OSTEOPOROSIS DETECTION FOR NORMAL AND ABNORMAL BIOFLUID BY FTIR

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ABSTRACT

Osteoporosis is a deadly bone disease. Early detection of this disease is an important issue for better treatment. There is for a novel technique to identify the disease at early stage. Tremendous research is going on in this aspect .However, more work is required to be done to develop cheap and reliable early detection techniques. In the present study new optical technique has been explored using optical studies.

Keywords: Osteoporosis, Blood, FTIR, UV-Visible

1. Introduction

The disease called Osteoporosis (OP) is a disorder characterized by abnormal rarefaction of the bone occurring most frequently in postmenopausal women. It is called a 'silent epidemic' or a 'silent disease'. Osteoporosis is a disease in which bone mineral density is reduced and microarchitecture is disrupted, thus bone gets impaired or porous leading to fragility of the bone. This makes the bone weaker and more likely to fracture. This deadly disease creeps silently inside the body. When the unaware patient realizes the diagnosis and treatments become unaffordable. Hence there is an urgent need for the early detection of the dangerous disease. In this study, we have made an attempt to explore the methods to optical detection using the blood analysis (Singh et.al, 2006).

2. Optical Study

The two optical techniques are used for the present study. Fourier Transform Infra-red spectroscopy can be used to identify the unique bimolecular and has been considered as an important tool for finding the abnormalities of the blood plasma or serum, based on measurements of the temporal coherence of a radioactive source, using time domain measurements of the electromagnetic radiation. Similarly, the UV-visible spectroscopy involves the photons. It uses light in the visible and adjacent near ultra violet and near infrared ranges. In the region the molecules undergo electron transition which helps characterize the molecules.

3. Method and Material

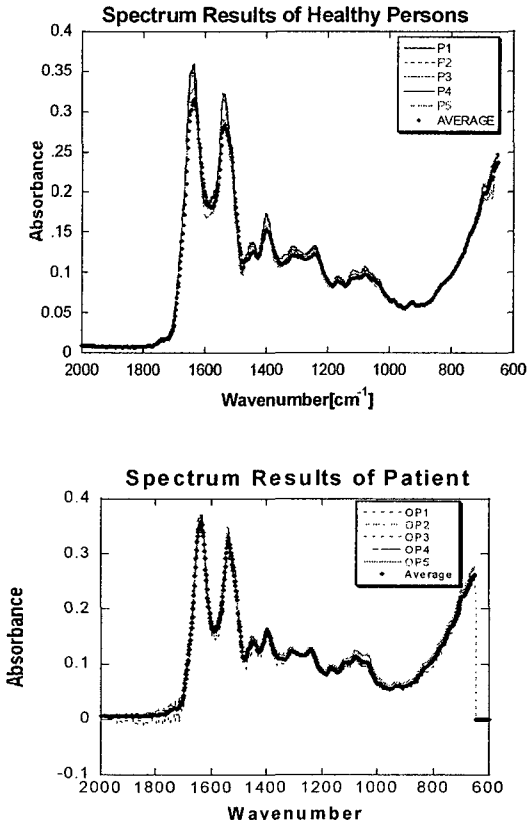
In the present study, blood samples were procured from the PNU Medical University Hospital, Busan, South Korea. The venous blood was obtained from arms of the human subjects. Approximately 3ml of blood was

obtained from each person. Blood samples were obtained from 5 healthy persons and 5 patient persons suffered from osteoporosis.

All tested persons were males and females at varied range of age between 25 and 75 years old. The blood samples were freshly centrifuged for 10 min at 3500 rpm in (model no.: KUBOTA 20101) centrifuge and the serum was removed and separated from the cellular material. The blood samples were maintained at -20°C for storage.

Serum spectra were recorded between 4 000 and 600 cm–1 using a FTIR spectrometer (model: Nicolet Thermo-electron cooperation) equipped with a KBr beamsplitter and a DTGS detector.

UV-Visible-NIR spectroscopy was used for the measurement of blood samples (model: CARY-5E).



(b)

Figure 1: FTIR Spectra of healthy and patient

4. Results

There are major variations where the absorbance is mainly due to CH2 and CH3 stretching vibrations from the lipids and proteins. The spectra are dominated by the absorbance bands at 1643 and 1544 cm_1, (Petibois, 2001) i.e. the amide I and II bands, respectively. The amide I band arises from C-O hydrogen bonded stretching vibrations, and the amide II from C–N stretching and CNH bending vibrations. Amide III band at 1270 cm^{-1} is contributed by proteins arising from coupling of C–N stretching and N–H bending, see figure 1. The new peaks were identified at 1050, 1456, 1600 in the patient's plasma which may help in identifying the biomarkers for early disease detection, see figure 2. The results were confirmed with the help of UV-Vis-NIR Spectroscopy. A new peak was identified in the range of 400-450 in the patients plasma sample, see figure 3. The results are considered to be the preliminary results but several spectral differences could be useful as biomarkers for discrimination between the two types of samples figure 3. The spectra acquisitions of the normal and abnormal samples showed the new peaks which have been due to the biomarker levels in the blood for patient.

5. Conclusions

The main emphasis is on the development of a biochip which may provide a new, early, cheap, portable point of care detection device. In this study the new optical study was explored. Spectroscopy was investigated and blood serum analysis was made. Optical techniques have been used to identifying the unique structure of the biomolecules.

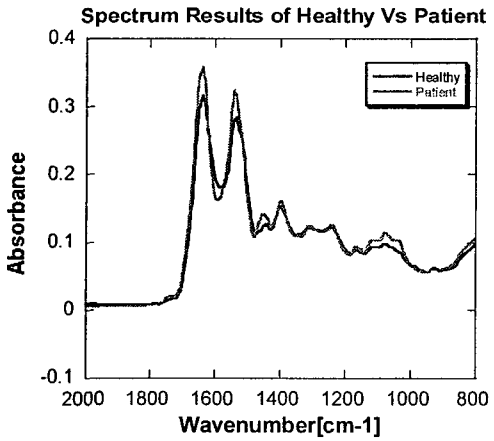


Figure2: Comparative Analysis

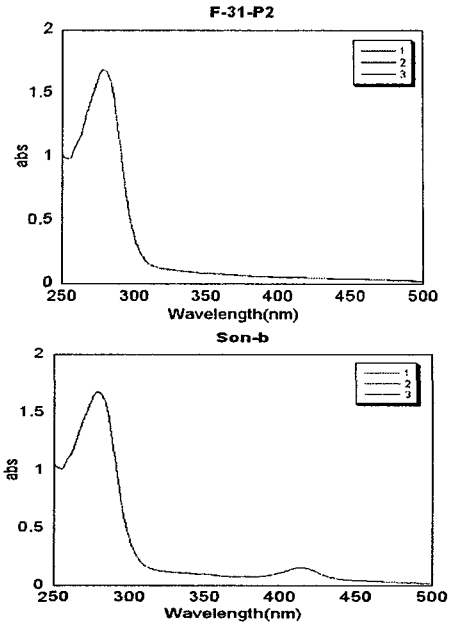


Figure 3: Healthy and Patient UV-visible spectra

6. References

1. K.Singh, S.H.Lee and K.C Kim, "Review: Osteoporosis: New Biomedical Engineering Aspects", Journal of Mechanical Science & Technology (in press), 2006.

2. C. Petibois, G. Cazorla, H. Gin, G. Deleris, J. Lab. Clin. Med. Differentiation of populations with different physiologic profiles by plasma Fourier-transform infrared spectra classification, 137-(2001) 184.

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