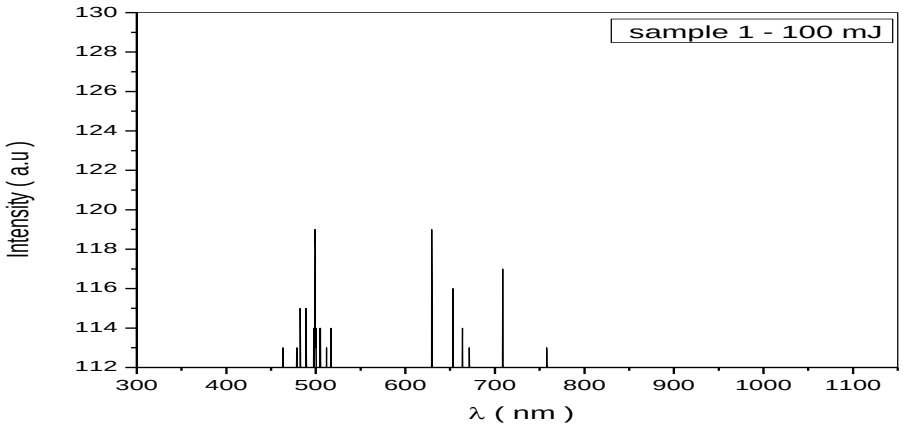

Figure (2) Optical emission spectra generated from dates fruits (Barakawi) measured by high resolution laser induced plasma spectroscopy by 100 mJ power

Table (1): Spectral lines of dates fruits (Barakawi) sample using 100 mJ and their atomic data

Element	Wavelength(nm)	Intensity(a.u)	Element	Wavelength(nm)	Intensity(a.u)
Pr I	463.9555	113.2786	Si I	500.6	114.0655
Gd I	462.4444	112.6098	Fe II	503.2444	114.1147
Er III	478.3111	113.0721	Fe II	511.9333	112.8163
Co II	480.5777	112.9836	S II	628.6666	115.8950
Xe II	483.2222	114.6557	Mo I	630.1777	119.0229
Fe I	489.6444	114.6557	Na II	652.4666	116.0229
	516.4666	114.0262	Ne II	653.9777	114.8622
	671.7333	113.1114	Cr I	663.8	114.0655
Th I	486.2444	112.5704		505.5111	114.1174
W II	499.0888	119.1409	Cu I	708.3777	116.6918
Eu I	497.5777	113.9668	V I	757.8666	113.1114

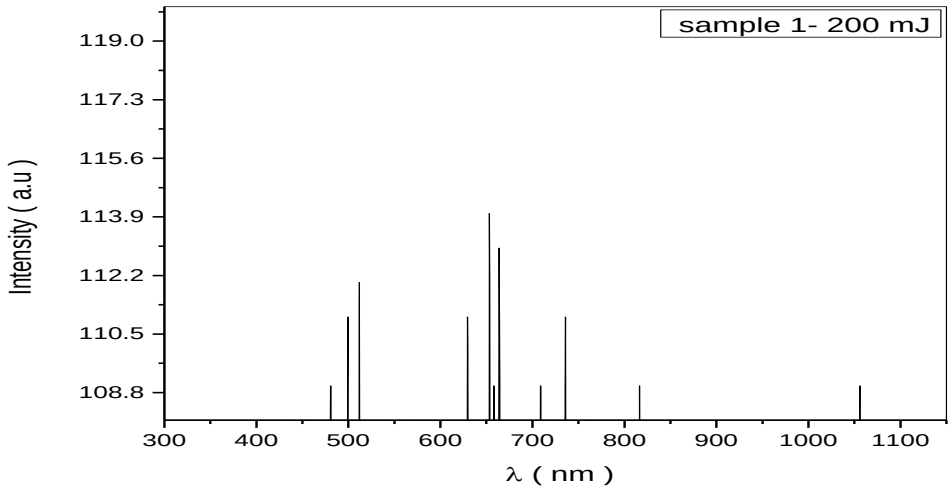

Figure (3) Optical emission spectra generated from dates fruits (Barakawi) measured by high resolution laser induced plasma spectroscopy by 200 mJ power

Table (2): Spectral lines of dates fruits (Barakawi) sample using 200 mJ and their atomic data

Element	Wavelength(nm)	Intensity(a.u)	Element	Wavelength(nm)	Intensity(a.u)
Co II	480.5777	109.1672	Xe I	663.044	113.1475
Th II	498.7111	111.0426	Np I	708.000	108.9377
Fe II	511.9333	112.1704	Pr I	709.5111	109.1672
Pr I	629.8000	111.1606	Ba I	735.9555	111.0688
Th I	653.2222	109.1409	In II	815.666	109.1409
	664.9333	112.4852	Na I	1056.689	109.2000

4. Discussion

The spectral lines of dates fruits (Barakawi) sample collected from north Sudan (Dongola) ill- saturated in Table (1) for the power 100 mJ and table (2) for the 200 mJ revealed the presence of the following many elements: (Pr, Gd, Er, Co ,Xe ,Fe, Th, W, Eu, Si, S, Mo, Na, Ne, Cr, Cu and V) for 100 mJ while when use 200 mJ power the spectral lines refer to (Co, Th, Fe, Pr, Xe, Np, Ba, In and Na). The effect of different laser power worked to hide some elements and showing other because of changed plasma temperature. All elements that showing in the results are very necessary for human health even if it is consumed in small amount Cr and Fe, Mn is doomed to be advantageous, Fe is the main component of hemoglobin and play a great role in preserving and enforcing the immune system, having too little amount of iron might develop iron deficiency anemia (National Heart, Lung and Blood Institute, 2019), Cr plays a role in glucose metabolism and Mn which helps in calcium absorption and blood sugar regulation ,also the elements (Cu, W, Fe, Xe, Th, Na, Ne, Co) in all Dates fruits samples with different irradiation pulse energy . Finally, the elements (Fe, Na, K, Mg, Cu and Ca) are important for the human body. The most of these elements could be common features of the sample or the soil.

5. Conclusions

We have performed laser induced breakdown spectroscopy (LIBS) measurements from dates fruits (Barakawi) sample by two laser power (100 and 200) mJ. We found that the dates fruits (Barakawi) sample content different elements. The change in laser power lead to appear and disappear for some elements in date fruit.

Reference

[1] A.Ndrzej and W. Miziclek, (2006). Laser-Induced Breakdown Spectroscopy (LIBS) Fundamentals and Applications, Cambridge University Press, UK.

[2] Reinhard Noll,(2012). Laser-Induced Breakdown Spectroscopy Fundamentals and Applications, Springer-Verlag Berlin Heidelberg, Germany

[3] Hamed , Aldesogi Omer , Ali, Hala Mohammed , Characterization of Adansonia digitata using Laser Induced BreakdownSpectroscopy (LIBS), Neelain Journal of Science and Technology Volume 2, Issue 1, December 2018, 42–49
[4] Sergio Musazzi and Umberto Perini, (2014).Laser-Induced Breakdown Spectroscopy Theory and Applications, Springer-Verlag Berlin Heidelberg
[5]] David A. Cremers and LeonJ. Radziemski , (2013), Handbook of Laser-Induced Breakdown Spectroscopy, John Wiley & Sons Inc, USA
[6] Taha , Maria Mohammed Ossman , (2015), Utilization of Laser Induced Breakdown Spectroscopy to detect the heavy metals and their concentrations from dairy products waste water, PHD thesis , Sudan University of Science and Technology
[7] Robert JGoldston and Paul H Rutherford,(1995).Introduction to Plasma Physics,Plasma Physics Laboratory Princeton University
[8] F. Richard , (2007), Introduction to Plasma Physics,The University of Texas at Austin
[9] A. Manickavasagan M. Mohamed Essa and E. Sukumar .**(**2012). Dates Production, Processing, Food, and Medicinal Values,ISBN-13: 978-1-4398-4947-7
[10] Amanat Ali, MostafaWaly, M. Mohamed Essa, and Sankar Devarajan.(2014),Nutritional and Medicinal Value of Date Fruit.
[11] NizarChaira, Abdessalem and Ali Ferchichi. (2009). Evaluation of untioxidant activity, phenolics, sugar and mineral contents in date palm fruits. Journal of food biochemistry 33(3),390-403.
[12] WHO, (2018). Lead poisoning and health. www.who.int.
[13] National Heart, Lung and Blood Institute,(2019), Iron deficiency anemia.www.nhlbi.nih.gov