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Study of Laser Radiation Effects on Diabetic Human Blood Using FTIR Spectroscopic Techniques

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ABSTRACT

Laser tissue interactions can be understood by using different spectroscopic techniques and Scanning electron microscope. In the present work blood samples were collected from diabetic human subjects under standard laboratory conditions. Diabetic blood samples were irradiated by HeNe (Helium-Neon) laser (wavelength λ=700 nm, Power =5 mW). The FTIR spectra of nonradiated diabetic blood samples are compared with the FTIR spectra of radiated diabetic blood samples. The significant changes are observed between the O-H(Free group),P-H(Phosphine) and C=O (amide group) due to laser radiation on diabetic blood samples for time 10 to 40 min. respectively. The decrease in percentage of transmittance for C=O (amide group) for 30 and 40 min. for diabetic blood samples shows the denaturation of proteins.

Keywords: He-Ne laser, Voltex Power supply (Model S-22), FTIR, Diabetic blood.

INTRODUCTION

Diabetes is serious disease that affects not only the patients internal organs,circulation system and eyesight but also their entire body[1]. Diabetic foot ulcers as one of the most common complications of diabetics for long lasting in diabetic patients [2].Diode lasers and free electron lasers have been important tools for advanced medical research, while pulsed lasers contributed more to laser surgery. In low power laser to have any effect on living biological system, the photons must be absorbed

by electronic absorption bands belonging to some molecular chromophores or photo acceptor [3]. Different advanced photonics methods & laser stimulation techniques are effectively used in biomedical science & clinical studies [4]. This wavelength effect is consistent with the absorption spectrum of hemoglobin, reflecting that hemoglobin may be one of the action targets under laser irradiation [5].

METHODOLOGY

Blood samples were collected from diabetic subjects from the Joshi Pathology, Pirangut-412115. Blood samples were also collected from age-matched persons. Fourier Transform Infra Red spectra were obtained using FTIR spectrophotometer (JASCO -6100) for control and He-Ne laser radiated whole (2ml) diabetic blood samples in vitro.

Experimental

The experimental set up consists of a He-Ne laser of wavelength λ=700nm, Power = 5 mW, sample holder, power supply and currents for whole blood sample. FTIR (Jasco-6100) system and scanning electron microscope (JEOI JSM -6360A) system were also part of the experimental setup. The Voltex "S" series of AC input power supplies has been given something new to this industry. They may now be plugged into any standard AC power from 115 to 240 VAC without setting any switches. It Operates most 2mW to 7mW HeNe lasers and has universal 115 to 240VAC input.

Specifications:

Input Volts: 115 to 240 VAC +/-10%.50/60 Hz
Input Current: .32 Amps at 115VAC, .16A at 230VAC*
Line filtering: Internal EMI line filter.
Remote plug: A low voltage removable plug on rear panel allows remote disconnected of AC power.
Output
Voltage: 1900-2600 VDC
Current: 4 to 7 mA . User adjustable
Start Voltage: >10KV
Output current Ripple: <5% P-P (<2% RMS.
Output Fault Protection: Open, Short, Arc
Conversion Efficiency: >85%
CDRH Delay: 3-5 seconds.
Output Connector: Alden style, high voltage

RESULTS AND DISCUSSION

FTIR spectra of normal diabetic blood without laser radiation shows the group O-H(Free group),P-H(Phosphine) and C=O (amide group) in the region between the wave number 4000 to 400cm^{-1} (Fig.1). The wave number 3319.54Cm^{-1}, 2360.93Cm^{-1} and 1643.93Cm^{-1}(table1) shows the O-H, P-H and C=O group. Fig. 2 to5 shows the HeNe laser radiation for 10, 20, 30and 40 min. respectively.

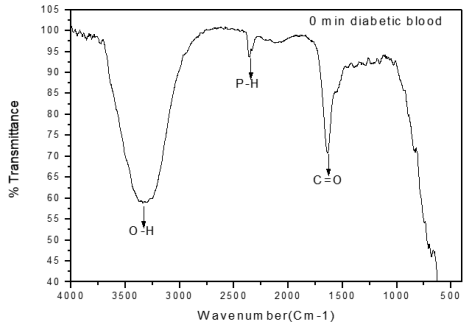

Fig 1: FTIR for diabetic Blood sample (Control)

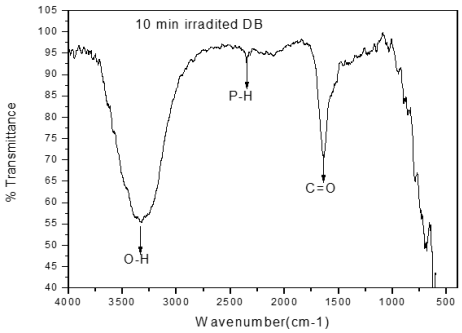

Fig 2: FTIR for radiated diabetic blood with He-Ne laser (10 min)

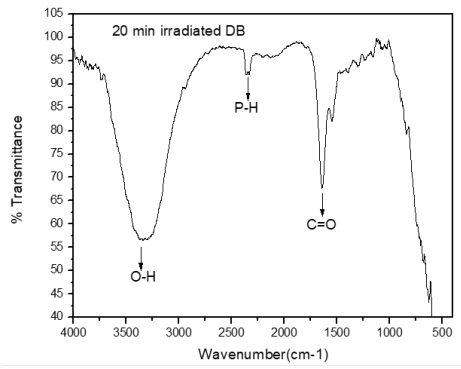

Fig. 3: FTIR for radiated diabetic blood with He-Ne laser (20 min)

Table 1: FTIR Spectra of diabetic blood (Control) & radiated with He-Ne laser for duration 10, 20, 30 & 40 minutes.

FTIR spectra Of diabetic blood				FTIR spectrum of diabetic blood radiated with He-Ne laser			
Sr. No.	Wavenumber cm^{-1}	Group	% T	Radiated Time (min)	Wavenumber cm^{-1}	Group	%T
1	3319.54	O- H (free group)	59.39	10	3330.25	O-H (free group)	56.65 ↓
2	2360.64	P-H (Phosphine)	94.04		2350.75	P-H (Phosphine)	93.38 ↓
3	1643.93	C=O (Amide)	71.47		1634.05	C=O (Amide)	70.80 ↓
4	3319.54	O-H (free group)	59.39	20	3340.13	O-H (free group)	56.43 ↓
5	2360.64	P-H (Phosphine)	94.04		2340.86	P-H (Phosphine)	92.47 ↓
6	1643.93	C=O (Amide)	71.47		1634.05	C=O (Amide)	67.60 ↓
7	3319.54	O-H (free group)	59.39	30	3299.77	O-H (free group)	58.94 ↓
8	2360.64	P-H (Phosphine)	94.04		2350.75	P-H (Phosphine)	89.73 ↓
9	1643.93	C=O (Amide)	71.47		1643.93	C=O (Amide)	65.55 ↓
10	3319.54	O-H (free group)	59.39	40	3330.25	O-H (free group)	55.74 ↓
11	2360.64	P-H (Phosphine)	94.04		2350.75	P-H (Phosphine)	91.78 ↓
12	1643.93	C=O (Amide)	71.47		1634.05	C=O (Amide)	67.82 ↓

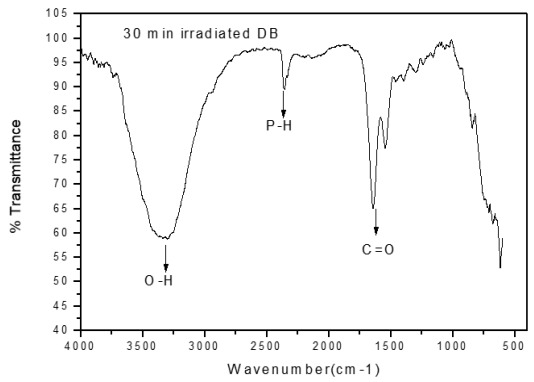

Fig.4: FTIR for radiated diabetic blood with He-Ne laser (30 min)

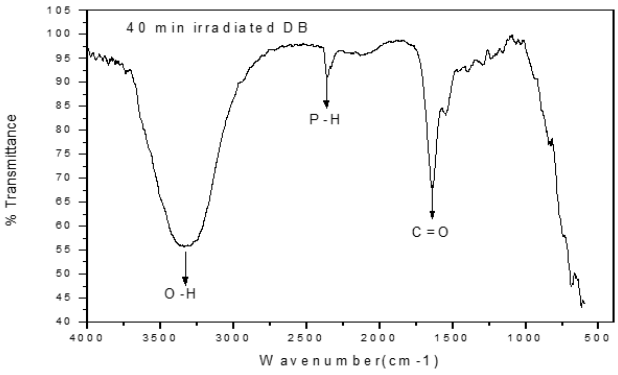

Fig.5 : FTIR for radiated diabetic blood with He-Ne laser (40 min)

The wave number 3319.54 cm^{-1} indicated O-H bonded peak. Amide I is mainly associated with C=O stretching vibrations and also related to the backbone conformation. Phosphine is mainly associated with P-H stretching vibrations. The wave numbers 2360.64 cm^{-1} & 1643.93 cm^{-1} are indicates that P-H & C=O peak. The spectral region 3400 – 2400 cm^{-1} comprises of O-H stretching vibrations of the proteins. The strong absorption band at 1643.93 cm-1 correspond to C=O stretching vibrations (amide I).

FTIR spectra of diabetic whole blood irradiated with He-Ne laser for10, 20, 30 & 40 min. duration respectively are shown in figure (2 to.5). FT-IR spectra of radiated diabetic whole blood with He-Ne laser shows transmittance decreases. The comparison of normal diabetic blood with radiated blood spectra shows the decrease in transmittance for group O-H,P-H , C=O and it shows the breaks of polypeptide bonds due to conformational changes of proteins[6,8] .

CONCLUSION

In present work we study the changes of diabetic blood before & after He-Ne laser radiation by using Fourier Transform Infrared Spectroscopy. The important groups O-H, P-H & C=O are observed in all FTIR spectra.FTIR analysis is good tool to study the molecular level changes in diabetic blood due to laser radiation.

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Conflicts of interest: The authors stated that no conflicts of interest.

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