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Study and Analysis Growing of E.Coil Bacteria and Effected of HeNe Laser

Asma Almontasser [1], S. H. Alsamhi[2] and Yas Alhadithi[3]

[1] Physics Department, IBB University
[2] Electronics Engineering, IIT(BHU),
Varanasi, UP, India
[1,2] IBB University, Yemen
[3] Department of physics, Milano University,
Italy, Iraq

Abstract

Laser is a light amplification by stimulated emission of radiation. It is risky to hazardous laser radiation to person exposed to it. Even if the low power laser beams can be unsafe to human being eyesight. Helium Neon (HeNe) laser is gas laser whose gain medium includes a mixture of helium and neon (10:1) inside of a small bore capillary tube. It is usually excited by a DC electrical discharge and the pressure inside the tube is 1 mm of Hg. The most widely used HeNe laser operates at a wavelength of 632.8 nm in the red part of the visible spectrum. In this paper, the effected of HeNe laser on the growth of Escherichia coli (E.coil) bacteria has been studied with considering the radiation of HeNe laser is λ=632.8 nm and the distance between HeNe and E.coil bacteria 25Cm. The result shown that E.coil Bacteria has not been effected because of the power which is used 1Mw.

Keywords: light amplification by stimulated emission of radiation (laser), Helium Neon (HeNe), Escherichia coli (E.coil) bacteria.

1. Introduction

Actually, there are two type of radiation, an ionizing and non-ionizing radiation and both are harmful to the natural environment with different effecting[1]. Generally, ionizing radiation is far more harmful to living organisms per unit of energy deposited than non-ionizing radiation. The ions which are produced at low radiation power leave behind atoms[2].

Non-ionizing radiation refers to electromagnetic radiation which does not carry enough energy per quantum to ionize atoms. It used for remove an electron from an atom[3]. The electromagnetic radiation has sufficient energy only for excitation, the movement of an electron to a higher energy state. There are two main regions for Non-ionizing spectrum: optical radiation and electromagnetic fields [3].

Ionizing radiation has a higher energy than nonionizing radiation and has enough energy to ionize atoms. The radiation of non-ionization with particle or photon energies is less than 10 electron volts(eV) [3]. Therefore, it can cause burns, radiation sickness, cancer and genetic damage. However, the International Agency for Research on Cancer recently stated that non-ionizing radiation could cause cancer in humans.

Laser treatment may enhance growth and resistance to fungal infection of hard wheat seeds studied in [4]. In 2002, Effects of 810 nm laser irradiation on in vitro growth of bacteria [5]. A low-intensity red laser at the low fluencies used in phototherapy has no effect on growth, but induces Fila mentation and alters the topological forms of plasmid DNA in E. coli cultures depending on the DNA repair mechanisms[6].Our study is concerned with the study of the biological effect of HeNe laser especially in growing E-coil bacteria.

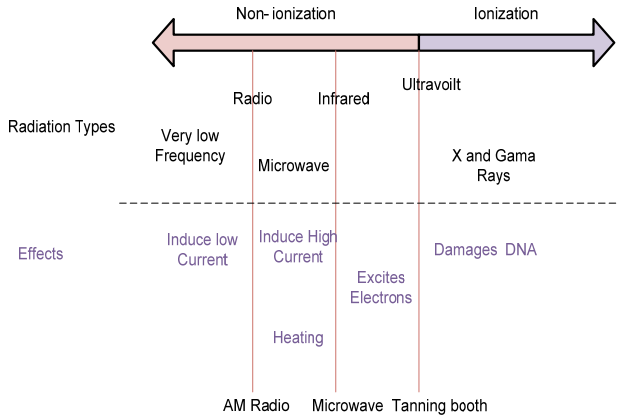

Fig.1. Type of radiation in the electromagnetic spectrum

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The rest of this work is organized as the following: section 2, described and explain laser and its application and biological effects are described in section3. In section 4, biological effect and non-ionizing radiation describes in section 5. Explanation of E. coil is in section 6. Methodology is described in section 7. Finally, the result and conclusion is shown in section 8 and section 9, respectively.

2. Laser

Laser is a device which emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. It emits light coherently, thus it differs from other light sources. The advantages of coherence light are the following: 1) Focused to a tight spot, 2) Beams stay narrow over long distance, 3) Enabling laser cutting and lithography. In fact, it is the most sought-after tool in metal-working, entertainment electronics, optical communications and bloodless surgery, weapon guidance in wars and in a wide variety of other fields.

2.1 HeNe Laser

The HeNe laser emits light at 1.15 μm and in the infrared spectrum. It uses wavelength of the 633 nm line which has the highest gain. The 3.39 μm transition has a very high gain but is prevented from lasing in an ordinary HeNe laser since the cavity and mirrors are loss at that wavelength. Therefore, HeNe laser operates at a wavelength of 632.8 nm in the red part of the visible spectrum.

2.1.1 Interaction laser with tissue biological

Laser beam aimed at tissue to perform a specific task. As the energy reaches the biological interface, one of four interactions will occur: reflection, transmission, scattering, or absorption.

1. Absorption: Specific molecules in the tissue known as chromospheres absorb the photons. In this practical case, each wavelength has specific chromospheres that absorb their energy. This absorbed energy is converted into thermal and and/or mechanical energy that is used to perform the work desired.
2. Reflection: it is usually an undesired effect. The laser beam bounces off the surface with no penetration or interaction at all.
3. Transmission: energy of laser can pass through superficial tissues to interact with deeper areas.
4. Scattering: Energy of laser enters the target tissue will scatter in various directions.

When laser heats oral tissues, certain reversible or irreversible changes can occur:

i. Hyperthermia – below 50 degrees C
ii. Coagulation and Protein Denaturation – 60+ degrees C
iii. Vaporization – 100+ degrees C
iv. Carbonization – 200+ degrees C

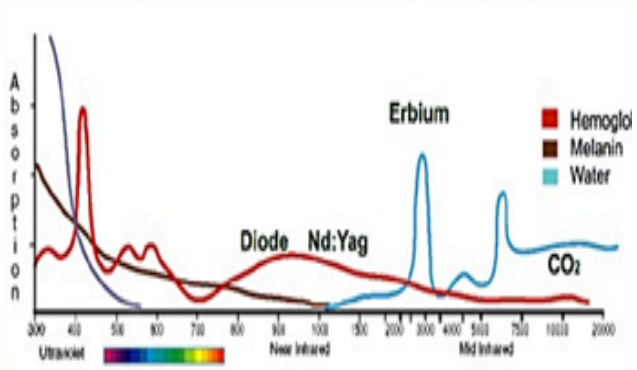

Fig.2. Chromophores

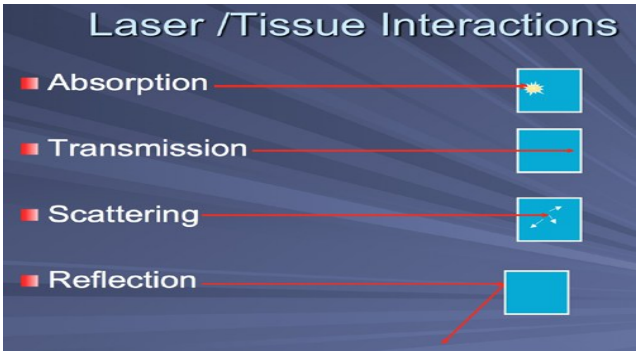

Fig.3. the four tissue interactions

2.1.2 Applications of Laser

Laser has many significant applications in common devices, communications, medicine and military. In common consumer devices, laser is available in such as optical disk drives, laser printers, and barcode scanners. For communications, laser is used for both fiber optic and free space optical communication. On the other hand, laser is used in medicine for laser surgery and various skin treatments, and in industry for cutting and welding materials. Finally, it is used in military and law enforcement devices for marking targets and measuring range and speed. Laser lighting displays use laser light as an entertainment medium.

3. Biological effects

There are five important types of biological effects that can occur due to enter the laser photons to the tissue: fluorescence, photo thermal, photo disruptive, photochemical, and photobiomodulation.

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3.1.1 Fluorescence

Fluorescence occurs when actively carious tooth structure is exposed to the 655nm visible wavelength of the Diagnodent diagnostic device. The amount of fluorescence is related to the size of the lesion, and this information is useful in diagnosing and managing early carious lesions.

3.1.2 Photo thermal

Photo thermal happens when the chromospheres absorb the laser energy and heat is generated. This heat is used to perform work such as incising tissue or coagulating blood. Heat is generated during these procedures and great care must be taken to avoid thermal damage to the tissues.

3.1.3 Photo disruptive

Photo disruptive is little bit more difficult to understand. Hard tissues are removed through a process known as photo disruptive ablation. Short-pulsed bursts of laser light with extremely high power interact with water in the tissue and from the hand piece causing rapid thermal expansion of the water molecules. This shock wave creates the distinct popping sound heard during erbium laser use. Thermal damage is very unlikely as almost no residual heat is created when used properly, particularly when the concept of thermal relaxation is considered.

3.1.4 Photochemical

Photochemical happens when photon energy causes a chemical reaction. These reactions are implicated in some of the beneficial effects.

3.1.5 Photobiomodulation

It refers to lasers speed healing, increase circulation, reduce edema, and minimize pain. They occur mostly through photochemical and photo biological interactions within the cellular matrix and mitochondria.

4. Biological effect and non-ionizing radiation

There is no controversy that the upper frequencies of non-ionizing radiation near, these energies are capable of non-thermal biological damage, similar to ionizing radiation. Therefore, Health debate centers on the non-thermal effects of radiation of much lower frequencies. However, the International Agency for Research on Cancer recently stated that non-ionizing radiation could cause cancer in humans.

The biological systems due to low-power ionizing and non-ionizing radiation, is not settled. Controversy continues about possible non-heating effects of low-power non-ionizing radiation, such as non-heating microwave and radio wave exposure. On the other hand, Biological effects of ionizing radiation in humans, due to physical and chemical processes, occur immediately following the passage of radiation through living matter. For acute whole-body exposures above a few gray from radiation of low linear energy transfer (LET), damage occurs principally as a result of cell killing. This can give rise to organ and tissue damage and, in extreme cases, death.

A second type of damage can occur at late times after exposure which is the nuclear material in the cell, causing radiation-induced cancer to develop in a proportion of exposed persons or hereditary disease in their descendants. Although, The probability of both cancer and hereditary disease increases with radiation dose.

Result in human exposure to a laser beam to make one or more of the following risks:

1-Damage of the eyes.
2-skin damage.
3- burns of the body.

This is done by: -

A) cut living tissue: identifies cutting depth by the ability of the laser intensity and exposure time of the laser.
B) Evaporation: The fall of lasers lead to quick transfer of heat from the laser to the cells and lead to:

- the complete destruction of the cell proteins and the cell itself as shown in Fig.4.(a).
- heating water to the boiling point cells. as shown in Fig.4.(b).
- Explosion of the cell and threw steam and cell debris. as shown in Fig.4.(c).

Fig.4. (a).Cell absorbed laser causing destruction due to boiling.

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Fig.4. (b). Blast cell and throwing steam and cell debris.

Fig.4. (c). The steam rising from the area of debris and c harred as a result of the interaction of laser.

C) Coagulation can coagulate vessels O.5 mm diameter immediately after exposure to the laser.
D) lead to tearing of membranes.

5. E.Coil

E. coli bacteria normally live in the intestines of healthy people and animals. Most varieties of E. coli are harmless or cause relatively brief diarrhea. But a few particularly nasty strains, such as E. coli O157:H7, which can cause severe abdominal cramps, bloody diarrhea and vomiting. E. coli can cause an infection even if you ingest only small amounts. Because of this, you can be sickened by E. coli from eating a slightly undercooked hamburger or from swallowing a mouthful of contaminated pool water. Potential sources of exposure include contaminated food or water and person-to-person contact.

6. Methodology

The following steps describe the procedure of growing E.coil bacteria and laser effect:

1) Prepare the culture medium according to instructions on the box.
2) Collect the samples of E.Coli bacteria from sewage.
3) Inject macconky broth by loop, which include E.Coli.
4) Implant that bacteria in Eeusin methyllene blue (E.M.B) by streaking method as shown in Fig.5.
5) Check the color of culture medium after growing bacteria.
6) Prepare dilution from 1up to 6 to reducing the concentration of E.Coli bacteria.
7) Using publishing manner for implant E.coil
8) After growth E.Coli, expose it to the HeNe laser in same distance and different time period with keep one of Petri dish is control for all dilution.
9) Numerate number of remaining colonies after exposure to the HeNe laser.

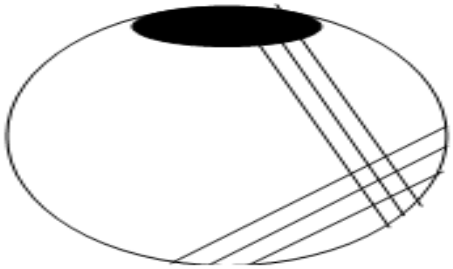

Fig.5. implant of bacteria

7. Result

In Fig.6 there is many colonies outgrowth have green color and luster inside E.M.B culture medium.
To ensure bacterias are E.coli , In Fig.7 and Fig. 8,the color of macconkey broth changed from purple to yellow color that means there was E.coli bacteria growth inside it.

In fig.9 after dilution to reduce concentration of bacteria colonies and growth that bacteria inside E.M.B .we exposed that bacteria to HeNe laser and used counting device to Numerate number of colonies before and after exposure to the HeNe laser we got to no level effect on that bacteria .

Fig.6.E.Coil after growth inside E.M.B culture medium

Fig.7. Before growth E.Coli inside M.B culture medium.

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Fig.8. After growth E.Coli inside M.B culture medium .

Fig.9. After growth E.Coli inside E.M.B culture medium.

8. Conclusion

It is shown that the effect low power laser on bacteria E.Coli is experimentally. In presence HeNe laser, when we exposed the E.Coli bacteria to the HeNe laser there was no notice level effect on that bacteria because the power that applied was 1Mwbut if the laser power is more than 1Mw, the growing E. Coil may be affected.

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