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A FTIR Spectroscopic Study on Quantitation of Albumin in Human Blood Serum

U. Vijaya Ushasree[1], G.Pushpa Chakrapani[2], Kaleem Ahmed Jaleeli [3], Adeel Ahmad [4]

Academic Associate, Department of Physics, Dr.B.R.Ambedkar Open University, Telangana. State, India[1]

HOD Department of Physics, Dr.B.R.Ambedkar Open University, Telangana. State, India[2]

Assistant Professor, Department Physics, Nizam College (Autonomous), Osmania University, Hyderabad, Telangana State, India[3]

Professor of Physics (Retd.), Biophysics Research Laboratory, Department of Physics, Nizam College (Autonomous), Osmania University, Hyderabad, Telangana State, India[4]

ABSTRACT: The measurement of concentration of Albumin has been achieved using FTIR Spectroscopy. The FT-IR spectra of human blood serum samples are recorded using liquid cell in Mid IR region 4000-400 cm-1.The normal blood serum is treated with Albumin at different concentrations viz 100, 200, 300, 400, and 500 and gm/dL and the FTIR spectra are recorded, which confirms the specific peak for Albumin. A graph between concentration of Albumin and intensity of absorption shows a linear relation. There is an increase in the intensity of absorption.

KEY WORDS: FT - IR Spectroscopy, Albumin, Serum.

I. INTRODUCTION

IR spectroscopy has been used by Biophysicist and Chemist as a powerful tool to characterize compounds. It has been applied in biology for studying the structure and conformation of molecules like proteins, nucleic acids and lipids. The advances made in instrumentation have paved the way for its utilization in medicine. Besides the application of FT-IR for tissue diagnostics, the investigation of body fluids has been gaining importance. The mid –IR region is very useful in the identification of disease patterns using the FT-IR spectrum of human blood serum. Precise quantification of several components such as Albumin, total protein, and urea can be achleved using FT-IR spectroscopy

II. RELATED WORK

Zhdanov et al [9] made a comparative study to determine the role of the skeletal base configuration of carbohydrate molecules, using IR and Raman spectroscopy. Theoretical calculations of the vibrational spectra of series of carbohydrates differed in the configuration of CO (CH) bonds in various positions of the pyranosering. The normal vibrations of carbohydrate molecules had, with few exceptions, close or coinciding frequencies; however, they differed greatly in the shape and contribution to the potential energy distribution(PED) of individual groups and bonds. Despite the cooperative character of the vibrations, each compound was characterized by a specific set of frequencies with'a prevailing contribution to the PED of particular CO and CC bondsof the molecule. They concluded that vibrations have a peculiar localization and that steric factors play an important role in the vibrational spectra of carbohydrates.

Minesh Patel et al [10] Studied poly acrylic acid and mucus using infrared, 1H and 13C nuclear magnetic resonance, and X-ray photoelectron spectroscopes and differential scanning calorimetry, which supported the hypothesis that hydrogen bonds, formed between the carboxylic acid functionality of the muco- adhesive material poly(acrylic acid) and the glycoprotein component of mucus, play a significant role in the process of muco-adhesion. They found fewer

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FTIR Spectroscopic Study on Quantitation of Billirubin in Human BloodSerum

[1]Dr.U. VIJAYA USHASREE, [2]Prof.G.PUSHPA CHAKRAPANI, [3]Prof.ADEEL AHMAD
[1]Department of Physics,Dr.B.R.Ambedkar Open University, Hyderabad - 500033, India.
[2]Department of Physics,Dr.B.R.Ambedkar Open University, Hyderabad - 500033, India.
[3]Biophysics Research Laboratory, Department of Physics, Nizam College (Autonomous), Osmania University, Hyderabad – 500 001, India
Email: dr_adeelahmad@yahoo.com, ulchala99@gmail.com, pushpanig@gmail.com

Abstract: *The Quantitation of Billirubin has been achieved using FTIR spectroscopy. The FTIR spectra of human blood serum samples are recorded in Mid IR region 4000-400cm^{-1}.The normal blood serum is treated with Billirubin at different concentrations and FTIR spectra are recorded, which confirm the specific peaks related to Billirubin. A plot between concentration of Billirubin and percentage of absorbance has shown linear relationship. The study being complementary to chemical analysis is very much useful for the estimation of Billirubin in the blood serum of patients suffering from diabetes and renal diseases.*

Key Words: *FTIR Spectroscopy, Quantitation, Human blood, Serum, Billirubin.*

1. INTRODUCTION:

IR spectroscopy has been used by Biophysicist and Chemist as a powerful tool to characterize compounds. It has been applied to biology for studying the structure and conformation of molecules like proteins, nucleic acids and lipids. The advances made in instrumentation have paved the way for its utilization in medicine. Besides the application of FTIR for tissue diagnostics, the investigation of body fluids has been gaining importance. The mid–IR region is very useful in the identification of disease patterns using the FT-IR spectrum of human blood serum. Precise quantification of several components such as albumin, total protein, Urea and Billirubin can be achieved using FT-IR spectroscopy.

Zhdanov et al [1] made a comparative study to determine the role of the skeletal base configuration of carbohydrate molecules, using IR and Raman spectroscopy. Theoretical calculations of the vibrational spectra of series of carbohydrates differed in the configuration of CO (CH) bonds in various positions of the pyranosering. The normal vibrations of carbohydrate molecules had, with few exceptions, close or coinciding frequencies; however, they differed greatly in the shape and contribution to the potential energy distribution(PED) of individual groups and bonds. Despite the cooperative character of the vibrations, each compound wascharacterized by a specific set of frequencies with a prevailing contribution to the PED of particular CO and C - C bonds of the molecule. They concluded that vibrations have a peculiar localization and that steric factors play an important role in the vibrational spectra of carbohydrates.

Minesh Patel et al [2] Studied poly acrylic acid and mucus using infrared, 1H and 13C nuclear magnetic resonance, and X-ray photoelectron spectroscopes and differential scanning Calorimetry, which supported the hypothesis that hydrogen bonds, formed between the carboxylic acid functionality of the muco -adhesive material (polyacrylic acid) and the glycoprotein component of mucus, play a significant role in the process of muco-adhesion. Theyfound fewer H-bonded interactions between the components than within the bulk of the pure muco-adhesive agent and pH of the medium influenced the structures of both the poly acrylic acid and the mucus, which in turn determine the nature and the extent of muco-adhesive interactions.

Davis and Mauer [3] highlighted the principles of FTIR spectroscopic analysis of bacteria; the advantagesand disadvantages of FT- IR applied to bacterial analysis; various sampling techniques; spectral manipulation statistical analysis of spectra; and applications in pathogen detection.

Jana kopikova et al [4] used FT-IR spectroscopy for the estimation of isolated high molecule fractions andalso for the identification of food hydrocolloids in confectionery jellies and food supplements. The simple comparisonof spectra of standards and samples proved that this technique is useful for the monitoring of food hydrocolloids inparticular food products.

SyedIsmailAhmadetal[5] estimated concentrationof glucose in human urine.They reported specific bandat1034 cm^{-1}for glucose and established are lation between glucose concentration in urine and Transmission(%) of IR band.

Vijaya Ushasree and AdeelAhmad[6]reported IR spectroscopic data on human blood and its constituents.IR an analysis was made on whole blood, plasma and serum. The characteristic spectral bands pertaining to fibrinogen,

Infrared Spectroscopic Study on Human Blood of Patients Suffering from Renal Failure

U. VIJAYA USHASREE[1], G. PUSHPA CHAKRAPANI[2], ADEEL AHMAD[3]
[1, 2] Department of Physics, Dr. BRAOU, Hydarabad – 500 033, India,
[3]Biophysics Research Laboratory, Department of Physics, Nizam College (Autonomous),
Osmania University, Hyderabad – 500 001, India

Abstract: *The paper reports IR spectroscopic data on blood of patients suffering from chronic renal failure. IR analysis has been made on whole blood, plasma and serum. The characteristic spectral bands pertaining to Albumin, Creatinine and Urea present in the blood are identified. The paper explores the possibility of disease analysis by IR spectroscopy.*

Keywords: *FTIR spectroscopy; Human blood; Plasma; Blood Serum; Chronic Renal failure.*

1. INTRODUCTION:

FTIR spectroscopy is being used by chemists as a powerful tool to characterize organic and inorganic compounds. IR spectroscopy was used to determine glucose concentration in dried serum [1]. IR spectroscopy is emerging as a potential diagnostic tool in the medical and pharmacological fields to provide information about the different chemical structures of healthy and pathological tissues [2]. In recent past, mid infrared and UV - Visible spectroscopy was efficiently employed in the fields of biological sciences [3]. The role of FTIR spectroscopy in diagnostic aspects involving body fluids, besides tissue diagnostic is gaining importance.

2. MATERIALS AND METHODS:

The blood samples were collected from patients suffering from Renal failure. The FTIR spectrum of blood was recorded. First, spectral grade pure KBr powder was dried in an oven up to 60 ^{0}C for 24 hours. Then 1 gm powder was taken in an agate motor and was ground until it becomes fine powder. The powder was mixed with blood sample and transferred into the bore of a cylinder so that it was distributed across the polished face of the lower plate. The polished face of the second plate towards the powder was inserted into the bore by a plunger. The die assembly was connected to a vacuum pump and was kept under vacuum for approximately 2 min so as to remove air from the sample disc. The die was dismantled and the KBr disc was removed without touching its faces.

Here, FTIR spectrometer of make Shimadzu FTIR-8400s was used. The resolution was kept at 4 cm^{-1} and scanning time was fixed at 38 sec. A total number of 32 scans were carried out on each sample. The scanning range fixed from 4000 cm^{-1} – 400 cm^{-1} for each sample.

3. RESULTS AND DISCUSSION:

Fig 1 shows IR spectrum of the blood drawn from the patients suffering from renal failure. The spectral data is presented in Table 1.

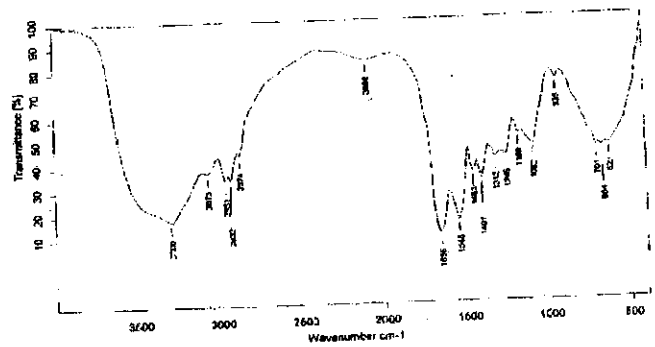

Fig. 1. A typical FTIR Spectrum of blood of Renal Failure patient

Table 1 present FTIR data on blood of patients suffering from renal failure. The data comprises wave numbers and corresponding transmittance (%) of bands concerned with characteristic vibration of functional groups of diseased blood sample.

Table 1- FTIR data on Blood of patients suffering from Renal failure

Wave Number (cm^{-1})	Transmittance (%)	Characteristic vibrations of functional groups
3362	63	N-H in $\upsilon_{(N-H)}$

BLOOD- VISCOSITY IN CANCER PATIENTS

G.PUSHPA CHAKRAPANI
Professor
Department of Physics
Dr.B.R.Ambedkar Open University, Hyderabad, Telangana State, INDIA

Abstract: Blood is a complex substance and is found in human beings and other animals. Since blood is viscous by nature ie the thickness and stickiness of an individual's blood is associated with many risk factors of health of a human being. The role of blood viscosity in maintaining good health is often neglected. Therefore it is necessary to understand the viscosity of blood, plasma and RBC and also useful to know how it affects the arterial walls in normal and cancer patients to preserve and save one's life.

In this study the viscosity of Blood of Cancer patients and its plasma and 90% of packed erythrocytes at different flow rates are studied using a simple capillary tube technique. The tool is developed based on the Poiseuille's theory to measure the coefficient of viscosity and volume flow rates of blood, plasma and 90% of packed erythrocytes at different radii of capillary tubes. The data is presented and findings and conclusions are drawn from the data and the study.

Index Terms : **Blood, Viscosity, Flow rate, Plasma, RBC**

I. INTRODUCTION

Blood is a vital fluid found in human beings. This provides important nourishment to all body organs and tissues and carries away waste materials. Human blood is a highly complex substance. There are three kinds of cells in the blood. (1) Red Blood Cells (RBC); (2) White Blood Cells (WBC); and (3) Platelets. Red blood cells carry oxygen from the lungs to the body tissues. They are major components found in the blood. White blood cells play a greater role in prevention and immunity of a disease. And platelets are important elements in the blood clotting process. There is a yellowish liquid called Plasma which consists of about 55% of human blood. The rest of the blood is made up of Red Blood Cells, known as Erythrocytes, white blood cells, known as Leukocytes and Platelets known as Thrombocytes. Plasma also contains other small molecules, including vitamins, minerals, nutrients, and waste products. Plasma is usually yellow in colour due to proteins dissolved in it.

The role of blood viscosity in maintaining good health is often neglected. Viscosity is nothing but the measure of the resistance of a fluid. The viscosity of healthy blood is low and it flows freely. Blood flow is necessary for delivering oxygen and nutrients to cells as well as clearing metabolic wastes. It would be worthwhile to note that osteoarthritis and rheumatoid arthritis are associated with an elevation of plasma viscosity (Houston et al 1949 – Gasen et al 1970) and an elevation of the degree of aggregation of red cells (Laine and Zilliacus 1950, Redioch et.al 1970). High blood viscosity always leads to a slow down of circulation and reduces oxygenation of tissues.

Wardle in 1967 suggested that it is the increased blood viscosity in the small digital arteries which is responsible for the common symptom of malignancy. Red cell aggregation, platelet aggregation and hyper-coagulability can contribute to this syndrome. Crenated red cells, raised fibrinogen, increased platelet stickiness, are all common features of malignancy.

Thus it is clearly evident that any individual's health depends upon the degree of blood viscosity. That is as long as all the nutrients contained in the blood are in good condition there is no problem with the health of an individual. If there is any change in the viscosity then definitely it affects the health of human being. The state of health always correlates inversely with the readings of blood pressure, pulse-rate, sedimentation rate, and platelet adhesion index and blood viscosity. High readings of any of these related parameters are an indication of disease whether symptoms are evident or not.

The flow rate of blood also affects the viscosity. The blood viscosity increases significantly with very low flow rates. This is because at low flow rates there are increased cell to cell and protein to cell adhesive interactions which causes erythrocytes to adher to one another and increase the blood viscosity.

Blood viscosity is one of the important contributory factors for cancer. Cancer is a class of diseases in which a cell or a group of cells display uncontrolled growth, invasion and sometimes metastasis. These three malignant properties of cancers differentiate them from benign tumours, which are self-limited and do not invade or metastasize. Most cancers form a tumour but some, like leukaemia, do not. As research develops, treatments are becoming more specific for different varieties of cancer. There has been significant progress in the development of targeted therapy drugs that act specifically on detectable molecular abnormalities in certain tumors, and which minimize damage to normal cells.

The types of cancers studied are Leukemia and Breast cancer. Leukemia can be divided into four different types. It is first classified as acute or chronic. In chronic leukemia, the leukemia cells come from mature, abnormal cells. The cells thrive for too long and accumulate. These type of cells slowly multiply. Acute leukemias, on the other hand, develop from early cells, called "blasts," which are young cells that divide frequently. In acute leukemia cells, they don't stop dividing like their normal counterparts do.

Miyapuram Ravi, Ghanta Pushpa Chakrapani, Mandava Balachandrika, Pavuluri Vasudevarao, Chendela Nageswararao, Lavudia Krishna Kishore Babu, Pulipati Mallikharjuna Prasad and Gurram Giridhar*

Photoluminescence studies on $LiNa_5(PO_4)_2:Dy^{3+}$, Sm^{3+} phosphor

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Abstract: This paper describes the preparation, structure and photoluminescence properties of a new class $LiNa_5(PO_4)_2:Dy^{3+}$, Sm^{3+}-phosphor. Crystalline nature confirmed by X-ray diffraction. The phases obtained are in good agreement with the standard phase. Excitation dependence and concentration effect on luminescence features are investigated. Color purity and optical bandgap are also estimated for the $LiNa_5(PO_4)_2:Dy^{3+}$, Sm^{3+} phosphors. The result shows $LiNa_5(PO_4)_2:Dy^{3+}$, Sm^{3+}-phosphor excited by 374 nm nUV light produces pure white light than others. Admixing of 4*f* configurations and energy transfer between dopants are identified while varying the concentration of Sm^{3+}. The CIE coordinates for $LiNa_5(PO_4)_2:0.05Dy^{3+}$, $0.05Sm^{3+}$ ($x = 0.309$, $y = 0.332$) are positioned well in white light region and very close to pure white light. The present study on $LiNa_5(PO_4)_2:Dy^{3+}$, Sm^{3+}-phosphor suggests that it is useful for the fabrication of white light emitting diodes.

Keywords: emission; excitation; phosphor; white light generation; X-ray diffraction.

1 Introduction

White light-emitting diodes (w-LEDs) have gained much attention in lighting and display applications because of their enormous features like low energy consumption, mercury-free, usage as a backlight of liquid crystal displays, traffic signals, and environmental friendliness [1]. The magnificent invention of the blue light-emitting diode by Nakamura [2], simplified the development of solid-state lighting devices.

Now a days, two major problems, tiny red and low color rendering indexes occur when a phosphor is combined with a blue LED. To overcome these obstacles, one has to follow two effective strategies [3, 4] one is to change the host network and another is to combine red color emitting rare-earth ions. In addition, it is also important to produce glare-less white light with a large emission area to protect human eyes which is possible only with a specific layered structure host [5].

Although the rare-earth ions possess unique features, Dy^{3+} has special characteristics, as it emits white light when placed in a suitable environment of the host material. To date, many researchers have reported on Dy^{3+} as a single doped and co-doped with various rare-earth ions for the fabrication of white light emission devices [6–12] and have attempted to overcome those challenges. To cater to the solid state lighting needs, it is important to produce new white light-emitting phosphors. The incorporation of Dy^{3+} is proper and effective in producing white light in a suitable host.

In recent years, phosphate based phosphors have gained much interest due to their structural feasibility in accepting foreign ions, thermal stability and higher optical absorption power. Dy^{3+} doped sodium-ortho phosphate phosphors with Mg/Ca/Sr/Ba as additives showed the variation and/or enhancement in emission intensities due to charge balance and can be tuned from cold-white to warm-white by alkali earth elements [13]. In $Sr_3Bi(PO_4)_3$: Dy^{3+} phosphor, a decrease in emission intensities due to concentration quenching was explained with multipolar interaction [14]. Furthermore, in co-doped $Na_3Sc_2(PO_4)_3:Dy^{3+}$, Eu^{3+} phosphor energy transfer is observed in between rare earth ions in white light emission and color tunability while concentration variation of dopant [15] $Na_2Sr(PO_4)F:Dy^{3+}$ phosphor demonstrated as the phosphors prepared by combustion synthesis with low

*Corresponding author: Gurram Giridhar, Department of Nanotechnology, Acharya Nagarjuna University, Nagarjuna Nagar, Guntur, Andhra Pradesh, India, E-mail: drggiridhar@rediffmail.com. https://orcid.org/0000-0001-6425-9191
Miyapuram Ravi and Ghanta Pushpa Chakrapani, Department of Physics, Dr. B. R. Ambedkar Open University, Jubilee Hills, Hyderabad, Telangana, India. https://orcid.org/0000-0002-3268-6575 (M. Ravi)
Mandava Balachandrika, Pavuluri Vasudevarao, Chendela Nageswararao, Lavudia Krishna Kishore Babu and Pulipati Mallikharjuna Prasad, Department of Physics, Acharya Nagarjuna University, Nagarjuna Nagar, Guntur, Andhra Pradesh, India; and Department of Nanotechnology, Acharya Nagarjuna University, Nagarjuna Nagar, Guntur, Andhra Pradesh, India

Article

Volume 13, Issue 2, 2023, 175

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Miyapuram Ravi [1], Ghanta Pushpa Chakrapani [2], Bezawada Mahitha [2], Karnati Srinivasulu [2], Porala Jayanth kumar [2], Gurram Giridhar [2,*]

[1] Department of Physics, Dr. B.R. Ambedkar Open University, Telangana, India

[2] Department of Nanotechnology, Acharya Nagarjuna University, A.P., India

* Correspondence: drggiridhar@rediffmail.com (G.G.);

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Keywords: phosphor; X-ray diffraction; emission; excitation; red emission.

1. Introduction

Nowadays, phosphors have great interest in the development of display and lighting devices. Various hosts like borates, aluminates, silicates, etc., are well known for commercial phosphors due to their chemical and thermal stability [1]. Among these hosts, phosphates are considered good because of their high acceptance of dopants, low synthesis temperatures, and chemical and thermal durability. So these materials are appearing continuously as potential candidates for luminescence applications. This kind of material is not only for optical applications but also useful for nonlinear optical applications with structure-property relationships [2]. Moreover, among various rare-earths ions, Eu^{3+} is an important source of red light due to its simple energy level structure, which explains the local environment of these ions with its characteristic transition intensities [3–5].

In search of high-performance phosphors for different multifunctional applications [6], Eu^{3+} doped phosphate phosphors had their significance [7,8] to support a pure white light generation [9–14]. In this context, we are working with this $LiNa_5(PO_4)_2$ host with different rare-earth ions [15]. However, no work has been reported earlier on Eu^{3+} ions doped $LiNa_5(PO_4)_2$. Therefore, this study investigated the luminescence properties with varied dopant concentrations by excitation and emission spectra with decay profiles.

2. Materials and Methods

$LiNa_{5-x}(PO_4)_2$:xEu^{3+} where x = 0, 0.1, 0.3 and 0.5 mol%; phosphors were prepared by using solution combustion method. $LiNO_3$, $NaNO_3$, Eu_2O_3, and $(NH_4)H_2PO_4$ are used to

AN IOT BASED ADVANCED WEATHER AND AIR QUALITY MONITORING AND ALERTING SYSTEM USING GSM TECHNOLOGY

R.YADAGIRI RAO[1], Prof.G.PUSHPA CHAKRAPANI[2]

[1]Head of the Dept. Humanities and Sciences, Sri Indu institute of Engineering and Technology, Ibrahimpatnam, Hyderabad
[2]Prof. Of Physics, Dean, Faculty of Sciences, Dy.D.E, Andhra Open university, Jubilee hills, Hyderabad

Abstract. One of Sustainable Development Goals (SDGs) declared by United Nation is Climate Action. Integrated climate change measurement is one of the point in this goal. The solution in this form is low cost and open source hardware to monitor weather and air quality real time. This study goals is developing Arduino platform to monitor wind speed, air temperature, air humidity, and smoke. All circuit board, electronic component specifications, and programming software are open source and freely available for anyone to use and modify. Inexpensive sensors and Arduino Uno were used to develop low-cost system. This system send data to Thing speak as Open Internet of Things (IoT) platform which provide real time data collection, data processing, and data visualization to users. This system provide a low cost solution (system cost around one million Rupiah) to monitor weather and air quality that easily deployed in the desired geographical area. The results are plotted in graphs to ease the users monitor data both locally and remotely. This system use Arduino Uno as main processor, Real Time Clock DS3231 to provide time information, anemometer to provide wind speed, DHT22 used as humidity and temperature sensor, MQ-2 used for smoke detection and CO level, and SIM900 as GSM shield for sending data to server. Results of measurements demonstrate the usefulness of this system in weather and air quality monitoring.

1. Introduction

Climate change is the defining issue in this time and the greatest challenge to sustainable development. United Nation has declared Sustainable Development Goals (SDGs) to achieve a better and more sustainable future for all. One of SDGs is Climate Action. One of the points in this goal is integrate climate change measurement [1]. Coastal area have many set of hazards that can threaten lives, property, and economies. Natural disasters and shoreline erosion are two of the main threats that coastal communities face. Coastal communities are vulnerable to hurricanes, storm, coastal flood, and high winds. These disasters can present major dangers to people along the coast [2]. Monitoring system needed to anticipate and respond to disasters. One of the kind is weather and air quality monitoring.

Weather and air quality data must be collected based on Government Regulation of The Republic of Indonesia number 46 of 2012 concerning on the implementation of meteorological and climatology observation and data management and Head of State Ministry for Environment decree number KEP-107/BAPEDAL/11/1997 concerning on technical guideline of calculation, reporting, and information standard index of air pollutants. Parameters of weather which should known are solar radiation, air temperature, air pressure, wind speed, air humidity, mass of cloud, rainfall, ocean waves, sea surface temperature, and tides. Parameters of air quality need to be measured are sulfur dioxide, nitrogen oxides and nitrogen dioxide, ozone, carbon monoxide, and chemistry composition in water.

Arduino as open source hardware has been used to produce instrument. One of the reason is efficiency in cost, large community and resources, documentation, and the ability to improve the system [3]. Arduino has been used to monitor temperature, humidity, light intensity, and smoke [4,5]. Adding wireless communication such as GSM, WiFi, and satellite in the system can be used for sending data to remote server [6-8]. Thingspeak is considered as open Internet of Things (IoT) platform consist of web services for IoT that allow users to connect their instruments and send the data to this service. Thingspeak provide real time data collection, data processing, and data visualization to their users [9].

In this paper, we propose a low cost and open source IoT system which can collect data and send it to server. Data collected in this system are wind speed, air temperature, and air humidity representing weather parameters and smoke represent the parameter of air quality. The objective of this paper is to introduce researchers and practitioners for implement Arduino platform in weather and air quality monitoring applications. Specifically, we 1) describe the Arduino development platform. 2) demonstrate monitoring system developed for weather and air quality monitoring. 3) gather data real time and online in Thingspeak.

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An International Open Access, Peer-reviewed, Refereed Journal

A STUDY ON ELASTIC AND ACOUSTIC PARAMETERS OF BLOOD AND ITS CONSTITUENTS IN CANCER PATIENTS

Dr. G. Pushpa Chakrapani[1] Dr. U. Vijaya Ushasree[2]

Professor in department of Physics[1] ·Assistant professor in department of Physics[2]

[1]Department of Physics, Dr. B. R. Ambedkar Open University, Hyderabad - 500033, India

[2]Department of Physics, Dr. B. R. Ambedkar Open University, Hyderabad - 500033, India.

Abstract : The objective of the present study is to review the elastic and acoustic parameters of blood and its constituents in cancer patients. Blood contains many chemical compounds to perform various functions. For describing the dynamics of blood flow, the viscoelastic parameters such as viscosity and elasticity should be obtained from the measurements under oscillatory shear flow.

Viscoelastic materials have interesting properties. They exhibit both viscous behaviour as well as elasticity. Because of this complex behaviour, the use of linear material properties is generally inadequate in accurately determining the final shape of viscoelastic materials, the time taken to arrive at that geometry, and the stress on the part. In these cases , the material's viscoelasticity must be taken into account in the simulation.

The paper presents the data on elastic and acoustic parameters of human blood its Plasma and 90% of erythrocytes of Cancer patients by using the Ultrasonic interferometer. By knowing the density of blood elastic constant, acoustic parameters like coefficient of absorption, modulus of elasticity and loss modulus are determined for different frequencies.

Key words: Elastic constant, absorption coefficient, modulus of elasticity and loss modulus

1. Introduction

Blood is a vital fluid found in human beings and other animals. Blood viscosity is a basic biological parameter that affects blood flow both at large arteries and in microcirculation. About 55% of the blood is composed of a liquid known as Plasma. The rest of the blood is made up of three major types of cells, as discussed above i.e. Red Blood Cells, known as Erythrocytes, white blood cells, known as Leukocytes and Platelets (thrombocytes).

Viscoelasticity is a rheological parameter that describes the flow properties of complex fluids like blood. There are two components to the viscoelasticity, the viscosity and the elasticity. From hemorheological point of view blood is considered as (1)Newtonian fluid, (2)Non-Newtonian fluid,(3) Micro polar fluid and (4) viscoelastic fluid based on the molecular composition, cellular constituents, and diameter of tube(blood vessel) in which it is flowing.

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A STUDY ON FTIR SPECTROSCOPY OF QUANTITATION OF CREATININE IN HUMAN BLOOD SERUM

[1]Dr.U. VIJAYA USHASREE, [2]Prof. G. PUSHPA CHAKRAPANI, [3]Prof.ADEEL AHMAD

[1]Assistant Professor, [2]Professor, [3]Rtd. Professor

[1]Department of Physics, Dr.B.R.Ambedkar Open University, Hyderabad - 500033, India.

[2]Department of Physics, Dr.B.R.Ambedkar Open University, Hyderabad - 500033, India.

[3]Biophysics Research Laboratory, Department of Physics, Nizam College (Autonomous), Osmania University, Hyderabad – 500 001, India

Abstract: The measurement of concentration of Creatinine has been achieved using FTIR Spectroscopy. The FTIR spectra of human blood serum samples are recorded using liquid cell in Mid IR region 4000-400 cm^{-1}. The normal blood serum is treated with Creatinine at different concentrations of Creatinine 100,200,300,400 and 500 gm/dL and FTIR spectra are recorded, which conforms the specific peak for Creatinine. A graph between concentration of Creatinine and intensity of absorption shows a linear relation. There is an increase in the intensity of absorption.

Key Words - FTIR Spectroscopy, Quantitation, Human blood, Serum, Creatinine

I INTRODUCTION

IR spectroscopy has been used by Biophysicist and Chemist as a powerful tool to characterize compounds. It has been applied to biology for studying the structure and conformation of molecules like proteins, nucleic acids and lipids. The advances made in instrumentation have paved the way for its utilization in medicine. Besides the application of FTIR for tissue diagnostics, the investigation of body fluids has been gaining importance. The mid–IR region is very useful in the identification of disease patterns using the FT-IR spectrum of human blood serum. Precise quantification of several components such as albumin, total protein, Urea and Billirubin ,creatinine can be achieved using FT-IR spectroscopy.

Minesh Patel et al [1] Studied poly acrylic acid and mucus using infrared, 1H and 13C nuclear magnetic resonance, and X-ray photoelectron spectroscopes and differential scanning Calorimetry, which supported the hypothesis that hydrogen bonds, formed between the carboxylic acid functionality of the muco - adhesive material (polyacrylic acid) and the glycoprotein component of mucus, play a significant role in the process of muco-adhesion. They found fewer H-bonded interactions between the components than within the bulk of the pure muco-adhesive agent and pH of the medium influenced the structures of both the poly acrylic acid and the mucus, which in turn determine the nature and the extent of muco-adhesive interactions.

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Viscosity of Normal Human Blood and Diabetic Blood – An Analytical Study

Dr. G. Pushpa Chakrapani
Department of Physics, Dr. B. R. Ambedkar Open University, Hyderabad - 500033, India

Abstract - **Blood is a vital fluid found in human beings and other animals. Blood viscosity is a basic biological parameter that affects blood flow both at large arteries and in microcirculation. Since blood is viscous by nature, the thickness and stickiness of an individual's blood is associated with many risk factors of health of a human being. In this study a simple technique is used to find out the viscosity of blood and its constituents at different flow rates by using normal capillary tubes, The tool is developed based on Poiseuille's theory to measure the coefficient of viscosity and volume flow rate at different radii. The data is presented and findings and conclusions are drawn from the data.**

Index Terms - **Viscosity, Flow rate, Diabetes mellitus.**

1.INTRODUCTION

Human blood is a complex substance. There are three kinds of cells in the blood. (1) Red Blood Cells (RBC); (2) White Blood Cells (WBC); and (3) Platelets. Red blood cells, which carry oxygen from the lungs to the body tissues are major components found in the blood. White blood cells have major role in disease prevention and immunity; and platelets are key elements in the blood clotting process. These blood elements are suspended in blood plasma, which is a yellowish liquid that comprises about 55% of human blood. The different kinds of blood cells have different "life spans." Red blood cells last about 120 days in the blood stream; platelets about 10 days; and the various kinds of white blood cells can last from days to years. Blood viscosity is a basic biological parameter that affects blood flow both at large arteries and in microcirculation. Since blood is viscous by nature, the thickness and stickiness of an individual's blood is associated with many risk factors of health of a human being. Under normal physiological conditions viscosity of blood varies because of many factors like gender, geography and heredity and other important factor that influences the blood viscosity is temperature. As temperature increases the viscosity decreases. Under pathological conditions the change in blood viscosity is mainly due to changes in the shear stress imparted by blood flow due to which the circulatory system and related tissues and organs damage. Plasma viscosity is determined by the concentration of plasma proteins, but the erythrocytes deformability and aggregation vary with different blood shear rates. Therefore, erythrocytes with high shear rates is a major determination of viscosity of blood.

2.MATERIALS AND METHODS

To study the rheological behaviour of blood, a simple capillary technique is used. Though Capillary Viscometry is the most traditional method for measuring the viscosity of the viscous materials, here in the present study, an open-ended capillary viscometer is used and a theory developed on the Poiseuille's theory for the of a liquid column in an open capillary tube. No external pressure is applied on the liquid column. The pressure at the two ends of the capillary tube is the atmospheric pressure. The simple capillary viscometry technique, which is employed in the study, is used to measure both viscosity and volume flow rate. The blood samples were collected from both normal and diabetic patients with Ethylene Diamine Tera Acetic (EDTA) in the powder form. Plasma was separated from blood by centrifuging. By taking out the Plasma, RBC (90% packed erythrocytes) were separated. Blood samples were prepared by mixing an equal amount of plasma and erythrocytes, by this process, Haematocrit of sample is maintained to be constant.

3.RESULT AND DISCUSSION

Table I indicates the data on coefficient of viscosity of water. Four capillary tubes of different radii i.e.

A Study on Viscosity of Normal Human Blood and Diseased Blood (Tuberculosis)

DR. G. PUSHPA CHAKRAPANI
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Indexed Terms- ***Tuberculosis, Viscosity, Flow rate***

I. INTRODUCTION

Tuberculosis (TB) is a highly contagious and infectious disease, that usually attacks the lungs. It can also spread to other parts of body like brain and spine. Mycobacterium tuberculosis, a type of bacteria is main cause for it. TB spread from person to person through the air. When people with lung TB cough, sneeze or split, they propel the TB germs into the air. A person needs to inhale only a few of these germs to become infected.

Blood viscosity is a basic biological parameter that affects blood flow both at large arteries and in microcirculation. Since blood is viscous by nature, the thickness and stickiness of an individual's blood is associated with many risk factors of health of a human being. Under normal physiological conditions viscosity of blood varies because of many factors like gender, geography and heredity and other important factor that influences the blood viscosity is temperature. As temperature increases the viscosity decreases. Under pathological conditions the change in blood viscosity is mainly due to changes in the shear stress imparted by blood flow due to which the circulatory system and related tissues and organs damage. Plasma viscosity is determined by the concentration of Plasma proteins, but the erythrocytes deformability and aggregation vary with different blood shear rates. Therefore, erythrocytes with high shear rates is a major determination of viscosity of blood.

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To study the rheological behaviour of blood, a simple capillary technique is used. Though Capillary viscometry is the most traditional method for measuring the viscosity of the viscous materials, here in the present study, an open-end capillary viscometer is used and a theory is developed based on the Poiseuille's theory for the dynamics of a liquid column in an open capillary tube. No external pressure is applied on the liquid column. The pressure at the two ends of the capillary tube is the atmospheric pressure. The simple capillary viscometry technique, which is employed in this study, is used to measure both viscosity and volume flow rate. The blood samples were collected from the patients suffering from diabetes mellitus. The samples are collected in siliconised bottles with EDTA (Ethylene Diamine Tetra Acetic) anticoagulant in the powder form. Plasma was separated from blood by centrifuging the blood at the rate of 1500 rmp about 10 to 15 minutes. By taking out the plasma, RBC (90% packed erythrocytes) were separated. Blood samples were prepared by mixing an equal amount of plasma and erythrocytes. By this process, Haematocrit of sample is maintained to be constant. In the case of Tuberculosis, samples collected from the patients are below 50 and above 30 years of age. All the samples belong to chest TB only.