

**International University of Africa**  
**Deanship of Graduate Studies**  
**Faculty of Pure and Applied Science**  
**Department of Physics**

**Biological Effects of He-Ne Laser on Human  
Blood**

**Thesis Submitted in Partial Fulfillment of the Requirement of Master Degree in  
Medical Physics**

**By**  
**Rumisa Ibrahim Mhmoud Ibrahim**

**Supervisor**  
**Dr. Abdelfatah Mohamed Mohamed Ahmed**

**November 2016**

## الآية

قال تعالى:

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

الرَّحْمَنُ (1) عَلَّمَ الْقُرْآنَ (2) خَلَقَ الْإِنْسَانَ (3) عَلَّمَهُ  
الْبَيَانَ (4)

## DEDICATION

*To my beloved father .. from whom I have learnt right and wrong*

*To my lovely mother .. for her endless giving*

*To my sisters and brothers ..*

*For sincerity and help*

*To my dear friends .. for encouragement*

## ACKNOLEGEMENTS

All thanks and praises be to Allah, the Lord of the mankind and all existing creatures. So the prayers and peace be upon mercy prophet Mohammed.

I wish to express my deepest gratitude, sincere appreciation to my supervisor Dr. Abdelfatah Mohamed Ahmed, for his constructive, valuable and inspiring guidance, suggestions, and encouragement throughout the study. Special thanks to and Mr. Abdelsakhy Sulieman for help during experimental work and thesis writing.

I express my deep thanks to my colleagues and friends for their support and all joyful moments. I am most grateful to my family, my father for his continuous support, and for being on my side throughout the research.

Last but not least my appreciation and thanks to everyone who helped me in different way during the study period.

## ABSTRACT

This research aims to study the effect of laser radiation on human blood properties. The interaction of laser with biomaterials is one of the most important areas of research in medical physics. In this study, blood samples were collected from a normal human being in a standard laboratory conditions. The blood samples was irradiation by helium neon laser pulse (wavelength = 632.8 nm, and the power = 3.2 mw) for different periods of time (10, 15, 20, 25 and 30) mentis. The absorption spectrum of blood samples was examined by using UV. VIS spectrometer and a complete blood count device (CBC). The exposed samples results was compared with control one.

The spectroscopic results showed change in the optical barometer of samples, and positive correlation between each of the absorption coefficient, extinction coefficient. The scattering coefficient increase with increasing exposure, inverse proportional in refractive index and electrical conductivity was observed after 20 minutes.

The results of the blood analysis of complete blood count device (CBC) showed change in the components and blood characteristics, where the number of red blood cells decreased significantly with increasing exposed time, either for white blood cells decreasing when exposed time increased, and also increase in the number of platelets was observed after 15 minutes and it decreased after 20 and 25 minutes and growing once again at 30 minutes. Random increasing and decreasing in hemoglobin and erythrocyte sedimentation rate was observed. The study was conclude that exposure to laser beams were changed in the optical properties and biological components of irradiated samples.

## مستخلص

يهدف هذا البحث لدراسة تأثير إشعاع الليزر على خصائص دم الإنسان. تفاعل الليزر مع المواد الحيوية أهم مجالات الأبحاث في الفيزياء الطبية. في هذه الدراسة، جمعت عينات الدم البشري السليم في الظروف المختبرية القياسية. شعت عينات الدم عن طريق ليزر الهيليوم نيون النبضي ( الطول الموجي = 632.8 نانومتر، وبقدرة = 3.2 مللي وات) لفترات زمنية مختلفة (10، 15، 20، 25 و 30) دقيقة ومن ثم درس طيف الإمتصاص للعينات باستخدام جهاز مطيافية الأشعة فوق البنفسجية وجهاز تحليل الدم (CBC). وقورنت مع عينات لم تعرض للتشعيع كمجموعة ضابطة.

أظهرت نتائج التحليل الطيفي حدوث تغيير في طيف الإمتصاص للعينات المشعة بالليزر حيث أوضحت الدراسة علاقة طردية ما بين كل من معامل الامتصاص و معامل التمدد ومعامل التشتت و زيادة جرعة أو زمن التعرض لأشعة الليزر، أما معامل الانكسار والموصلية الكهربائية فقد لوحظت علاقة عكسية بعد الدقيقة 20 و زمن التعرض لأشعة الليزر . أما نتائج تحليل الدم أظهرت تغير في مكونات و خصائص الدم حيث تناقص عدد كريات الدم الحمراء بشكل ملحوظ مع زيادة زمن التعرض لشعاع الليزر، أما بالنسبة لكريات الدم البيضاء تناقص عددها بزيادة الزمن ، ولوحظت زياده في عدد الصفائح الدموية عند الدقيقة 15 وتناقصت بعدها في الدقيقة 20 و 25 وتزايد مره اخرى عند الدقيقة 30، ولوحظ تزايد وتناقص بشكل عشوائي في الهموكلوبين ومعدل الترسيب. خلصت الدراسة الي أن التعرض لأشعة الليزر يحدث تأثيرا واضحا في خصائص ومكونات الدم التي درست.

# LIST OF CONTENTS

Content	Page
Quran	I
Dedication	II
Acknowledgement	III
Abstract	IV
Arabic Abstract	V
List of contents	VI
List of figures	IX
List of tables	XI
<b>CHAPTER ONE</b>	
1.1 Introduction	2
1.2 Research Problem	3
1.3 Objectives	3
1.3.1 General Objective	3
1.3.1.1 Specific Objectives	3
<b>CHAPTER TWO</b>	
2.1 Helium-Neon Lasers	4
2.2 Spectroscopy	6
2.3 Classification of methods	8
2.4 Blood	11
2.5 Blood Components	11
2.5.1 Plasma	11
2.5.3 White Blood Cells (leukocytes)	13
2.5.4 Platelets (Thrombocytes)	14
<b>CHAPTER THREE</b>	
Materials and Methods	17
3.1 Material and Apparatus	17
3.1.2 Principles	17
3.2 Method	17
<b>CHAPTER FOUR</b>	
<b>RESULTS AND DISCUSSION</b>	
4.1 Introduction	18
4.2 Results	18



## LIST OF FIGURES

Figures	page
Figure 2.1: Components of the Blood	12
Figure 2.2: Red Blood Cells	13
Figure 2.3: White Blood Cells	14
Figure 2.4: Platelets	15
Figure 1.3 Experimental setup	17
Figure 3.2 Sample when irradiated	17
Figure 4.1: Absorbance spectra of blood samples irradiated by (He-Ne – laser 3.2 mW-PW)	18
Figure 4.2: the variation of absorption coefficient ( $\alpha$ ) Vs ( $\lambda$ ) for blood samples irradiated by( He -Ne –laser 3.2 mW-PW )	19
Figure 4.3: The variation of extinction coefficient (K) with wavelength ( $\lambda$ ) for blood samples irradiated by (He -Ne –laser 3.2 mW-PW)	20
Figure 4.4: The variation of refractive index (n) with wavelength ( $\lambda$ ) for blood samples irradiated by (He -Ne –laser 3.2 mW-PW )	21
Figure 4.5: Plot of electrical conductivity ( $\sigma$ ) as wavelength ( $\lambda$ ) for blood samples irradiated by (HeNe – laser 3.2 mW-PW) period time 10,15,20,25 and 30 min ) and compeer with control sample is non-radiated	22
Figure 4.6: The variation of scattering coefficient ( $\mu_s$ ) with wavelength ( $\lambda$ ) for blood samples irradiated by(He-Ne–laser 3.2 mW-PW)	23
Figure 4.7: The variation of number of RBCs with time for blood samples irradiated by (He-Ne–laser 3.2 mW-PW)	24
Figure 4.8: The variation of number of WBCs with time for blood samples irradiated by (He-Ne–laser 3.2 mW-PW)	25
Figure 4.9: The variation of number of PLT with time for blood samples irradiated by (He-Ne–laser 3.2 mW-PW).	26
Figure 4.10: The variation of HCT% with time for blood samples irradiated by (He-Ne–laser 3.2 mW-PW)	27





## LIST OF TABLES

TABLES	page
Table 4.1: refractive index of samples at 510nm	22
Table 4.2: Electrical conductivity of samples at 510nm	23
Table 4.3: Scattering coefficient of samples at 510nm	24
Table 4.4: Complete Blood Count (CBC) for different samples	24