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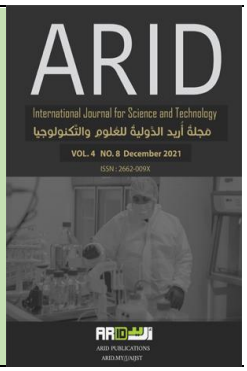

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

رسالة المحرر في العدد الثامن لمجلة أريد الدولية للعلوم والتكنولوجيا

على بركة الله نقدم للباحثين أبحاث العدد الثامن لمجلة أريد الدولية للعلوم والتكنولوجيا، والتي زاد عددها إلى عشرة أبحاث بدلا من ستة أبحاث لأن المجلة تتجه للدخول إلى قواعد البيانات العالمية ويتطلب أحد شروط سكوبس نشر 20 بحثا سنويا.

أما رسالتنا في هذا العدد فتتركز حول أهم وظائف المستقبل الأكثر طلباً وتوجيه الدعوة لجامعتنا لهذه التخصصات.

لقد طُرِحَ في مؤتمر الوظائف العالمي العام 2019م عشرة وظائف سوف تسود العالم في العام 2024-2025م، ولكن أزمة كورونا عجلت الموضوع، والسؤال كيف ستكون وظائف المستقبل الأكثر طلباً؟

تعتبر أتمتة الروبوتات (Robotic Process Automation) من الوظائف التي ستحل مكان المهن اليدوية، حيث في القطاع الطبي يستخدم الروبوت داخل غرف العمليات، وفي مختبرات وعيادات الأسنان، وفي الزراعة فالروبوتات ستكون الرقم 1.

والذي يبرمج الروبوت هو تخصص الذكاء الصناعي، وهي رقم 2 من الوظائف التي دخلت في العالم بقوة ولذلك الوظائف القادمة ستعتمد على التكنولوجيا خاصة أول 6-7 وظائف.

أمـــا الوظيفـــة الثالثـــة هـــي التـــي تتحـــدث عـــن البيانـــات الضـــخمة (big data) والأمـــن الســـيبراني وتقـــدر اســـتثماراتها بمليـــارات الـــدولارات تقـــوم بهـــا شـــركات قواعـــد البيانـــات لمؤسســـات ووزارات مهمـــة بالدولـــة، ومنها نظم للمعلومات والنظم الإدارية.

وتخـــتص الوظيفـــة الرابعـــة بالطابعـــات ثلاثيـــة الأبعـــاد ففـــي القطـــاع الهندســـي تســـتخدم فـــي تصـــميم وبنـــاء المنـــازل حيـــث يحتـــاج ذلـــك بالعـــادة مـــدة ســـنة بينمـــا يـــتم الآن التصـــميم والبنـــاء فـــي أســـبوعين مـــن خـــلال هـــذه الطابعـــات، وتكـــون الجـــودة أفضـــل والســـرعة أكثـــر والكلفـــة أقـــل، وتتجـــه الآن الكثيـــر مـــن شـــركات المقـــاولات إلى الطباعة الثلاثية الأبعاد في الهندسة كما دخلت مجالات الصناعة في مصانع المعدات الآلية.

ويعتبـــر مجـــال إنترنـــت الأشـــياء الوظيفـــة الخامســـة وأبســـط تطبيـــق عليهـــا هـــو نظـــام التموضـــع العـــالمي (GPS) حيـــث لا يمكـــن الـــذهاب لأي مكـــان بـــدون الـــ (GPS) فاصـــبحت الألـــة المبرمجـــة هـــي التـــي تقـــود. وهنـــاك تطبيقـــات أخـــرى ربمـــا غيـــر شـــائعة فـــي مجتمعنـــا مثـــل اليكســـا التـــي تـــدير بيـــت كامـــل فـــي أمريكـــا، وحتـــى ثلاجة المنزل تقوم بطلب المواد وتدفع على الفيزة وتصل الطلبات إلى المنزل.

والوظيفـــة الأخـــرى هـــي العمـــل فـــي الواقـــع الافتراضـــي (Virtual Reality) وكـــل تخصـــص عليـــه أن يرتبط بالواقع الافتراضي، وأن يفهمه المهندس والطبيب وهذا الواقع هو الذي يجمع العالم.

أمـــا وظيفـــة الواقـــع المعـــزز (Augmented Reality) فـــيمكن قيـــام أفـــراد مـــن عـــدة دول بســـفرة ســـياحية لزيـــارة مـــثلا رومـــا ويتفـــاعلون، ولكـــن يبقـــى كـــل واحـــد جـــالس فـــي بلـــده، وعنـــد رغبـــة أحـــدهم بشـــراء عطـــر مـــن محـــل فـــي رومـــا، فـــيمكن تحويلـــه مـــن مستشـــعر (sensor) إلـــى حالـــة رقميـــة (digital) وإذا كـــان عنـــد هـــذه الشـــركة مستشـــعر فـــي مدينـــة ذلـــك الشـــخص، فســـيتم إرجـــاع الحالـــة الرقميـــة إلـــى استشـــعار حالـــة الشـــم، ويمكـــن تحسس العطر بالفعل هناك.

كمـــا لا ننســـى وظيفـــة الطاقـــة المتجـــددة والبديلـــة لأن العـــالم يمـــر بضـــائقة المـــوارد، ويتجـــه لكـــل مـــا يتعلـــق بهندسة البيئة والاستدامة.

ولا يـزال التعلـيم رقـم 10 لأن المعلـم هـو الـذي يخـرج كـل هـؤلاء وهـو المؤهـل تكنولوجيـاً، ولـم تعـد الأميـة عـدم القـراءة والكتابـة، إنمـا هـي الأميـة الرقميـة، وحتـى المصـطلحات بـدأت تتغيـر وكنـا نتحـدث فـي العـام 2018-2019 عن الاقتصاد المعرفي والأن الحديث عن الاقتصاد المعرفي الرقمي.

ولـذلك فـإن رسـالتنا إلـى الجامعـات هـي التوجـه لعمليـة تعليميـة عاليـة الجـودة مـن حيـث التعلـيم والـتعلم، وإعـداد خريجـي المسـتقبل ليكونـوا مقتـدرين علـى تقـديم المعـارف والخبـرات التكنولوجيـة لمجتمعـاتهم، وينشطون في فرص النمو المهني والبحثي والابتكاري تمزج ما بين النظرية والتطبيق التكنولوجي.

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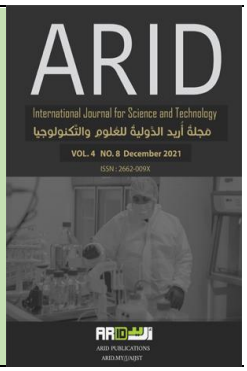

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العدد 8 ، المجلد 4 ، كانون الأول 2021 م

The Educational Aspects of Electronic Components and Their Related Circuits

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الجوانب التعليمية للمكونات الإلكترونية والدوائر المرتبطة بها

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Abstract

In the modern age, it's almost impossible to imagine a world without electronic items and devices. We take it for granted at the forefront of practical technology, improving daily-based used devices and systems from individual electronic components to the smallest circuit boards for new smartphone systems, with innovation to meet society's communication, technology and energy needs. Therefore, thousands of students, each year, are required to gain in-depth knowledge and experience of basic and high skills of electronic equipment and devices. But the fear and apprehension of the use of electronic pieces, particularly during the online teaching with the difficulties of accessing the laboratories due to the COVID-19 situation, maybe one of the problems of students as they feel that the use of these pieces is difficult and needs external expertise to do them. Nevertheless, nowadays teaching electronics and providing informative sources to a wide spectrum of students from high school, college, and university levels at different departments became an important need for capacity building and training programs. In this article, an informative review of the electronics components and devices supported with simulation results using the Proteus design suite is provided that is useful for both high-level secondary school and the wide level of undergraduate and postgraduate university students.
The research paper has referred, as much as possible, to the hierarchy and the cognitive sequence of using these electronic components such as resistors, capacitors, diode, transistors etc. It is also referred to some electronic circuits and devices such as electronic generator, switching, amplifier that are designed and implemented using the Proteus software which taking into account the learning outcomes and most important physical parameters that can be obtained from each electronic circuit. Then a microprocessors circuits and Arduino have been provided as a compact electronic board for wide range of electronic applications.

Keywords: Electronics components, transistors, resistors, diode, integrated circuit, microprocessors circuits, Proteus and Arduino.

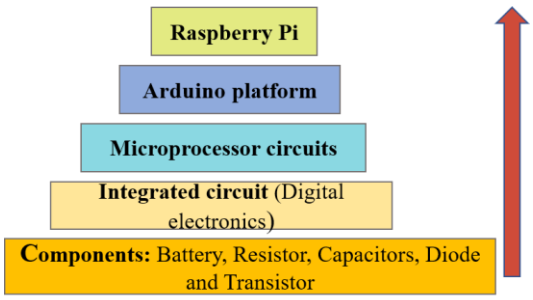
الملخص:

في العصر الحديث، يكاد يكون من المستحيل تخيل عالم بدون عناصر وأجهزة إلكترونية، نحن نعتبر ذلك أمراً مسلماً به في طليعة التكنولوجيا العملية، لتحسين وتطوير الأجهزة والأنظمة الإلكترونية المستخدمة في حياتنا اليومية من المكونات الإلكترونية الفردية إلى أصغر لوحات الدوائر المستخدمة في أنظمة الهواتف الذكية الجديدة، مع الابتكارالمستمر لتلبية احتياجات المجتمع من الاتصالات والتكنولوجيا والطاقة. لذلك، يُطلب من الآلاف من الطلاب وفي كل عام، اكتساب خبرة ومعرفة متعمقة بالمهارات الأساسية والعالية للمعدات والأجهزة الإلكترونية. لكن الخوف والتخوف من استخدام القطع الإلكترونية، خاصة أثناء التدريس عبر الإنترنت مع صعوبات الوصول إلى المختبرات بسبب حالة COVID-19 ، ربما تكون إحدى مشاكل الطلاب حيث يشعرون بصعوبة استخدام هذه القطع ويحتاج إلى متخصص خارجي للقيام بذلك. لذلك، أصبح تدريس الإلكترونيات في الوقت الحاضر وتوفير مصادر إعلامية لمجموعة واسعة من الطلاب من المدارس الثانوية والكليات والجامعات في الأقسام المختلفة حاجة مهمة لبناء القدرات وبرامج التدريب. في هذه المقالة، نستعرض مراجعة غنيةً بالمعلومات لمكونات الأجهزة الإلكترونية والمدعومة بنتائج المحاكاة الحاسوبية باستخدام برنامج Proteus والتي تكون مفيدة لكل من المدارس الثانوية عالية المستوى وطلبة الجامعات من الدراسات الأولية والعليا في تخصصات متعددة. أشارت الورقة البحثية، قدر الإمكان، إلى التسلسل الهرمي والتسلسل المعرفي لاستخدام هذه المكونات الإلكترونية مثل المقاومات والمكثفات والصمام الثنائي (الدايود) والترانزستورات وما إلى ذلك، كما تمت الإشارة إلى بعض الدوائر والأجهزة الإلكترونية مثل المولد الإلكتروني والمفتاح الإلكتروني، مكبر للصوت الذي تم تصميمه وتنفيذه باستخدام برنامج Proteus مع مراعاة نتائج مخرجات التعلم وأهم المعلمات الفيزيائية التي يمكن الحصول عليها من كل دائرة إلكترونية. أيضاً، في هذه المراجعة البحثية، تم توفير معلومات عن دوائر المعالجات الدقيقة و Arduino كلوحة إلكترونية مدمجة لمجموعة واسعة من التطبيقات الإلكترونية.

1. Introduction

Paper Structure and Learning Outcomes:

This paper provides a review and provision information of key electronic components and devices with validation of the electronic circuits using Proteus simulation, hence, provide a compact online solution for electronics laboratories at the engineering and science undergraduate students, particularly, during the COVID-19 pandemic time and lockdown. Proteus simulation is a good opportunity to encourage students to build a virtual electronic circuit and run it using the proteus simulation, therefore, helping them to study their practical module as well as build new electronic circuits and systems. This step will help students with self-learning and feel like a part of a learning community and also present an overview of the key features of the electronic fundamentals that students can refer back to. However, the paper is structured as shown in the chart below.



The structure includes the importance of the electronics components with their connection such as the serial and parallel resistors and capacitors connection that are delivered to school students in the high-level to build their knowledge. It also includes the transistors, analog, gates, and digital electronics that have been taught to different academic levels at the university since the 70th of the last century to train students in the designing and implementation of different electronic devices such as an audio amplifier, switching, and so on so far. The Proteus design

software tool has been used in this paper to simulate some circuits and devices, hence presenting the output results in the form of figures and curves. Moreover, this review also contains the recent new built-in devices such as Arduino and Raspberry pi that have been implemented and become more popular than anticipated for student projects and postgraduate research as well as for young and community hobbies.

Therefore, the learning outcomes of this paper are to be able to:

- Explain how electronic components work such as a resistor, diode, capacitor, and transistor.
- Demonstrate and understand the fundamentals of analogy and digital circuits.
- Demonstrate and understand the Microprocessors and Arduino circuits.
- Help a wide spectrum of students about creating, designing, and characterize circuits, devices, and projects.
- Understand the online teaching with the difficulties of accessing the laboratories due to the COVID-19 situation.

2. Electronic Components:

I. Electrical Battery is an electronic component that contains single or many electrochemical cells and external wire connections [1] which converts the stored chemical energy into electrical potential energy through a transient chemical process, after which their activity ceases. This energy is accessible through two terminals, called poles, electrodes, or terminals. One of them is a positive pole which is named the cathode and the other is a negative pole which named anode as shown in the common schematic symbols in Fig. 1 [2]. These two terminals are connected to two different types of metallic plates, called electrodes, that are submerged in chemical materials inside the battery.

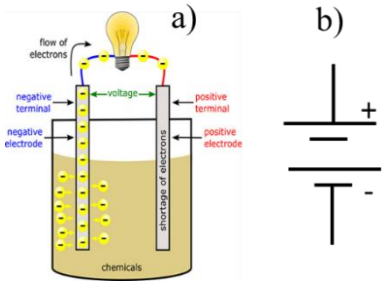
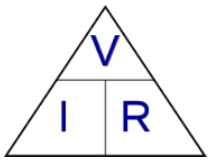


Fig. 1: (a) battery chemical cell and (b) battery schematic symbols.

The chemical liquid interacts with the metals, causing electrons to overflow to build upon the negative electrode (terminal) and producing a lack of electrons on the positive electrode (terminal). Therefore, the negative terminal is the source of electrons flow through an external load circuit such as a lamp to the positive terminal allowing the current to flow from the positive to the negative. In the case of connecting to the external load, the redox interaction will convert high-energy reactants to lower-energy products, hence, the free-energy difference will transfer to the external load circuit in the form of electrical energy [3].

II. Resistor (R): is two terminals passive electrical component that represents the electrical resistance as a circuit member. It is used in the electronic and electrical circuits to reduce current flow from the positive to the negative and hence adjust the flow levels of the electrons. It is also used as a voltage divider, bias active elements, gain controller, and terminate transmission lines, among other uses. It has two common schematic symbols (Fig. 2a) when using it in the circuit diagram. Resistors can have a fixed value which only changes slightly with high temperature, long time, or high operating voltage; It can also have a variable value that can be used to adjust current flow in the circuit such as in temperature (heat) sensing devices, position lighting, humidity sensing, tunable amplifier or chemical activity. The electrical resistance unit is the Ohm as in the symbol of Ω. The ideal resistor behaved according to the relationship specified

by Ohm's law which states that "the current through a conductor between two points is directly proportional to the voltage across the two points" as follow [4, 5]:



$\boldsymbol{V = I \,.\, R}$ Ohm's law triangle

Where V is the applied voltage, I is current flow in the circuit, and R is the resistance. The equation interchangeability can be illustrated by a triangle shape above.

Resistors can be connected in series and parallel in the electronic circuit [6, 7]. In series-connected as shown in Fig. 2b, the total resistance is the sum of their resistance values, the current is the same across each resistor and voltage is the adding up across each resistor. While in the parallel connection as shown in Fig. 2c, the total resistance is the reciprocal of the sum of the reciprocals of the individual resistors, the current adds up and voltage is the same across each resistor. Table 1 illustrates the features of both series and parallel resistors connection.

The Power dissipation by the resistor is calculated as $P = IV$, hence can be derivative from Ohm's law to become $P = I^2R$ or $P = V^2/R$, where V is the voltage across the resistor and measured by Volts unit, I is the current passing through the same resistor and measured by amper. This kind of power will convert to thermal energy (heat) which needs to dissipate by the resistor's package or heat sink before the temperature rises dramatically.

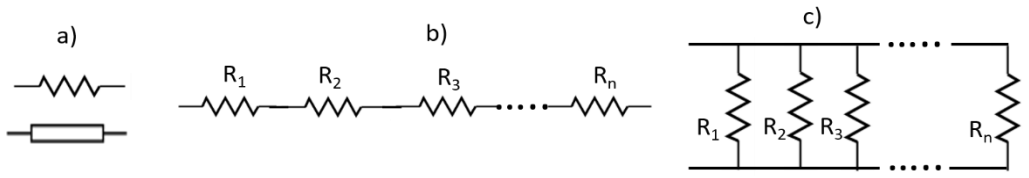
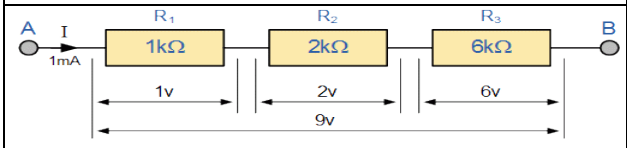
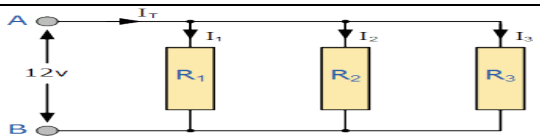


Fig. 2: a) Resistor schematic symbols; b) series connection of the resistors; and c) parallel connection of the resistors.

Table(1): Resistor series and parallel connection features.

Resistor series connection features	Resistor parallel connection features
$\boldsymbol{R_T = R_1 + R_2 + R_3 + - - - - - + R_n}$	$\boldsymbol{\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + - - - - + \frac{1}{R_n}}$
$I_T = I_1 = I_2 = I_3 = - - - - - = I_n$	$\boldsymbol{I_T = I_1 + I_2 + I_3 + - - - - - + I_n}$
$\boldsymbol{V_T = V_1 + V_2 + V_3 + - - - - - + V_n}$	$\boldsymbol{V_T = V_1 = V_2 = V_3 + - - - - - + V_n}$
	

In electronics, current-voltage which is called I-V characteristic curve is one of the main graphical curves that could be utilized to define and describe the process and behavior of any electronic component (resistors, diode), circuit (amplifiers), and devices (semiconductors, lasers diodes and solar cells). So, the I-V curve can help students to understand the behavior of the current and voltage combinations in the electronic circuit. Students can also learn from the I-V curve about determining the circuit operation.

For instance, the I-V characteristics of the electronic circuit [8] in Fig 3 a) illustrate the link between the current passing through the resistor and the voltage across the same resistor. So, with the implementation of Ohm's electronic circuit and simulate it using Proteus 8 software, I-V characteristic curves can be generated as shown in Fig. 3b) and students can learn the followings:

- The current flow through the resistor is a function of the voltage across the same resistor and it is clearly can demonstrate this visually in the linear characteristics curve on both I (forward bias) and III (backward bias) regions.
- In the other words, based on Ohm's law, the flowing current through the resistor is increasing by increase the voltage across the resistor.
- Students can construct from the graph the linear relationship between the voltage and the current (fitting line or slope; V/I) which represents the value of R while 1/R is the relationship between the current and the voltage (inverse of the slope; I/V).

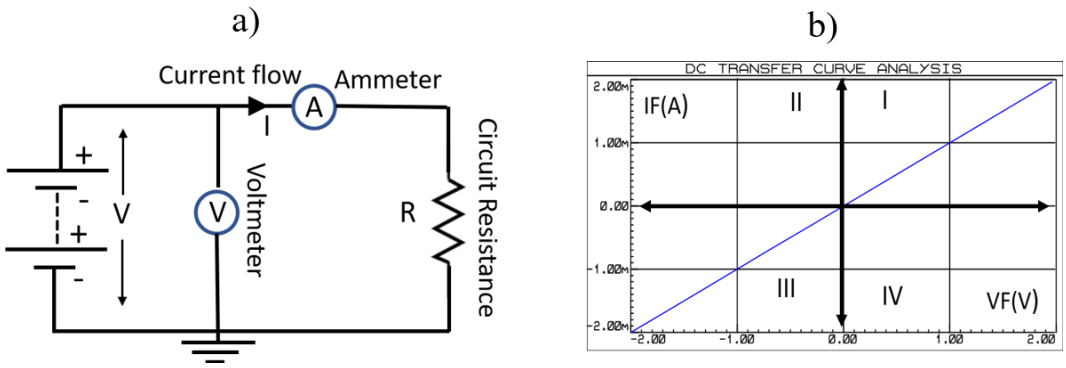


Fig. 3: a) Simple Ohm's electronic circuit [8] and b) its I-V characteristic using Proteus 8 software.

III. Capacitors (C): is a passive component with two distinguished terminals (plats), one is positive and another is negative, The main capacitors task is to store the electrical energy and supplied to the circuit in the form of the electric field. It can also have a fixed and variable value as shown in the common symbol in Fig. 4a. In contrast to the resistance, an ideal capacitor does not suffer from energy dissipation, while in reality, actual capacitors suffer from a very low energy dissipation. When the voltage from the battery is applied across the capacitor two terminals, charges flow onto and from the plates and create an electrical potential difference between the plates. Hence, an electric field develops through electron charge separation where a

net positive charge accumulates around one plate and the net negative charge accumulates around the second plate. An ideal capacitor is characterized by a constant capacitance (C) that also measures the amount of electrical energy stored (or separated) for a given electric potential. C which is measured in Farads defined as "the ratio of the positive or negative charge Q on each conductor to the applied voltage *V*" as given below [9]:

$$C = Q/V$$

It can be described as the ability of a body to hold an electric charge. Unlike the resistors, using the schematic diagram in Fig. 4b, capacitors connected in series reveal that the total series is smaller than any of its capacitors in the circuit because it is the reciprocal of the sum of the reciprocals of the individual capacitors. The total capacitor charge is the same as every charge in the circuit. So, the total voltage difference from end to end is the sum of the voltage for every single capacitor. Whereas, the total capacitors connected in parallel as shown in the schematic diagram (Fig. 4c) is the sum of their capacitances values which mean that each capacitor contributes to the total capacitor value, while the charge is distributed among them by size and each capacitor has the same applied voltage. Table 2 illustrate the features of both series and parallel resistors connection

The energy that the capacitor can store is [10] $\frac{1}{2}QV = \frac{1}{2}CV^2$

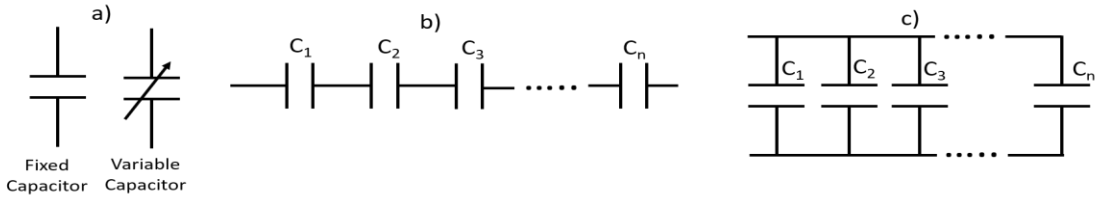
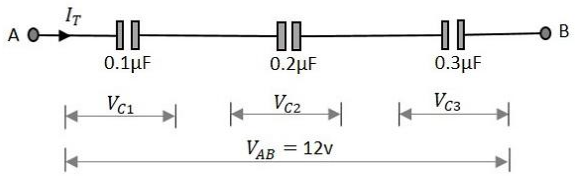
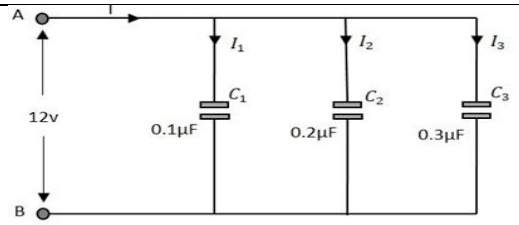


Fig. 4: a) Fixed and variable capacitors schematic symbols; b) capacitors series connection; and c) capacitors parallel connection.

Table (2): Capacitors series and parallel connection features.

Capacitors series connection features	Capacitors parallel connection features
$\frac{1}{C_T}=\frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}+-----+\frac{1}{C_n}$	$C_T = C_1 + C_2 + C_3 + ------ + C_n$
$I_{CT} = I_{C1} = I_{C2} = I_{C3} = ------ = I_{Cn}$ $Q_{CT} = Q_{C1} = Q_{C2} = Q_{C3} = ---- = Q_{Cn}$	$I_{CT} = I_{C1} + I_{C2} + I_{C3} = ---+ I_{Cn}$ $Q_{CT} = Q_{C1} + Q_{C2} + Q_{C3} + ------ + Q_C$
$V_{CT} = V_{C1} + V_{C2} + V_{C3} + ------ + V_{Cr}$	$V_{CT} = V_{C1} = V_{C2} = V_{C3} + ------ + V_{Cr}$
	

IV. Diode (D): is an active electronic component with two asymmetric conductance terminals. Idea diode has low resistance in one terminal that allows the current to pass forward, and high resistance in the other terminal that prevents the current from passing backward. A crystalline semiconductor diode [11] is the most commonly used type today with a positive (p)–negative (n) junction as shown in Fig. 5a, where the empty circles on the left-side represent the holes and the filled circles on the right side represent the electrons. The depletion layer (region) causes by holes that recombined with free electrons (n-type, negative signs) and electrons that recombined with free holes (p-type, positive signs). Such recombination originates a p-type layer to be negatively charged and the n-type layer to be positively charged forming the depletion region with a potential difference of about 0.7 V (separation between the p-type and n-type materials). Due to this potential difference, a very small current will flow, and for this reason, an external voltage supply such as a battery that should have a higher potential difference

can be used to increase the current flow. However, the diode diagram is shown in Fig. 5b clarifies the p-n diode symbol with two terminals' names anode which is the positive, and cathode which is negative. However, when the circuit is forward-biased by the applied voltage, the current will flow from p-type towards n-type in the direction of the orange arrow. The diode can also be designed to emit light and called a light-emitting diode (LED) as in Fig. 5c. The main difference between the diode and LED is that the diode allows the current to pass through only one direction and prevents it in the opposite direction while the LED works based upon the electroluminance phenomenon where the semiconductor material emits light when electrons and holes integrated under the influence of the applied voltage as in the LED in the TV remote control and laser pointer.

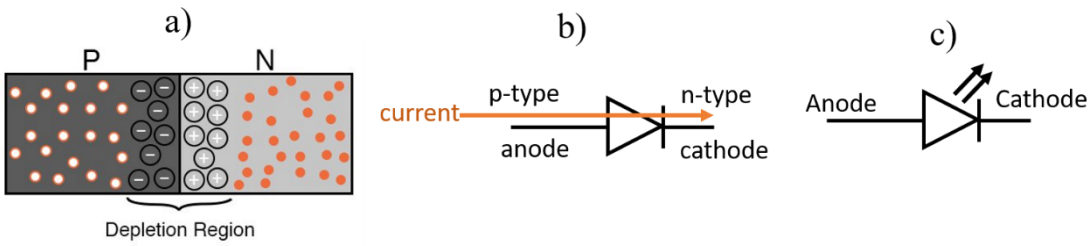


Fig. 5: a) P-N diode junction, b) diode schematic symbols; c) Light-emitting diode schematic symbols.

When the diode is forward biased in the circuit such as in Fig. 6 a), by means of anode positive to the cathode, a forward current passes through the diode and operates in the top right quadrant of its I-V characteristics curves shown in Fig. 6 b) [8]. By simulating the circuit in fig. 6 a) using Proteus 8 software simulation, we plot the I-V characteristic and students can learn from this curve the followings:

- Compared to the I-V linear curve for resistor, diode I-V characteristic curve is nonlinear behavior on both I (forward bias) and III (backward bias) regions.

- In case of the diode is forward biased, the forward current will not change from zero till the applied voltage exceeds the 0.7V of the internal barrier, after that the current will increases dramatically with a distinctly small increase in the applied voltage forming a straight-line upward with fitting line intersect the x-axis at 0.7V (the "knee" point on the right side of Fig. 6b)[11].
- On the other side, in the case of the diode is backword (reversed) biased, the diode blocks the current (I=0) until the applied voltage exceeds the breakdown voltage which is -0.7V, the reverse current also increases rapidly forming straight-line downward in the lower left quadrant (shaded as a grey).
- This reverse breakdown voltage point is utilized for good effect with Zener diodes [11].

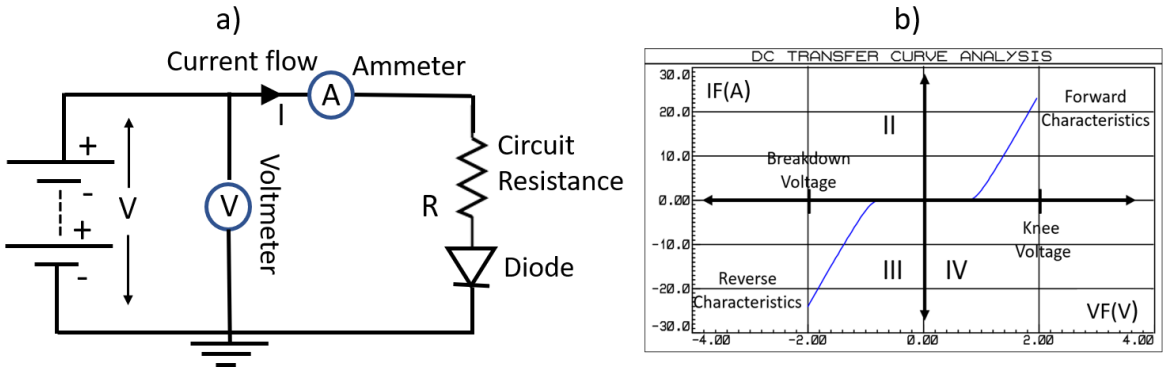


Fig. 6: a) Simple diode-based electronic circuit [8] and b) its I-V characteristic using Proteus 8 software.

V. Transistor (T_r): is a semiconductor active device with three terminals named Base, Collector, and Emitter to connect with the external circuit. The Tr can be placed in the electronic circuit depends on the application, it works as a switch, amplifier, and power controller. It is composed of semiconductor material (silicon, germanium, and some other semiconductor materials) usually with at least three terminals (Base, Collector, and Emitter) for connection to an external circuit. Transistors can be NPN as shown symbol in Fig. 7a or PNP in

Fig. 7b. For instance, Tr works as a switch by controlling the output voltage or current between the collector and emitter terminals via control the small voltage or current at the base terminal (that is, flowing between the Base and the Emitter) [12]. Likewise, due to the controlled output voltage or current is higher than the input voltage or current, hence produce a stronger output signal. The Tr works here as a signal amplifier and this property is called again which is proportional between the high output signal to the weak input signal as shown in Fig. 7c [13]. For example, in this circuit, a microphone transferred the vocal sounds into an electrical signal which can be amplified using a transistor in some useful way and hence feedback to a loudspeaker, which would replicate the tones originally picked up by the microphone. From this circuit, students can learn:

- How to build a car and mobile audio stereo amplifier.
- They also can learn how to control the gain value which is the division of resistor value between Base and Collector (1.2kΩ) over resistor between Base and Emitter (220Ω) which gives a gain of 5.45.

Alternatively, the transistor can be used as an electrically controlled switch in the circuit to turn the current on or off where the amount of current is determined by other circuit elements. For a field-effect transistor (FET) in Fig. 7d, which is a type of transistor that uses the electric field to control the current flow, has three terminals which are labelled gate, source, and drain. likewise NPN and PNP terminology, FETs can be also N-channel and P channel to control the current flow by the application of a voltage to the gate, which in turn alters the conductivity between the drain and source. However, transistors have developed electronics generations and revolutionized smaller and cheaper devices such as computers, radios and calculators, among

other things. Today, many Tr can found instilled in integrated circuits or could also be packaged individually.

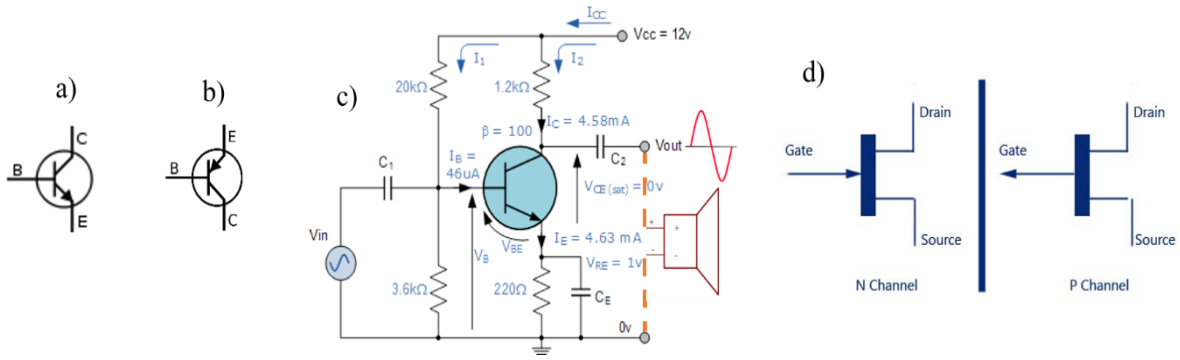


Fig. 7: a) NPN transistor schematic symbols (arrow towards outside); b) PNP transistor schematic symbols (arrow towards inside); c) audio amplifier using the transistor [13] and d) N and P-channel FET.

Figure 8 shows the simulation results using Proteus 8 software for output characteristics for common PNP and NPN configuration.

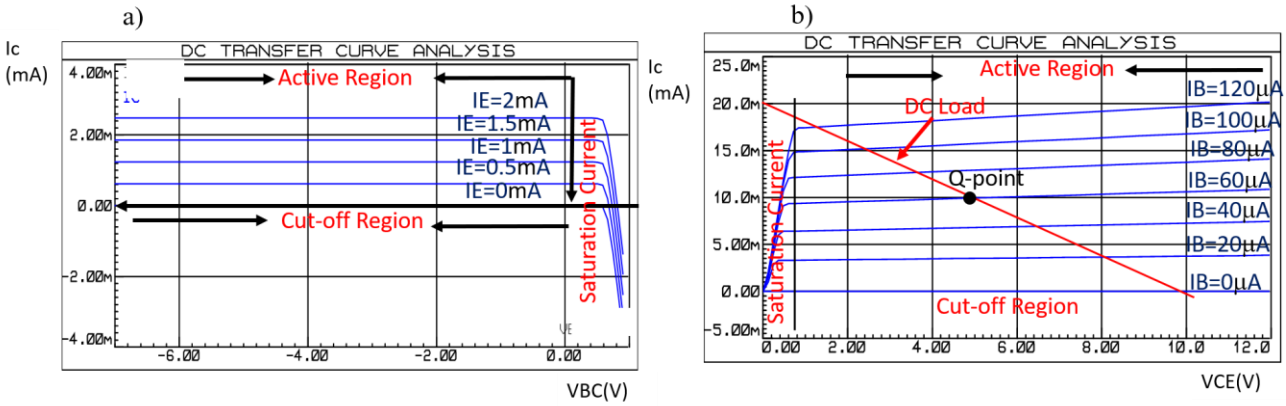


Fig. 8: Output results characterization of a) PNP configuration; b) NPN configuration using Proteus 8 software.

From these two figures, students can learn from these figures the followings:

- For PNP transistors, the curve (Fig. 8 a) is plotted between the output current (I_C) and input voltage (V_{BC}) for different input Emitter current (I_E) values (0-2.5mA).

- For NPN transistors, the curve (Fig. 8 b) is plotted between the output current (I_C) and output voltage (V_{CE}) for different input Base current (I_B) values (0-120μA).
- Both transitions output characteristics curves have three regions of interest stated as an active or operation region, cut-off region when the Tr acts as an 'OFF' switch, and saturation region when the Tr acts as an 'ON' switch.
- In the Cut-off region, both the Base Emitter junction and Collector Base junction are reverse biased ($V_{CC}=V_{BC}$ for PNP and $V_{CC}=V_{CE}$ for NPN; because $I_c=0$), while in the saturation area, both the Base Emitter junction and Collector Base junctions are forward biased ($V_{CC}=I_CxR_L$; because V_{BC} and $V_{CE}=0$ for PNP and NPN respectively).
- Whereas in the active region, the Base Emitter junction is connected in the forward-biased whereas the collector-base junction is connected in the reverse-biased ($V_{CC}=I_CxR_L+V_{BC}$ for PNP and $V_{CC}=I_CxR_L+V_{CE}$ for NPN) [14].

More information about the open/closed transistor switching characteristics is explained in table 3.

Student can build up their practice transistor switching as shown in Fig. 9. In this figure at the cut-off region, the transistor is off because the input base current (I_B) and output collector current (I_C) are zero. This means that the maximum voltage across the collector and the emitter are V_{CC} as the current is not passing through the device due to the large depletion layer. Therefore, the transistor is switched "fully-off". While in Fig. 9 b) at the saturation region, the transistor is biased with the maximum value of I_B, which results in a maximum I_C. This means that the collector-emitter voltage is dropped to a minimum and hence a maximum current passing through the transistor because the depletion layer is as small as possible. Therefore, the transistor is switched "fully-on".

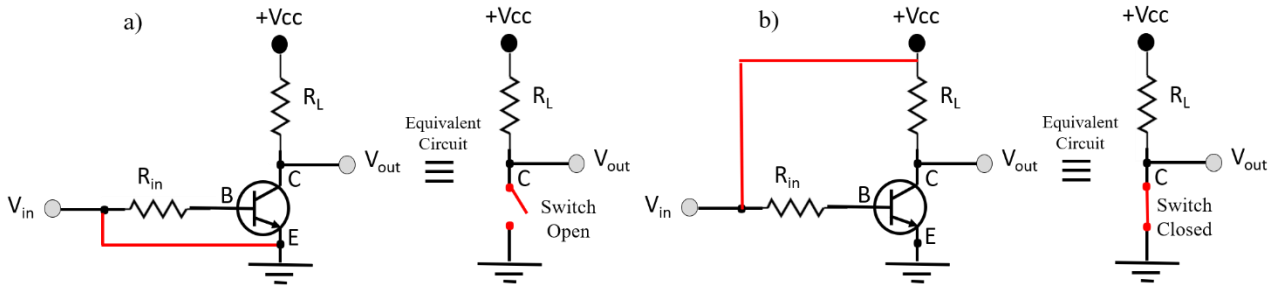


Fig. 9: a) Cut-off Characteristics; b) Saturation characteristics [14].

Table (3): The characteristics differential between open and closed switching transistors.

Cut-off Characteristics (open switch)	Saturation characteristics (closed switch)
The Base is at 0V	The input and Base are connected to V_{CC}
Base-Emitter voltage $V_{BE} < 0.7V$.	Base-Emitter voltage $V_{BE} > 0.7V$
Base-Emitter junction is reverse biased	Base-Emitter junction is forward biased
Base-Collector junction is reverse biased.	Base-Collector junction is forward biased
The transistor is OFF in this region (Cut-off region)	The transistor is ON in this region
The Collector current flows is zero ($I_C = 0$)	Max Collector current flows ($I_C = Vcc/R_L$)
$V_{OUT} = V_{CE} = V_{CC} =$ ”1″	$V_{OUT} = V_{CE} =$ ”0″ (ideal saturation)
Transistor operates as an “open switch”	Transistor operates as a “closed switch”

VI. Integrated circuit (IC): ICs are mainly taught to a higher level at the university level and also are widely used in student graduate projects and postgraduate research studies. It is a set of active components (e.g., transistors and diodes) and passive components (e.g., capacitors and resistors) with multi-terminals that fabricated as a single flat chip, or a microchip that build upon a thin substrate of semiconductor material that is normally silicon by

using a lithography technique. The integration of large numbers of these electronic components into a very small chip results in circuits that are orders of magnitude smaller, faster, and less expensive than those constructed of discrete electronic components. Today, ICs lead to the revelation of the electronics world and developed the generation of mobile phones, computers, TVs, and other digital home devices which are now inextricable in modern societies. ICs can be either Transistor–transistor logic (TTL) [15] or metal oxide semiconductor (MOS) [16] integrated circuits. ICs can be either analog or digital circuits. Analog, or linear, circuits usually utilise only a few electronic components. Generally, analog ICs circuits are used as a signal generator as shown in Fig. 10 a) and Fig. 10 b) of the NE556 schematic symbol and the circuit diagram of the dual signal generator. By implementation and simulating the circuit in fig. 10 a), a student here can learn the followings:

- How to operate the single or dual signal generator to generate a square pulse.
- Practices the electronics components and IC connections as well as supplying the right value of the voltage to the circuit.
- Calculate the signal generated by the IC556 using the following equation. Here we use R_1=R_2= R_3=10KΩ and C=0.1μF, hence generating a pulse period of 1.91 ms (as shown in Fig. 10 e) which corresponding to the frequency of 523 Hz compared to 2.08 ms which is corresponding to the frequency of 480 Hz (with a percent error of ~8%) based on the calculation from the equation below:

$$t = 0.693x3RxC_1 = 0.693\ (3x10x10^3)x0.1x10^{-6} = 2.08\,ms.$$

ICs are also broadly used as an operational amplifier (op-amp) as shown in Fig. 10 c) and d) for the IC741 schematic symbol and the circuit diagram of the general audio amplifier. The op-amp is a common IC that is used for increasing the size of a signal. Inside the op-amp, there is a large

number of transistors, several resistors, and a few capacitors. A typical op-amp has an inverting (pin 2) and non-inverting (pin 3) inputs (Fig. 10 c), two DC power supply connections (positive, pin 4 and negative, pin 4), an output terminal (pin 6), and a few other specialized connections for fine-tuning the performance. After implementing and simulating this circuit using Proteus 8 software, a student here can learn the followings:

- How to operate the op-amp by amplified and invert the input signal when it is connected to pin 2, whereas can only amplify (without inverting the input signal) when it connected to pin 3.
- Calculate the amplifier value (gain) from the simulation software output figure as shown in Fig. 10 f) by measure the peak to peak amplitude which is about 9.98 and compared with the theoretical calculation by dividing R_2/R_1 (R_2=100 KΩ and R_1=10 KΩ) which is equal to 10 (with a percent error of ~0.2% from simulation result), this means the output electrical signal is 10 times higher than the input signal which is 1V.

Moreover, analog ICs circuits can be used as environmental sensors for collecting data and monitoring the environment such as the temperature and pressure sensors.

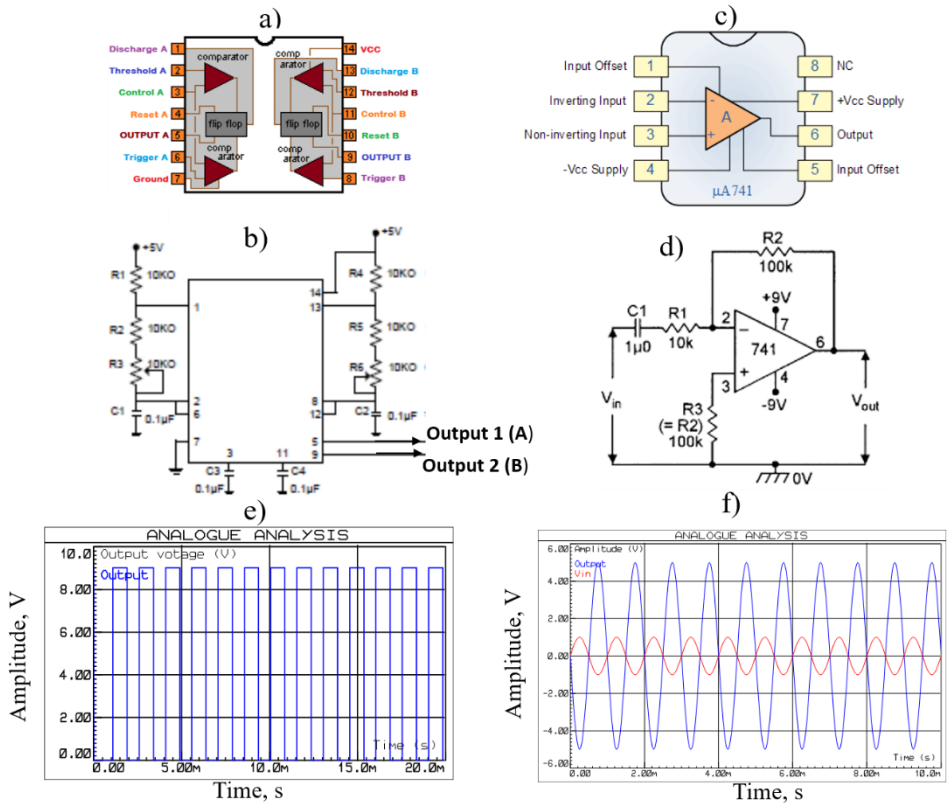


Fig. 10: a) schematic symbol, b) the circuit diagram of the NE556 dual signal generator; c) schematic symbol, d) the circuit diagram of an op-amp based on IC741, e) the generated signal from IC556 using Proteus 8 software, and f) output amplified signal from Proteus 8 software.

On the other hand, a digital circuit is designed to work with specific voltages values known as a binary circuit. It was designed with quantities of 1 and 0 representing on and off or like true and false respectively in the form of logic gates as shown in Fig 11 which shows the schematic symbol that simulates using Proteus software, truth table, and ICs circuit of the different logic gate. Different gates have been simulated in Fig. 11 which explains the output from each gate at the different input levels. In general, these gates are constructed using electronic switches such as transistors, diodes. It is used in microcontrollers and microprocessors for embedded system applications, and electronic project circuits. Therefore, these basic elements called gates are combined in the design of ICs and represent the backbone of digital computers, TVs, and modern

electronic devices [17, 18]. The logic gates, in general, have three terminals, two for inputs and one for output (except the NOT gate that has only one input and one output) are categorized into seven: NOT, AND, OR, NOR, XOR, NAND, and XNOR. These logic gates, their symbols, and truth tables are illustrated below.

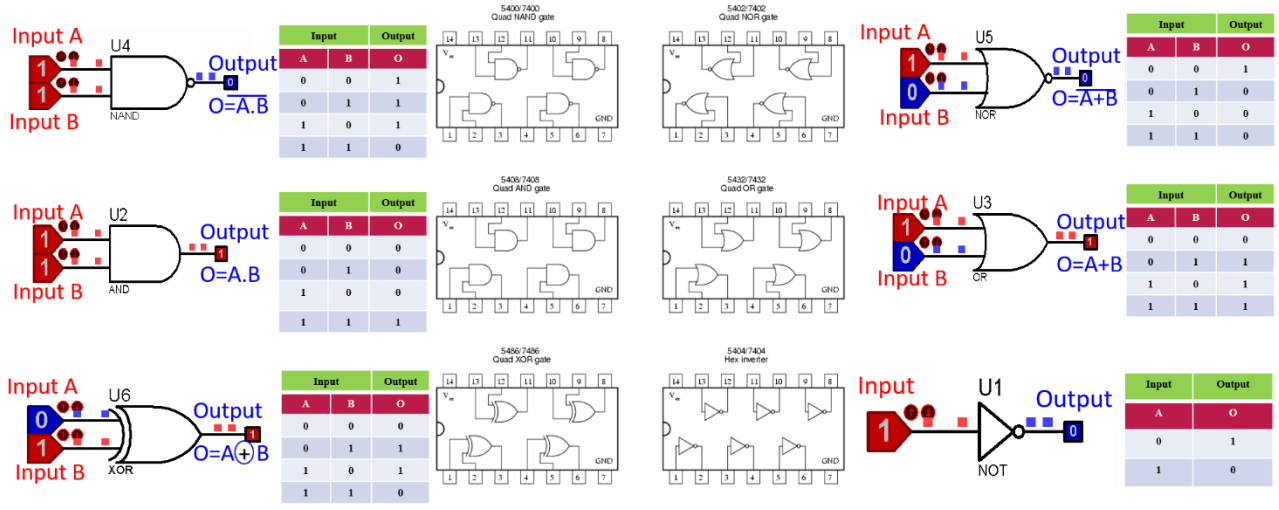


Fig. 11: Schematic symbol, truth table, and ICs circuit [19] of the digital logic gate.

NOT Gate: This only the gat that has one input and one output. The output of this gate is the reverse of the input; therefore, it operates as an inverter of the input. For example, in the case of the input signal is 1(true), the output from this gat is 0 (false) and vice versa.

AND Gate: This gate has two inputs and one output. The output of this gate is 1 (true) only when all the inputs are 1. Whereas, the output is 0 when one or both inputs are 0 (false).

OR Gate: The output of the OR gate is 1 when one or both inputs are 1 whereas the output is 0 when both inputs are 0.

NAND Gate: This gate is the combination of the AND and NOT gates, employing AND gate followed by NOT gate. If the two inputs of this gate are 1, then the output of the gate will be 0, where the output is 1 when one of the inputs is 0. So, it is exactly the reverse of the AND gate.

NOR Gate: The NOR gate carries out the principle operation of the OR gate followed by the NOT gate (combining the OR and NOT gates). When any one of the inputs of this gate is 1, then the output will be 0. It is exactly the reverse of the OR gate.

Exclusive-OR Gate (XOR): The XOR gate performs based on the operation of the OR gate. If any of the two inputs is 1, then the output from this gate is 1. Whereas the output is 0 when both inputs are either 1 or 0.

Exclusive-NOR Gate (XNOR): XNOR gate performs based on the operation of NOR gate. The output from this gate is 1 when both inputs are either 1 or 0. Whereas the output is 0 when the two inputs are different.

VII. Microprocessors circuits are the most complex integrated circuits that contained billions of transistors configured into thousands of individual digital circuits, each one performing a specific logic function [20]. Teaching the principle of the microprocessors to undergraduate and postgraduate students is important to expand their knowledge about using this device in a different practice setup and devices. So, the students can widen their knowledge about the concepts and architecture of this device and also learn how to drive and communicate with the electronic device through complete assembly language programs (software). The microprocessor is built completely from the logic gates in Fig. 11 which are synchronized to each other. So, the microprocessors model includes many components such as registers, memory the central processing unit (CPU) of a computer, and some other piece of electronic equipment. Figure 12 a and b shows the picture and schematic symbol of the 80C51 microprocessors which have 4 parallel input ports from P_0 to P_3, and each port uses 8 pins.

This device can be programmed to work as time-division multiplexing for communicating many data users within nano-second (part of billions) time [21]. Normally, the 8051 microcontrollers

are widely used in touch screens of media players, gaming devices, and cell phones; medical devices such as handy heart rate and blood pressure; in hybrid motor vehicles automobiles; and in energy management of calculating energy consumption applications.

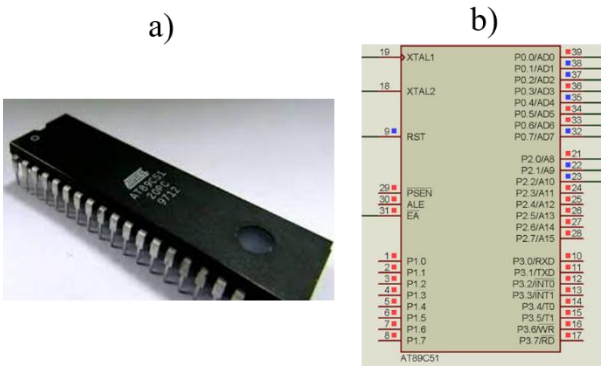


Fig. 12: a) and b) showing the picture and schematic symbol of the 80C51 microprocessors.

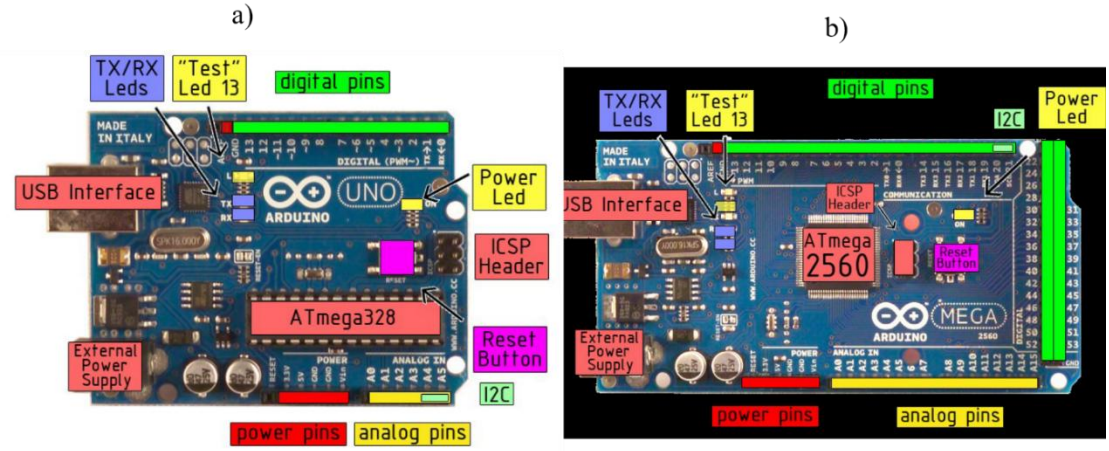
VIII. Arduino: is a built-in open-source electronics platform consisting of easy-to-use hardware equipment and software programs. This item is designed and manufactured as single-board microcontrollers (microcontroller kits) for supporting a diverse group of professional students in building digital devices for different applications. It is also aimed at people who want to use programmable-electronic hardware without needing to investigate deeply into how a microcontroller operates. This platform is increasingly used in mechanical engineering programs. Arduino boards are designed based on the use of a set of microprocessors and controllers as shown in Fig. 13 a and b for ATmega microcontroller 328P and 2560 respectively. Both are equipped with a variety of analog and digital input/output (I/O) pins as shown in Fig. 13c for the ATmega microcontroller 328P board layout that may be interfaced to different expansion boards and other circuits, more details about the Aurdino board, block and circuit diagrams are available in [22,23] as well as in the data sheets and manual user. The Arduino includes all of the software and hardware needed to be powered and programmed through Universal Serial Bus (USB), and all of its inputs and outputs are brought out on

connectors running on two edges. On the Arduino Uno, digital I/O pins are given the numbers 0 to 13 (see figure 13), and within the Arduino software, any reference to 5, for example, will be a reference to digital pin 5. The boards have a feature called serial communications interfaces that includes micro USB for communication through computer and loading software programs to drive the device based on the application. The board has also designed supplied with 5V DC through the USB connection or also could be through the Vin pin. Microcontrollers can be programmed using C++ programming languages. The Arduino project, therefore, offers a control line tool as an integrated development environment device. It has several facilities for communicating with another electronic device such as with another Arduino board, computer, sensors, microcontrollers, the communication between Arduino and other devices can be done via the TTL (5V) serial communication or through USB serial communication that appears as a virtual com port to software on the computer. The transmitter (Tx) and receiver (RX) LEDs on the board will flash when data is being transmitted via the USB connection to the computer.

The Arduino UNO is designed for students, programmers, designers, beginners, and hobbyists. It is relatively inexpensive, simple, open-source, and extensible hardware, open-source and extensible software, as well as that, can run on many operating systems (Windows, Macintosh OSX, and Linux). Therefore, this board became an ideal, entry-level board for student projects who are new to developing on the Arduino platform as well as for the postgraduate and researchers for rapid prototyping. In addition, students can expand their knowledge with Arduino by practices the construction of low-cost scientific electronic circuits and devices, to explain the principles of electronics and physics, or to begin with programming and robotics. For instance, it can demonstrate the basics of sensors and actuators as well as a perfect introduction to electronics and coding. The Arduino board started recently adapted with new electronic demands and

challenges, showing its offer from simple 8-bit boards to products for Internet-of-things (IoT) applications, wearable, 3D printing, and embedded environments [24-27]. Another example, designers and architects are able now to build interactive musical instruments based on the Arduino board such as laser harp. Moreover, the Arduino project features are wireless control, automation, motors control, robots arm and cars, Radar, range measurer, computer numerically controlled (CNC) foam cutting machine, RC airplane, LEDs matrix scrolling text, and thousands of different projects and applications. For instance, Fig. 14 a and b show LED matrix scrolling text Arduino and the robot car wireless control projects respectively. Further to the wide applications of such robotic cars in the environment based on IoT, it has also become hobbies of middle and high school students, who design and operate them in clubs and scientific societies.

For the novel COVID19 pandemic battle, the Arduino board helped the society in this fighting through developed new devices such as automatic sanitization machine, contactless temperature screening, and cough detection system [28, 29] to distinguish between the noise and cough sound, hence detect the Coronavirus suspect by machine learning techniques.



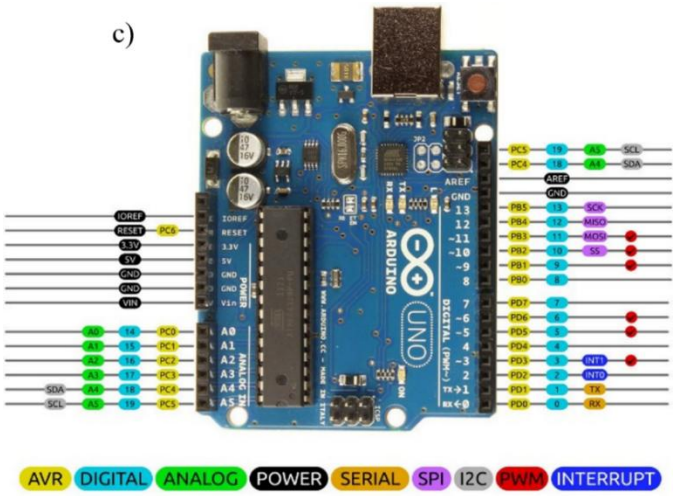


Fig.13: Arduino board based on ATmega microcontroller, a) 328P, b) 2560 and c) ATmega microcontroller 328P board layout [22,23].

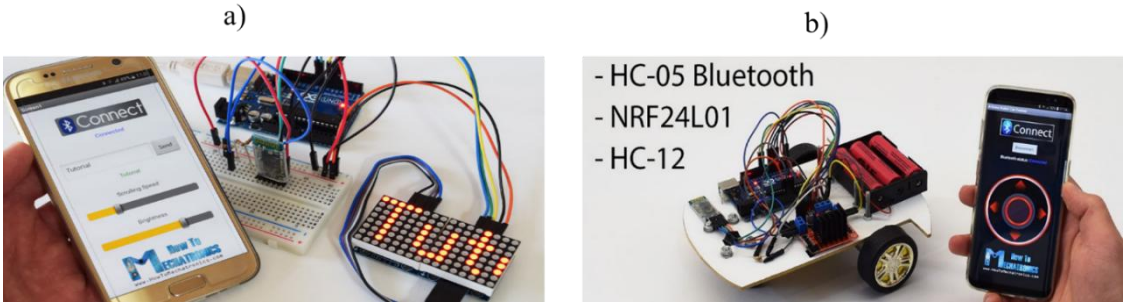


Fig. 14: (a): LED Matrices control system through a smartphone, (b) Robot car wireless with three different control methods HC-05 Bluetooth module, the NRF24L01 transceiver module, and the HC-12 long-range wireless module [24-27].

IX. Raspberry Pi: is a compact and small single computer board that offers endless opportunities, particularly for promoting teaching the concepts of the basic computer for undergraduate and postgraduate students. It is a high speed, connectivity, and simply connected through the IoT into your workplace (laptop, mouse, keyboard, power supply), robotic and even TV, further to make complex computer-controlled systems, and, hence providing various functionalities. Because of the low cost and portability of this device, it is now used extensively by students in their final year projects, research projects, and many other applications such as robotic, communication, and weather monitoring. Moreover, there are also add-on boards

available to enable other uses, such as camera, liquid-crystal display (LCD) screen modules, media players, education to gaming, IoT monitoring integration working conditions, work productivity, and other many ranges of applications. Raspberry has also developed through the years and all models at the moment contains featured of Broadcom system on a chip with an integrated Random-Access Memory (RAM)-compatible central processing unit (CPU) and on-chip graphics processing unit (GPU) as shown in Fig. 15. It has up to 1.5 GHz process speed and 2 GB RAM [30]. The boards also have 1-5 USB ports, HDMI for video output, and tip-ring audio output as well as Wi-Fi and Bluetooth. Therefore, Pi is an excellent candidate for wired and wireless data, audio and video communication systems as well as for environmental sensing applications.

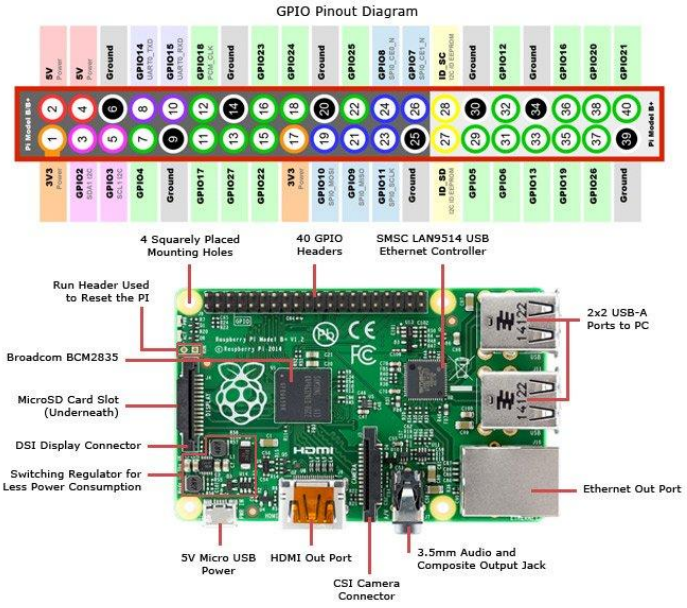


Fig. 15: Raspberry board layout [30].

3. Conclusions:

Within the hard situation similar to the COVID-19, students believe that they do not have the capacity to carry out electronic devices and projects themselves and that their studies are not sufficient to receive such skills, but it is believed that what has been reviewed above will help that students to have the capabilities and skills to localize and work independently with such techniques. Proteus 8 simulation software offered a solution for online laboratory learning in the absence of the physical laboratory due to the national lockdown and social distance. Proteus simulation results are very good in agreement with the theoretical calculations for all the electronic circuits were simulated using this software. It is more important for the teacher in the online class and future normal classroom to conduct an existed and new experiment with the students and request the implementation of projects with open specifications that leave the freedom for students to choose what they want to do. This will expand the practical design and implantation skill, hence, expand the knowledge of the students which leads them to build up their projects that can be connected with IoT for future applications. Furthermore, this study will give an opportunity for hard-working students interested in studying and learning to innovate, research and gain experience while at the same time a great challenge for students who are not properly exploited. The general goal of students will always be the attention to study, education, and the desire for a distinctive and good achievement.

List of Abbreviations.

1	AC	Alternating current
2	CNC	computer numerically controlled
3	CPU	central processing unit
4	DC	Direct current
5	FET	field-effect transistor
6	GPU	graphics processing unit
7	IC	Integrated circuit
8	I/O	analogue input/output
9	IoT	Internet-of-things
10	LCD	liquid-crystal display
11	LED	light-emitting diode
12	MOS	Metal oxide semiconductor
13	op-amp	operational amplifier
14	RAM	Random-Access Memory
15	TTL	Transistor–transistor logic

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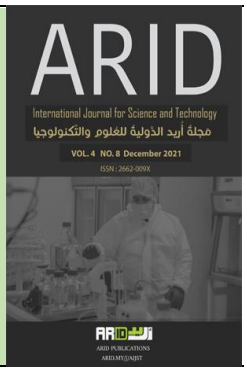

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

Epidemiology and Characteristics of Yemeni Hypertensive Patients Attended 48 Hospital Sana'a City- Yemen at 2019

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Selangor-Malaysia

وبائيات وخصائص ارتفاع ضغط الدم بين المرضى اليمنيين الداخلين مستشفى 48 صنعاء خلال العام 2019م

نايف توفيق النواني

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Abstract

Hypertension is one of the most health problems in the world. People who have hypertension are at high risk of other diseases. This study was conducted to identify distribution of hypertension among patients who attended to 48 Hospital during 2019.

A cross-sectional study was conducted and collected the data of all patients diagnosed with hypertension during the year 2019 as registered by 48 medical compound. The study area has electronic information system where is data collected and filled by physician or specialist in different medical departments and outpatient clinics. The data in excel sheet contain information's about the disease including: age, sex and complications and laboratory tests lipid profile for each patient.

Hospital registration system indicated the admission of total number of patients with hypertensive was 2225 during that year .Chi square and fisher test analysis showed that the most patients with hypertension were with age group above 60 year (50%), residence in Sana'a 88.4% .Females under age 60 years (62%), males above age 60 years (56.9%) and hypertension was significant with age with ***p***-value 00.001.Hypertensive heart diseases patients without heart failure (82.7%) most them : (83%) above age 40 years , females (84.7%) .The most complication of hypertension were heart disease (82%), renal disease (5.9%) , heart failure (5.1%) and stroke (3.2%). In future the researchers need study more about hypertension risk factors such as efforts should be put on more studies about epidemiological distribution of the disease in our community.

Keywords: epidemiology, characteristics, hypertensive, distribution, Sana'a, Yemen.

الملخص:

ارتفاع ضغط الدم واحد من المشاكل الصحية في العالم، الناس الذين يعانون من ارتفاع ضغط الدم عرضة لأمراض أخرى. هدفت هذه الدراسة لتمييز توزيع ارتفاع ضغط الدم بين المرضى الذين دخلوا مستشفى 48 لعام 2019، وقد أجريت دراسة مقطعية وجمعت المعلومات لجميع المرضى الذين تم تشخصيهم ارتفاع ضغط الدم، وتم تسجيلهم بنظام إلكتروني بواسطة الأطباء والأخصائيين في مختلف الأقسام الطبية بما فيها العيادات الخارجية علما أن المعلومات حول المرض تضمنت الاسم وعمر المريض، وكذلك نوع الجنس والحالة الاجتماعية والمضاعفات والفحوصات المخبرية. وقد وضحت النتائج العدد الكلي للمرضى الداخلين المستشفى عام 2019 وعان عددهم 2225 مريض واستخدم تحليل مربع كاي وفايشر، موضحا أن حوالي 50% كانوا فوق عمر 60 عاما، بينما الساكنين صنعاء 88.4%. الإناث تحت عمر 60 عاما 62% والذكور فوق عمر 60 عاما 56.9%. علما أن ارتفاع ضغط الدم ذات دلالة إحصائية مهمة. كان نسبة مرضى ضغط الدم الذين لديهم إمراض القلب بدون فشل القلب 82.7% أغلبهم فوق عمر 40 عاما 83% منهم إناث 84.7%. أغلب مضاعفات ارتفاع ضغط الدم كان مرض القلب 82% وفشل كلوي 5.9% بينما فشل القلب 5.1% وجلطة الدماغ 3.2%. في المستقبل الباحثين سيدرسون عوامل أخرى لها علاقة بضغط الدم مثل تغيير نمط أسلوب الحياة.

الكلمات المفتاحية: وبائيات، خصائص، ارتفاع ضغط الدم، التوزيع، صنعاء، اليمن.

1. INTRODUCTION

Hypertension is a major public health problem in the world and a leading cause of heart diseases , renal diseases , stroke , diabetic mellitus, death , disability and other diseases globally[1]approximately 20% of the world's adults are estimated to have hypertension, when hypertension is defined as blood pressure in excess of 140/90 mm Hg , force of the blood against artery walls whereas heart failure means that heart can't keep up with its workload, heart failure is insufficient in cardiac output when heart is unable to pump sufficiently to maintain blood flow to meet the body tissues. The prevalence markedly increases in patients older than 60 years. one billion people have hypertension , tow-third are in developing countries and may be increase to 1.56 billion adults will be living with hypertension by 2025, hypertension kills nearly 8 million people every year , worldwide and nearly 1.5 million people each year in the South- East Asia region, approximately one- third of the adult population in the SEA region has blood pressure [2].It is estimated that about 17 million deaths occur worldwide because of cardiovascular diseases every year , of which complications of hypertension alone accounts for 9.4 million deaths [3].As per World Health Organization report, about 40% of people aged more than 25 years had hypertension [4].

Most people with hypertension have no symptoms at all; this is why it is known as the "silent killer". Sometimes hypertension causes symptoms such as headache, shortness of breath, dizziness, chest pain, palpitations of the heart and nose bleeds, but not always[5,6]. Hypertension may be primary, which may develop as a result of environmental or genetic causes, or secondary, which has multiple etiologies, including renal, vascular, and endocrine causes. Primary or essential hypertension accounts for 90-95% of adult cases, and a small percentage of patients (2-10%) have a secondary cause [7]. Hypertensive emergencies are most often precipitated by inadequate medication or poor compliance. Risk factors for hypertension such as a sedentary

lifestyle, obesity, consumption of fatty foods and resultant dyslipidemia are highly prevalent in the population and these factors contribute to the epidemic [8, 9 ,10].

Problem statement

In most developing countries including, Yemen diabetes and cardiovascular diseases in concert with other non-communicable diseases have not been addressed under specific control programs such as those that exist for several infectious and communicable diseases.

In Yemen, population are homogenous and no ethnically uniform. Additionally, the country characterized by a highly traditional lifestyle, the capital, Sana'a, is located at an altitude of 2300 m (7500 ft) in the highlands, one of the highest capital cities in the world. The absence of railways and the poor road transportation system make communications with the coastal plains difficult.

Information regarding prevalence, risk factors awareness, treatment and control rates of hypertension in Yemen is limited to the capital area.Yemen is experiencing urbanization and modernization which cause changes in diet and physical activity particularly in the cities including Sana'a city. Furthermore, like many other developing countries, and as a result of increased longevity and improvement in the standard of living as well as the influence of the western lifestyle such as cigarette smoking and alcohol consumption and chewing khat have assumed a major public health dilemma.In addition, and above living style in Yemen in general and Sana'a city in particular became very stressing as a result of the current conflict which been taken place several years ago.

Rational

our knowledge about epidemiology and characteristic of Yemeni patients are poor as result of scanty information about non-communicable diseases and defective national health information system. In view of the burden of inter world communicable diseases highlighted above there is

need to have a systematic nation-wide data to determine the magnitude of the problem of non-communicable non- communicable diseases.

Therefore, the findings from this study will be used to increase the scientific knowledge base to the scientific world. Also we hope that this new data will high light this problem and help discoing makers in the county allocate more budget in the diagnoses screening and treatment of this disease

makers and practiced people about the characteristic of Yemeni hypertensive patients to reduce the incidence to implants programs that could be prevent the modified risk factors

The findings from this study will be used to increase the scientific knowledge base to the scientific world. The findings may further help to guide policy markers (Ministry of health and social welfare) with the aim of planning interventions to improve patient compliance to antihypertensive therapy to reduce the impact of hypertension and its complications and improve the quality of life of the patients and the health cost burden.

2.0: OBJECTIVES OF THE STUDY

2.1: GENERAL OBJECTIVE

To identify the epidemiology and characteristicsof Yemeni Hypertensive patients

(Hypertensive patients in 48 hospitals at 2019)

2.2: SPECIFIC OBJECTIVES

1. determine the prevalence and determinants of hypertension
2. to identify relationship between hypertension and sex
3. to identify relationship between hypertension and age
4. To give a suggestion how changes the modified factors

3. Methodology

a) Study design

Prevalence cross sectional analytical study.

b) Study area

This study was carried out based on data as registered by 48model medical compound its consist of two hospitals 48 hospital for males and Yamani Chinese for mothers and Childs which is located in Sana'a City, it's a governmental, referral and educational hospital receives patients from all governorates of Yemen.

c) Sampling method and size

collected the data of all patients diagnosed with hypertension during the year 2019 as registered by 48 medical compound.

d) Study instruments

the study area has electronic information system which is data collected from this information filled by physician or specialist in deferent medical department and outpatient clinic but unfortunately the components of the data were not completely filled. The electronic system present data in excel sheet contain information's about the disease including: name , diagnosis , age, sex, marital status, lipid profiles and hypertension category for each patient

e) Inclusion criteria:

All patients from all governorates diagnosed with hypertension and attended 48 Hospital during 2019.

f) Exclusion criteria:

Non-Yemeni patients diagnosed with hypertension during the year 2019

Dependent and Independent variables –

- Dependent variable: hypertension.

- Independent variables: Socio-demographic characteristics of the patients including age, sex, marital status and place of residence and hypertension diseases categories.

Variable definition

- Socio-demographic status

Age was classified to the following three categories: -

less than40 years

from 40 to 60

more than 60 years

- Sex: Males and Females.
- hypertension disease categories:

g) Statistical analysis

The data were analyzed using SPSS 20 application. Statistical explanation were made as the following:

- Frequency (%) to describe the qualitative variables, and mean and standard deviation to describe the quantitative variables.
- Chi-square and Fisher test were used to show the significant of association between socio-demographic factors, complications at level of significance (0.05) and 95% confidence interval

4. Results

The aim of this study is to identify the distribution of hypertension among patients attended the 48 Hospital during 2019. Hospital registration system indicated the admission of total number of patients with hypertension was 2225at 2019.

i. Socio-demographic characteristics of registered patients

The mean age of the patients was 54.5 years with standard deviation of 5.93 years. Ages ranged from 21 years to 96 years. About half of the patients (1113) which represent 50.0% of all patients were in the age group of >60 years, followed by 996 patients (44.8%) in the age group of 40-60 years, then 116 patients in the age group of less than 40.

Table(1): Socio-demographic characteristics of the patients (n- number of patients)=2225) (48 hospital, 2019)

		Mean (SD) standard division	Freq.	%
Age (year)		54.5(5.93)		
age groups (year)				
	<40		116	5.2%
	40-60		996	44.8%
	>60		1113	50.0%
Sex				
	Male		1062	47.7%
	Female		1163	52.3%
City				
	Thamar		130	8.5%
	Hajjah		5	0.2%
	Amran		9	0.4%
	Abian		3	0.1%
	Al Baida'a		5	0.2%
	Taiz		16	0.7%
	Sana'a		1967	88.4%
	Sadah		3	0.1%
	Rimah		14	0.6%
	Marib		2	0.1%
	Al Mahwit		6	0.3%
	Jahj		2	0.1%
	Ibb		63	2.8%

The number of female patients were nearly the same as male patients. The females were 1163 (52.3%)and males 1062 (52.3%)and the ratio was 1.1:1 respectively.

Sana'a Governorate were the most governorate patients come from with a number of 1967 patients (88.4%), followed by Thamar with 130 patients (8.5%), and Ibb with 63 patients (2.8%).

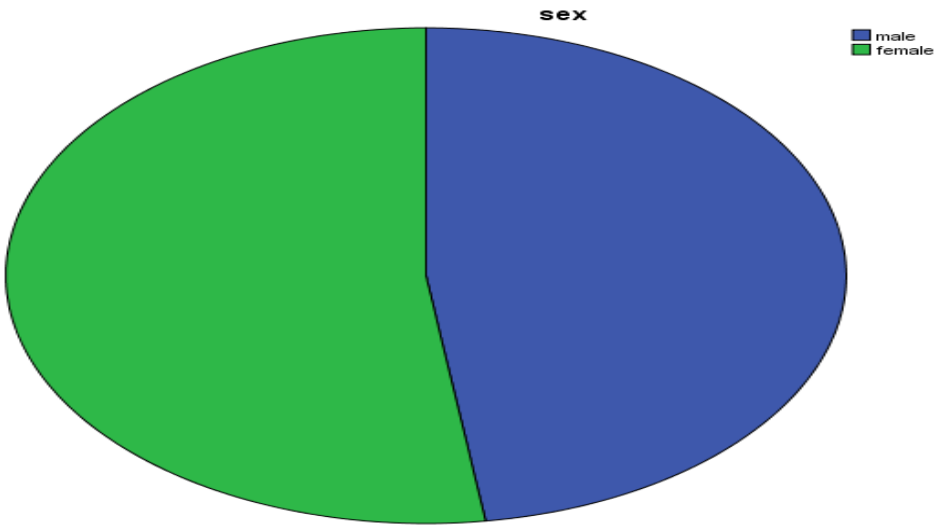


Figure (1): Distribution of hypertension according to Gender

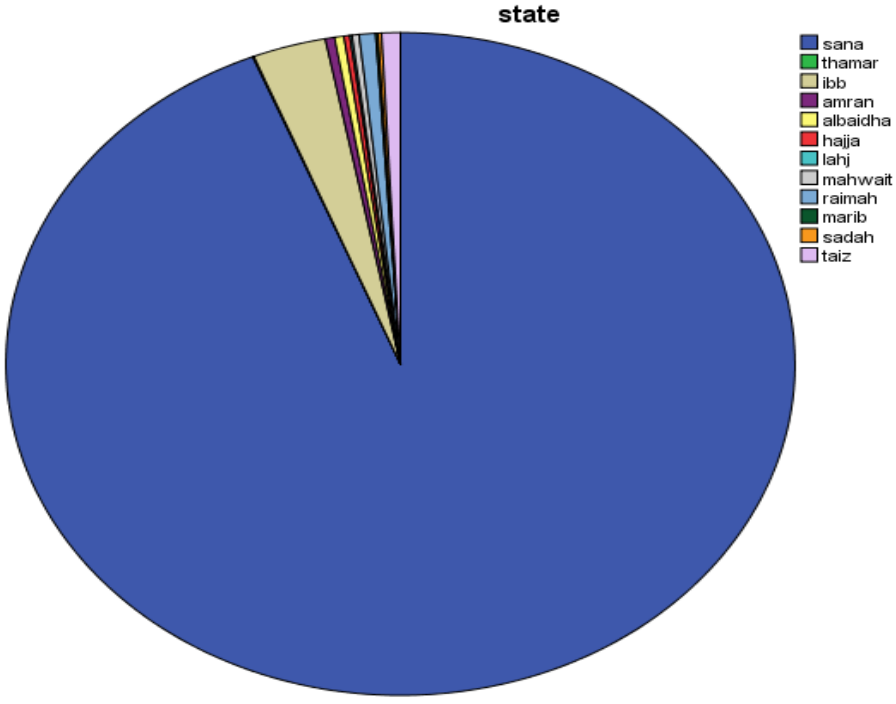


Figure (2): Distribution of hypertension according to Governorate

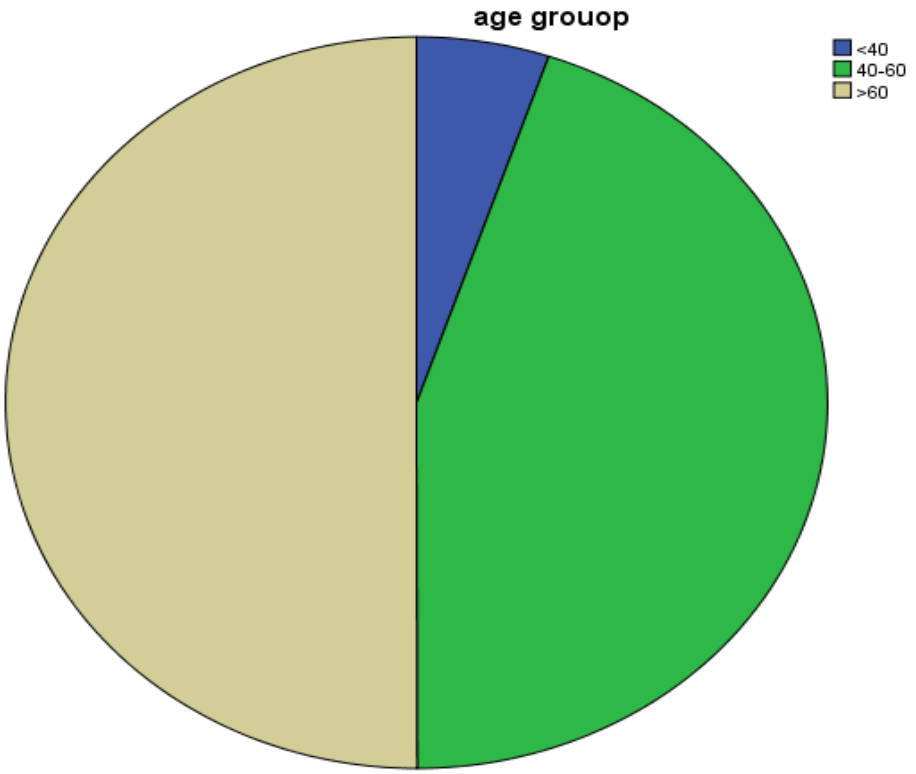


Figure (3): Distribution of hypertension according to age group

Table (2) show that the females are more affected by hypertension than males among age groups less than 60 years, (< 40 year (62.1%) and 40-60 year (61.4%)) but the males are more affected among age more than 60 year 56.9%. This difference is statistically significant (p-value <0.001).

Table (2): Distribution of sex of hypertensive patients by age groups (48 hospitals, 2019)

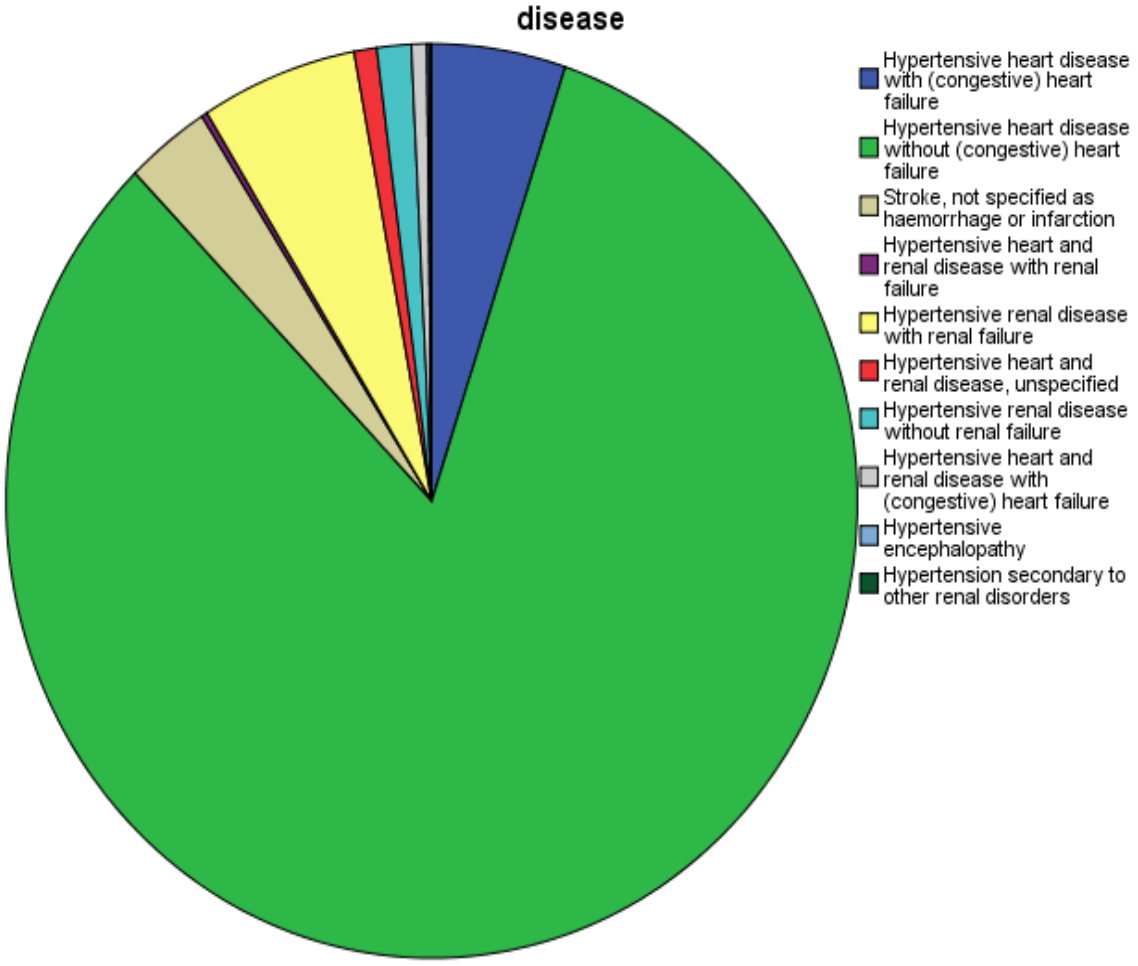
	Male		**Female**		***p-value***
age (year)	Freq.	%	Freq.	%	
<40	44	37.9%	72	62.1%	0.001
40-60	385	38.7%	611	61.3%	
>60	633	56.9%	480	43.1%	

ii. Hypertension categories:

The majority of 1839 patients (82.7%) were with hypertensive heart disease without (congestive) heart failure followed by 132 patients (5.9%) with hypertensive renal disease with renal failure than 113patients (5.1) with hypertensive heart disease with (congestive) heart failure.Table (4) shows that 71 patients (3.2%) had Stroke, not specified as hemorrhage or infarction , 29 (1.3%) with hypertensive renal disease without renal failure , 19 (0.9%) with hypertensive heart and renal disease(unspecified) , 13(0.6%) with Hypertensive heart and renal disease with (congestive) heart failure , 5 patients (0.2%) with hypertensive heart and renal disease with renal failure , 2 (0.1%) with hypertensive encephalopathy and 2 (0.2%) with hypertension secondary to other renal disorders.

Table(3): Hypertension categories (n=2225) (48 hospital, 2019)

Category	Freq.	%
Hypertensive heart disease with (congestive) heart failure	113	5.1
Hypertensive heart disease without (congestive) heart failure	1839	82.7
Stroke, not specified as hemorrhage or infarction	71	3.2
Hypertensive heart and renal disease with renal failure	5	.2
Hypertensive renal disease with renal failure	132	5.9
Hypertensive heart and renal disease, unspecified	19	.9
Hypertensive renal disease without renal failure	29	1.3
Hypertensive heart and renal disease with (congestive) heart failure	13	.6
Hypertensive encephalopathy	2	.1
Hypertension secondary to other renal disorders	2	.1



Figure(4): Distribution of hypertension categories

Table(4): Distribution of Hypertension categories by age groups (48 hospital, 2019)

Category	Age group					
	<40		40-60		>60	
	Freq.	%	Freq.	%	Freq.	%
Hypertension secondary to other renal disorders	0	0%	1	0.1%	1	0.09
Hypertensive encephalopathy	0	0%	1	0.1%	1	0.09
Hypertensive heart and renal disease with (congestive) heart failure	0	0%	3	0.3%	9	0.8
Hypertensive heart and renal disease with renal failure	0	0%	1	0.1%	4	0.4
Hypertensive heart and renal disease, unspecified	3	2.6%	14	1.4%	2	0.2
Hypertensive heart disease with (congestive) heart failure	2	1.7%	54	5.4%	57	5.1%
Hypertensive heart disease without (congestive) heart failure	82	70.7%	827	83%	930	83.6%
Hypertensive renal disease with renal failure	18	15.5%	49	4.9%	65	5.8%
Hypertensive renal disease without renal failure	2	1.7%	16	1.6%	11	1%
Stroke, not specified as hemorrhage or infarction	9	7.8%	30	3%	32	2.9%
Total	**116**	**100%**	**996**	**100%**	**1113**	**100%**

Majority of patients in age group < 40 year were 82 (70.7%) with hypertensive heart disease without (congestive) heart failure , 18 patients (15.5%) with hypertensive renal disease with renal failure , 9 patients (7.8%) with Stroke, not specified as hemorrhage or infarction.Majority of patients in age group 40-60 year were 827 (83%) with hypertensive heart disease without (congestive) heart failure , 54 (5.4%) with hypertensive heart disease with (congestive) heart failure and 49 patients (4.9%) with hypertensive renal disease with renal failure.Majority of patients in age group> 60 year were 930(83.6%) with hypertensive heart disease without (congestive) heart failure , 65(5.8%) with hypertensive renal disease with renal failure and 57 patients (5.1%) with hypertensive heart disease with (congestive) heart failure.

Table(5): distribution of Hypertension categories by gender (48 hospitals, 2019)

Category	Sex			
	Male		Female	
	Freq.	%	Freq.	%
Hypertensive heart disease with (congestive) heart failure	59	5.6%	54	4.6%
Hypertensive heart disease without (congestive) heart failure	854	80.4%	985	84.7%
Stroke, not specified as hemorrhage or infarction	52	4.9%	19	1.6%
Hypertensive heart and renal disease with renal failure	5	0.5%	0	0
Hypertensive renal disease with renal failure	65	6.1%	67	5.8%
Hypertensive heart and renal disease, unspecified	8	0.7%	11	0.9%
Hypertensive renal disease without renal failure	11	1%	18	1.5%
Hypertensive heart and renal disease with (congestive) heart failure	6	0.6%	7	0.6%
Hypertensive encephalopathy	2	0.2%	0	0
Hypertension secondary to other renal disorders	0	0%	2	0.2%
Total	**1062**	**100%**	**1163**	**100%**

Gender distribution among the different hypertension categories were nearly the same.

Table (6): distribution of Hypertension categories by material status (48 hospitals, 2019)

Category	Married		single		Divorced	
	Freq.	%	Freq.	%	Freq.	%
Hypertensive heart disease with (congestive) heart failure	113	5.1%	0	0	0	0
Hypertensive heart disease without (congestive) heart failure	1800	82.7%	30	79%	9	90%
Stroke, not specified as hemorrhage or infarction	64	2.9%	7	18.4%	0	0
Hypertensive heart and renal disease with renal failure	5	0.2%	0	0	0	0
Hypertensive renal disease with renal failure	132	6.1%	0	0	0	0
Hypertensive heart and renal disease, unspecified	18	0.8%	0	0	1	10%
Hypertensive renal disease without renal failure	28	1.3%	1	2.6%	0	0
Hypertensive heart and renal disease with (congestive) heart failure	13	0.6%	0	0	0	0
Hypertensive encephalopathy	2	0.1%	0	0	0	0
Hypertension secondary to other renal disorders	2	0.1%	0	0	0	0
Total	**2177**	**100%**	**38**	**100%**	**10**	**100%**

5. Discussion

The aim of the present was to identify distribution of hypertension among patients attended 48 hospital during 2019. The hospital where the patients attended, located in Sana'a capital. The present study showed that total hypertension patients was 2225.The most hypertension patients were elderly age group (50%). Thisfinding supported by many studies conducted in Kenya[11] Bangladesh[12] Kerala India [13]United states [14] Brazil [15] and Myanmar [16] that showed that prevalence of hypertension was associated with increase of age . our study showed that frequency hypertension was higher among females than males,this finding supported by A worldwide study in 17 countries reported a higher prevalence of hypertension among

women[17]however in some previous studies conducted in other countries such as Nigeria [18] showed reverse it , these differences may be because differences in the age of the population

some previous studies conducted in Nigeria [19] showed that hypertension was more prevalent in the urban area than in the rural area and this difference was statistically significant. our study

showed that Sana'a city was the most common for frequency hypertension in Yemen 88.4%. The reasons offered for high frequency hypertension in Sana'a include change in diet with higher salt and calorie intake and reduced potassium intake, sedentary life style, obesity and more psychosocial stress which are worse in urban dwellers or may be difficult access to capital Hospitals from rural areas surrounding of Sana'a because war and poverty, thus, we observed high number of patient's hypertension came from Sana'a in our study.

Result from present study showed that females (with age < 40 YR) more affected by hypertension than males in the same age group and males (with age >60 YR) more affected by hypertension than females in the same age group , this difference are statistically significant (p-value <0.001).However many studies were conducted in other countries such as Arabia countries and Afghanistan, that showed that prevalence hypertension among females elderly age more than males in same ages and reverse in young [20 , 21]. The reason for high and low prevalence hypertension among both sex by age groups in our setup may be difference in number of patients among groups. Result from present study showed that the most common complication due to hypertension was heart disease without heart failure, renal disease, heart failure and stroke (82%, 5.9%, 5.1%, 3.2%)respectively, this finding supported by many studies conducted in other countries such as Fihaya etal [22] and WHO[23] that showed that most complication of hypertension was heart disease, renal disease and stroke .our study showed that these complications were most prevalence among age groups >40 year this is the most important of information in this research, it indicates that most of the diagnosed patients with hypertension in

Yemen are diagnosed at late stages, in seems that the hypertension is not brought to the attention until the patient is symptomatic with heart failure.

Global study showed that strokes and myocardial infarctions have been attributed to suboptimal blood pressure control and two-thirds of this attributable burden occur in middle-aged individuals (45–69 years) [24]. Present study showed that stroke due to hypertension more among males than females. This finding supported by systematic review study showed that strokeis more common among men, but women are more severely ill [25]. However, previous studies showed that hypertensive heart disease and stroke more among males than females in adulthood [26]. Our study showed that females more hypertensive heart disease than males. The reason for high heart disease due to hypertensive among females in our study that, after 40 years of age, a higher percentage of women than men have hypertension in our study, and the gap will likely increase with the continued aging of the female population. In menopause transition many women have vasomotor symptoms which may affect their normal daily activities. With the decline in estrogen levels, risk factors for coronary heart disease become more apparent.

Results from present study showed that most complications of hypertension were among married patients. However, previous studies in other countries showed that opposite is true [27]. The reason for a higher prevalence complications of hypertension among married patients in our setup maybe low in number of singles patients.

6. Conclusion

This study showed that prevalence of hypertension among patients attended 48 Hospital was low. Prevalence of hypertension and its complications was most common among patients who were females elderly age group, married, resident Sana'a. The most common hypertension complications were heart diseases, renal diseases, heart failure and stroke. In Yemen, a country characterized by a highly traditional lifestyle, hypertension burden is favorably affected by

urbanization and by living in the capital area. We recommend change traditional lifestyle especially among resident in Sana'a. changes the modified factors:

1) Maintain normal weight for adults (body mass index 20-25 kg/m^2)

2) Reduce salt intaketo <100 mmol/day (<6g NaCl or <2.4 g Na^+/day)

3) Engage in regular aerobic physical exercise(brisk walking rather than weight lifting) for ≥30 minutes per day, ideally on most of days of the week but at least on three days of the week.

4) Consume at least five portions/day of fresh fruit and vegetables.

5) Reduce the intake of total and saturated fat.

6) Psychological support and avoid of stress a tensions.

7) Stop of smoking.

8) Early detection and frequency of measurements of blood pressure by visiting clinics or health care centers.

List of abbreviations

p-value	Probability	
WHO	World health organization	
N	Number of patients	
SD	Standard division	
YR	Year	
Freq.:	Frequency	

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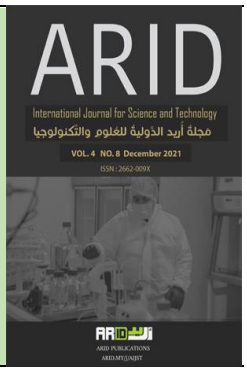

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

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Potential Using Vehicle to Vehicle Communication Based on Wireless Fidelity (Wi-Fi) for Supporting Intelligent Transportation Systems (ITS)

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إمكانية استخدام الاتصال من مركبة إلى مركبة (V2V) عن طريق تقنية wireless Fidelity (Wi-Fi) لدعم أنظمة النقل الذكي (ITS)

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Abstract

Vehicular Ad-hoc Network (VANET) becomes one of the most popular modern technologies these days, due to its contribution to the development and modernization of Intelligent Transportation Systems (ITS). The primary goal of these networks is to provide safety and comfort for drivers and passengers in roads. There are many types of VANET that are used in ITS, in this paper, we particularly focus on the Vehicle to Vehicle communication (V2V), which each vehicle can exchange information to inform drivers of other vehicles about the current state of the road flow, in the event of any emergency to avoid accidents, and reduce congestion on roads. We proposed V2V using Wi-Fi (wireless fidelity); the reason of its unique characteristics that distinguish it from other types. There are many difficulties and the challenges in implementing most types of V2V, and the reason is due to the lack of devices and equipment needed for real implementation. To prove the possibility of applying this type in real life, we made a prototype contains a modified toy car, a 12-volt power supply, sensors, visual, audible alarm, a visual "LED" devices, and finally a 12-volt DC relay unit. As a conclusion, the proposed implementation in spite of minimal requirements and use simple equipment, we have achieved the most important main objectives of the paper: preventing vehicles from collision, early warning, and avoiding congestion on the roads.

Keywords: Vehicle-to-Vehicle, Vehicular Ad-hoc networks, VANET, Intelligent Transportation System (ITS) .

الملخص:

أصبحت تقنية تخاطب المركبات مع بعضها البعض من أكثر التقنيات الحديثة انتشارا ورواجًا هذه الأيام؛ لمساهمتها في تطوير وتحديث أنظمة النقل الذكية (ITS)، وتعتبر هذه التقنية ذاتية التنظيم؛ حيث يتم إنشاؤها بين المركبات، أو بين المركبات والبنية التحتية. إن الهدف الأساسي من هذه الشبكات هو توفير السلامة والراحة للسائقين والركاب، وسوف يتم التركيز في هذه الورقة على النوع الذي يعني بتخاطب المركبات مع بعضها البعض Vehicle to .Vehicle Communication (V2V) حيث تقوم كل مركبة بتبادل المعلومات لإبلاغ سائقي المركبات الأخرى بالحالة الحالية للطريق أو في حالة حدوث أي طارئ؛ لتجنب الحوادث، وتقليلها، والحد من الازدحام على الطرق المختلفة. سيتم تسليط الضوء علي عملية تواصل المركبات باستخدام شبكة Wi-Fi (wireless fidelity) ؛ وذلك لما لها من خصائص فريدة تميزها على باقي الأنواع. من أهم المشاكل التي تناولتها الورقة هي الصعوبات والتحديات الكبيرة في تطبيق معظم أنوع V2V ، والسبب يعود إلى قلة وعدم توفر الامكانيات والمعدات اللازمة للتنفيذ الفعلي على أرض الواقع؛ لذا فإن الهدف الرئيسي من هذه الورقة هو إثبات أن V2V based on Wi-Fi هي الطريقة المناسبة والفعالة والقابلة للتطبيق داخل المجتمعات لا سيما الفقيرة منها. ولإثبات إمكانية تطبيق هذا النوع بأقل الإمكانيات قمنا بعمل مجسم يحتوى على مجموعة من المكونات التي تستخدم عادة في مجال التحكم الالي، وشبكات الحاسوب المتوفرة بشكل كبير، وأهم هذه العناصر: سيارة لعبة معدلة، وإمداد طاقة بجهد 12 فولت، وأجهزة استشعار، ووحدات إنذار مرئي و مسموع، و "LED" مرئي وأخيرًا وحدة ترحيل التيار المستمر بجهد 12 فولت ، كل هذا من أجل إثبات أهمية تطبيق V2V داخل الطرق المختلفة؛ حيث كانت النتائج إيجابية أكثر من المتوقع، باستخدام معدات بسيطة، وإمكانيات محدودة استطعنا تطبيق أهم أهداف الورقة المتمثلة في منع المركبات من التصادم، والإنذار المبكر.

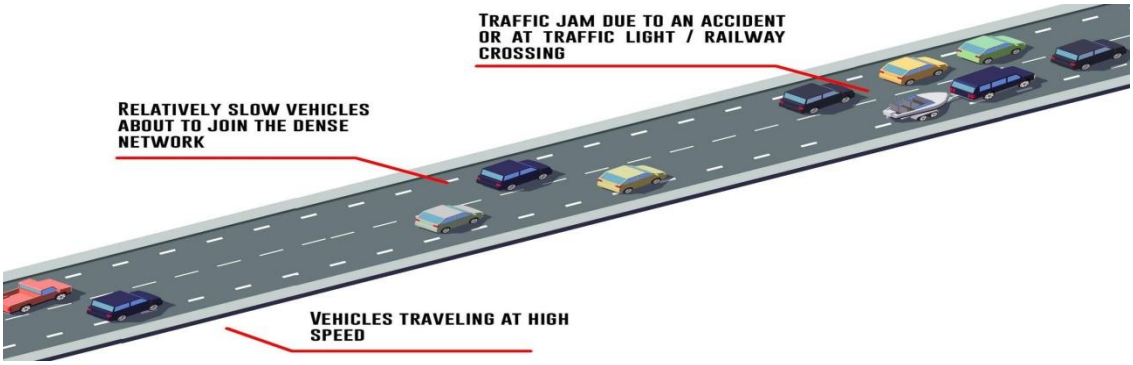
الكلمات المفتاحية:-

تخاطب العربة مع العربة، العربة مع كل شيء، العربات الذكية، أنظمة النقل الذكية.

1. Introduction

Vehicular Ad-hoc Networks VANET are designed to make the possibility of communicating different vehicles with each other. These days, networks have become the most important technology in Intelligent Transportation Systems (ITS). Safety issues in transportation are one of the main concerns, receiving much interest from both society and research communities. In the ITS field, VANETs emerge as an efficient. It can also be used to improve traffic management conditions in addition to reducing congestion and various road accidents. In addition, a VANET is characterized by its lack of a central coordinator, and thus a data or safety message may pass through multiple intermediate vehicles during its transmission from the source vehicle to the destination vehicle[1]. It is a self-organizing network that is established between vehicles together, or between vehicles and infrastructure. The smart city the best environment to apply ITS based on V2V communication, where it has a good infrastructure with artificial intelligence components for the communication process between V2V Communication. There are many applications for V2V communication; such as use Internet of Things (IoT), Light Fidelity(Li-FI), and Wireless communication technologies. In this paper, we focused on V2V using Wi-Fi; the reason of its unique characteristics that distinguish it from other types. V2V using Wi-Fi (wireless fidelity) has unique characteristics that distinguish it from other types. The most important of these characteristics are: flexibility, ease of use, low cost, and applicability. Building and maintaining a multi-hop routing route between the vehicles become much more complicated under these conditions. VANET node density corresponding to the number of vehicles sharing the route and the channel for wireless transmission of safety messages[2]. Each vehicle can exchange information with other vehicles to inform drivers about the current state of traffic tracking or the presence of a hazardous situation. Besides safety applications, VANET

also provides very important data to the road users like weather information, different paths cases, traffic around, preventing vehicles from collision, early warning, and avoiding congestion on the roads. VANET is an available network where each vehicle is permitted to join the network. There are three main types of VANET, Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I), and Infrastructure-to Infrastructure (I2I). There is no particular method, which can ensure the trustworthy nature of the vehicles. Therefore, security becomes One of the main problems as communication between nodes, where any node can transfer fake data and may cause significant harm to other vehicles. These networks are made of sensor nodes deployed in large areas. Figure 1 shows VANET overall work.



Figure(1): VANET overall work

2. Problem Statement

Road crashes and the damage they entail represent a serious issue and are one of the main causes of death[3], some statistics have shown that the majority of road accidents are due to human error and a lot of these accidents could have been avoided if the drivers had been warned at least half a second beforehand. Traffic congestion is a major issue in urban areas as well as on highways. Accidents caused the majority of the traffic congestion. It occurs for a variety of causes, including driver error, road accidents, road obstructions, environmental conditions, and

so on. As a result, vehicles are either at a standstill or going at a low speed, causing time to pass, and wasting a significant amount of fuel. There are difficulties and obstacles in implementing some types of V2V. One of these is a lack of devices and equipment required for real environment. In a vehicular network, the most important challenge is the exchange of reliable and correct data among nodes[4]. In some cases, a traffic jam may be fixed in a matter of hours, while in others, it may take several days. As a consequence, traffic congestion has a negative effect on the economy as well as the environment. As a result, many automotive companies are taking the initiative to find effective solutions for traffic management, even though congestion worsens the situation. The more serious the congestion, the longer it will take to clear until the root cause has been resolved. Knowing the traffic conditions on the road ahead would allow a driver to follow alternative routes, saving time, and fuel. In addition, passing another vehicle without giving it advance notice presents a major risk, which can result in catastrophic accidents. How to find that there is a V2V path between vehicles x and y that are communicating with each other using the cellular network[5].

The main aim of this paper is to improve road safety and reduce the number of accidents by using Wi-Fi and to prove the possibility of applying this type in real life. we have set the following objectives:

1- Highlight the importance of V2V communication based on Wi-Fi, which has a significant impact on reducing congestion and road accidents with the least tools, devices, and equipment.

2- Making inter-communication between the nodes to avoid accidents and journey comfort and safety.

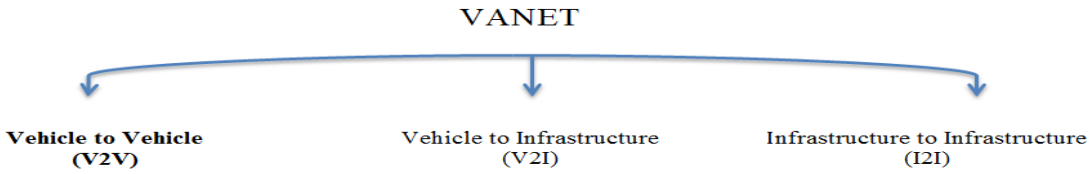
3- Providing vehicles with sensors to sense traffic if it is crowded, there is any obstruction on the road, accident, sudden break of the front car, or sudden pass without prior notice.

4- Identify and detect crowding, its location, intensity, and boundaries through lamps of different colors on the road or display them on the Application Unit.

5- Providing the vehicles with an external airbag in the event of any malfunction in the system, and no warning was given about the presence of a vehicle in the range and the approaching of the vehicle at a high speed causing it to collide with another vehicle.

3. VANET Overview

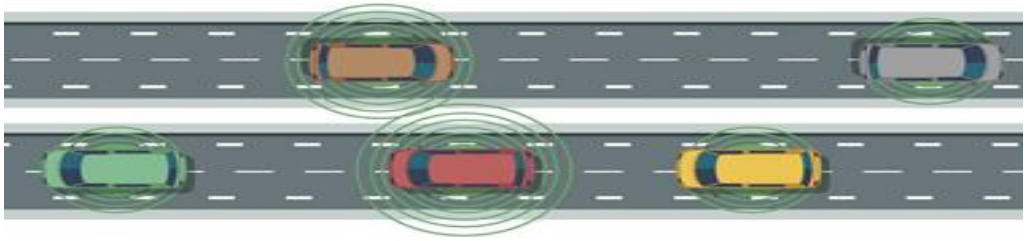
VANET is a subclass of Mobile Ad-hoc Network (MANET), which belongs to a family of Wireless Ad-hoc Network (WANET). Road congestion, traffic accidents, fuel consumption, and environmental pollution due to a large number of vehicles have become serious global issues. VANETs represent a crucial view of the ITS. Increasing the daily traffic represents a great challenge for the citizen of all urban and rural places[6]. There are three main types of VANET which include systems that provide for communication and information exchange by vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and infrastructure-to infrastructure (I2I) means[7]. figure 2 shows types of VANET



Figure(2): Types of VANET

4. VEHICLE-TO-VEHICLE (V2V)

Vehicle-to-vehicle (V2V) communications is a wireless network on which drivers send each other notices with information about their activities. This information will include things like speed, position, travel path, braking, and loss of stability. Technics such as brake lights, turn signals, and the horn allowed for greater understanding between drivers, resulting in safer and more organized roadways[8]. V2V technology uses dedicated short-range communications (DSRC), a standard set forth by bodies like FCC and ISO By creating a network of vehicles capable of communicating with each other. VANET comes to life, meaning that various transportation-related applications can be realized[9]. There are various aspects of the V2V charging problem that need to be taken into consideration before developing complete V2V solutions, such as, the users' privacy, data security, and the cost and profit models[10]. Figure 3 shows (V2V) communications.



Figure(3): (V2V) communications

5. Wireless Communication Technologies used for V2V

There are many types of wireless network technologies used in the process of communicating with V2V, the characteristics and features of each type differ from the other. Therefore, there is a strong desire for finding better wireless networking solutions to address the challenges in V2V communications[11]. These communication technologies are expected to increase traffic efficiency, road safety and provide comfort to passengers and drivers by providing both safety and non-safety applications[12]. Few of these technologies are discussed below:

6.1 Bluetooth (IEEE 802.15.1)

Bluetooth is a wireless technology standard used for exchanging data between fixed and mobile devices over short distances using short-wavelength. It uses a short-range wireless technology based on the IEEE 802.15.1 standard and operates in the industrial, scientific, and medical frequency band (2.4 GHz)[13]. Products that implement the Bluetooth specification can facilitate the automatic establishment of a connection between the car's hands-free system (typically part of its audio system) and a mobile phone.

6.2 ZigBee (IEEE 802.15.4):

Zigbee communication is specially built for control and sensor networks standard for Wireless Personal Area Networks (WPANs). It is a new low-cost, low-power wireless PAN standard, intended to meet the needs of sensors and control devices. However, the most unique features of the IEEE 802.15.4 standard are only obtained in the beacon-enabled mode[14].

6.3 UWB (IEEE 802.15.3a), or Ultra Wide Band

Ultra Wide Band (UWB) is a technology for the transmission of data using techniques, which cause a spreading of the radio energy over a very wide frequency band. UWB uses very low-powered, short-pulse radio signals to transfer data over a wide spectrum of frequencies that makes it tolerant to all types of disturbances. Recently, ultra wideband (UWB) has been used for radar or sensing in vehicular communications that play an essential role into operational areas in Smart Cities[15].

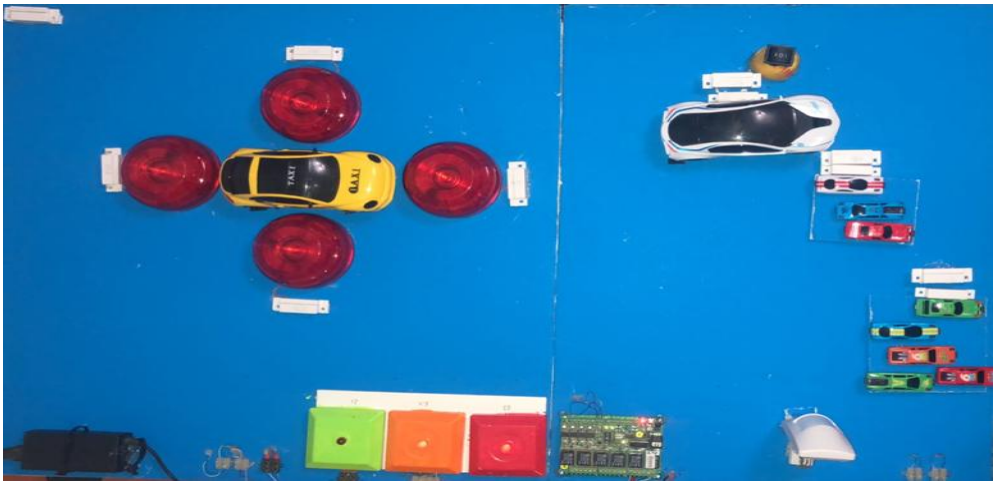
6.4 Wi-Fi (wireless fidelity)

Wireless network technology is considered one of the most important technologies used in the process of communicating with each other because it has great advantages of high flexibility, low cost, and ease of use. Wi-Fi is a wireless networking technology that allows devices to exchange information with one another. This is the general term for any type of IEEE 802.11 network. Examples of 802.11 networks are the 802.11a (up to 54 Mbps), 802.11b (up to 11 Mbps), and 802.11g (up to 54 Mbps). These networks are used as WLANs. Radio signals, router, and antenna are fundamental elements in wireless communications[16].

6.5 GPS Tracking V2V System

Global Positioning System (GPS) and route map provide a location of vehicles in VANETs. Every vehicle is provided by (GPS) device and Radio Frequency (RF)[17]. Location information can be used to find a route from a source to the destination for propagating a message. GPS Tracking V2V is a powerful, high security, and high-performance vehicle-to-vehicle GPS tracking system. It uses a tablet PC or Laptop plus a RF or GSM/GPRS modem to send, receive, and display location data of vehicles of a small group.

To demonstrate the possibility of implementing V2V based on Wi-Fi to increase vehicle safety, also to decrease the effect of traffic. we made a prototype carried out different experiments as shown below in figure 4. A complete experimental material and work have been provided and carried out including modified Toy Vehicle, 12V Dc Power supply, Sensors, Visual/Audible Alarm units, Visual "LED" devices, Cables, Switches, and finally 12V DC Relay module. Dedicated short-range communications (DSRC), a standard developed by the FCC and ISO, is used in vehicle-to-vehicle communication. Since one of the potential frequencies is 5.9GHz, which is used for Wi-Fi, it's also called a Wi-Fi network. At highway speeds, the range is up to 300 meters (1000 feet) or around 10 seconds. V2V would be a mesh network, meaning every node (car, smart traffic signal, etc.) could send, capture and retransmit signals.



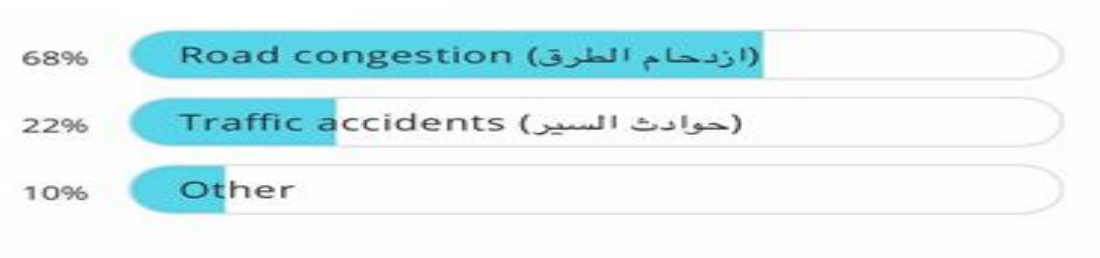
Figure(4): The laboratory prototype

6. Results and Discussion

To obtain useful data, a questionnaire was presented to people interested in road accidents and set of questions were asked related to the roads problems. After collecting and analyzing questionnaire data, the results for each question were presented as a percentage. The questions were as follows:

What is the most problem you face in the traffic?

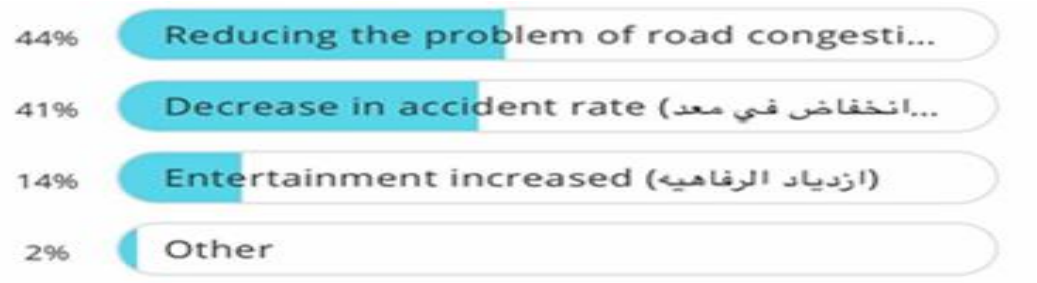
In this question, it was allowed to choose more than one an answer, and through analyzing the results, 68% of the sample faced problems of road congestion, 22% "Traffic accidents", and 10% other causes.



Figure(5): The most problems in the traffic

In your opinion, if we implement V2V systems in smart cities, what are the most important benefits it will provide?

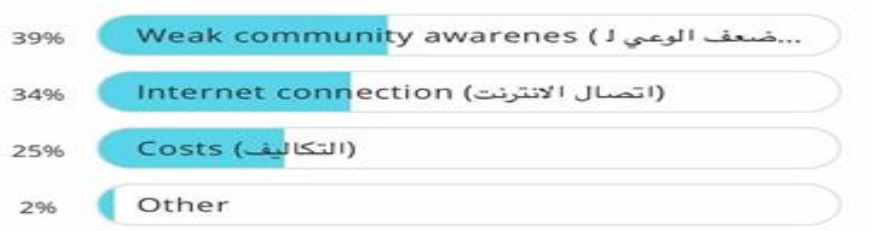
In this question, it was allowed to choose more than one an answer, 44% of the sample "Reducing the problem of road congestion", 41% "Decrease in the accident rate", 14% " Entertainment Increased ", and 2% "Other benefits".



Figure(6): Benefits V2V systems

In your opinion, if V2V technology is imposed on roads and vehicles in our country, what are the issues that will be faced?

In this question, it was allowed to choose more than one an answer, The survey was conducted based on people's opinions about issues in the implementation of roads for V2V systems in their city. 39% "weak community awareness", 34% "Internet connection", 25% "costs", and 2% "other ".



Figure(7): Implementation issues

7. Conclusion

This paper presented one of the emerging technologies that are still under study and development in the wireless network community. VANET received the attention of many researchers due to its unique nature. This Technology has great potential in facilitating road transport safety, and other vehicular communication applications, also VANET is to improve road safety as well as supports ITS. We have highlighted the importance of using V2V to provide safety and comfort

for drivers and passengers in roads. Data from the paper questionnaire is discussed, the most of the participants were agreed that use V2V can be used to improve traffic management conditions, reducing congestion, and road accidents especially in ITS. we proposed using V2V base on Wi-Fi; the reason of its unique characteristics that distinguish it from other types. To prove the possibility of applying this type in real life, We made a prototype contains simple devices usually used in the automatic control and a wireless network, such as sensors, visual, audible alarm, visual "LED" devices, and finally a 12-volt DC relay unit. The results were very motivating, we have achieved the most important main objectives of the paper: preventing vehicles from collisions, early warning, and avoiding congestion on the roads.

List of Abbreviation

DSRC	Dedicated short-range communications
GPS	Global Position System
ITS	Intelligent Transportation Systems
I2I	Infrastructure to Infrastructure
LED	Light Emitting Diode
MANET	Mobile Ad-hoc Network7
RF	Radio Frequency
UWB	Ultra Wide Band
VANET	Vehicular Ad-hoc Network
V2V	Vehicle-to-vehicle
WPAN	Wireless Personal Area Networks
Wi-Fi	Wireless Fidelity

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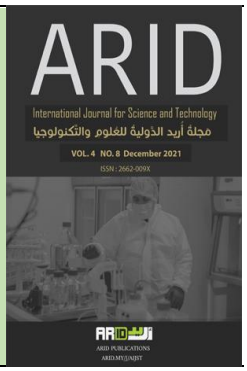

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

Electrical Properties of GaAs Implanted with High Energy (100meV) ^{28}Si and ^{120}Sn Ions

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الصفات الكهربائية لزرنيخ الجاليوم المقذوف بطاقة عالية (100 مليون إلكترون فولت) بأيونات السيليكون والقصدير

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Abstract

Single crystal n-GaAs substrates have been implanted at 300 K with 100 MeV ^{28}Si and ^{120}Sn ions to a dose of $1x10^{18}$ions/m^2 independently. The electrical properties of these samples has been investigated and compared after implantation and annealing up to 850 °C by current voltage (I-V) measurements. It has been observed that the I-V curves for the samples implanted with ^{28}Si ions show p-n junction like characteristics which then show a linear I-V characteristics for the annealing treatment between 150-550 °C. Annealing the samples at 650 °C results in a typical diode like I-V characteristics which become less non-linear after further annealing at 750 °C. Further annealing at 850 °C results in to a back ward diode like behavior. However the I-V curves for the samples implanted with ^{120}Sn ions and annealed up to 450°C were linear which then show a weak non linearity for the annealing treatments between 550°C-750°C. After 850°C annealing the samples show a strong nonlinearity typical of a p-n junction. The temperature dependence of resistance of both ^{28}Si and ^{120}Sn implanted GaAs samples after implantation and different annealing steps are investigated and the possible conduction mechanisms are discussed.

Keywords : GaAs , MeV Ion implantation, I-V curves , Defects in crystals. Electrical conduction

الملخص

يهدف هذا البحث إلى دراسة الصفات الكهربائية لبلورات الزرنيخ الجاليوم بعد تعرضها للانغراس الأيوني بطاقة عالية جدا (100 مليون إلكترون فولت) بأيونات السيليكون والقصدير بشكل مستقل.
قذفت بلورات أحادية، من نوع سالب من مركب زرينخيد الجاليوم بأيونات سيليكون وأيونات قصدير بطاقة عالية مقدارها 100 مليون إلكترون فولت. بجرعة مقدارها $1* 10^{18}$ أيون لكل متر مربع عند درجة حرارة الغرفة. تم دراسة ومقارنة السلوك الكهربائي للبلورات المقذوفة بدراسة منحنى التيار – جهد بعد القذف وكذا بعد تعرضها لعملين التلدين الحراري عند درجات حرارة مختلفة حتى 850 درجة مئوية. لوحظ أن منحنى التيار – جهد للبلورات التي قذفت بأيونات السيليكون أبدت سلوكا يشبه سلوك الوصلة الثنائية، ثم سلكت السلوك الخطي بعد تعرضها للتلدين الحراري ما بين درجات الحرارة (150 – 550 درجة مئوية) وبعد تلدينها إلى درجة حرارة 650 درجة مئوية أظهرت هذه العينات ثانية سلوك الوصلة الثنائية، وعند زيادة درجة حرارة التلدين إلى 850 درجة مئوية بدأ يختفي سلوك الوصلة الثنائية ليظهر سلوك يشبه الوصلة الثنائية العكسية. بالمقابل أظهرت منحنيات التيار – جهد للعينات المقذوفة بأيونات القصدير سلوكا خطيا بعد عملية الانغراس الأيوني وظلت محتفظة بهذا السلوك بعد تعرض العينات للتلدين الحراري حتى 450 درجة مئوية، ثم أظهرت سلوكا غير خطي ضعيف عند التلدين بدرجات حرارة بين 550 – 750 درجة مئوية، وبزيادة درجة حرارة التلدين إلى 850 درجة مئوية أظهرت العينات سلوك الوصلة الثنائية في منحنيات التيار – جهد. تمت دراسة تأثير درجة الحرارة على مقاومة العينات المقذوفة بكل من السيليكون والقصدير بعد الانغراس الأيوني مباشرة، وكذا العينات التي لدنت حراريا وذلك بقياس مقاومة العينات من خلال منحنيات التيار- جهد عند درجات الحرارة المختلفة. تمّ دراسة سلوك العينات بدراسة آليات التوصيل الكهربي التي تسيطر على السلوك الكهربي لهذه العينات.

الكلمات المفتاحية: زرنيخيد الجاليوم، الانغراس الأيوني ذو الطاقات العالية، منحنيات التيار- جهد، أعطاب البلورات، التوصيل الكهربي.

1. Introduction:

Ion implantation in III-V compound and especially in GaAs has become a well-known procedure for device technology [1, 2]. In recent years high energy ion implantation has attracted considerable attention as a tool for fabrication of special device structures, which require deep conductive layers [3, 4]. Many of these devices are sensitive to electrically active defects and therefore the investigations of defects produced by high energy ion implantation and effect of annealing on their electrical characteristics are desirable. As such, the defect creation and the annealing process for MeV implantation seems to be more complicated than that for conventional implantation [5]. The objective of this paper is to understand and compare the change in the electrical characteristics of n-GaAs substrates due to radiation defects associated with high energy implantation of ^{120}Sn and ^{28}Si ions, and the effect of annealing on their electrical behaviour.

2. Experimental Details:

The samples used in this experiment were mirror polished <100> n-GaAs substrates with background doping concentration of 2×10^{22} m^{-3} having an area of 7 mm x 7mm and thickness of 400 μm. All the Samples were carefully cleaned then immediately loaded into the target chamber connected to one of the beam lines of the NEC 16 MV Pelletron accelerator [6] at Nuclear Science Centre, India. Cleaning procedure of the samples has been described elsewhere [7]. The energy of implantation for the samples implanted with ^{120}Sn ions and ^{28} Si ions was 100 MeV. All samples implanted at room temperature, and with a total implanted dose of $1x10^{18}$ ions/m^2. During implantation the beam current was held at 1-5 particle Nano ampere (pnA) and the ion beams were scanned over the full sample surface. The samples were oriented at an angle of 7° with respect to the beam axis so as to minimize the channeling effect. The implanted samples

were isochronally annealed for 10 minutes at different temperatures in the range of 100-850 °C in high purity hydrogen ambient. To prevent the out diffusion of As from the GaAs surface during the annealing process at high temperature, the implanted samples were capped with a clean polished piece of unimplanted n-GaAs of the same size with the polished surface in contact. The unimplanted samples were used as reference samples to monitor any change in the electrical properties due to degradation during annealing process.

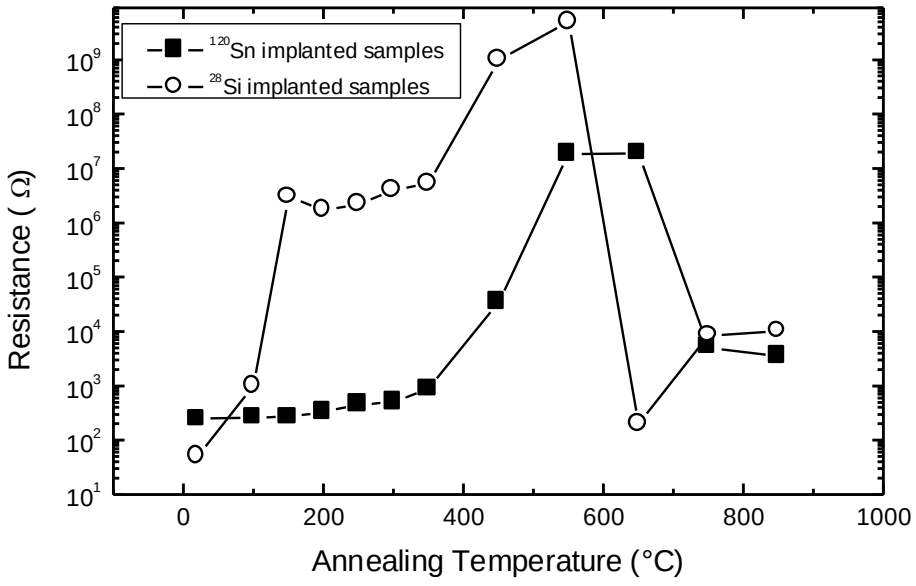
The electrical measurements have been done by fabricating ohmic contacts of small area dots on the front of the sample and large area contacts on the back of the surface. The back contacts were made by evaporating a uniform coating of Au-Ge-Ni alloy. The top contacts were made by evaporating Au-Ge-Ni dots of area 0.0045 cm2 through a metal mask. The Au-Ge-Ni contacts was then alloyed at 450 °C in hydrogen ambient for one minute to form ohmic contacts. The ohmic contacts were made before implantation for those samples to be annealed at temperatures less than 450 °C. The Current voltage (I-V) measurements were carried out over a temperature range 100-473 K by using a programmable voltage source, a Keithley digital electrometer and a variable temperature cryostat.

3. Results and Discussion:

Current voltage (I-V) characteristics for the ^{28}Si and ^{120}Sn implanted samples before and after annealing have been measured. We find that for the samples implanted with ^{28}Si ions the I-V curve for the as-implanted sample shows a highly non-linear diode like behaviour. After annealing at 100 °C the characteristics become weakly non-linear. The samples annealed between 150°-550 °C show a fairly linear I-V characteristics. The samples annealed at 650°C again show a non-linear diode like I-V characteristics. Annealing of the sample to 750 °C produces a leaky diode-type I-V behaviour. After annealing the sample to 850 °C the samples

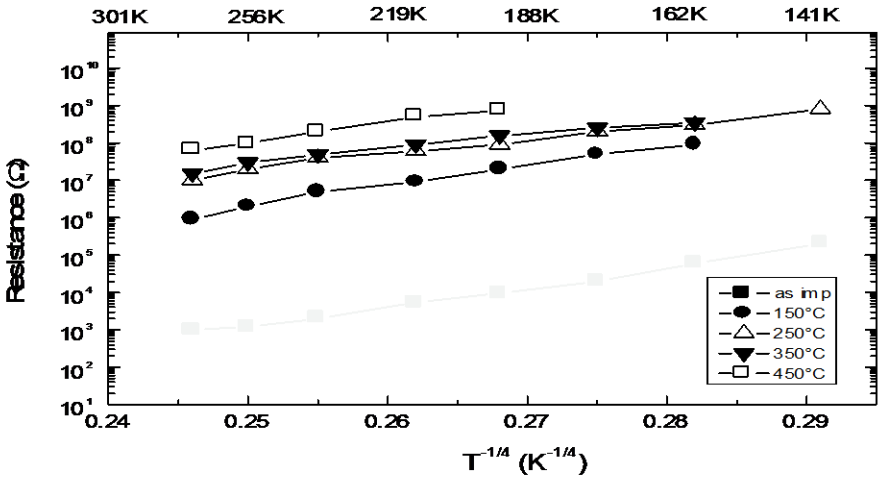
shows a backward diode like I-V characteristics. On the other hand, for the samples implanted with ^{120}Sn ions, the I-V characteristics of the as implanted samples and samples annealed up to 450 °C are linear. Further annealing of the samples to 550 °C and 650 °C shows a weak non linearity which increases considerably as the annealing temperature increase to 750 °C. After 850 °C annealing, the samples show p-n junction like behaviour. The I-V curve of the unimplanted sample remains ohmic and does not show any significant change of resistance due to annealing treatment. This suggests that there is no degradation of the material and the complex I-V characteristics are therefore attributed to the defects in the implanted layers.

In order to understand the complex behaviour of the as implanted and annealed samples, we estimate the equivalent effective series resistance from various linear and nonlinear I-V curves. For weakly and strong nonlinear I-V characteristics the effective series resistance is estimated from the high current region where the series resistance is dominating.

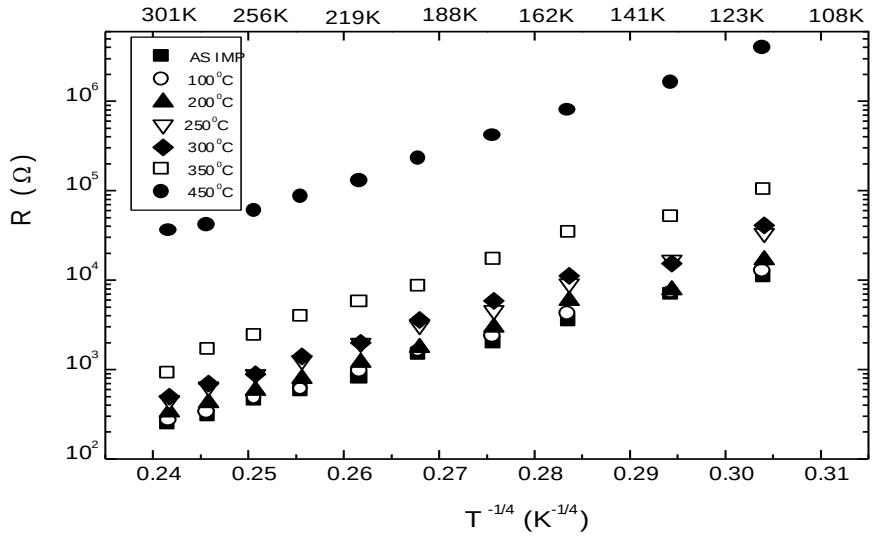


Figure(1): Room temperature resistance of the as-implanted sample and samples annealed at different temperatures for samples implanted with ^{28}Si and ^{120}Sn ions.

Fig.1 shows room values of effective resistance as measured above for different annealing temperatures for both ^{28}Si and ^{120}Sn implanted samples. It has been observed that for the samples implanted with ^{28}Si ions, the room temperature resistance of the as implanted sample is about 50 Ω, which increase with increasing annealing temperature and reaches a maximum values of about $5x10^9$ Ω at 550 °C. Further annealing at 650 °C, causes a drastic decrease in the resistance value to 200 Ω which again increases to about 10^4 Ω after annealing at 850 °C. The effective resistance of the GaAs samples implanted with ^{120}Sn ions is $2.5x10^2$ which increase with an increase in annealing temperature and reaches a value $2x10^7$ Ω for the sample annealed at 650°C. However, the samples annealed at temperatures higher than 650°C show a reduction in their resistance values and reaches a value of $3.5x10^3$ Ω for the sample annealed at 850°C. It has been observed that for the samples implanted with ^{28}Si ions there is an annealing stage occur between room temperature and 150 °C, which is not observed for the samples implanted with ^{120}Sn ions. This suggests that for the samples implanted with heavy ^{120}Sn ions a large defects concentration that are responsible for the p-n junction like behaviour in the case of Si implanted samples before the first annealing stage may be annealed by bulk annealing during implantation. The p-n junction like behaviour for the as implanted samples with ^{28}Si ions indicating a p-type conductivity of the implanted region. Some investigations involving high dose proton and neutron irradiation suggest that the irradiated layers are p-type [8] Temperature dependence of resistance of the as-implanted sample and the samples annealed at different temperatures are examined next. It is observed that for the samples implanted with ^{28}Si and ^{120}Sn ions the as implanted sample and the sample annealed up to 450°C satisfy the relation $\log R \propto T^{-1/4}$ in the temperature range (110 K-270 K) as shown in Fig. 2 and Fig. 3. respectively.



Figure(2): Resistance vs. $T^{-1/4}$ of the samples implanted with ^{28}Si ions and annealed at various temperatures up to 450 °C.



Figure(3): Resistance vs. $T^{-1/4}$ of the samples implanted with ^{120}Sn ions and annealed at various temperatures up to 450 °C.

These observations suggest that up to 450°C annealing, there remains large concentration of defect states in the implanted samples. As a result, the conductivity mechanism of these samples

in the low temperature range is dominated by variable range hopping between defect energy levels in the forbidden gap and the result may be described by [9]:

$$\rho = \rho_0 \exp\left(T_0/T\right)^{1/4} \qquad (1)$$

The values of T_0 are obtained from the slopes of log R vs. $T^{-1/4}$ curve and are given in Table I. We can estimate the localized states density at Fermi level $N(E_F)$ according to[10]:

$$N(E_F) = (C^4\alpha^3 / T_0 k) \qquad (2)$$

where $C^4 \cong 20$, $\alpha(cm^{-1}) = (2m^*/\hbar^2)^{1/2}(E_g/2)^{1/2}$ is the attenuation distance of the

wave function for the localized state, E_g is the band gap and m* is the effective mass of the electron. The values of N (E_F) for the as-implanted sample and the samples annealed at temperatures up to 450°C are listed in Table I and can be assigned to the vacancy clusters. It is observed that for both ^{120}Sn and ^{28}Si implanted samples the $N(E_F)$ values decrease with the increase in the annealing temperature indicates that the high concentration of these defect states decreased with the increase in annealing temperature.

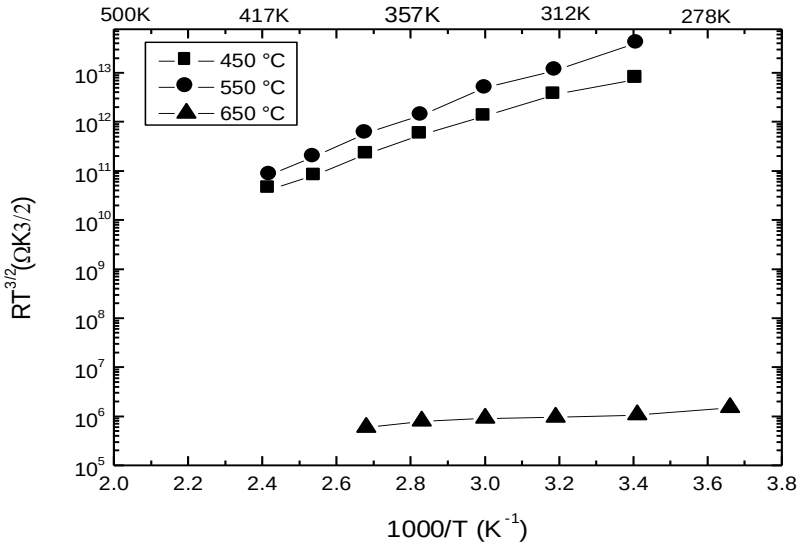
It is observed that value of $N(E_F)$ at room temperature for samples implanted with Si ions is large as compared to that of the samples implanted with Sn ions. The values of N (E_F) for the Si implanted samples after 150 °C annealing are comparable to N (E_F) at room temperature for the GaAs samples implanted with ^{120}Sn ions. This supports our previous speculation that some of the defect states are annealed during the implantation of heavy ^{120}Sn ions. It is also observed that the defect density of states at fermi level after

Table(I): T_0 values and corresponding $N(E_F)$ of the samples implanted with ^{28}Si and ^{120}Sn ions for different annealing temperatures:

Samples implanted with ^{28}Si ions			Samples implanted with ^{120}Sn ions		
Annealing Temperature (°C)	$T_0 x10^7$ (K)	$N(E_F)x10^{19}$ ($cm^{-3}.eV$)	Annealing Temperature (°C)	$T_0 x10^7$ (K)	$N(E_F)x10^{19}$ ($cm^{-3}.eV$)
As- implanted	0.137	293	As- implanted	1.288	3.11
150	1.200	3.34	100	1.336	3.00
200	1.494	2.68	200	1.342	2.99
250	1.797	2.23	250	1.859	2.16
300	1.832	2.20	300	1.992	2.01
350	2.345	1.71	350	2.507	1.60
450	6.990	0.574	450	2.952	1.36

annealing to 450 °C is larger in the samples implanted with ^{120}Sn ions than samples implanted with ^{28}Si ions. The departure from $T^{-1/4}$ behaviour for the samples annealed at temperatures higher than 450°C for both ^{120}Sn and ^{28}Si implanted samples suggests that the high concentration of the damage states is annealed and the tunnel assisted hopping conduction mechanism between the defect states at low temperatures no longer exists.

Next we shall consider the temperature dependence of the resistance for the samples annealed between 450-850 °C in the measurement temperature range of 300-470 K. It is observed that the samples implanted with Si ions and annealed between 450-650 °C satisfy the relation $\log (RT^{3/2}) \propto T^{-1}$ in the as shown in Fig. 4. This is possibly because

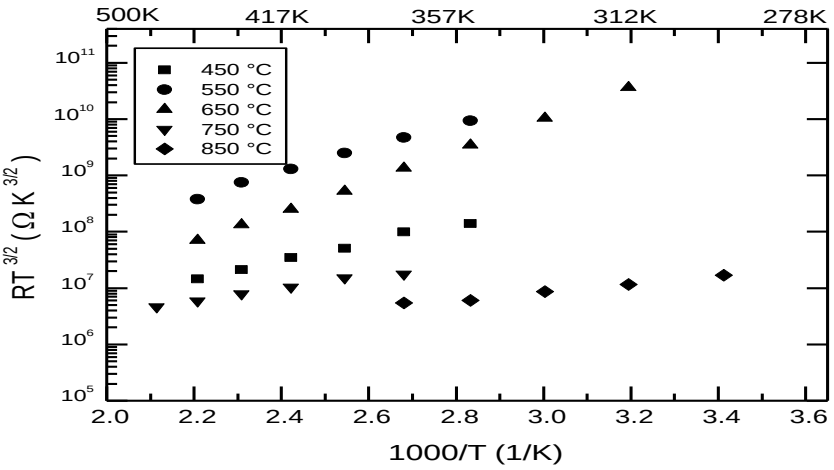


Figure(4): $RT^{3/2}$ vs. 1/T of the samples implanted with ^{28}Si ions and annealed at various Temperatures up to 650 °C.

of the electrical transport in this temperature region being dominated by carriers in the extended states for which the resistivity of the sample can be expressed by [11]:

$$\rho(T) = \frac{1}{N^* T^{3/2} q\mu(T) \exp\{-(E - E_F)/kT\}} \qquad (3)$$

where, $N^* = 2\{2\pi m_n{}^2\}^{3/2}$, m_n is the effective mass of the charge carrier, E is the energy of the band edge, μ is the mobility, q is the electron charge, E_F is the Fermi energy, T is the absolute temperature, k is the Boltzman's constant and $\hbar$ is the Planck's constant. The ($E - E_F$) values of these samples are calculated from slopes of the plots of log ($RT^{3/2}$) vs. 1/T and listed in table II. The ($E - E_F$) values for the samples annealed at 450°C is 0.47 eV and reach 0.54 eV for the samples annealed at 550 °C. Further increase of the annealing temperature to 650 °C, ($E - E_F$) value decrease to 0.10 eV. Similar electrical transports have been observed for the samples implanted with ^{120}Sn ions and annealed between 450- 850 °C and shown in Fig. 5.



Figure(5): $RT^{3/2}$ vs. 1/T of the samples implanted with ^{120}Sn ions and annealed at various temperatures up to 850 °C.

Table(II): $(E-E_F)$ of the samples implanted with ^{28}Si and ^{120}Sn ions for different annealing temperatures:

Samples implanted with ^{28}Si ions		Samples implanted with ^{120}Sn ions	
Annealing Temperature (°C)	$(E-E_F)$ (eV)	Annealing Temperature (°C)	$(E-E_F)$ (eV)
450	0.47	450	0.36
550	0.54	550	0.42
650	0.10	650	0.56
-	-	750	0.24
-	-	850	0.17

The $(E-E_F)$ calculated from slopes of the plots of log $(RT^{3/2})$ vs. 1/T for these samples are listed in table II. These values range from 0.36 eV for 450 °C annealed samples and increased to 0.42 eV after annealing to 550 °C, and reach 0.56 eV for samples annealed at 650 °C. At higher

annealing temperatures, ($E-E_F$) decreases with annealing temperature such that the ($E-E_F$) for 850 °C annealing sample is 0.17 eV.

It is clear that the annealing behaviour of the samples implanted with ^{28}Si and ^{120}Sn ions are complex, but the general nature of the electrical characteristics is somewhat similar. However the samples implanted with ^{120}Sn ions requires higher annealing temperature to attain similar characteristics of the samples implanted with ^{28}Si ions. The samples implanted with ^{28}Si ions and annealed at temperature higher than 650 °C did not satisfy the relation log ($RT^{3/2}$) $\propto T^{-1}$.This suggests that the implanted region still consists a large concentration of the defect complexes and the annealing treatment for these samples modify the electrical transport due to the modification of the defect structure. More understanding is required to understand the behaviour of these samples. Therefore an annealing up to 850 °C does anneal out the entire defect states for both ^{120}Sn and ^{28}Si implanted samples and higher annealing temperatures are required for the recovery of the residual defects.

4. Conclusions:

We have implanted ^{120}Sn and ^{28}Si ions in single crystal n-GaAs substrates at energy of 100 MeV respectively. The I-V curves at room temperature for the as implanted samples and samples annealed up to 850 °C show a series of complex behaviour. We have tried to understand this complex electrical behaviour by measuring the resistance of the samples as a function of temperature in the temperature range 100-433 K for the as implanted sample and after annealing at different temperatures. The temperature dependence of both ^{28}Si and ^{120}Sn as-implanted samples and the samples annealed upto 450°C seems to follow variable range hopping conduction at low temperatures (100 K-270 K). At room temperature and above the samples

implanted with Si ions and annealed between 450-650 °C, and for the ^{120}Sn implanted samples and annealed between 450-850 C is dominated by carriers in the extended states.

The annealing behaviour of the samples implanted with ^{28}Si and ^{120}Sn ions are complex, but the general trend of the electrical characteristics is somewhat similar. However the samples implanted with ^{28}Si ions requires lower annealing temperature to attain similar characteristics of the samples implanted with ^{120}Sn ions.

Annealing up to 850 °C does anneal out the entire defect states for both ^{120}Sn and ^{28}Si implanted samples and higher annealing temperatures are required for the recovery of the residual defects. The annealing treatment to higher temperatures by using rapid annealing processes or laser pulse processes is required to make the defects either to become stable or to anneal out, which will give a permanent electrical property to the materials under investigations and qualifies them for electronic devices requiring deep conducting or insulating layers.

List of Abbreviations:

GaAs	Gallium arsenide
μm	Micron
^{28}Si	Silicon
^{120}Sn	Tin
MeV	Million electron volt
I	Current
V	Voltage
R	Resistance
T	Absolute Temperature
ρ	Resistivity
μ	mobility
m_n	Effective mass of the charge carrier
q	Electron charge
E_F	Fermi energy
E	Energy of the band edge (conduction or valance)
$N(E_F)$	Localized states density at Fermi level
α	Attenuation distance of the wave function for the localized state
$\hbar$	Planck's constant
k	Boltzmann's constant

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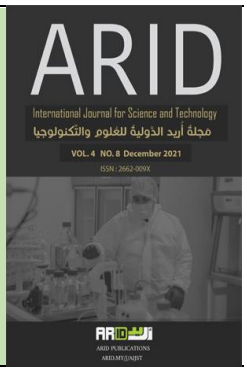

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

Preparation and Characterization ZnO Nanorods for Photocatalyst Application

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تحضير وخصائص قضبان أوكسيد الزنك النانوية وتطبيقاتها كمحفز ضوئي

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Abstract

Zinc oxide (ZnO) nanorods are prepared onto glass substrates via chemical bath deposition method. ZnO nanoparticles is prepared onto glass substrate to act as a seed layer for grown ZnO NRs. Field Emission Scanning Electron Microscope (FESEM) image confirmed that the grown rods have hexagonal shape covered the surface of substrate. Further, the prepared ZnO NRs appeared good crystallinity according to X-ray diffraction method. The absorption edge for seeds nanoparticles layer appeared at wavelength of 362nm (3.42 eV) while it was at around 479nm (3.27 eV) nm for the grown ZnO NRs. The grown ZnO NRs showed two emission peaks at 381nm and 540nm corresponding to near band-to-band electron-hole recombination and oxygen vacancies, respectively. Degradation rate of methylene blue (MB) dye was 0.01% after 1h of illumination by UV light and increased to 71.4% after 4h of illumination.

Keywords: ZnO, Nanorods, methylene blue, photocatalyst.

الملخص:

قضبان أوكسيد الزنك النانوية تم تحضيرها على قواعد زجاجية بطريقة الحمام الكيميائي. دقائق أوكسيد الزنك تم ترسيبها على قواعد الزجاج لتعمل كطبقة بذرات لإنماء قضبان أوكسيد الزنك النانوية. صور المجهر الإلكتروني الماسح أكدت الحصول على تركيب القضبان النانوية لأوكسيد الزنك السداسية الشكل وبتبلورية جيدة بحسب فحوصات حيود الأشعة السينية. حافة الامتصاص البصري لطبقة البذرات كانت عند أطول الموجي (3.42eV) 362 nm بينما كانت عند (3.27 eV) 479 لأغشية قضبان أوكسيد الزنك النانوية. قضبان الزنك النانوية المحضرة أظهرت قمتان لانبعاث الضوء عند 381nm وأخرى عند 540nm تعودان لإعادة الالتحام إلكترون-فجوة والأخرى لفراغات الأوكسجين على الترتيب. نسبة التحلل لصبغة المثيلين الزرقاء كانت 0.01% بعد مدة تشعيع مقدارها ساعة بالأشعة فوق البنفسجية ازدادت لتبلغ 71.4% بعد فترة تشعيع استمرت إلى 4 ساعات.

الكلمات المفتاحية: أوكسيد الزنك، القضبان النانوية، المثلين الزرقاء، المحفز الضوئي.

1. Introduction

Nanomaterials have received much attention because of their unique physical, chemical, and mechanical properties that distinguish them from the bulk-phase materials [1]. One-dimensional (1-D) nanostructures such as nanorods, nanowires, nanotubes, and nanobelts, have attracted much attention and play an interesting role as candidates for future electronic components. The 1-D nanostructures have several unique advantages, such as high surface-to-volume ratio, quantum confinement phenomena, and slow electron–hole recombination [2,3]. Zinc oxide (ZnO) is the most interesting metal oxide semiconductor due to its large bandgap of 3.37 eV and high binding energy of 60 meV [4]. In addition, ZnO nanostructures, such as nanorods and nanowires, have a high-surface-area-to-volume ratio, which is the most significant property of ZnO nanostructures that are used for many of applications such as gas sensor [5], ultraviolet detector [6,7], Light emitting diode (LED) [8,9]. ZnO nanorods as well as nanowires is prepared through different physical and chemical methods like CVD [10], electrochemical [11], thermal evaporation [12], hydro and solvothermal [13,14]. Among these methods, chemical bath method (CBD) which is a simple and inexpensive to deposit homogeneous and high quality thin films and has been widely used to synthesize nanocrystalline semiconductor thin films [15]. Therefore, CBD is widely used to grow ZnO nanorods onto various substrates [16-18]. One of the most important application of metal oxides semiconductors is photocatalyst that can be used as effective method to remove organic pollutants from water. Photocatalysis process is an abundant green energy source for different application such as hydrogen fuel produced and wastewater treatment by assist of solar radiation. ZnO nanostructure is considered as a promising photocatalytic material due to its high catalytic activity, low cost, environmental friendliness, chemical stability, and easy synthesis in nanostructured forms [19]. In current work, ZnO

nanorods are prepared via CBD method and their morphology, structural, and optical properties are investigated. Photoactivity of the grown ZnO nanorods was tested against methylene blue dye under UV illumination for different exposed time.

2. Experimental part

2.1 Preparation ZnO NRs and characterization

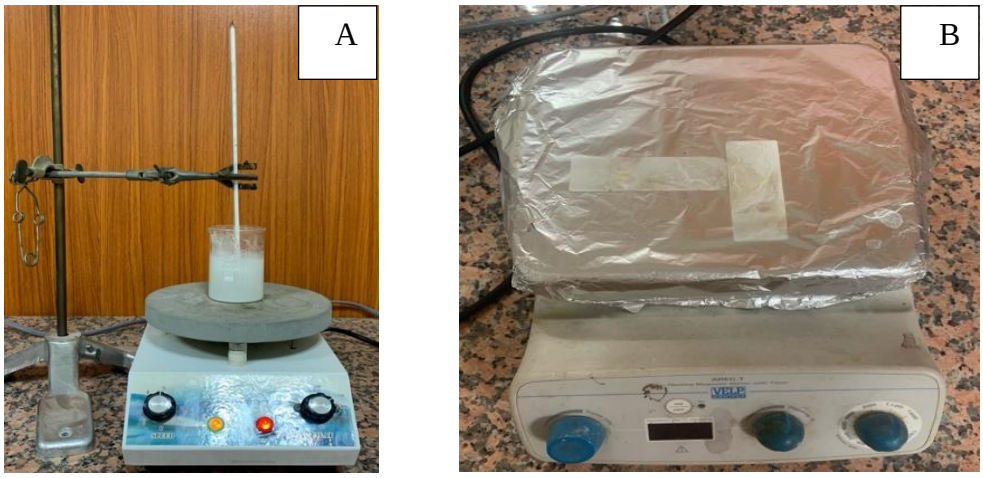
Zinc oxide nanocrystalline thin films are prepared onto glass substrates via chemical bath deposition method. Substrates are cleaned by diluted HCl aced and distilled water (DI) for three times flowed by ethanol for two times and finally by DI with sonication for 15 min. Preparation ZnO nanorods (NRs) onto glass substrate need to ZnO nanoparticles acts as a seed layer [6]. Seed layer was prepared using 0.1M/100 ml H_2O of zinc acetate mixed very well using magnetic stirrer at room temperature for 10 min. Zinc acetate solution is , then, drop casted onto cleaned substrates and heat treated at 300 ^oC for 1 hr to obtain ZnO nanoparticles thin film as shown in Fig.1. To grow ZnO NRs thin films, prepared seeded substrates are immersed inside solution contains 2.9g of zinc nitrate [$Zn(NO_3)_2.6H_2O$] and 1.4g of hexamine ($C_6H_{12}N_4$) that added drop wise with total volume of 100ml H_2O. Temperature is increased gradually to 90 ^oC by hot plate and total preparation time was 2h then samples are removed from the solution, washed by DI and left to dry naturally. The grown ZnO NRs thin films are annealed at 350 ^oC for 1h to enhance their crystallinity and Zn/O ratio stoichiometry. Figure 2A&B shows the solution that used for grow ZnO NRs thin films and prepared samples, respectively. The surface morphology of the prepared samples is studied using a NovaSEM 450 scanning electron microscope (SEM; FEI Co.). The crystalline structure of the prepared samples was investigated using x-ray diffraction (XRD) (PANalytical X'PertPRO with CuKα; 1.5406 A radiation). The optical absorption was investigated using ultraviolet (UV)-visible spectroscopy UV-1800 Shimadzu Co. (Japan) while

the photoluminescence (PL) spectra is investigated by Fluo-Time 300 for Time-Resolved and Steady-State Spectroscopy (Germany) under 360nm excitation light.

2.2 Measurements Photocatalytic activity

The photocatalytic activity of the prepared ZnO NRs was investigated against Methylene blue (MB) dye. A 0.01g of MB is dissolved in 250ml of DI and 50ml of prepared solution was used in every test. The prepared ZnO NRs sample cut into 2.5x2.5 cm immersed in MB solution for different times. The sample is exposed by UV light with 260 nm wavelength for 0-4h and 2ml is taken every 1h to measure the optical absorption.

Figure(1): ZnO seed layer onto glass substrates

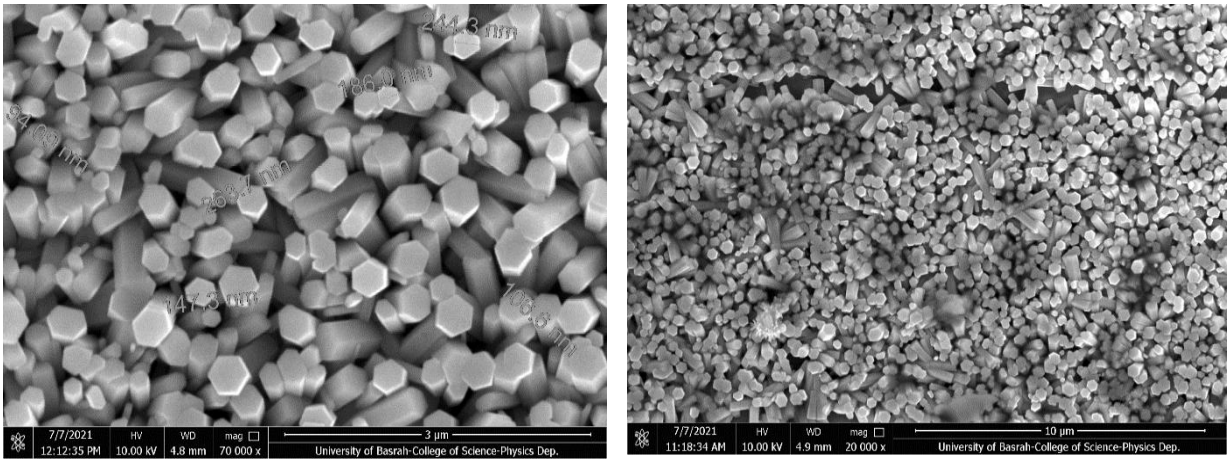


Figure(2): (A) The solution that used for grow ZnO NRs thin films, (B) The prepared ZnO NRs thin films

3. Results and discussion

3.1 Surface morphology

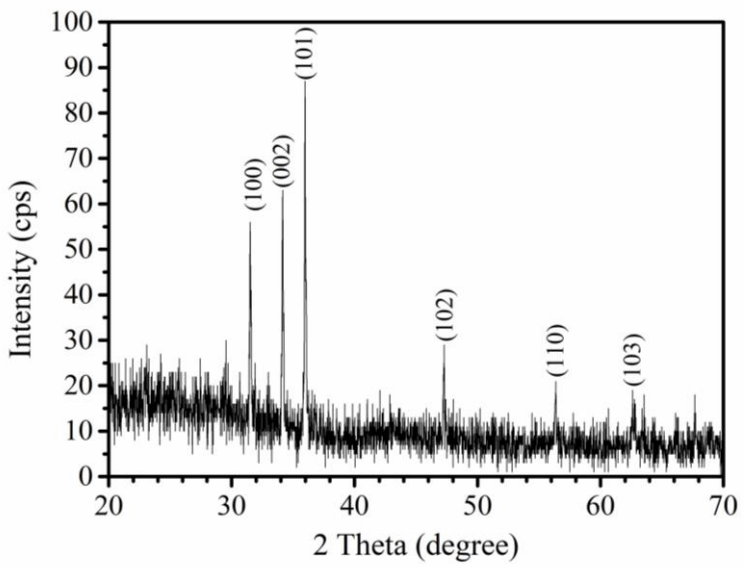
Figure 3 shows the FE-SEM image of prepared ZnO NRs grown onto glass substrates via chemical bath method. The ZnO are structured as hexagonal shaped nanorods covered the surface of substrate. Diameter of the grown ZnO NRs is ranged from 150nm to 260nm. ZnO nanoparticles seeds will act as a centers for grow ZnO NRs and the different in the dimeter of prepared rods is could be due to the seeds aggregated with different size.



Figure(3): FE-SEM image of grown ZnO NRs onto glass substrate via chemical bath deposition

3.2 Crystalline structure

Figure 4 shows the XRD pattern of grown ZnO NRs that prepared onto glass substrate. The pattern appeared in around 6 diffraction peaks at 2θ of 31.5, 34.15, 36.0, 47.3, 56.37, and 62.63 corresponding to (100), (002), (101), (102), (110), and (103) planes of hexagonal ZnO phase. The ZnO NRs is single crystal grown toward (002) crystalline plane, however appearing more than diffraction peak in the XRD pattern is comes from the sides of ZnO NRs where the rods are not growing in alignment vertically on the substrate.

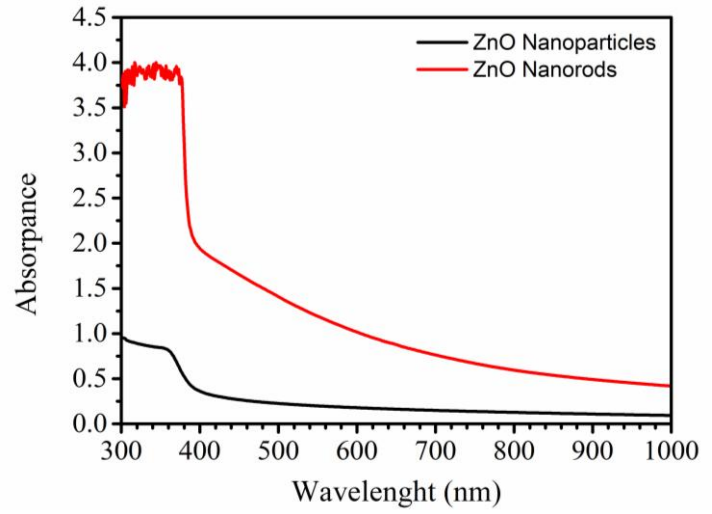


Figure(4): XRD pattern of ZnO NRs grown onto glass substrate via

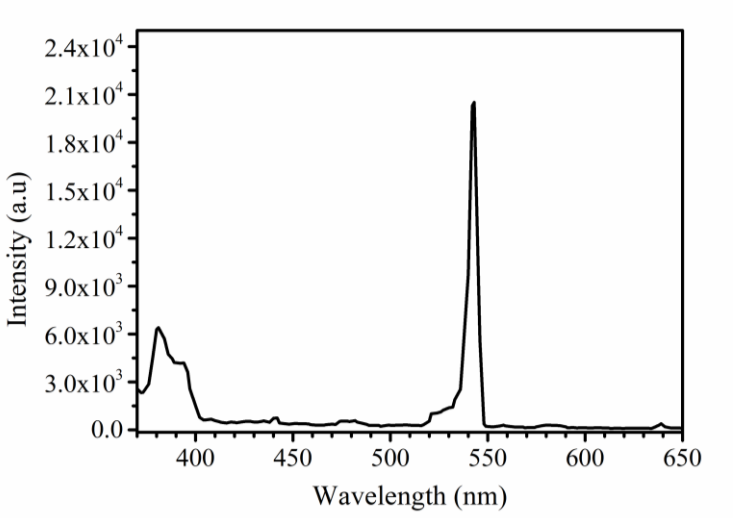
3.3 Optical properties

Figure 5 shows the optical absorption of ZnO seed layer and ZnO NRs thin films that prepared onto glass substrate. The grown ZnO NRs appeared sharp absorption edge compared by ZnO nanoparticles seeds layer due to the different in the thickness as well crystallinity between them. The absorption edge for seeds nanoparticles layer appeared at wavelength of 362nm (3.42 eV) while it was at around 479nm (3.27 eV) nm for the grown ZnO NRs. However, value of

optical band gap is affecting by more than reason such as particles size, shape and the ratio between elements in the compound (Zn/O ratio) thus, obtain band gap in the ZnO seed layer bigger than that for ZnO which could be related those reasons. Photoluminescence (PL) spectrum is shown in Fig.6 and two emission peaks are appeared, abroad one at a wavelength of 381nm and sharp peak at 540nm. However, the emission peak at UV region is corresponding to near band-to-band electron-hole recombination while the other one at visible is related to oxygen vacancies.



Figure(5): Optical absorption of ZnO seed layer and ZnO NRs grown onto glass substrate



Figure(6): Photoluminescence spectrum of ZnO NRs grown onto glass substrate

3.4 Photocatalytic activity

Photocatalytic activity of prepared ZnO NRs is studied through investigating photo degradation of MB dye by measuring the absorbance spectra after exposure by UV light with various times (0-4hr). Figure 7 shows that the absorbance peak decreases with the irradiation time, this indicates a decrease in concentration of MB dye with time. Degradation rate of MB blue dye is calculated using the equation below [19]:

$$Degradation\ rate(\%) = \frac{A_\circ - A}{A_\circ} \times 100, \qquad \ldots.1$$

where A_o, A are the absorbance value before and after exposure by white light for several minutes, respectively. Degradation rate of MB blue dye was just 0.01% after 1h of illumination increased to 1.58% and 3.0% when the time is 2h and 3h, respectively. However, the highest degradation rate was obtained for 4h of illumination with value of 71.4% and it is good result compared by the published literature [20,21]. Dye degradation is happening by photo catalysts when a photon with energy higher than the energy gap illuminates the catalyst leading to excite electrons from valance band (VB) to conduction band (CB) leaving holes. High oxidation potential of holes in CB allows direct oxidation of dye in the reaction medium followed by the degradation process. Dye decay is caused by its interaction with free radicals of hydroxyl (HO·) and superoxide(O2·) that produce by the catalyst according to the interaction that shown by equations [19]:

$$ZnO + h\upsilon \rightarrow ZnO\ (e^-_{CB} + h^+_{VB}) \qquad \ldots\ldots\ldots\ldots \quad 2$$

$$ZnO(h^+) + OH \rightarrow ZnO + OH^{\cdot} \qquad \ldots\ldots\ldots\ldots \quad 3$$

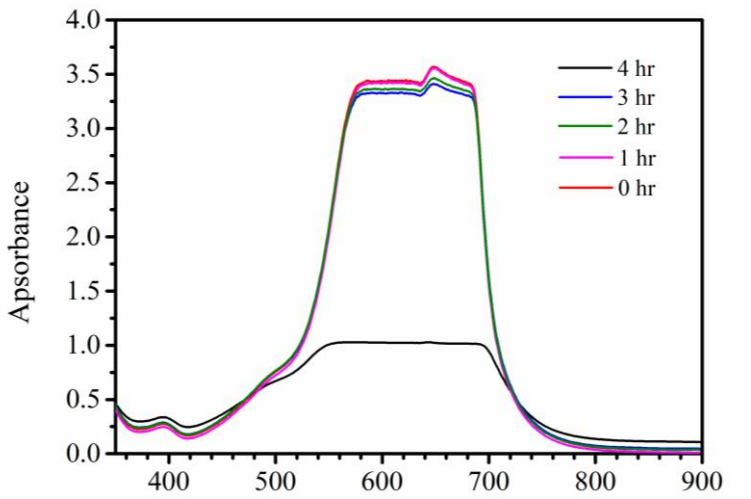
$$ZnO(e^-) + O_2 \rightarrow O_2^{\cdot} \qquad \ldots\ldots\ldots\ldots \quad 4$$

$$O_2^{\cdot} \xrightarrow{H^+} HO_2^{\cdot} \qquad \ldots\ldots\ldots\ldots \quad 5$$

$$Dye + h^+ \rightarrow oxidation\ products \qquad \ldots\ldots\ldots\ldots \quad 6$$

$Dye + e^{-} \rightarrow$ reduction $products$ 7

$Dye + OH \rightarrow$ degradation $product$ 8



Figure(7): UV–Vis spectra of MB dye under different UV illumination time

4. Conclusions

ZnO nanorods can be prepared onto glass substrates using CBD method using ZnO nanoparticles seed layer. The produced ZnO NRs have good crystallinity with hexagonal phase. The grown ZnO NRs formed as a hexagonal rods covered the whole surface of the substrate. The energy band gap was 3.27eV which closed to standard value of ZnO. Two emission peaks are appeared in the photoluminescence (PL) spectrum at a wavelength of 381nm and other one at 540nm corresponding to near band-to-band electron-hole recombination and due to oxygen vacancies, respectively. Degradation rate of MB blue dye was increased from 0.01% after 1h of illumination to 71.4% after 4h of illumination. Thus, the present results show that ZnO nanorods can be used for photocatalytic application.

Abbreviations

CBD: chemical bath deposition
FESEM: Field Emission Scanning Electron Microscope
NRs: Nanorods
CVD: chemical vapor deposition
UV: ultra violet
XRD: ray diffraction
PL: photoluminescence

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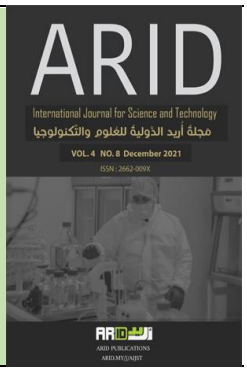

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

THE QUALITY OF E-LEARNING ON THE WEBSITE (CLASSROOM, EDMODO, MOODLE, ZOOM, FREE CONFERENCE CALL, MEET, WEBEX MEET, TELEGRAM, WHATSAPP, VIBER, AND YOUTUBE)

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INTERNATIONAL SAKHAROV ENVIRONMENTAL INSTITUTE OF BELARUSIAN STATE UNIVERSITY (ISEI BSU)

جودة التعليم الإلكتروني في موقع الويب (CLASSROOM, EDMODO, MOODLE, ZOOM, FREE CONFERENCE CALL, MEET, WEBEX MEET, TELEGRAM, WHATSAPP, VIBER, AND YOUTUBE)

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Abstract

The goal of the current study is to learn more about different online apps that can be used in E-learning. The study also aims at shedding light on more important methods using applications on the web in the quality of E-learning. Applications are taken from the website: Classroom, Edmodo, Moodle, Zoom, Free Conference call, Meet, WebEx Meet, Telegram, WhatsApp, Viber, and YouTube. These applications are used in E-learning. The study focuses on various types of university education, and it is made public through social media. The study uses Google Forms approach that consists of a set of questions that are answered entirely and at random. The study was conducted on 288 samples during the 18 hours ending on 29/ 05/2020 at 13:50:30. The results were a questionnaire of seeing which website applications are mostly used in the quality of E-learning. Google, statistical package for the social sciences (SPSS), and Excel data analysis system is scrutinized by using the questionnaire results. Now E-learning uses more interactively in universities than any other time during the different web applications for creating conferences, seminars, classes for students.

Keywords: E-learning, website, applications Google, Classroom, Zoom.

الملخص:

تهدف هذا الدراسة إلى معرفة أكثر التطبيقات من موقع الويب استخداما في التعليم الإلكتروني. أيضا تهدف الدراسة إلى معرفة أهم طرق مستخدم موقع الويب لتطبيقات مختلفة في جودة التعليم الإلكتروني. حيث تم أخذ 11 تطبيق من تطبيقات موقع الويب: **Classroom** و**Edmodo** و**Moodle** و**Zoom** و**Free Conference call** و**Meet** و**WebEx Meet** و**Telegram** و**WhatsApp** و**Viber** و**YouTube**. حيث تعتبر هذه حاليا من أكثر التطبيقات المستخدمة في التعليم الإلكتروني. الدراسة تستهدف فئات مختلفة من التعليم الجامعي حيث تم نشر الدراسة عبر وسائل التواصل الاجتماعي. باستخدام طريقة نماذج جوجل، حيث تم استخدام مجموعة من الأسئلة تمت الإجابة عليها بشكل كامل وبشكل عشوائي. أجريت الدراسة على عينات مكونه من 288 حالة خلال 18 ساعة. كانت النتائج عبارة عن استبيان لمعرفة أكثر تطبيقات موقع الويب استخدامًا في جودة التعليم الإلكتروني كما في المناقشة والنتائج. حيث تم استخدام نظام تحليل البيانات **SPSS** وجوجل واكسيل لتحليل نتائج الاستبيان. التعلم الإلكتروني يستخدم الآن بشكل أكثر تفاعلاً في الجامعات من أي وقت مضى من خلال تطبيقات الويب المختلفة لإنشاء المؤتمرات والندوات والفصول الدراسية للطلاب.

كلمات مفتاحية: التعليم الإلكتروني، موقع الويب، تطبيقات جوجل، صف دراسي، منصة زووم.

1- Introduction:

E-learning is a simple matter of education that uses electronic technologies to access educational curricula outside traditional classrooms. Distance education, computer E-learning, online E-learning, and a variety of other words are all used to describe education provided online. E-learning can be defined as lessons that are offered privately by the Internet elsewhere (for students) other than the traditional semester in which the teacher teaches students online [1,2]. These are not lessons that the professor offers to students by disk, CD, videotape, or through a television channel, but rather interactive lessons. The interactive characteristic appears directly between professors and students. The students can interact with the professor by raising the hand in the E-learning program and interacting with the professor directly in his electronic lessons. The E-learning resources are related to the different websites education that students can register for these lessons by the Internet, and communicate and interact with the professor by using these different websites [1,2,3].

The first device for electronic lessons was invented in 1924. As this device allows to give lectures to students. Then in 1954, BF-Skinner is a professor of psychology at Harvard University from 1958 until his retirement in 1974, has discovered a teaching machine that enables schools to manage programmatic E-learning for their students [CF 1,2]. It did not appear until 1960 when the first computer-based training program was introduced to the world. This was a computer-based training (CBT) program for automated teaching processes. The first online educational systems have already been created to provide information only to students, but with the development of the seventies decade, online education began to become more interactive in Britain [1]. The Open University was keen to benefit from E-learning, as the educational system has been mainly based on distance education in the past, as the study

materials were delivered by e-mail and correspondence with students by email. The Open University has begun to offer a broader set of interactive learning experiences and faster correspondence with students by e-mail. With the evolution of computers and the Internet in the late twentieth century, E-learning tools and teaching methods have expanded. The first Macintosh (Mac) in the 1980s enabled individuals to have computers at home, making it easier to identify specific subjects and develop specific skill sets [1]. The virtual E-learning processes began in companies and universities and many schools to offer lessons or online courses. Technological developments have helped educational institutions reduce the costs of distance education, that is, to save time of learning for students, which has helped to provide education for students more broadly [1,2,3].

Companies and universities started using E-learning in 2000 to train new and seasoned staff, workers providing opportunities for them to gain industry knowledge, broaden their skill sets, and others. In 2010, new perspectives began to open the doors of the future to E-learning by taking advantage of the applications (social media) and huge open courses across the Internet as such different websites in YouTube, Moodle, and other applications were used in E-learning [1]. However, in 2020, it is noted that the qualitative prosperous that has occurred in E-learning. Using more interactively in universities through the different websites to create conferences, gave lectures for students and others [2,4].

The problem of the study is for the current research in using E-learning website applications in an irregular and random method. With the spread of modern means of communication from a computer, the Internet, and multiple media, such as audio, image, and video. E-learning has played an essential role in the success of the educational process, allowing a large number of people to receive education with ease and with less time and effort. However, due to the current

conditions that the entire world is experiencing as a result of the spread of the Coronavirus, the institutions were forced to switch to E-learning to ensure the continuity of the learning process. As well as to communicate with students remotely by using the Internet, smartphones, and computers. Universities that were forced to switch to E-learning and use communication methods they had never used before, and their faculty members communicated with students in a variety of ways, with some faculty members questioning the results of electronic tests because there were no tangible indicators on commitment. Students are subjected to the test instructions, which raises questions regarding e-effectiveness learning among university students. Some issues have arisen in the application of E-learning, such as the ineffective use of some E-learning software due to a lack of prior knowledge of E-learning or distance learning, as well as the ineffective E-learning infrastructure which necessitates the adoption of specific software and the provision of internet networks, smartphones, and computers for each student. In addition, various issues arose in the use of E-learning tools on a random and irregular basis. A professor's time and effort in classes, conferences, webinars, and other activities are considerable. As a result, there is a persistent need to understand and evaluate the performance of E-learning, including how well it satisfies educational objectives, how well it can meet student needs, and how well it can create an interactive environment that reduces the need for university attendance. Because each program differs in terms of its use, E-learning quality, and conclusions, there are several ways to use E-learning website programs regularly as stated in conclusions. One of the problems of the study presented by the research is the quality of E-learning on the website. Some sub-questions can be identified as follows:

1. What is E-learning?
2. What are the applications used in E-learning?

3. What are the E-learning platforms?

Among the most important objectives of the study is the current research. The study aims at:

1 -Reveal the level of obstacles by using the website in E-learning, and the level of interaction of students and faculty members with E-learning through the website.

2 -Enhancing levels of education, learning, and creativity.

3 -Using modern website technologies to create an interactive learning environment.

4 -Organizing and managing the activities of educational institutions through website technologies.

5 -The best-using methods of E-learning

6 -Knowing the use of each application in E-learning by the web.

7 -Differences between applications in their use of E-learning.

8 -Sensitizing the professor and students on how to use an E-learning by the web.

The importance of the current research from recent studies and research in E-learning is shown as follows:

Theoretical importance:

1. The importance of finding a modern and advanced method in E-learning.
2. The importance of finding a way to use each of the different applications of the website in E-learning.
3. Finding studies and significant strategies in E-learning.
4. The results of the study can be used to search by using website applications in E-learning in an organized, professional, and modern method.
5. Researchers can benefit from the current study to conduct modern research in E-learning.

Practical importance:

The findings of this study will help to improve the performance of the E-learning system, the development of human cadres, the material capabilities and trends in the selection of educational methods, and the development of plans for E-learning as an alternative to education attendance in universities. The tool of study can also be used to determine how effective a university E-learning system. The research is noteworthy since it is suitable for a real-world phenomenon, namely the spread of the Coronavirus. The results of this study can be valuable in the use of web applications regularly with the teaching and students in lessons, conferences, and forums via the internet and others, as shown in conclusions.

2- Material and Methods

The study is conducted via questionnaire by Google Forms method using the website in E-learning. The study mains goal is to use the best methods of various web applications in E-learning. This study shows that every application lags behind other applications in its use in E-learning. To identify the quality of E-learning in the website where the most used applications in each paragraph are calculated and arranged according to the graph. As shown below in the table of the questionnaire (a simple form of a questionnaire) to download the complete questionnaire inside this link: https://drive.google.com/file/d/1D9CiwUSuwsCU-JmAqLntOJHYGQdFvc4v/view?usp=sharing therapy. As in the table:

Table(1): Form of a questionnaire

5/28/2020 9:06:40	Male	From 20 to 30 year	Degree BSC	university student	Classroom, Zoom, Free conference call, Telegram, WhatsApp
5/28/2020 9:08:45	Male	From 30 to 40 year	Degree MA	Professor	Edmodo
5/28/2020 9:09:01	Male	From 20 to 30 year	Degree MA	university student	Classroom, Free conference call
5/28/2020 9:12:33	Female	From 50 to 70 year	Prof Dr	Professor	Classroom, Edmodo, Moodle, Zoom, Free conference call, Meet, Webex Meet
5/28/2020 9:23:15	Male	From 50 to 70 year	Prof Dr	Professor	Classroom, Zoom, Telegram
5/28/2020 9:29:59	Female	From 20 to 30 year	Prof Dr	Professor	Classroom, Zoom, Meet, Telegram
5/28/2020 9:37:24	Female	From 20 to 30 year	Degree BSC	university student	Zoom, Telegram, YouTube
5/28/2020 9:53:39	Male	From 30 to 40 year	Degree MA	university student	Free conference call
5/28/2020 9:55:08	Female	From 20 to 30 year	Degree BSC	university student	Classroom
5/28/2020 9:57:13	Female	From 20 to 30 year	Degree BSC	university student	Classroom, Zoom, Free conference call, Meet, Telegram, WhatsApp, Viber, YouTube
5/28/2020 10:22:54	Female	From 30 to 40 year	Degree MA	Professor	Classroom, Free conference call, Telegram
5/28/2020 10:29:30	Male	From 30 to 40 year	Degree MA	university student	Edmodo
5/28/2020 10:48:28	Male	From 50 to 70 year	Degree PHD	Professor	Classroom
5/28/2020 11:29:59	Male	From 40 to 50 year	Degree MA	university student	Zoom
5/28/2020 11:42:53	Female	From 30 to 40 year	Degree PHD	Professor	Classroom, Moodle, Free conference call, Meet, Telegram, WhatsApp, Viber
5/28/2020 12:14:56	Male	From 20 to 30 year	Degree MA	university student	Free conference call

These results indicate that the research sample supports that the majority of the questionnaire paragraphs are using applications website in E-learning to teach students through electronic classes, webinars, conferences, courses, and to others by the Internet as shown in the results and discussions.

2-1 E-learning:

Previous studies on E-learning were discovered a century ago until now as further development on platforms used in E-learning in 2020 more interactive use in universities through website applications.

E-learning is education using electronic technologies and technology to access educational curricula outside-of traditional classrooms. Education refers to lessons, an organized course, educational experience, or degree of exams that are offered entirely online. Downloaded done lectures and lecture schedules by the online classroom. Students can enter through these different website applications that are used in E-learning. E-learning has two types of Synchronous E-learning and Asynchronous E-learning.[1,2,3]

Synchronous E-learning refers to direct online lessons, concurrent online lessons, or virtual lessons in the classroom. Synchronous E-learning is used in online conference systems, webinars, or others as these applications Zoom, and Free Conference call, Meet, WebEx, etc . .[1,2,4]

Asynchronous E-learning is a self-paced step that students can access lesson materials on a computer, or web-based, at the speed that is appropriate for students and then choose what they want to learn and set the date for education with students. Asynchronous E-learning programs include pre-recorded lecture content, video, visuals, or text and other interactive elements such as Classroom, Edmodo, Moodle, YouTube, Telegram, WhatsApp, Viber, etc. [1,2,5].

2-2 Using Classroom, Edmodo, and Moodle in E-learning

These applications are commonly used in E-learning. These applications are free and provide a platform for E-learning in an easy and simplified method. They help various professors significantly representing lessons and the organizations of the lectures and the curricula during applications. Then facilitates interaction with students by the applications. The applications are incorporated into the classroom for a variety of uses include:

1. Create an electronic classroom for students.
2. Publishing lectures in an electronic classroom.

3. Posting assignments, competitions, and interactions through dialogue and discussion among students in an electronic class.
4. Conducting exams in an electronic class.
5. Create polls for student responses to exams and assignments.
6. Providing links to obtain useful information. The apps allow students to upload assignments, view and rate them.

2-3 Using Zoom, Free Conference call, Meet, and WebEx Meet in E-learning

These are applications used in workshops, webinars, video-conferences, and simple meetings on the Internet. These are mainly used by universities and companies to host meetings with professors, colleagues, and international clients. They are also a great way to start quick and easy meetings on the Internet. The free plan allows universities to collaborate with other universities in conferences and other posts on high-quality screens, web cameras, VoIP, and chat messages in one session.

Features of applications in E-learning include:

1. Free applications.
2. High-quality video and audio, or summons for listening to the meeting audio using the phone.
3. Easy-to-use tools for collaborating online with others, including sharing, shared comment, hacking and polling rooms, and whiteboards.
4. Allows high-quality meeting records and downloading those records as MP4 files.
5. Full feature apps for iOS and Android.

2-4 Using Telegram, WhatsApp, and Viber in E-learning

These applications are free instant messaging. they are applications for smartphones that works across multiple platforms and are widely used among college students to send multimedia messages such as photos, videos, and audio along with simple text messages. E-learning has been implemented through these applications. Professors and students can exchange photos, videos, and audio media messages by creating a group for studying class via these applications. These applications are used by a phone number as an identity. These applications allow free phone calls or send text messages or audio recordings to many groups (student groups). Once download any of the apps (Telegram, WhatsApp, and Viber), an access code will be sent by SMS or call back to activate applications to verify the user's identity in applications by Wi-Fi or even over 3G. Features of Telegram, WhatsApp, and Viber applications in E-learning include:

1. Free applications.
2. Used on mobile devices and computers and can be opened through different web browsers.
3. Downloading applications require a small space.
4. All file types, Messages or audio recordings can be sent to all students. And it is easy to send and receive any type of file that contains the learning process within the E-learning by these applications.
5. Possibility to create groups or channels in these applications for each semester or every stage or every course. The professor communicates with his or her students in the entire curriculum through groups. Feedback can be provided as a kind of response to students with everything related to the content of lectures.

6. Through group, possibility to publish study dates, schedules, scientific forums, conferences, and seminars. In addition to start and end dates of lessons for students in E-learning.
7. Make a voice call with one of the students to clarify what the professor cannot explain in the electronic lecture.

Through groups in the applications, the contents of the materials can be downloaded in the electronic class and an explanation is made for students. Messages can also be exchanged between the professor and students. The classes and discussions in the lectures do the role of competition between students' duties. Or asking questions during the explanation of the electronic lecture.

2-5 Use of the YouTube platform in E-learning

In recent years YouTube has been used in E-learning by creating a channel on YouTube, and lessons are downloaded on the YouTube channel too. Online lessons are broadcasted directly through a channel to explain the contents of the materials for students. E-learning on YouTube is used for lessons, seminars, or scientific conferences in more interactive, fun, and truly informative. The transform can be boring or complex topic into an exciting and attractive E-learning experience in general gives YouTube the ability to create fully customized playlists. A playlist of all the topics can be created in E-learning lessons so that students can quickly access videos that will help them expand understanding or learn more about the contents of the material. This makes it an ideal tool for lessons students. YouTube gives the E-learning specialist the ability to create videos that students can access even after the E-learning lessons have already done, whether they were webinars or conferences, or other applications. The invaluable reference tools enable students who want to update their memory and general information about the topics

unit or review content before any exams. Videos also can attract students to education. Difficult explanations of complex topics done through the use of text or images. However, videos can illustrate a complex concept or process of visualizing the steps or ideas involved. Even finding an existing video on YouTube that provides students with an in-depth look at how these ideas performed. They help students to acquire and retain knowledge sets and skills more effectively. They also provide a visual context for the content of E-learning courses for E-lectures.

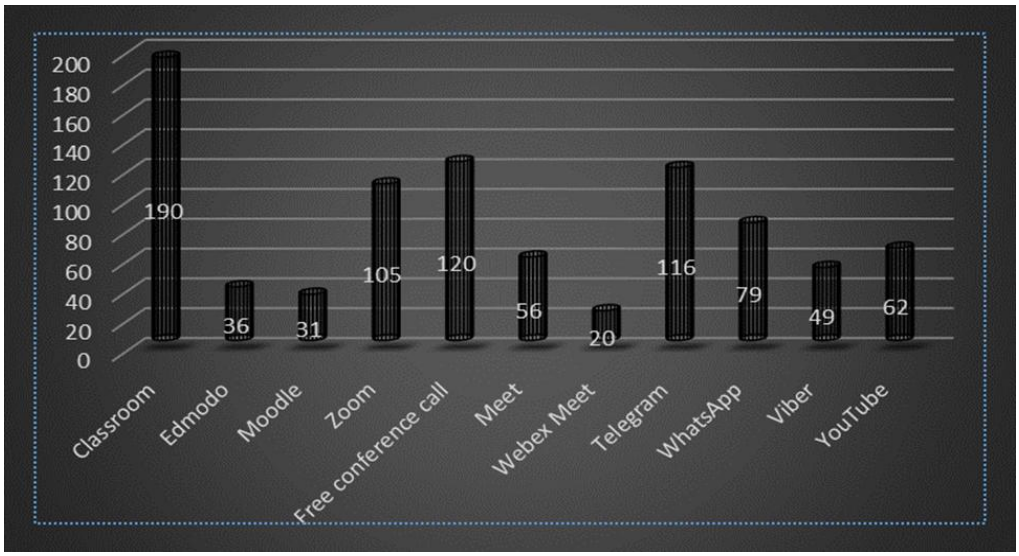
3- Results and Discussion

The study explains the quality of E-learning on the website applications including Classroom, Edmodo, Moodle, Zoom, Free Conference call, Meet, WebEx Meet, Telegram, WhatsApp, Viber, and YouTube. The comparison is made between applications used in E-learning by questionnaire method randomly. At different scientific levels of the professor and the students ranging in age from (20-100) years. Showing in a questionnaire that the percentage more used in website applications is Classroom, Free Conference call, Telegram, and Zoom in the E-learning. These four possibilities were high in a questionnaire. The study finds out that most of the community groups have sufficient knowledge about E-learning and educational methods. Using the Google forms method for creating the questions in a questionnaire. The set of questions completely and randomly answered. Questions that are used in a questionnaire are gender, age, certificates of the participants in the questionnaire, and the relative knowledge of the participants in the questionnaire for the professor and university students. The web applications eleven were identified to choose the participants for applications used in education. The number of all participants to a questionnaire is 288 samples. The number of answers of type gender participating in a questionnaire is 287 samples. The number of answers of age participating in a questionnaire is 287 samples. The number of answers for the cognition of certificates

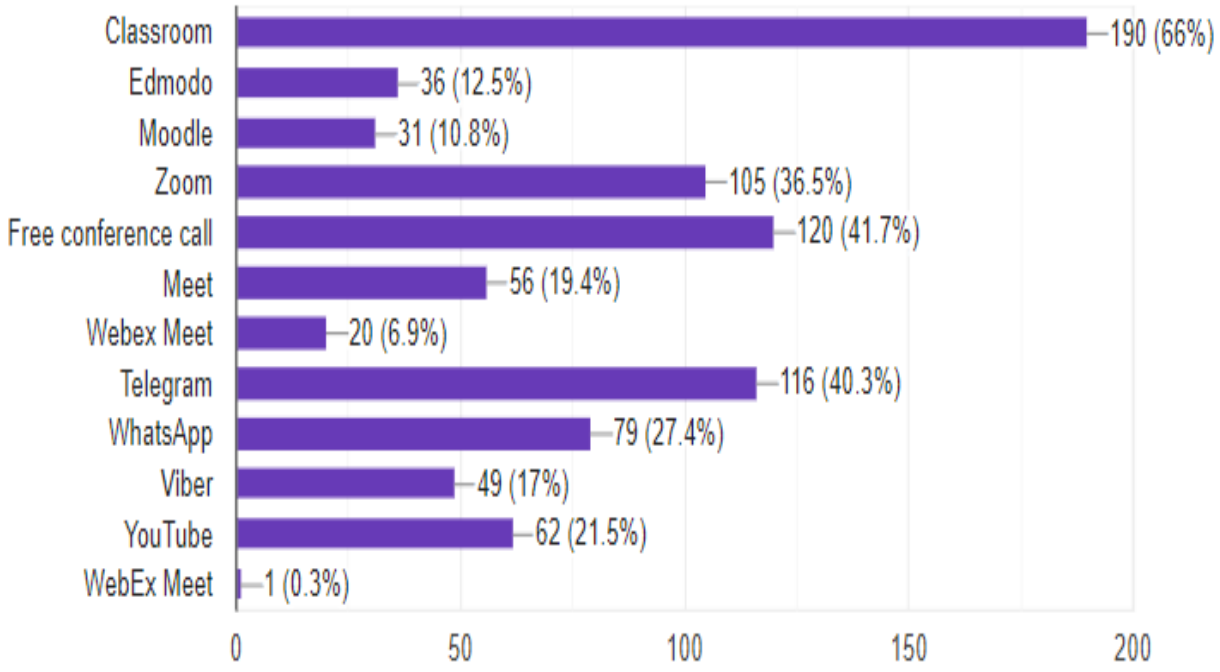
participating in a questionnaire is 281 samples. The number of answers for determining participating in a questionnaire than the professor and the university students is 273 samples. The number of answered choices for website applications mostly used in E-learning in a questionnaire is 288 samples.

AS in Figure 1 A-B, The number of participants in a questionnaire is 288 samples. The answer to a question is on boxes form as in the last paper. The percentage used on Classroom in E-learning in the questionnaire is 66%. The percentage used on Edmodo in E-learning in the questionnaire is 12.5%. The percentage used on Moodle in E-learning in the questionnaire is 10.8%. The percentage used on Zoom in E-learning in the questionnaire is 36.5%. The percentage of using Free conference call on E-learning in the questionnaire is 41.7%. The percentage used on Meet in E-learning in the questionnaire is 19.4%. The percentage used on Webex Meet in E-learning in the questionnaire is 6.9%. The percentage used on Telegram in E-learning in the questionnaire is 40.3%. The percentage used on WhatsApp in E-learning in the questionnaire is 27.4%. The percentage used on Viber in E-learning in the questionnaire is 17%. The percentage used on YouTube in E-learning in the questionnaire is 21.5%. The web applications mostly used in the quality of E-learning are Classroom, Free Conference call, Telegram, Zoom, and Meet. They are applications that are mostly used in E-learning for teaching students in universities. AS in figure 1 A-B, and figure 2:

(A)



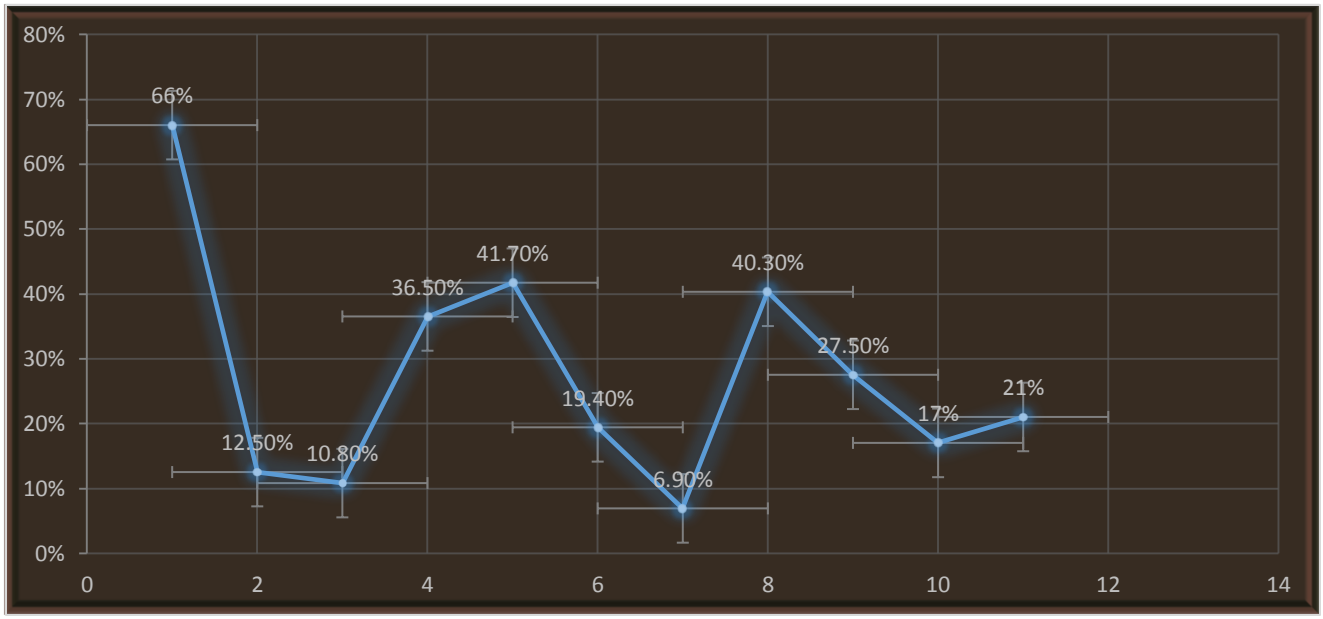
(B)



Figure(1 A-B): Graph for using the website eleven in the quality of E-learning

As in Figure 2, he classroom is the most used application in E-learning, creating online classes and enables students to collect, distribute and manage these classes, allows them to communicate and

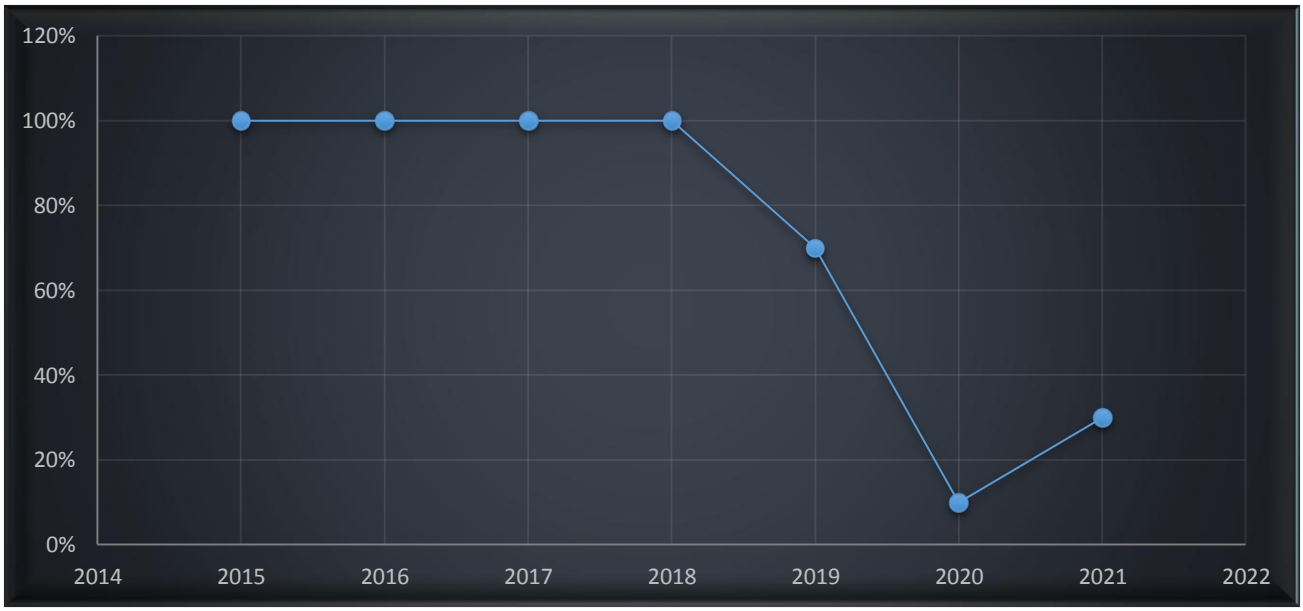
collaborate with students, share study materials and other related documents with students, and allows teachers to share files from their computers, YouTube videos, Google Drive links, or any other links once these materials are saved and stored online. Students can access them from anywhere, even mobile devices. In Student section, the teacher can decide whether their students are allowed to comment on questions, announcements, and assignments they create or if they can only post. The teacher can also choose to be the only one in their class who can post and comment. Google Classroom allows teachers to create, distribute, collect, and grade homework, and they can do other things like adding useful links to assignments, re-use the same assignment again, schedule the assignment for a later date. Educators can make ads through Google



Figure(2): most used application in E-learning

Classroom, and it will be automatically emailed to all students in the class, and they will also be able to view it in the Classroom's stream tab. The service also allows educators to schedule when an announcement, post, or assignment appears on the student's stream tab.

As in Figure 3, students are taught to attend universities. They are lectures, conferences, seminars, etc. at universities. However, E-learning is used in some universities to train new

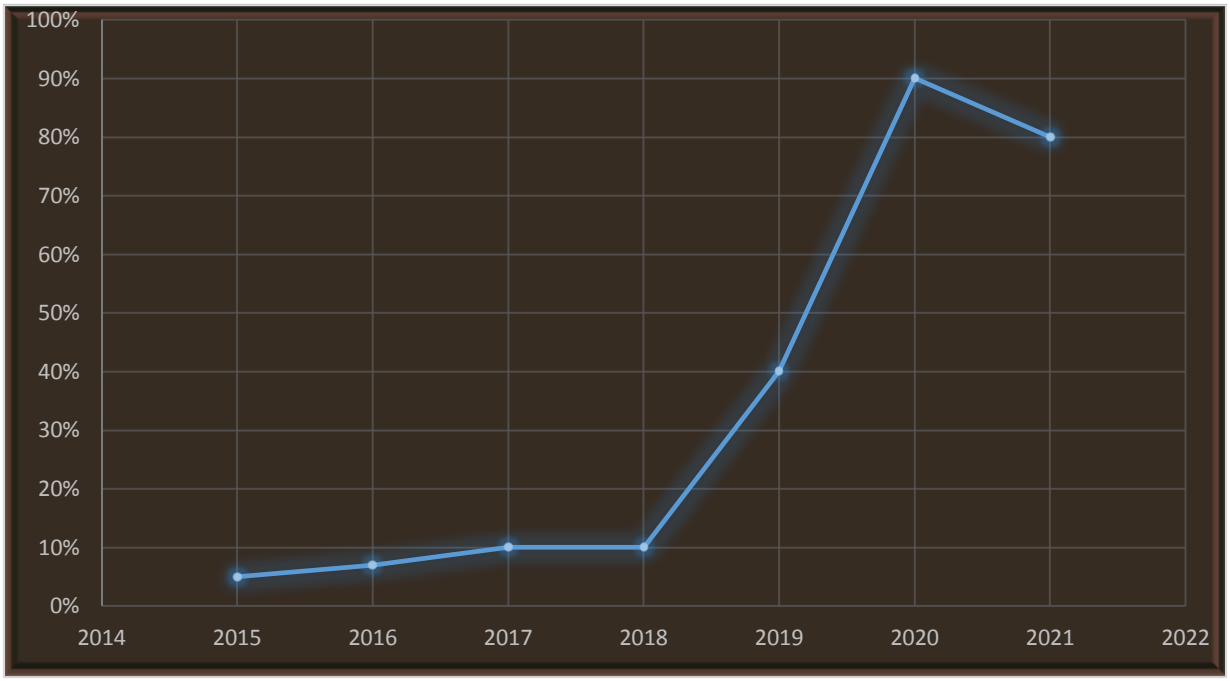


employees and conduct open online courses and others.

Figure(3): Use of attendance education in universities

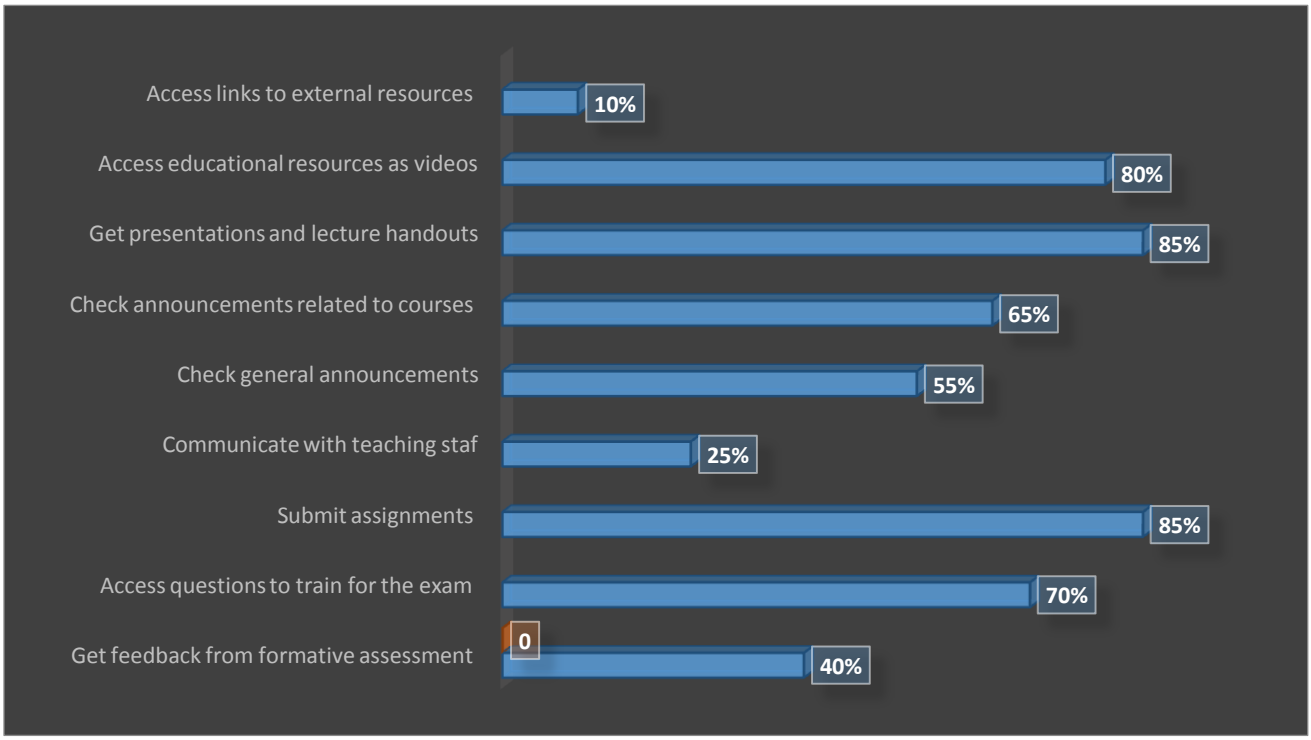
E-learning is used in 2020 and 2021 at universities by 100% due to the outbreak of the coronavirus, through the website used in E-learning. The website is used in E-learning to create lectures, conferences, workshops, and others. Classroom, Edmodo, Moodle, Zoom, free conference call, Meet, WebEx Meet, Telegram, WhatsApp, Viber, and YouTube are more common E-learning applications. Through the website applications, classes downloaded, lecture schedules on the E-learning site that students can access. In addition to the blackboard screen, interaction occurs in the classroom through instruction, tasks, and competitions. The lesson presented completely. It also has a live video for the professor to explain the semester for

students and interactions in lecture between the professor and students in the semester curriculum, duties, competitions, and stimulating discussion among students by the website. As in Figure 4:



Figure(4): The use of E-learning in universities

The quality of interaction between students and online teaching is an imperative factor in determining the effectiveness of E-learning via a website to create and maintain sustainable learning communities. Interaction with the content is an internal dialogue of reflective thought that occurs between the learner and the content. Interaction is often triggered and supported by events in the learning environment focusing on how the learner reacts to what is to be learned. The interaction between students and teaching has been undertaken to improve the design and delivery of documented content via the website, to maximize the effectiveness of the online learning environment for undergraduate and postgraduate distance learning courses. As in Figure 5:



Figure(5): Students interaction with teaching via E-learning

4- Conclusions:

This study came to clarify the importance of the quality of E-learning in conformity with international standards of quality, for the success of the E-learning experience as a modern experience in many countries. The study done on using website applications including (Classroom, Edmodo, Moodle, Zoom, Free Conference call, Meet, WebEx Meet, Telegram, WhatsApp, Viber, and YouTube) in quality of E-learning, and how to use all web applications regularly in E-learning as shown in the following cases:

- The (Classroom, Edmodo, and Moodle) website applications are used in electronic classes for students, lectures, files, and slide presentations in electronic classes and are explained on it, and also students' exams are done during these applications.

- The (Classroom, Edmodo, and Moodle) website applications are used for designing huge courses for professors and students in different specializations, and after completing the courses, the certificate directly will be sent to Gmail.
- The (Zoom, Free Conference Call, Meet, and WebEx Meet) website applications are used by professors in conferences, webinars, and workshops to broadcast live direct presentations during these applications.
- The (Telegram, WhatsApp, and Viber) website applications are used for exam, advertisements, study dates, schedules, scientific forums, conferences, and webinars, and other, also set start and end dates of lessons for professors and students during these applications.
- The YouTube website application is used for lecture reviews for students before exams and also used in conferences, webinars, and others for live direct presentations during this application.

With the work to spread out the culture of quality among all workers in this field by holding conferences and scientific and training courses to raise the level of performance and reduce errors:

1 -Investing in the positive directives for students and faculty members towards E-learning, developing plans and programs to benefit from these directives, and giving training courses in the field of E-learning to both students and faculty members.

2 .Training and encouraging teachers to communicate with students through electronic pages and E-mail, given that many students have Internet service at home.

3 -The university should conduct more studies and research to find out the effectiveness of E-learning in the presence of harsh conditions and hold conferences and seminars for the development and advancement of E-learning.

4- The necessity for the university to offer materials that give the student the skills and techniques of E-learning to facilitate the process of interaction and benefit students with the educational materials presented electronically.

Abbreviations:

CBT: computer-based training
MAC: Macintosh
CBT: computer-based training
SPSS: statistical package for the social sciences

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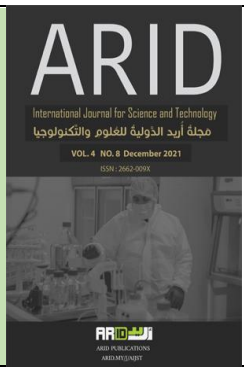

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

Radon Monitoring by Alpha Track Detection Using Cn–85 Plastic Track

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مراقبة الرادون عن طريق كشف مسار ألفا باستخدام الكاشف البلاستيكي CN-85

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ABSTRACT

Radon sources can be found in external and internal radiation. Lead pencil (LP) is often used for drawing, sketching, etc. regardless of age nowadays. Paracetamol (PC) is commonly used around the world especially to treat fever, headache, menstrual pain, and common pain. Hence, the aim is to study the procedures for determining the radon gas comes out from different types of lead pencil and paracetamol.

Eight and five samples were collected from different companies of lead pencil and paracetamol, respectively. The samples were measured using the sealed technique in cylindrical plastic containers with CN–85 detectors. After irradiation, the detectors were chemically etched using 2 N sodium hydroxide (NaOH) solution at a temperature of 70 ºC for 62 min. The alpha track density on the surface of detectors was measured using an optical microscope at a magnification of 100×. Tracks on detectors were counted using Image software.

Radon concentration values including all samples in this study are within the limits of international which is 1000 Bq/m^3. The concentration of radium in LP and PC samples are lower than those reported in previous study. The result of the uranium concentration of both samples is quite low compared with the allowed limit which is 11.7 ppm. Annual effective dose levels are all below the dose limit which is 10 mSv/y. Lastly, there was a linear relationship between radium activity and radon exhalation rate. Therefore, using LP and eating PC cause no danger to humans. All results showed in this study are within internationally permissible limits, and therefore not a threat to human health.

Keywords: *lead pencil; Paracetamol; Radon; Track; alpha particles;detector*

الملخص:

يمكن العثور على مصادر الرادون من مصادر الإشعاع الخارجية والداخلية غالبا ما يستخدم قلم الرصاص للرسم والكتابة وما إلى ذلك بغض النظر عن عمر المستخدم، كما إن الباراسيتامول يستخدم بشكل شائع في جميع أنحاء العالم لعلاج الحمى والصداع وآلام الدورة الشهرية والآلام الشائعة الأخرى، لذلك كان الهدف من هذه الدراسة تحديد غاز الرادون الذي يخرج من أقلام الرصاص والباراسيتامول المصنعة من مختلف الشركات. جمعت ثمانية من الرصاص وخمس عينات من الباراسيتامول من شركات مختلفة. تم قياس العينات باستخدام تقنية محكمة الغلق في حاويات بلاستيكية أسطوانية مع كاشفات (سي ان -85). بعد التشعيع، تم حفر الكاشفات كيميائيًا باستخدام محلول 2 نيتروجين هيدروكسيد الصوديوم عند درجة حرارة 70 درجة مئوية لمدة 62 دقيقة. تم قياس مسار ألفا على سطح الكاشفات باستخدام مجهر ضوئي بتكبير 100 واستخدام برنامج خاص اسمه (امج-جي). وكانت قيم تركيز غاز الرادون بما في ذلك جميع العينات في هذه الدراسة هي ضمن الحدود الدولية وهي 1000 بيكريل / م 3. تركيز الراديوم في عينات أقلام الرصاص وحبوب الباراسيتامول أقل من تلك المذكورة في الدراسة السابقة. حيث كانت نتيجة تركيز اليورانيوم في كلتا العينتين منخفضة جدًا مقارنة بالحد المسموح به وهو 11.7 جزء في المليون. مستويات الجرعة الفعالة السنوية كلها أقل من حد الجرعة وهو 10 ملي سيفرت/ سنة. أخيرًا، كانت هناك علاقة خطية بين نشاط الراديوم ومعدل انبعاث الرادون. لذلك، اقلام الرصاص وحبوب الاراسيتامول لا يسبب خطورة للإنسان. جميع النتائج التي تظهر في هذه الدراسة ضمن الحدود المسموح بها دوليًا، وبالتالي لا تشكل تهديدًا لصحة الإنسان.

كلمات مفتاحيه: قلم رصاص – باراسيتامول- رادون- المسار - جسيمات الفا- كاشف

1. INTRODUCTION

In Solid State Nuclear Track Detection (SSNTDs) the track formation is correlated to the charged particles that produce damage permanently on the detector caused by the excess of the threshold unit. An ionizing particle that producing the intensity of ionization damage is directly proportional to the square of its charge and about inversely proportional to the square of its velocity. The most sensitive plastic is the type of organic polymers [1].

Compared to other materials the radiation damage path is more sensitive to chemical reactions. They will appear as black on the detectors when these canals reach a width similar to the wavelength of the visible light [4]. The most popular etching techniques using in laboratories are chemical etching because of its related parameters such as the concentration of the etchant solution, etching temperature, and duration of time are optimized and well established [8].

Polymer SSNTDs such as Columbia Resin No. 39 (CR–39) and Cellulose Nitrate 85 (CN–85) are most reactive to the energetic alpha particles. Alpha particles can cause severe damage trail as it passing through the detectors. SSNTDs have their own impressive characteristics which are insensitivity to visible (UV-, X-, β- and γ-rays) and non-fading of latent tracks [10].

Humans are continuously being exposed to background radiation. The source of background radiation is man-made and natural radiation. Other sources are terrestrial and cosmic radiations. Terrestrial sources come naturally from the soil, water and, air. While cosmic radiation is the radiation from outer space that mainly contain positively charged ions from the proton to larger nuclei.

Ionizing radiation can discard the electrons from the orbits to stabilize the atoms. Charged particles and atoms are called ions. Both natural and man-made radioactive materials

can emit ionizing radiation. Types of radiation are alpha radiation (α), beta radiation (β), photon radiation (gamma γ and x-ray), and neutron radiation (n). Their ability can discard one or more electrons away from the atoms in any material they pass through [7].

Radon (Rn) is a chemical element and the atomic number is 86. Radon half-life is 3.8 days. It is colorless, odorless, tasteless, naturally occurring, radioactive noble gas that is formed from the decay of radium. Radon is the heaviest gas that remains under normal conditions and is a health hazard [7].

From the previous studies, a study of radium in vegetables and foods become interesting. High radioactive chemical elements in radium consist in an assortment of foodstuffs. Under normal conditions of temperature and pressure, radium is a solid radioactive element [5].

Currently, black-core pencils contain graphite, not lead [2]. Pencil graphite core intercalated with clay particles (majorly silica and a few metal oxides) in conductive graphite [1].

Paracetamol or also known as acetaminophen commonly used around the world especially to treat fever, headache, menstrual pain, and common pain. The poisoning could lead to serious liver injury and even death [3].

Based on the previous study they are using drinking water, materials building, animal bones, vegetables, and biscuits to determine the radon gas. For our study, we are using different materials such as lead pencils and paracetamol. Most children prefer to use pencils during classes, especially in primary school. Another common thing humans always consume when they have a fever, headache, menstrual pain, and common pain which is paracetamol. Therefore, this study aims to determine the radon gas that comes out from lead pencil and paracetamol.

2. METHODOLOGY

Eight LP samples and five PC samples were collected from different companies in Malaysia. Each sample weight about 5 g (Table 1), in powder form by grinding using mortar and pestle.

Table (1): Weight sample and distance from surface of sample to the detector CN–85

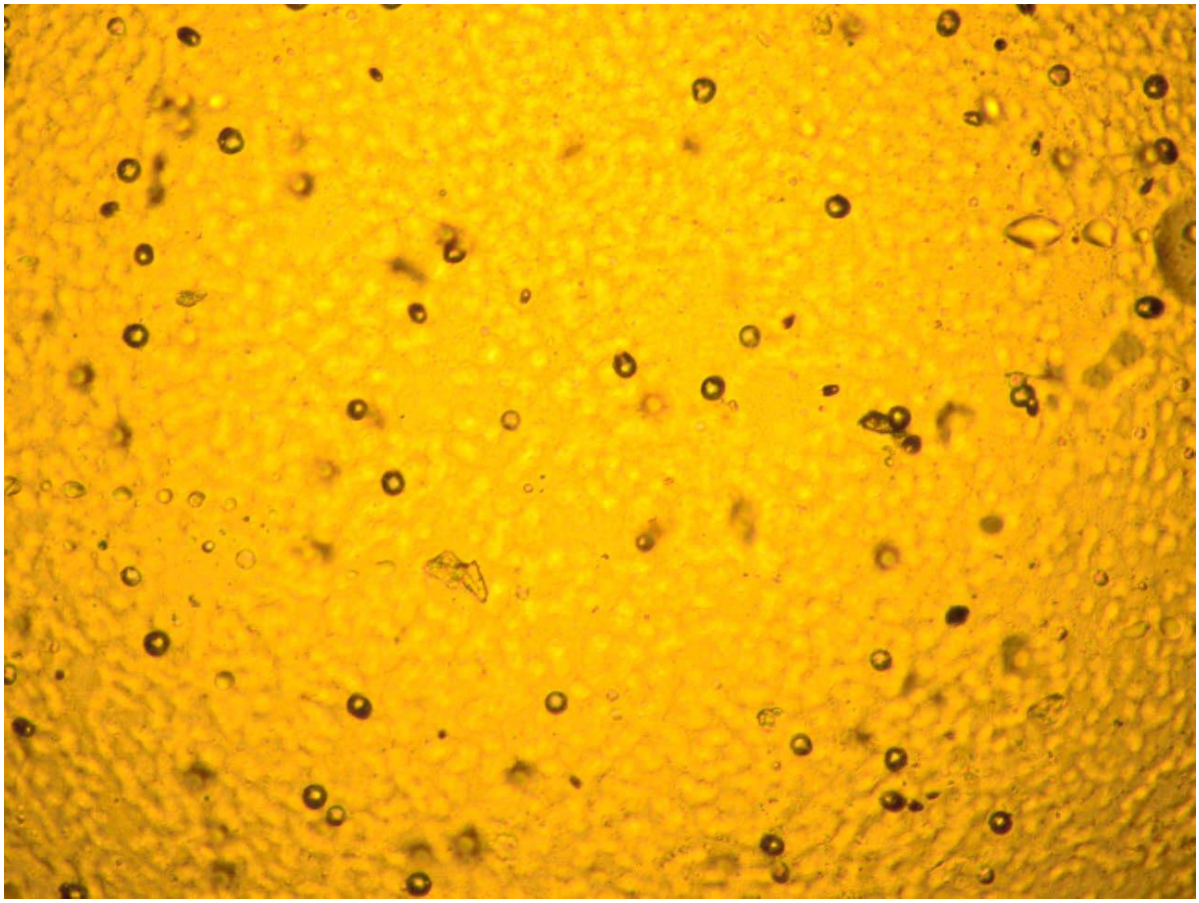
Code samples	Weight sample (g)	Distance from surface of sample to the detector CN–85 (cm)
LP1	5	3.0
LP2		2.6
LP3		3.9
LP4		2.6
LP5		4.0
LP6		2.8
LP7		3.0
LP8		3.0
PC1	5	2.2
PC2		2.0
PC3		2.0
PC4		2.6
PC5		2.6

Weighed samples were placed in cylindrical plastic containers of length 4.8 cm and diameter 2.1 cm. CN–85 in the form of sheets were cut into thirteen pieces, eight for LP samples while five for PC samples with dimensions 1×1 cm^2. One sheet of CN–85 was placed under the cap of the cylindrical plastic containers fixed by double-stick tape. From Table 1 the distance from the surface of each sample to the detector CN–85 is different. The cylindrical plastic containers were sealed to irradiate the detectors with alpha particles emitted from radon on 18th February 2020 and reopened on 22nd June 2020 for 126 days/4 months 5 days.

Put 20 g NaOH pellets in the beaker 500 mL. Pour 250 mL distilled water into the beaker. To ensure the solution mix well, the solution was stirred with the magnetic stirrer on the hot plate magnetic orientation.

After 126 days of irradiation, the detectors were pulled off from the double-stick tape. A Crocodile clip was wrapped around the stir rod. Then, the detectors were clipped by a crocodile clip and soaked in the NaOH solution. During the process, the detectors were etched by heater using 2 N NaOH solution at 70 °C for 62 minutes. Then the detectors let dry before being put in the plastic jar.

After the chemical etching process, the detectors from the plastic jar were put under an optical microscope with a digital camera on the microscope using a magnification of 100× and defined it on the computer. Twenty regions images were captured on each detector. After all images of detectors for each sample are captured, store these images (pixel unit) in the computer in the form (jpg) and name it. Then for alpha tracking image analysis, the images were inserted to program analysis ImageJ. ImageJ one of the designed program, and contain full options in processing and analysis. The number of tracks on the image appeared as a black round shape as in Figure 1. Each image contains the number of tracks was counted using ImageJ.



Figure(1): example image number of tracks for LP1 at region 1.

1. RESULTS AND DISCUSSIONS

After collecting data for a number of tracks, the average number of tracks were calculated and recorded as in Table 2.

Table(2): Average number of tracks for samples

Code samples / Reading		LP								PC				
		1	2	3	4	5	6	7	8	1	2	3	4	5
Number of tracks	1	42	23	66	37	53	35	31	68	21	18	54	37	30
	2	48	21	62	57	39	39	18	28	11	19	57	28	41
	3	45	32	36	42	41	64	17	39	19	24	58	46	43
	4	58	34	33	60	40	56	9	45	19	29	53	46	41
	5	63	36	22	32	26	61	11	54	11	26	52	38	42
	6	40	15	25	14	31	59	14	42	23	14	40	45	44
	7	34	16	28	19	29	62	13	19	8	13	55	58	54
	8	56	14	18	43	30	47	11	21	10	14	54	50	33
	9	55	15	34	56	20	56	23	17	19	16	63	30	46
	10	44	26	44	42	35	53	14	17	13	18	72	41	51
	11	53	20	42	23	43	65	16	38	20	14	48	52	39
	12	63	21	40	25	41	56	10	21	7	24	45	54	39
	13	58	34	55	28	25	55	11	25	19	25	57	48	46
	14	56	37	56	25	28	61	14	29	17	15	56	51	41
	15	45	92	28	32	48	53	18	61	13	17	52	39	49
	16	73	40	32	33	42	64	10	46	11	18	41	38	46
	17	57	21	23	46	40	56	14	55	12	15	49	54	33
	18	35	32	21	26	27	68	16	74	18	28	49	41	39
	19	41	43	20	45	32	64	13	44	13	10	62	53	42
	20	81	72	29	30	40	49	16	72	32	17	47	29	46
	Average	52.35	32.2	35.7	35.75	35.5	56.15	14.95	40.75	15.8	18.7	53.2	43.9	42.25

From this study, the results was analysed to determine the radon concentration in lead pencil and paracetamol. The measurements of track density (ρ), radon concentration (C_{Rn}), dissolved radon concentration of the sample (C_S), annual effective dose (AED), surface exhalation rate (SER), mass exhalation rate (MER), radium concentration (C_{Ra}), and uranium concentration (C_U) were recorded in Table 3.

Table (3): Track density (ρ), radon concentration (C_{Rn}), dissolved radon concentration of the sample (C_S), annual effective dose (AED), surface exhalation rate (SER), mass exhalation rate (MER), radium concentration (C_{Ra}), and uranium concentration (C_U) using CN-85 detectors for eight and five samples of LP and PC, respectively.

Parameters / Samples		No. of tracks (Track)	ρ (Track/cm^2)	C_{Rn} (Bq/m^3)	C_S (Bq/m^3)	AED (mSv/y)	SER (mBq/m^2.h)	MER (mBq/kg.h)	C_{Ra} (Bq/kg)	C_U (ppm)
LP	1	52.35	5235.000	227.214	6182.481	5.732	54.882	4.173	0.552	0.671
	2	32.2	3220.000	139.757	2696.521	3.526	29.257	2.224	0.294	0.358
	3	35.7	3570.000	154.948	10961.950	3.909	48.655	3.699	0.489	0.595
	4	35.75	3575.000	155.165	2993.808	3.915	32.482	2.469	0.327	0.397
	5	35.5	3550.000	154.080	12577.540	3.887	49.623	3.773	0.499	0.607
	6	56.15	5615.000	243.707	5570.256	6.148	54.942	4.177	0.553	0.672
	7	14.95	1495.000	64.887	1765.579	1.637	15.673	1.192	0.158	0.192
	8	40.75	4075.000	176.866	4812.533	4.462	42.721	3.248	0.430	0.522
PC	1	15.8	1580.000	68.576	947.335	1.730	12.147	0.924	0.122	0.148
	2	18.7	1870.000	81.163	946.479	2.048	13.070	0.994	0.131	0.160
	3	53.2	5320.000	230.903	2692.656	5.825	37.182	2.827	0.374	0.455
	4	43.9	4390.000	190.538	3676.313	4.807	39.887	3.032	0.401	0.488
	5	42.25	4225.000	183.377	3538.137	4.626	38.388	2.918	0.386	0.469

The range for track density values was between 1495–5615 (Track/cm^2) and 1580–5320 (Track/cm^2) for LP and PC samples, respectively. The track density values were corresponding to the radon concentrations values.

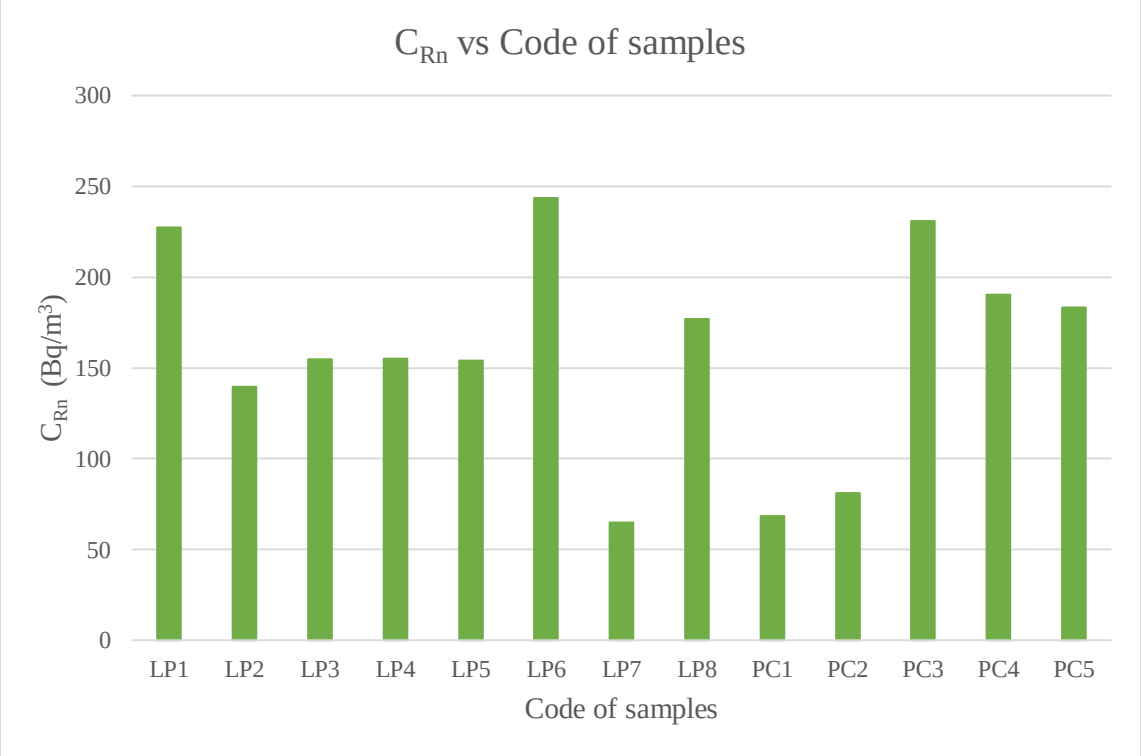
From Figure 3 the highest radon concentration was 243.707 Bq/m^3 found in ASTAR Rainforest 2B Pencil P1700 (LP6) while the lowest radon concentration was 64.887 Bq/m^3 found in Pencil HB Elite 161 (LP7).

The higher grade of pencil contains a higher graphite percentage. The highest radon concentration is 2B pencil which has a higher blackness, and the marks drawn are relatively black, while the lowest radon concentration is HB pencil which has a lower blackness, and the color of the marks drawn is relatively light, which is very different. There are obvious differences in the composition of the core between the two. The main component contains in 2B pencil lead is graphite, while the composition of HB pencil is in addition to half of the graphite. The usage of 2B pencil and HB pencil is not similar. 2B pencil is darker in color and lowers in hardness. It is suitable for drawing and painting. But HB pencil is not. It has high hardness and is not easy to break. It is suitable for writing, especially for children who have just learned to write. Besides, HB pencil is also suitable for marking on hard objects.

But for PC samples, the highest radon concentration was 230.903 Bq/m^3 found in Panadol Cold And Flu Day (PC3) while the lowest radon concentration was 68.576 Bq/m^3 found in Panadol 6 strip (PC1) based on Figure 4.1. PC3 caplets can be used for blocked and runny nose, headache and body ache, fever, sinus and pain relief. Active ingredients contained in each caplet are 500 mg of paracetamol, 25 mg of caffeine, 5 mg of phenylephrine hydrochloride. While PC1 is used for the fast effective temporary relief of pain and discomfort associated with headache, muscular aches, period pain, arthritis/osteoarthritis, toothache, migraine, colds and flu, tension headache, sinus pain/headache and backache. PC1 also reduces fever. It also acts in the brain to reduce fever. PC1 contain 500 mg of paracetamol as the active ingredient and they also contain

starch-pregelatinised maize, starch-maize, talc-purified, stearic acid, hypromellose, povidone, glycerol triacetate, potassium sorbate and carnauba wax.

Radon concentration values including all samples in this study are within the limits of international which is 1000 Bq/m^3 [6].



Figure(3): Bar chart showing radon concentration in LP and PC samples

Figure 4 shows the relation between uranium concentration with the radium concentrations in LP samples while Figure 5 shows the relation between uranium concentration with the radium concentrations in PC samples. A positive correlation has been observed between uranium concentration and radium concentration in both Figures 4 and 5.

ASTAR Rainforest 2B Pencil P1700 was characterized by the highest radium concentration was 0.553 Bq/kg and the lowest value radium concentration in LP samples was

found in Pencil HB Elite 161 0.158 Bq/kg. In addition to that, the average value of radium concentration in LP samples were 0.356 Bq/kg. While for PC samples, the highest radium concentrations was 0.401 Bq/kg found in Redamol by Royce Pharma Manufacturing Sdn. Bhd and the lowest radium concentrations was 0.122 Bq/kg found in Panadol 6 strip. The average value of radium concentration in LP samples was 0.262 Bq/kg. The concentration of radium in LP and PC samples are lower than those reported by [9] for a garden rocket, and are similar to the values typically found for cucumber, carrot, spinach, green beans, and green haricots.

The uranium concentrations are found to vary from 0.192–0.672 ppm with a mean value of 0.432 ppm for LP samples. While for PC samples the uranium concentrations are found to vary from 0.148–0.488 ppm with a mean value of 0.318 ppm. From Table 3, it has been observed that there are variations in the values of uranium and radium concentrations among both samples. This variation may be arisen due to the difference in the nature of the samples and nuclei content of these samples. The result of the uranium concentration of both samples is quite low compared with the allowed limit which is 11.7 ppm [11,12].

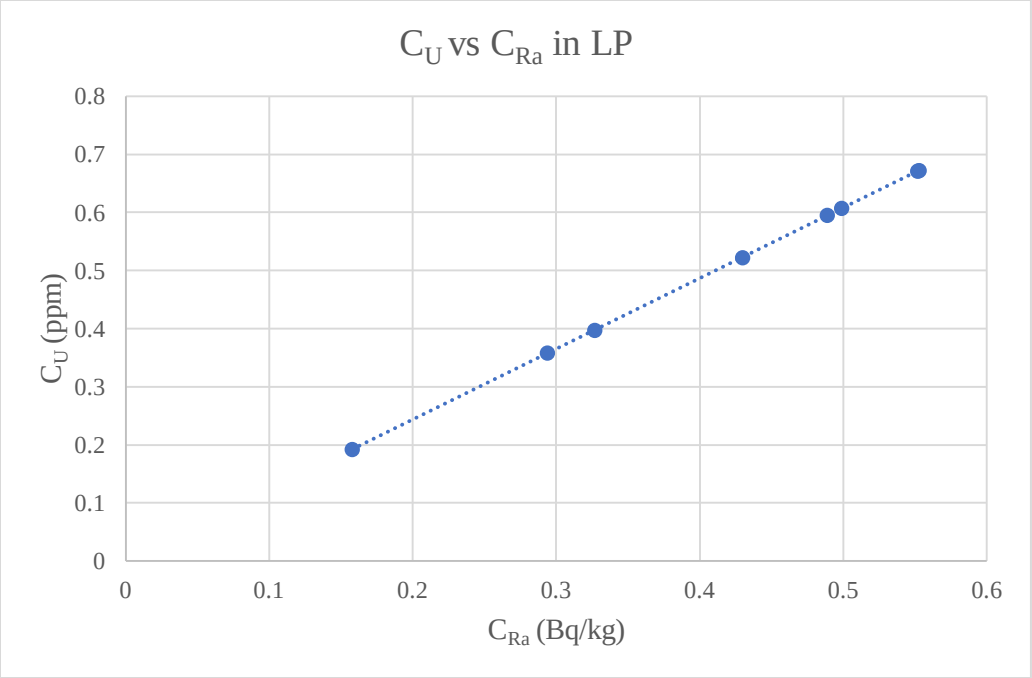
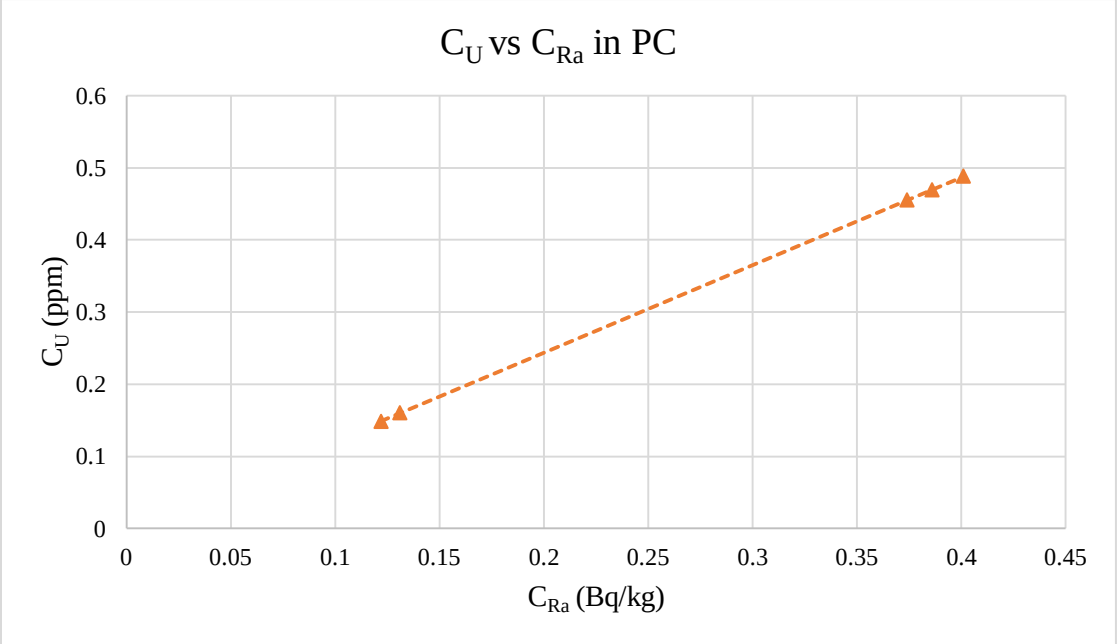
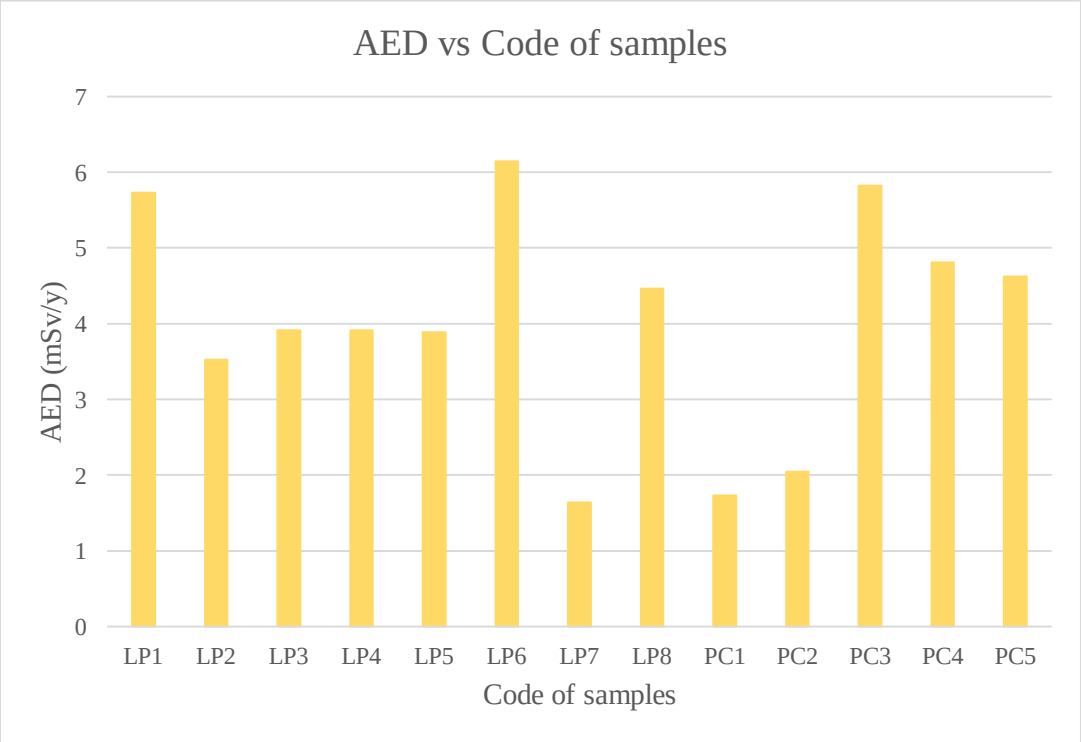


Figure (4): The correlation between radium and uranium concentrations in LP samples



Figure(5): The correlation between radium and uranium concentrations in PC samples

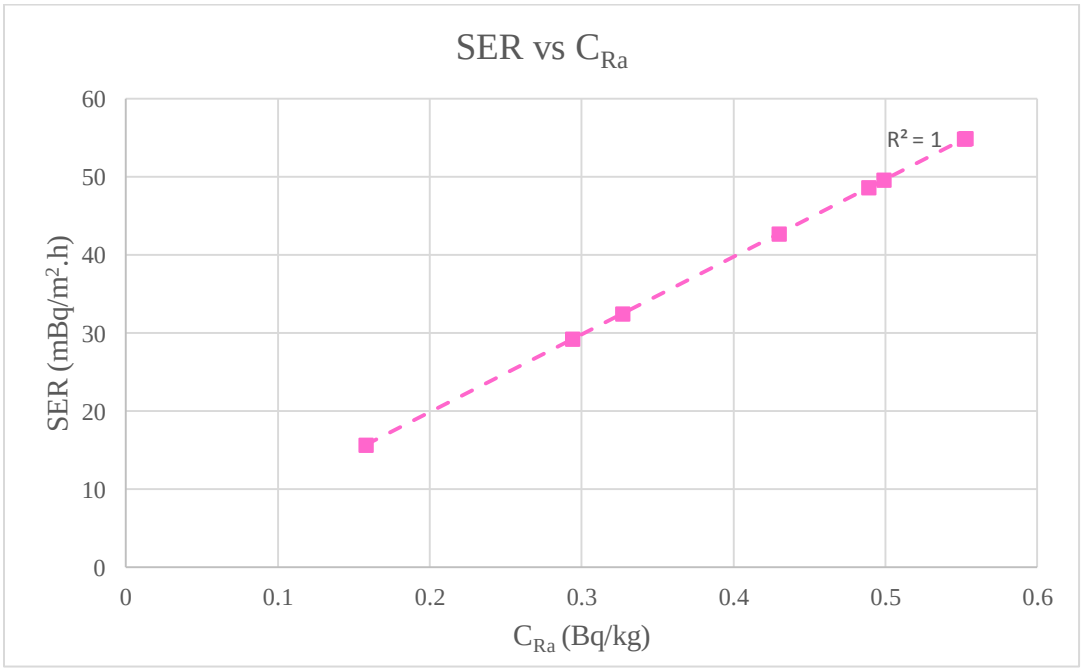
From Figure 6, the highest value of annual effective dose for LP samples is 6.148 mSv/y from (ASTAR Rainforest 2B Pencil P1700) and the lowest value of annual effective dose is 1.637 mSv/y (Pencil HB Elite 161). While for PC samples, the highest value of annual effective dose is 5.825 mSv/y (Panadol Cold And Flu Day) and the lowest value of annual effective dose is 1.730 mSv/y (Panadol 6 strip). Since the effective dose depends on the radon concentrations, the samples which recorded high concentrations also had high values of annual effective dose. These levels are all below the dose limit which is 10 mSv/y [6].



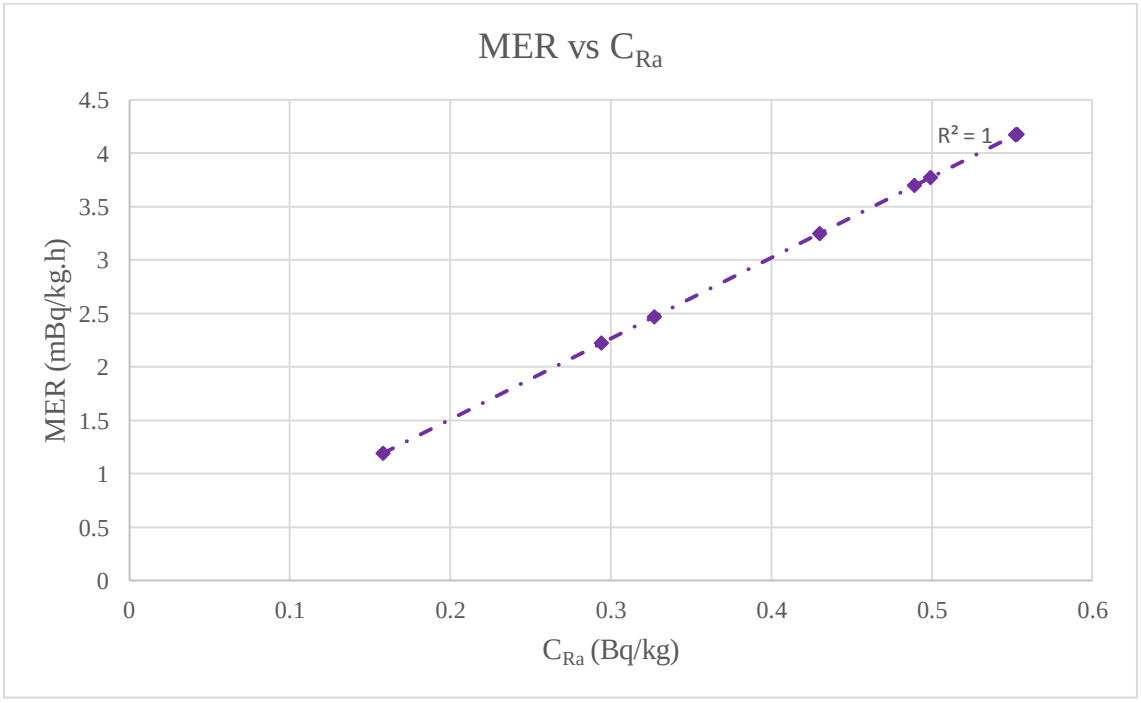
Figure(6): Bar chart showing annual effective dose in LP and PC samples

The surface exhalation rate values were in the range of 15.673–54.942 (mBq/m^2.h) and 12.147–39.887 (mBq/m^2.h) for LP and PC samples, respectively. While the mass exhalation rate was in the range of 1.192–4.177 (mBq/kg.h) and 0.924–3.032 (mBq/kg.h) for LP and PC samples, respectively. Figures 7 to 10 shows a direct relationship between radium activity and

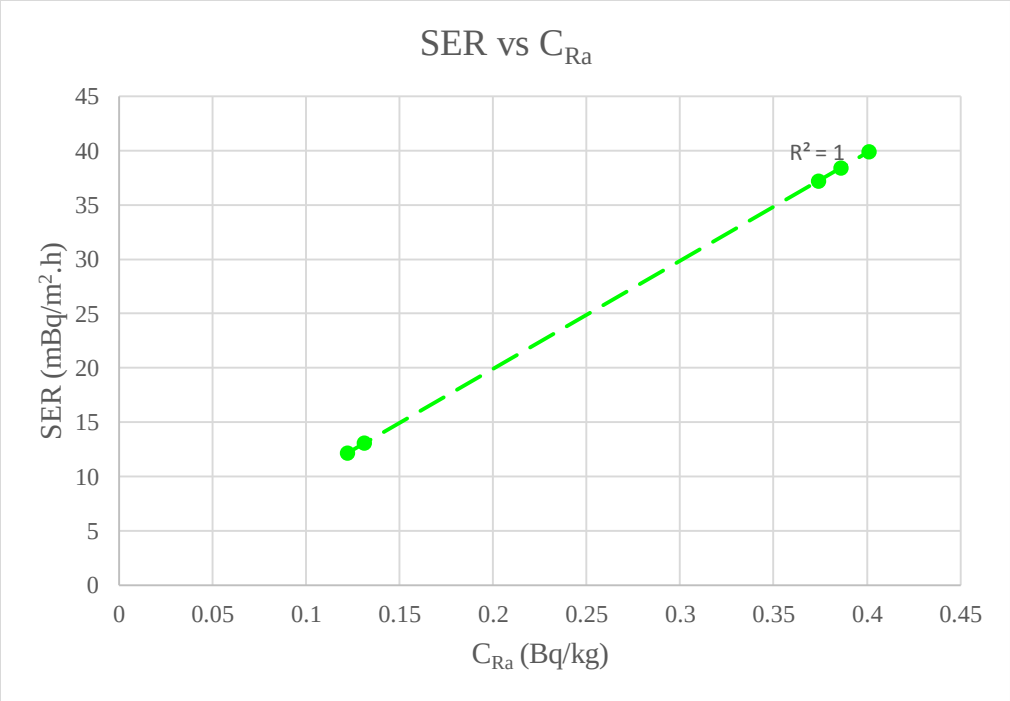
radon exhalation rate in LP and PC samples (R^2=1). Hence, there was a linear relationship between radium activity and radon exhalation rate.



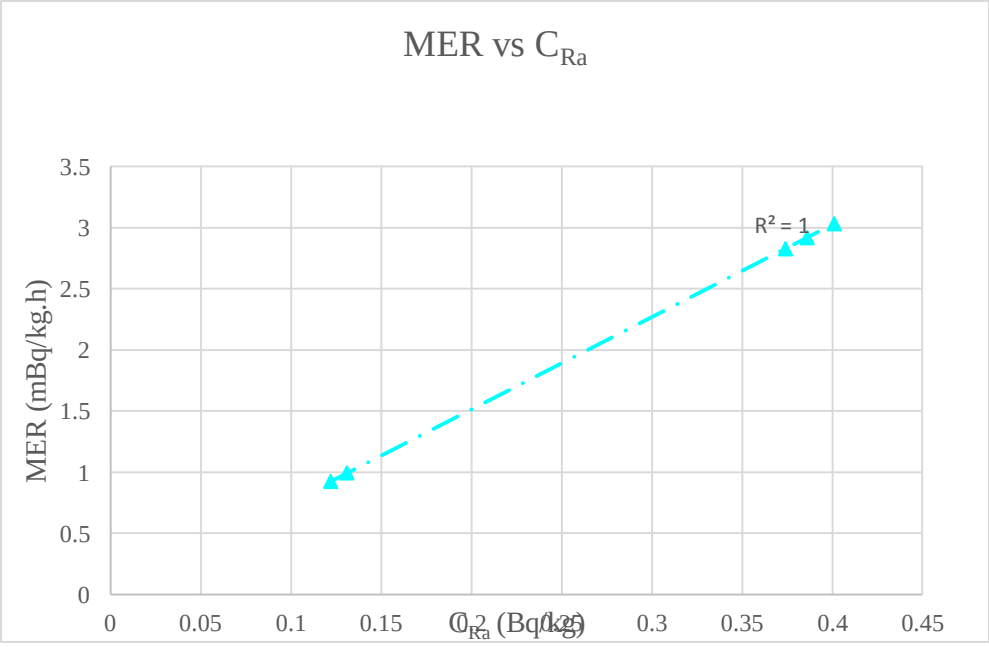
Figure(7): Correlation between radium concentration and surface exhalation rate for LP samples



Figure(8): Correlation between radium concentration and mass exhalation rate for LP samples



Figure(9): Correlation between radium concentration and surface exhalation rate for PC samples



Figure(10): Correlation between radium concentration and mass exhalation rate for PC samples

1. CONCLUSION

Radon concentration values including all samples in this study are within the limits of international which is 1000 Bq/m^3. The concentration a radium in LP and PC samples are lower than those reported by privious studeis. The result of the uranium concentration of both samples is quite low compared with the allowed limit which is 11.7 ppm . Annual effective dose levels are all below the dose limit which is 10 mSv/y. Lastly, there was a linear relationship between radium activity and radon exhalation rate. Therefore, using LP and eating PC cause no danger to humans. All results showed in this study are within internationally permissible limits, and therefore does not pose a threat to human health.

Acknowledgements

The authors appreciate the financial and technical support from School of Physics and RCMO (USM) via the research grant (304/PFIZIK/6315514).

List of Abbreviations

Bq	Becquerel
LP	Lead pencil
PC	Paracetamol
Rn	Radon
(SSNTD	Solid State Nuclear Track Detection

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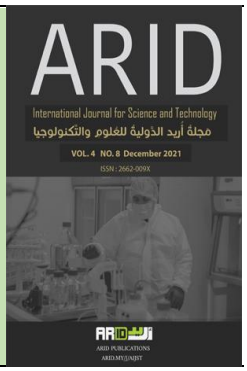

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

The Radiological Background Inside and Outside the Libyan Iron and Steel Company in Misurata City, Northwest of Libya

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Abstract

Radioactive background is very important with regard to the exposure of the population to radiation, many countries of the world measure the rate of exposure caused by natural radiation for different purposes, where radioactive pollution represents an important problem as a result of the spread and the frequent use of radioactive materials in different applications, such as medicine, agriculture, industry, and others, and some industrial facilities in the city of Misurata like Libyan Iron Company use some techniques that depend on radioactive sources. In this study, over a whole year with its four seasons, the levels of radiation background were evaluated in the area surrounding the Libyan Iron and Steel Company in the Qasr Ahmed region in Misurata city and within the company's. It is measured for primary and secondary directions for a distance of 8 km.

The radiation levels outside and inside the company's perimeter were within the natural limits of the radiation background in the area, radiation levels do not different between the monitoring points that were measured within the company's borders from those that were measured in the area surrounding the company. The radiation levels are not affected by the measurement season, and therefore that the obsession of radioactive contamination that some people have is unfounded and that the situation from this aspect is reassuring.

Keywords: Radiation background, Radiation Protection, Misurata city, Libya, Iron and Steel Company.

الملخص:

يعد النشاط الإشعاعي الطبيعي أو ما يعرف بالخلفية الإشعاعية مهمًا جدًا فيما يخص تعرض السكان للإشعاع، تقوم كثير من دول العالم بقياس معدل التعرض الناجم عن الإشعاع الطبيعي لأغراض مختلفة، حيث يمثل التلوث الإشعاعي مشكلة مهمة ومعقدة نتيجة الانتشار وكثرة استخدام المواد ذات النشاط الإشعاعي في مجالات مختلفة ومتنوعة كالطب والزراعة والصناعة وغيرها، وتستخدم بعض المنشآت الصناعية في مدينة مصراته بعض التقنيات التي تعتمد على المصادر المشعة كما هو الحال في الشركة الليبية للحديد، وتم في هذه الدراسة على مدار عام كامل بمواسمه الأربع تقييم مستويات الخلفية الإشعاعية بالمنطقة المحيطة بالشركة الليبية للحديد والصلب بمنطقة قصر أحمد بمدينة مصراته وداخل محيط الشركة وفي جميع الاتجاهات الأصلية والفرعية ولمسافة 8 كم.

كانت مستويات الإشعاع بشكل عام في المنطقة خارج وداخل محيط الشركة ضمن الحدود الطبيعية للخلفية الإشعاعية في المنطقة، ونلاحظ من خلاله أن مستويات الإشعاع لا تختلف كثيرا بين نقاط المراقبة التي تم قياسها داخل حدود الشركة عن تلك التي تم قياسها في المنطقة المحيطة بالشركة كما أننا نلاحظ أن مستويات الإشعاع لا تتأثر بموسم القياس وبالتالي فإننا نرى أن هاجس التلوث الإشعاعي الذي ينتاب البعض لا أساس له وأن الوضع من هذا الجانب مطمئن.

الكلمات المفتاحية: الخلفية الإشعاعية، الحماية من الإشعاع، مدينة مصراته، ليبيا، شركة الحديد والصلب.

1. المقـــــدمة

يعد النشاط الإشعاعي الطبيعي أو ما يعرف بالخلفية الإشعاعية مهمًا جدًا فيما يخص تعرض السكان للإشعاع، تقوم كثير من دول العالم بقياس معدل التعرض الناجم عن الإشعاع الطبيعي لأغراض مختلفة، منها اختيار مواقع المنشآت النووية وخطط الطوارئ لرصد أي حالة زيادة في النشاط الإشعاعي [1]. يمثل التلوث الإشعاعي مشكلة مهمة ومعقدة نتيجة الانتشار وكثرة استخدام المواد ذات النشاط الإشعاعي في مجالات مختلفة ومتنوعة كالطب والزراعة والصناعة وغيرها ويقصد بالتلوث الإشعاعي وجود تراكيز من النويدات المشعة لم تكن موجودة أصلا في بيئة معينة أي أعلى من الحد الطبيعي لها [2]، أما عن مصادر الإشعاع في البيئة فتكون إما طبيعية أو صناعية كتلك الناشئة عن دورة الوقود النووي ومخلفات الصناعة النووية، وينشأ الإشعاع الطبيعي (ويسمى أيضًا إشعاع الخلفية الطبيعي) من مصدرين رئيسيين، هما: الإشعاع الكوني (الإشعاع الكوني أو الأشعة الكونية) والنويدات المشعة الأرضية، ويتم إنتاج النويدات المشعة الكونية من تفاعل الأشعة الكونية عالية الطاقة (المنبعثة من المصادر النجمية) مع نوى الذرات في الغلاف الجوي، ويبلغ متوسط الجرعة السنوية التي يتلقاها الأشخاص من هذه الإشعاعات هو 0.39 ملي سيفرت في السنة، وهي تختلف باختلاف الارتفاع وخط العرض. والنويدات المشعة الأرضية هي النويدات المشعة البدائية طويلة العمر والنويدات الموجودة على قشرة الأرض منذ نشأة الأرض، وتعتبر التربة أهم مصدر للنويدات المشعة الأرضية التي يختلف مستوى إشعاعها من مكان إلى آخر ويرتبط بالتركيب الجيولوجي للتربة وتكوينها. [3]، وحسب تقارير لجنة الأمم المتحدة العلمية المعنية بآثار الإشعاع الذري (UNSCEAR) فإن متوسط الجرعة السنوية التي يتلقاها البشر من الإشعاع المؤين المنبعث من الإشعاع الطبيعي والاصطناعي هو 2.8 ملي سيفرت منها 2.4 ملي سيفرت في السنة من المصادر الطبيعية و 0.4 ملي سيفرت/سنة ناتجة عن التعرض للإشعاعات الاصطناعية [4].

وفقا لتقارير المسوحات التي أجرتها منظمة الصحة العالمية World Health Organization (WHO) واللجنة الدولية للحماية الاشعاعية The international commission on radiological protection (ICRP) تبين أن مخاطر التعرض للإشعاعات الطبيعية تزداد خطورتها داخل المباني منها خارج المباني حيث يقضي الأفراد 80% من وقتهم داخل المباني سواء كانت منازل أو مدارس أو مكاتب عمل وغيرها، وهي ذات المعدلات الأعلى من مكافئ الجرعات السنوية من الإشعاع، وفقا للدراسة التي أجراها Masok وفريقه سنة 2015 حول معدل مكافئ الجرعة السنوية والتي ذكر فيها أن هذا المعدل داخل المباني كان 1.54 مللي سيفرت/سنة بينما كان المعدل خارج المباني 0.44 مللي سيفرت/سنة [5] ، وفي ذات السياق بينت دراسة أجرتها Al-Shariff وأخرون سنة 2017 على النيوكليدات المشعة حول مصنع إسمنت لبدة في ليبيا أن

مكافئ جرعة الإشعاع السنوية من المصادر الطبيعية كانت خارج المباني أعلى بشكل ملحوظ منها داخل المباني فقد تراوحت بين 0.05 – 0.072 مللي سيفرت/سنة و0.21 – 0.29 مللي سيفرت لكل منهما على التوالي كما بينوا أنها بشكل عام كانت أقل من المعدل العالمي لمكافئ الجرعة الإشعاعية السنوية والذي كان 0.07 و 0.47 مللي سيفرت /سنة خارج وداخل المباني على التوالي [6]، وقد ذكر Sanusi وأخرون في دراستهم سنة 2017 أن توصيات اللجنة الدولية للحماية الإشعاعية (ICRP) بمستوى من 1-20 مللي سيفرت/سنة كمستوى مرجعي مقبول للمقارنة بالمعدلات السنوية للتعرض للجرعات الإشعاعية، وبالرغم من أن نتائج الجرعة المكافئة المحسوبة في دراستهم كانت اقل من هذا المعدل المرجعي إلا أنهم أشاروا إلى احتمال تعرض بعض الأفراد لمخاطر الإصابة بالسرطان نتيجة لتواجدهم فترات طويلة في الأماكن ذات المعدلات العالية، من الإشعاع [7].

توجد أنواع كثيرة ومتنوعة من الكواشف لقياس ومراقبة الإشعاع في الهواء وإجراء مسح إشعاعي عام للتعرف على الخلفية الإشعاعية، فمثلا الكواشف الغازية مثل عداد جايجر ومولر وعداد التناسب يستعملان للكشف عن الخلفية الإشعاعية وذلك لكفاءتهما العالية في قياس الأشعة المؤينة مثل أشعة بيتا، أما الكواشف الوميضية فتعتمد كفاءة القياس فيها على نوع البلورة وطاقة الإشعاع وهي مناسبة لقياس أشعة جاما، وكذلك كواشف الحالة الصلبة حيث تستخدم عادة بلورات الجرمانيوم النقية لقياس أشعة جاما فيما تستخدم الأفلام الحساسة في قياس الأشعة السينية وتستخدم طريقة قياس الآثار للكشف عن أشعة ألفا والأشعة الكونية [8]، وهنالك عدة وحدات مستخدمة في قياس مقدار الإشعاع فوحدة التعرض للإشعاع رونتجن تستخدم في قياس الجرع الإشعاعية الممتصة، ووحدة الراد (Rad) والجراي (Gy) في قياس تأيين الهواء، أما وحدتي السيفرت (Sv) والريم (rem) فأنهما تستخدمان في قياس الجرعة المكافئة [8].

1.1. مصادر الخلفية الإشعاعية:

الأشعة الكونية المصدر الرئيسي لهذه الأشعة ناتج عن الحوادث النجمية في الفضاء الكوني البعيد ومنها ما يصدر عن الشمس خاصة خلال التوهجات الشمسية التي تحدث مرة أو مرتين كل 11 سنة، مولدة جرعة إشعاعية كبيرة إلى الغلاف الغازي للأرض. وتتكون هذه الأشعة الكونية من 87% من البروتونات و11% من جسيمات ألفا، وحوالي 1% من النوى ذات العدد الذري ما بين 4 و26 وحوالي 1% من الإلكترونات ذات طاقة عالية جداً وهذا ما تمتاز به الأشعة الكونية، لذلك فإن لها قدرة كبيرة على الاختراق، كما أنها تتفاعل مع نوى ذرات الغلاف الجوي مولدة بذلك إلكترونات سريعة وأشعة غاما ونيوترونات، ولا يستطيع أحد تجنب الأشعة الكونية ولكن شدتها على سطح الأرض تتباين من مكان لأخر [9].

النشاط الإشعاعي الطبيعي في القشرة الأرضية إن من أهم العناصر المشعة في صخور القشرة الأرضية هي البوتاسيوم 40 والروبيدوم 87 وسلسلتا العناصر المشعة المتولدة من تحلل اليورانيوم 238 والثوريوم 232 وهناك ما يقارب الأربعين من النظائر المشعة، وأعمار النصف للعناصر المشعة الأساسية في صخور القشرة الأرضية طويلة جداً، لهذا بقيت في الأرض إلى الآن منذ خلقها، فعمر النصف للبوتاسيوم 40 يزيد على ألف مليون سنة وعمر النصف الروبيدوم 87 يزيد على أربعين ألف مليون سنة وهذه النظائر المشعة تبعث أنواعاً مختلفة من الإشعاع الذري كجسيمات بيتا وألفا وأشعة غاما [10]. ومستوى النشاط الإشعاعي الطبيعي في القشرة الأرضية متقارب جداً في معظم الأماكن، حيث لا يوجد اختلاف يذكر عن مكان وآخر بصفة عامة، إلا أن هناك أماكن على الأرض يزداد فيها الإشعاع الطبيعي بشكل كبير نتيجة وجود تركيزات عالية من العناصر المشعة طبيعياً في صخور القشرة الأرضية.

النشاط الطبيعي داخل جسم الإنسان، يشع جسم الإنسان من الداخل عن طريق كل من الهواء الذي يتنفسه والغذاء والماء الذي يصل إلى جوفه، فالهواء هو المصدر الرئيسي للجرعة الإشعاعية الطبيعية التي تصل إلى داخل جسم الإنسان ومصدرها الأساسي غاز الرادون الموجود في جو الأرض والمتولد عن التحلل التلقائي لنظير اليورانيوم -238 الموجود طبيعياً في صخور قشرة الأرض. وكذلك فإن كلا من الغذاء الذي يتناوله الإنسان والماء الرئيسي لتلك المواد المشعة في النبات هو التربة التي تمتص منها النباتات تلك المواد مع غيرها من المواد الطبيعية فتدخل في بنائها. كما أن بعض الغبار الذي يتساقط على النبات يحوي آثاراً من تلك المواد المشعة، وتصل المواد المشعة إلى داخل جسم الإنسان عن طريق تناوله النباتات أو لحوم الحيوانات التي تتغذى على النباتات وتدخل المواد المشعة أيضاً مع الماء الذي نشربه حيث تحتوي المياه على آثار قليلة جداً منها، إضافة إلى ذلك فإن جميع أجسام الكائنات الحية وكذلك جسم الإنسان يحتوي على نظير الكاربون المشع-c 14لذلك تكون أجسامنا مشعة قليلاً من الداخل نظراً لوجود بعض العناصر المشعة فيه [11]، وفي مدينة قنا بصعيد مصر وجد Khalifa أن متوسط الجرعة الفعالة السنوية التي يأخذها السكان الذين يشربون ماء الصنبور فيها قد يصل حتى 0.008 ملي سيفرت لكل شخص، [12]. كما بينت دراسة أجراها Abdalla and Al-Naggar سنة 2019 أن قيم الجرعة الفعالة السنوية الناتجة عن غاز الرادون المنبعث من عينات البلاط الإسباني تراوحت من 3.16 إلى 12.55 ملي سيفرت/سنة لعينات سيراميك الجدران، ولعينات بلاط سيراميك الأرضيات من 3.67 إلى 11.69 ملي سيفرت/سنة، بينما في سيراميك الأرضيات المصرية كانت تتراوح بين 7.34 و 8.19 ملي سيفرت/سنة. [13]. وذكر كل من Sirc و Carman أنه في عام 2018 في الجزء الأوسط من سلوفينيا قدرت الجرعة الفعالة من الإشعاع الخارجي من Cs^{137} (بشكل رئيسي من حادث تشيرنوبيل) بنحو 4.7

ميكرو سيفرت/سنة، بينما قُدرت الجرعة الفعالة الإجمالية لشخص بالغ نتيجة التلوث العالمي للبيئة بالنويدات المشعة الاصطناعية (الإشعاع الخارجي) بـ 6.1 ميكرو سيفرت/سنة، وتم تقدير ما يتلقاه الشخص البالغ في سلوفينيا من إشعاع طبيعي في البيئة (2500 - 2800 ميكرو سيفرت). وقد أشارا إلى أن الجرعة المستنشقة من الغبار الجوي من النويدات المشعة الانشطارية لا تذكر مقارنة بما يتم ابتلاعه مع الطعام. [14]

وفي ليبيا وجدت دراسة حول الخلفية الإشعاعية لبعض مواد البناء في الجنوب الليبي وجد إن أعلى قيمة الجرعة الإشعاعية السنوية من أشعة جاما في عينة تربة خام الحديد أشكدة 702.9061 ميكروسيفرت وأقل قيمة في عينة تاروث 417.33 ميكروسيفرت حيت لم تتجاوز الحدود المقبولة 1500ميكروسيفرت، أما بالنسبة لعينات الإسمنت أظهرت أعلى قيمة للجرعة الإشعاعية السنوية من أشعة جاما في عينة الإسمنت التركي 736.17 ميكروسيفرت وأقل قيمة في عينة الإسمنت التونسي الأبيض المقبولة 78.53ميكروسيفر حيث لم تتجاوز الحدود. وبالنسبة لعينات الرخام والسيراميك فقد تراوحت قيمة الجرعة الإشعاعية السنوية ما بين 12.14و1501.56 ميكروسيفرت في عينة الرخام الهندي والإيراني على التوالي، حيث تجاوزت الحدود المقبولة في عينة الرخام الهندي، بينما في السيراميك تراوحت ما بين 527.16 و1075.49 ميكروسيفرت في عينة السيراميك المصري والإسباني على التوالي [15].

2.1. مستويات الخلفية الإشعاعية:

توجد المواد المشعة الطبيعية على سطح الأرض بتراكيز متفاوتة تختلف من منطقة إلى أخرى منذ أن تكونت الأرض يمكن أن تتركز هذه المواد بفعل بعض الصناعات غير النووية مثل صناعة الأسمدة الفوسفاتية وصناعة النفط والغاز إضافة إلى صناعة الكهرباء بعد أن تنقل من موطنها إلى مواقع تكثر فيها الحياة البشرية. يسهم الإشعاع الصادر عن هذه المواد المشعة الطبيعية الموجودة في الصخور والتربة وكثير من مواد البناء في خلفية الإشعاع الأرضي الذي يتعرض له الجسم البشري من الخارج، ويعد البوتاسيوم– 40 واليورانيوم– 238 والثوريوم– 232 من أهم العناصر الطبيعية التي تساهم في جزء كبير من الجرعة الإشعاعية التي يتلقاها البشر. وقد قدرت لجنة الأمم المتحدة للوقاية الإشعاعية (UNSCEAR-2008) متوسط الجرعة التي يتلقاها الإنسان من المصادر الطبيعية بـ 2.4 ميلي سيفرت/سنة مع وجود اختلاف كبير بقيمة الجرعة من مكان إلى آخر تبعًا لكثير من العوامل [4]، حيث تبين أن بعض المناطق في العالم تحتوي على نشاط إشعاعي طبيعي كبير نسبيًا بالمقارنة مع مناطق أخرى وقد يصل إلى عشرة أضعاف المتوسط العالم [16]. هذا وينشأ غاز الرادون الغاز المشع الطبيعي من وجود وتفكك كل من اليورانيوم والثوريوم في التربة ومواد البناء، والذي يشارك مع نواتج تفككه المصدرة لأشعة ألفا في تكوين أكبر

مصدر إشعاعي طبيعي يعرض الجسم البشري داخليا بطريق التنفس أو الجهاز الهضمي. وتكون مشاركة غاز الرادون في الجرعة الإشعاعية للرئة مهملة قياسا بمنتجات تفككه التي تترسب في مختلف أجزاء الجهاز التنفسي مصدرة جسيمات ألفا مؤدية إلى جرعة تزيد بمائة مرة على ما يسببه الرادون نفسه، وتبلغ القيمة العالمية المسموحة بها كخلفية إشعاعية 0.31 ميكروسيفرت/ساعة [17].

وقد أجريت العديد من البحوث لقياس الخلفية الإشعاعية لمناطق مختلفة من العالم منها ما تم باستخدام عداد الجرمانيوم لقياس التلوث حول مركز بحوث الطاقة الهندية وأثبت أن مستويات التلوث لا تشكل خطورة على العاملين به [18]. وفي دراسة عن الخلفية الإشعاعية حول المنطقة الصناعية لمحطة Rivers وجد أن معدل التعرض يساوي 0.14 ميكروسيفرت/ساعة أي أن هناك ارتفاع قليل في مستوى الخلفية الإشعاعية والتي كانت في حدود 0.13 ميكروسيفرت/ساعة[19]، ولوحظ حصول ارتفاع في مستوى الخلفية الإشعاعية بمقدار 88.9% في مراكز الغاز والنفط بنيجريا [20]. وفي قياس للخلفية الإشعاعية العمودية وعلى ارتفاعات مختلفة في مدينة هونغ كونغ Hong-Kong تم الحصول على علاقات تجريبية بين معدل الجرعة الممتصة ومعدل العد count/s [21]، وكان المعدل العام للخلفية الإشعاعية في سوريا 0.1 ميكروسيفرت/ساعة [22]، وتشير المصادر إلى أن متوسط الجرعة التي يتلقاها الإنسان من مصادر طبيعية في أوروبا 2 مللي سيفرت/سنة، وفي أستراليا 1.5 مللي سيفرت/سنة، وفي أمريكا 3 مللي سيفرت/سنة [10، 23]، وتبين أن جرعة الإشعاع الطبيعي الكلي لكل شخص في وسط أوروبا تصل حتى 4.50 مللي سيفرت/سنة، وتعادل 6.0 مللي سيفرت/سنة في أمريكا وهي مجموع الجرعات الطبيعية والجرعات الطبية المعتادة ومنها أشعة كونية أتية من السماء عند مستوي سطح البحر حوالي 0.24 مللي سيفرت/سنة وأشعة أرضية من الصخور والرمال وجدران المباني تكافئ 0.40 مللي سيفرت/سنة وأشعة من مكونات جسم الإنسان نفسه 0.40 مللي سيفرت/سنة [11] ، بالإضافة الى 0.85 مللي سيفرت/سنة أشعة من صخور الجرانيت في الولايات المتحدة الأمريكية، ويبلغ متوسط الجرعات الإشعاعية لكل شخص خلال الفحوصات الطبية بأشعة إكس وغيرها في أوروبا 2.5 ملي سيفرت سنويا، الولايات المتحدة الأمريكية 3.0 مللي سيفرت/سنة ومتوسط الجرعة الكلية لأعضاء طاقم الطيارين 9.0 مللي سيفرت/سنة بسبب تعرضهم المستمر للأشعة الكونية، وهي عالية في الطبقات الجوية العليا، ويصل متوسط الجرعة لمدخني السجائر (في الرئة) حتى 60 مللي سيفرت/سنة [10]. كما وجد Rahmanet أن متوسط قيم الجرعة الفعالة السنوية في الداخل والخارج 0.42 ± 0.03 و 0.10 ± 0.01 ملي سيفرت على التوالي. [24]. وقام Nizam سنة 2013 بتقييم تركيز نشاط النويدات المشعة الطبيعية والبشرية المنشأ في جزيرة شارفاسيون Charfassion ، في بنغلاديش وذكر أن الجرعة

الخارجية السنوية الفعالة الناتجة عن النويدات المشعة الطبيعية في الرواسب في منطقة الدراسة بلغ 0.07 ملي سيفرت [25]، وقام Saleh سنة 2013 بإجراء مسح وقياسات بيئية للنشاط الإشعاعي في عينات التربة التي تم جمعها من منطقة الصقامات Segamat بمنطقة جوهور Johor في ماليزيا. وباستخدام النتائج قام بحساب متوسط معدل الجرعة السنوية والذي كان 1.169 ملي سيفرت/سنة. [26]

وعلى المستوى المحلي في ليبيا فتشير دراسة أجراها Elnimr وأخرون سنة 2017 إلى أن معدل الجرعة الفعالة السنوية المقابلة من التعرض الخارجي، 203 1 – µSv y وأن معدل الجرعة الفعالة السنوية من استنشاق الرادون، 3096 – µSv y 1 وذلك بالقرب من مخازن الأسلحة بمنطقة وادي رواغ، الذي يقع في منطقة جبلية بالقرب من بلدية الجفرة وسط الصحراء الليبية، على بعد 600 كيلومتر جنوب شرق طرابلس [27] . وتم قياس تركيز النشاط الإشعاعي الطبيعي لعينات التربة التي تمّ جمعها من المناطق الغربية والوسطى الليبية باستخدام كاشف HPGe. من قبل القطاوي Algattawi وفريقه [28] سنة 2019 ووجدوا أن معدلات الجرعة الفعالة السنوية الناتجة عن Ra226 و Th232 و K 40 كانت 0.297 ± .03 mSv / y وهي أقل من القيم المتوسطة العالمية (0.8 مللي سيفرت/سنة)، كما وجد أن معدلات الجرعة الفعالة السنوية كانت في النطاق (153.23 ± 14.50 - 263.89 ± 28.1 ميكرو سيفرت/سنة) بمتوسط 296.75 ± 29.60 ميكرو سيفرت/سنة، وقام العجيلي Alajeeli سنة 2019 بحساب قيم حسابية للجرعة الفعالة السنوية المتلقاة من إشعاع جاما الأرضي في المنطقة الساحلية الواقعة بين طرابلس والزاوية شمال غرب ليبيا، ووجد أنها تقع في نطاق 23.03 - 30.83 ميكرو سيفرت/سنة بمتوسط قيمة 27.33 ميكرو سيفرت/سنة. [3]

1. 3. الهدف من الدراسة:

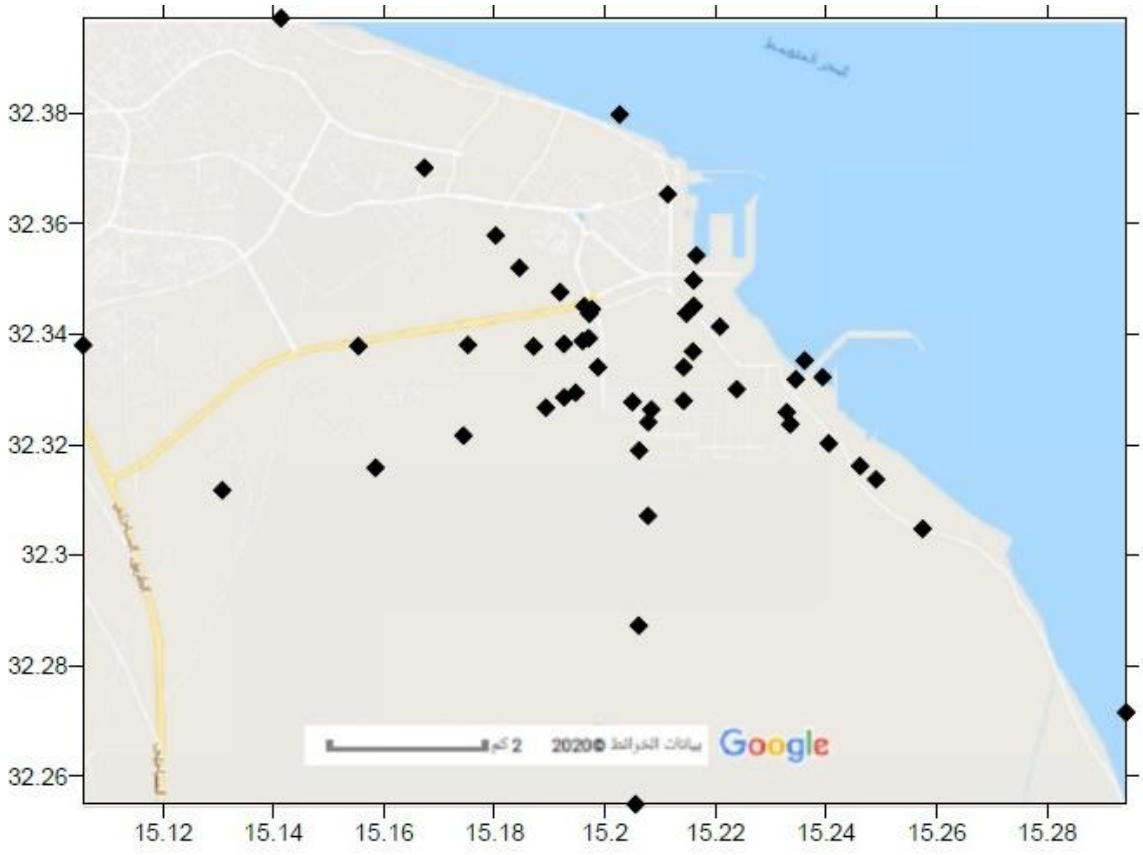
تهدف هذه الدراسة إلى قياس مستويات الخلفية الاشعاعية داخل مقر الشركة الليبية للحديد والصلب وفي المنطقة الصناعية المحيطة بها ومقارنة التراكيز المتحصل عليها مع مستويات الخلفية الإشعاعية في دول العالم.

2. المواد والطرق:

2. 1 موقع الدراسة:

تمت الدراسة على المنطقة المحيطة بمقر الشركة الليبية للحديد والصلب بمنطقة قصر أحمد بمدينة مصراته وفي جميع الاتجاهات الأصلية والفرعية ولمسافة 8 كم لتغطية كامل المنطقة الصناعية بالمدينة، حيث تم إجراء القياسات عند مجموعة من نقاط مراقبة تغطي جميع الاتجاهات الأصلية والفرعية بشكل شعاعي وتقع على مسافات متباعدة عن موقع الشركة بشكل

متوالية هندسية حيث تقع على مسافة 100، 500، 1000، 2000، 4000، و8000 متر من محيط موقع الشركة في كل اتجاه (شكل 1)، بالإضافة إلى عدد 15 نقطة مراقبة موزعة داخل الشركة وعلى محيط سورها من الداخل وفي جميع الاتجاهات ونقاط مراقبة بجوار وفوق وداخل مخزن المصادر المشعة الخاص بالشركة، وبالقرب من ساحات الخردة وأماكن تجميع المخلفات الصلبة، وقد تم أخذ القياسات لعدد (5) مكررات في كل نقطة بحيث تشمل نقطة القياس المحددة ونقطتين على يمينها ونقطتين على يسارها وتبعد كل نقطة عن الأخرى مسافة 10 متر بما يضمن إلى حد كبير تمثيل النتائج للاتجاه كاملا، وأخذت القياسات في جميع مواسم السنة بدءاً من الربيع وصولا إلى الشتاء بشكل متكرر بمعدل 4 إلى 6 جولات في كل موسم.



شكل(1): خريطة لموقع الدراسة وعليه نقاط المراقبة التي تم اعتمادها لقياس الخلفية الإشعاعية بالمنطقة.

2. 2. طريقة قياس الخلفية الإشعاعية:

تم قياس مستويات الإشعاع في المنطقة باستخدام جهاز Ranger_EXP مزود بكاشف مستقل من نوع (Detector: RAP-RS2 Probe – External Halogen-quenched Geiger-Mueller)، ويعتمد هذا الجهاز على تقنية أنبوب جيجر

للكشف عن الإشعاع وقد تمت معايرة الجهاز داخل مختبر الجودة بمقر الشركة الليبية للحديد والصلب باستخدام مصدر مشع Cs^{137} - 37 kBq (1µCi) وذلك وفقا للطريقة المذكورة في دليل الاستخدام الخاص به.

2. 3. التحليل الإحصائي:

تم إجراء التحاليل الإحصائية للبيانات باستخدام برنامج ستاتيستيكا STATISTICA V:6 وذلك لحساب المعاملات الأساسية وملخصات النتائج والارتباطات، كما تم استخدامه أيضا في المقارنات عن طريق إيجاد جدول تحليل التباين ANOVA بتصميم التجارب العاملية Factorial Design ورسم المقارنات وفق معدل الانحراف، كما تم رسم البيانات على شكل خطوط كنتورية وأشكال ثلاثية الأبعاد باستخدام برنامج سيرفر SURFER 13.

3. النتائج

3. 1 مستويات الاشعاع في المنطقة المحيطة بالشركة:

يمثل الجدول (1) مستويات الإشعاع بوحدة مللي سيفرت في اليوم ويلاحظ منه عدم وجود ارتفاعات في مستويات الاشعاع في المنطقة عن معدلاته الطبيعية وان الارتفاع النسبي في المستويات على بعد 500 و1000 متر من موقع الشركة ليست ذات تأثير معنوي وإنها فروق طبيعية في مستويات الإشعاع ترجع بالدرجة الأولى إلى تأثير الإشعاع الكوني والأرضي الطبيعي وأنها في جميع الأحوال تعد ضمن المستويات الآمنة ويلاحظ أن معدلاتها لم تبلغ 1 مللي سيفرت في أي موسم وعند أي مسافة.

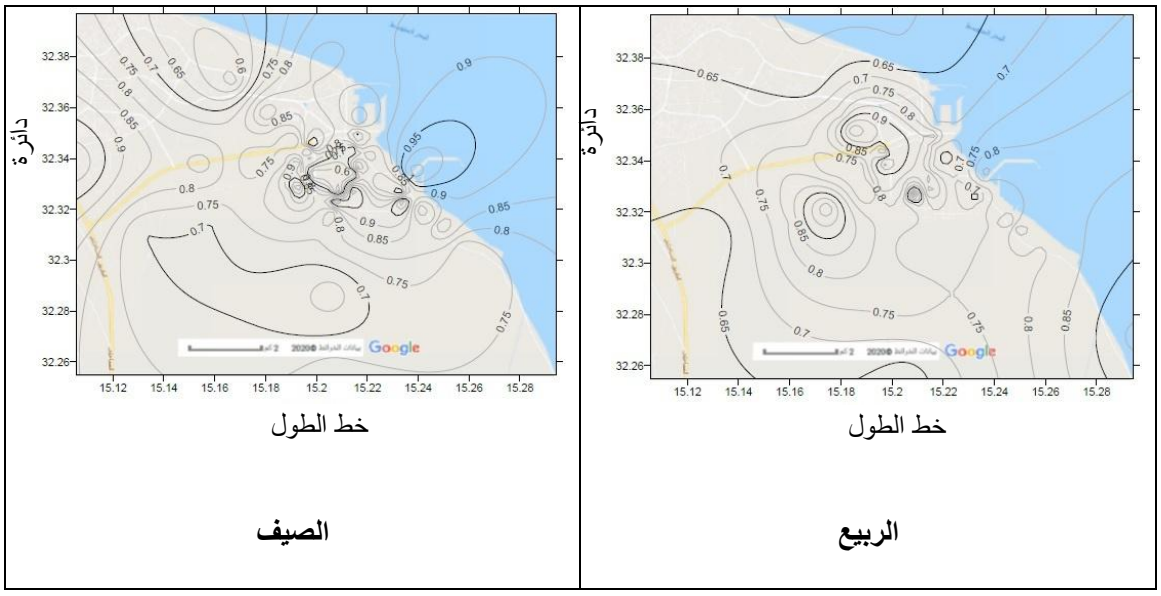
جدول (1) معدلات مستويات الاشعاع في المنطقة المحيطة بالشركة الليبية للحديد والصلب وتأثرها بالبعد عن موقع الشركة وموسم القياس*.

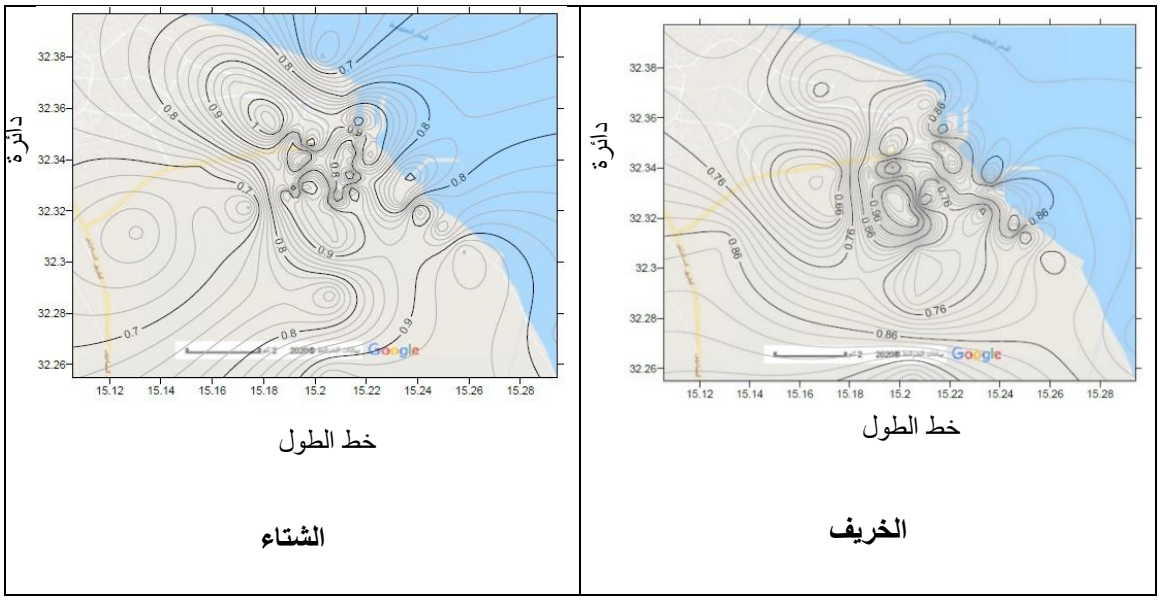
Level of	عدد النقاط	الإشعاع مللي سيفرت/سنة	الإشعاع مللي سيفرت/سنة	الإشعاع مللي سيفرت/سنة	الإشعاع مللي سيفرت/سنة
Factor		Mean	Std.Err.	-95.00%	+95.00%
100	24	0.81	0.04	0.72	0.90
500	24	0.87	0.03	0.81	0.93
1000	24	0.86	0.03	0.80	0.92
2000	24	0.80	0.03	0.74	0.86
4000	24	0.74	0.02	0.69	0.79

8000	20	0.78	0.03	0.71	0.85
Spring	35	0.76	0.02	0.71	0.81
Summer	35	0.81	0.03	0.76	0.87
Autumn	35	0.84	0.03	0.78	0.90
Winter	35	0.83	0.02	0.79	0.88

* لا تدخل نقاط المراقبة داخل الشركة في هذه المعدلات.

من الشكل (2) والذي يمثل خطوط الكنتور لمستويات الشعاع التي تم قياسها عند نقاط المراقبة المختلفة في المنطقة ونلاحظ من خلاله أن مستويات الشعاع لا تختلف كثيرا بين نقاط المراقبة التي تم قياسها داخل حدود الشركة عن تلك التي تمّ قياسها في المنطقة المحيطة بالشركة كما أننا نلاحظ أن مستويات الاشعاع لا تتأثر بموسم القياس وأن الفروق التي تظهر في الشكل هي غير معنوية وإنها ترجع إلى العوامل الطبيعية بين فترة قياس وأخرى.





شكل(2): خطوط الكنتور لمستويات الاشعاع في منطقة الدراسة في فصول السنة بوحدة مللي سيفرت/يوم.

بمراجعة مستويات الخلفية الإشعاعية في المنطقة تبين أن الجرعة الإشعاعية السنوية التي تم التحصل عليها في منطقة الدراسة لم تتجاوز الحدود المسموح بها في أي من القياسات التي تمت، وعند جميع نقاط المراقبة حيث كانت أقل قراءة 0.68 و لم تتجاوز أعلى قيمة 1 مللي سيفرت في السنة وبدون أي فروق معنوية بين نقاط المراقبة، وبمقارنة هذه الجرعة المتحصل عليها في منطقة الدراسة مع نظيراتها في مناطق أخرى نجد أنها كانت مقبولة جدا، فعلى سبيل المثال يبلغ متوسط جرعة الإنسان من مصادر طبيعية في أوروبا 2 مللي سيفرت/سنة، في أستراليا 1.5 مللي سيفرت/سنة، في الولايات المتحدة الأمريكية: 3 مللي سيفرت/سنة [10، 23]، ويبلغ مجموع الجرعات الطبيعية والجرعات الطبية المعتادة في الولايات المتحدة الأمريكية منها أشعة كونية آتية من السماء حوالي 0.24 مللي سيفرت/سنة وأشعة أرضية من الصخور والرمال وجدران المباني تكافئ 0.40 مللي سيفرت/سنة وأشعة من مكونات جسم الإنسان نفسه 0.40 مللي سيفرت/سنة، بالإضافة إلى 0.85 مللي سيفرت/سنة أشعة من صخور الجرانيت في الولايات المتحدة الأمريكية[11] .

3. 2. مستويات الإشعاع داخل الشركة:

نظرا لما قد يشكله التلوث الإشعاعي من خطورة على صحة العاملين فقد تم إجراء بعض القياسات لعدة نقاط داخل مخزن المواد المشعة بالشركة للوقوف على تأثيراتها المحتملة على العاملين، وأظهرت نتائج دراسة مستوى الإشعاع بالمخزن الموجود بميناء الشركة للعناصر المشعة المستنفذة نصف عمرها الافتراضي تبين أنه لا يوجد أي فروق معنوية لمستويات الإشعاع خارج

مخزن المواد المشعة بالمقارنة بباقي نقاط المراقبة في منطقة الدراسة، ويبين (جدول 2) أن التراكيز خارج المخزن كانت تتراوح بين 0.53 و 0.61 مللي سيفرت/سنة في السنة، إلا أنه لوحظ ارتفاع نسبي في مستويات الإشعاع داخل المخزن مقارنة بمستوياته خارجه حيث كانت الجرعات داخل المخزن تتراوح بين 1.05 و60.97 مللي سيفرت/ سنة، وأظهرت القياسات للمصادر المستنفذة نفسها أن مستويات الإشعاع كانت تتراوح بين 50.81 و 84.80 مللي سيفرت/سنة، وهذه الأرقام تدل على أنه لا توجد خطورة من المواد المشعة خارج المخزن، أما داخل المخزن فبالرغم من أن القياسات لا تدل على وجود خطورة على صحة العاملين به إلا أنه ينصح العاملين بأخذ الاحتياطات اللازمة وعدم البقاء في المخزن إلا للضرورة ولفترات زمنية محدودة، وأنه في حال بقاء العامل بجوار المصادر داخل المخزن لمدة 8 ساعات (يوم عمل) فإن الجرعة التي سيتعرض لها لن تتجاوز 60 ميكروسيفرت وهو رقم صغير جدا مقارنة بالجرعة المسموح بها، ولا تظهر مع جرعة أقل من 250 مللي سيفرت/يوم أي أعراض للتأثير الإشعاعي [29].

جدول (2): مستويات الاشعاع داخل وحول مخزن المواد المشعة بالشركة.

الموقع	متوسط الجرعة ميكروسيفرت/ساعة	متوسط الجرعة مللي سيفرت/سنة
فوق مخزن المخلفات المشعة من الخارج	0.06	0.53
خارج المخزن (شمال شرق)	0.06	0.53
خارج المخزن (شمال غرب)	0.061	0.53
المدخل الشمالي	0.07	0.61
خارج المخزن (جنوب شرق)	0.063	0.55
خارج المخزن (جنوب غرب)	0.062	0.54
المدخل الجنوبي	0.06	0.53
داخل المخزن (شمال شرق)	1.28	11.21
داخل المخزن (شمال غرب)	3.8	33.29
داخل مخزن النفايات المشعة في الوسط	6.96	60.97
داخل المخزن (جنوب شرق)	0.12	1.05
داخل المخزن (جنوب غرب)	0.12	1.05
مصدر متروك خارج المخزن (صندوق حديد)	1.48	12.96
مصادر داخل المخزن	7.6	66.58
مصادر داخل المخزن	5.8	50.81
داخل صندوق معد للتصدير	9.68	84.80

4. الاستنتاجات:

كانت مستويات الإشعاع بشكل عام في المنطقة خارج وداخل محيط الشركة ضمن الحدود الطبيعية للخلفية الإشعاعية في المنطقة، وبالتالي فإننا نرى أن هاجس التلوث الإشعاعي الذي ينتاب البعض لا أساس له وأن الوضع من هذا الجانب مطمئن.

شكر وتقدير:

نتوجه بجزيل الشكر للشركة الليبية للحديد والصلب والمركز الليبي لدراسات وبحوث علوم وتكنولوجيا البيئة، على ما قدموه من دعم لوجستي ومعنوي للفريق البحثي أثناء إجراء القياسات الميدانية.

قائمة المختصرات:

UNSCEAR: United Nations Scientific Committee on the Effects of Atomic Radiation
WHO: World Health Organization.
ICRP: The international commission on radiological protection
HPGe: high purity germanium

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[2] بهاء الدين معروف، "النشاط الإشعاعي البيئي في العراق"، المؤتمر العلمي عن آثار استعمال أسلحة اليورانيوم المنضب على الإنسان والبيئة في العراق – وزارة التعليم العالي والبحث العلمي - جمهورية العراق (2002).

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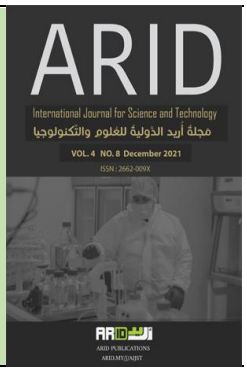

مَجلةُ أُريد الدَّوليةُ للعُلومِ والتِّكنولوجيا

العدد 8 ، المجلد 4 ، كانون الأول 2021 م

The Effect of Temperature and Solar Intensity on Performance of Commercial Silicon Solar Cell as Case Study En Nahud Town

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دراسة أثر الحرارة وكثافة الإشعاع الشمسي على كفاءة الخلية الشمسية السيلكونية التجارية ـ دراسة حالة مدينة النهود

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Abstract

The objective of this research is to study the variation of temperature and solar intensity on the performance of commercial silicon solar cells. This experiment was done at West Kordofan University, Department of Physics. A silicon solar cell was positioned at 45^0 in the direction of the sun. Then the current-voltage relationship (I-V) was recorded every hour during the day. The results in terms of I-V characteristics demonstrated that the short-circuit current increased linearly with the increase in temperature in the range of $(26\text{-}33)^0$ C, while the open-circuit voltage decreased logarithmically. On the other hand, the fill factor was found to be in the range of 72-78, and the corresponding efficiency was in the range of (6-11%). This result showed that En- Nahud town has a high solar intensity of approximately 1000 W/m^2. Therefore, it is found to be a perfect chosen area for providing solar cell investigations and projects in different renewable energy applications.

Keywords: silicon, solar cell, intensity, temperature, efficiency

الملخص:

يهدف هذا البحث لدراسة تأثير درجات الحرارة وشدة الاشعاع الشمسي على أداء وكفاءة خلايا السيليكون الشمسية التجارية. أجريت هذه التجربة في قسم الفيزياء بجامعة غرب كردفان. تم وضع الخلية الشمسية السيليكون بزاوية $\frac{\pi}{4}$ في اتجاه الشمس. ثم تمّ تسجيل العلاقة بين التيار والجهد (I-V) كل ساعة خلال النهار. أظهرت النتائج من حيث خصائص I-V أن تيار الدائرة القصيرة زاد خطيًا مع زيادة درجة الحرارة في المدى (26-33) درجة مئوية، بينما انخفض جهد الدائرة المفتوحة لوغاريتميًا. من ناحية أخرى، وجد أن عامل الملء في حدود 72-78 ، والكفاءة المقابلة كانت في حدود (6-11٪). أظهرت هذه النتيجة أن كثافة الطاقة الشمسية في بلدة النهود عالية تبلغ حوالي الـ 1000 واط / م^2. لذلك، وجد أنها منطقة النهود تتميز بإشعاع شمسي قوى جدا لذا تصلح لإقامة مشاريع وتطبيقات الطاقة الشمسية المختلفة.

كلمات مفتاحية: سليكون، خلية شمسية، الشدة الإشعاعية، درجة الحرارة، الكفاءة.

1. **Introduction**

Photovoltaics is the direct conversion of sunlight into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons and release electrons. These free electrons are captured and directly converted to electric current [1-2]. Solar radiation is used in two categories; either it is used as a heat source, or it is used to generate electricity from solar energy using photovoltaic cells. This phenomenon is known as the photovoltaic effect [3].

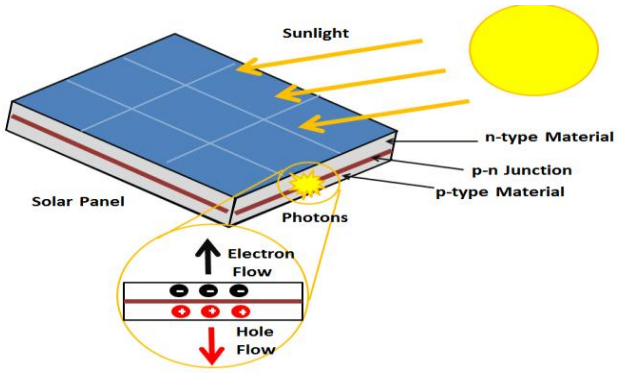
Since the global crisis in 1973, more attention has been given to renewable energy, especially solar energy. First, observed in 1839, a French physicist called Edmund Becquerel noted that voltage appeared when one of two identical electrodes in a weak conducting solution was illumed [4]. In 1870, Adam and Day studied this effect in solids, especially in selenium. Moreover, in 1880, selenium PV was fabricated with an efficiency of about 1%. Solar energy is highly attractive as a primary energy source because it is a continuous renewable source which cannot be depleted. It is available everywhere, and doesn't require transportation or transmission. It is environmentally clean and is possible to collect, convert, and store with present techniques [5].

Solar energy is an attractive approach to overcome limited access to energy and expected energy crises in the future, due to the fact that Sudan receives sufficient amounts of sunlight during the day, especially in the West State, mainly in the En Nahud area. The development of Sudan depends on the quality of scientific research to address this issue of solar energy and solar cells [6]. Solar cells are semiconductor photovoltaic devices that produce current when exposed to sunlight. They are usually made of very thin crystalline silicon, having a thickness of 200-300

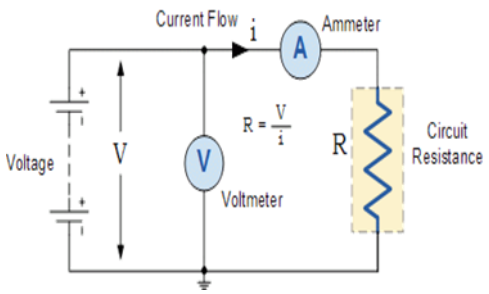
μm as in fig. 1. [7]. Photovoltaic phenomena mean converting sunlight directly into electrical current, but only a small percentage of the incident solar energy on the PV cell is converted into electrical current. The maximum efficiencies for most solar cells converted to electrical current are in the range between 20% and 28%, depending on the type of material used for the solar cell fabrication. The achievable efficiencies were generally between 2% to 20% [8]. However, the efficiencies of commercially available solar cells have recently been in the 10% to 15% range. Although some of the losses cannot be eliminated, many other losses can be reduced by proper design or selection of material. Solar energy has become more widespread and the intensive research and development of solar cells has become achievable for economical harnessing in order to reduce the production costs and to accelerate market penetration, especially in remote rural areas where the photovoltaic is an excellent solution to electricity provision [9]

Large scale application of photovoltaic for power generation, either on rooftops of houses or in large fields connected to the utility grid, is promising as well, to provide clean, safe alternatives to current methods of electricity generation [10]. When a solar cell is illuminated by sunlight, the photon energy of the incident light is converted to direct current through the process of photovoltaic effect [11]. Photovoltaic (PV) technologies for solar energy conversion characterize promising routes to green and renewable energy generation [12].

In this study, we focus on studying the efficiency and performance of silicon solar cells through the variation of cell temperature in the range of $(26\text{-}35)^0$ C, and intensity in between (400-1000) W/m^2



Figure(1): The Incident Light on Atypical



Figure(2): The Equivalent Circuit for Solar Cell [13].

2. Materials and Methods:

Silicon Solar cell $(10 \times 10)cm^2$with Power =10 Watts (min), 16.4 volts, temperature 25^0 C and 100 mw/cm^2, was fixed with 45^0 directly to the sun, the values of the voltage and current were taken during every hour from the 10 am in the morning, the cell temperature was recorded by changing cell resistance taken the corresponding values of current and voltage during every hour until the sunset at 6 pm through variation of resistance, Figure.2 explain the solar cell circuit of current-voltage characteristic, the current and voltage recoding during two days controlled by the values of the, shunt resistance (Rsh) mainly changing the resistance, this step repeating many time through different temperature within two days from the morning until night, the data of the plotting as shown in figures3 and 4, the I-V curves drawing below, then the photovoltaic parameter's such as short current, and open voltage circuit is justified.

$$\mathbf{I_{Cell} = I_{Ph} - I_D} \quad (1)$$

$$\boldsymbol{Hence,} \quad \boldsymbol{I_D = I_0\left(e^{\frac{qv}{KT}} - 1\right)} \quad (2)$$

$$\boldsymbol{I_{Cell} = I_{Ph} - I_0\left(e^{\frac{qv}{KT}} - 1\right)} \quad (3)$$

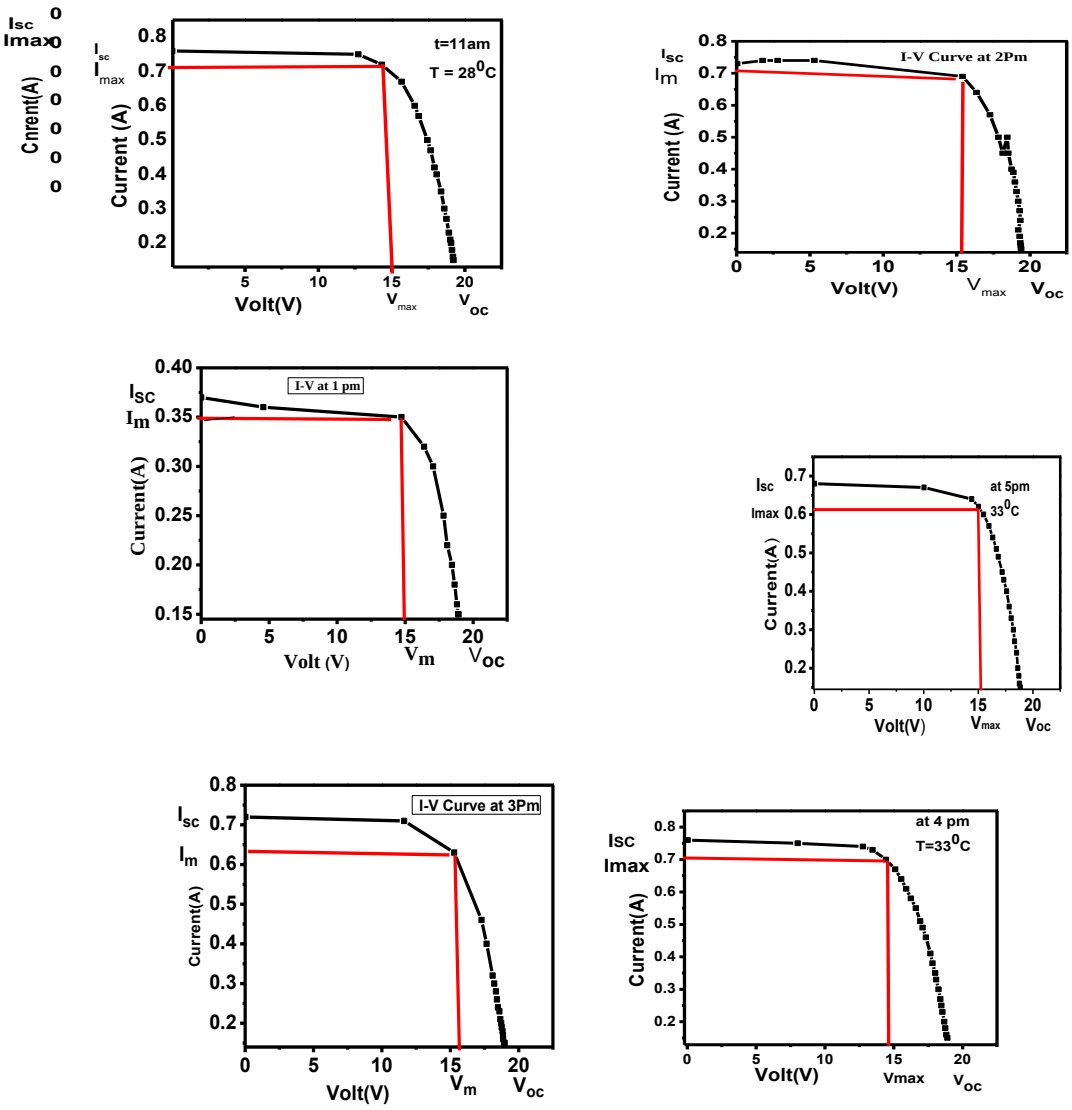
$$FF = \frac{V_m . I_m}{V_{OC} . I_{SC}} \quad (4)$$

$$P_m = I_m V_m \quad (5)$$

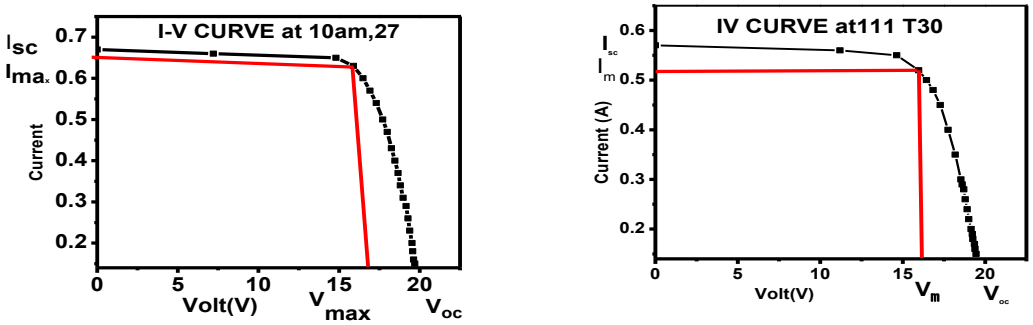
$$\eta = \frac{FF . V_{oc} . I_{sc}}{P\_in} \quad (6)$$

3. Results

The photovoltaic current-voltage characteristics of (10×10) cm^2 Si solar cell are represented in fig 3, fig 4 fig 5 respectively, and Tables 1, 2 through two days respectively and at different temperatures. The photovoltaic data current and voltage were recoded using a digital multimeter from 10 am until 6 pm with a corresponding temperature of (299-309) K throughout two days.



Figure(3): Silicon solar cell: I-V Curve of Si solar cell during the 1st day



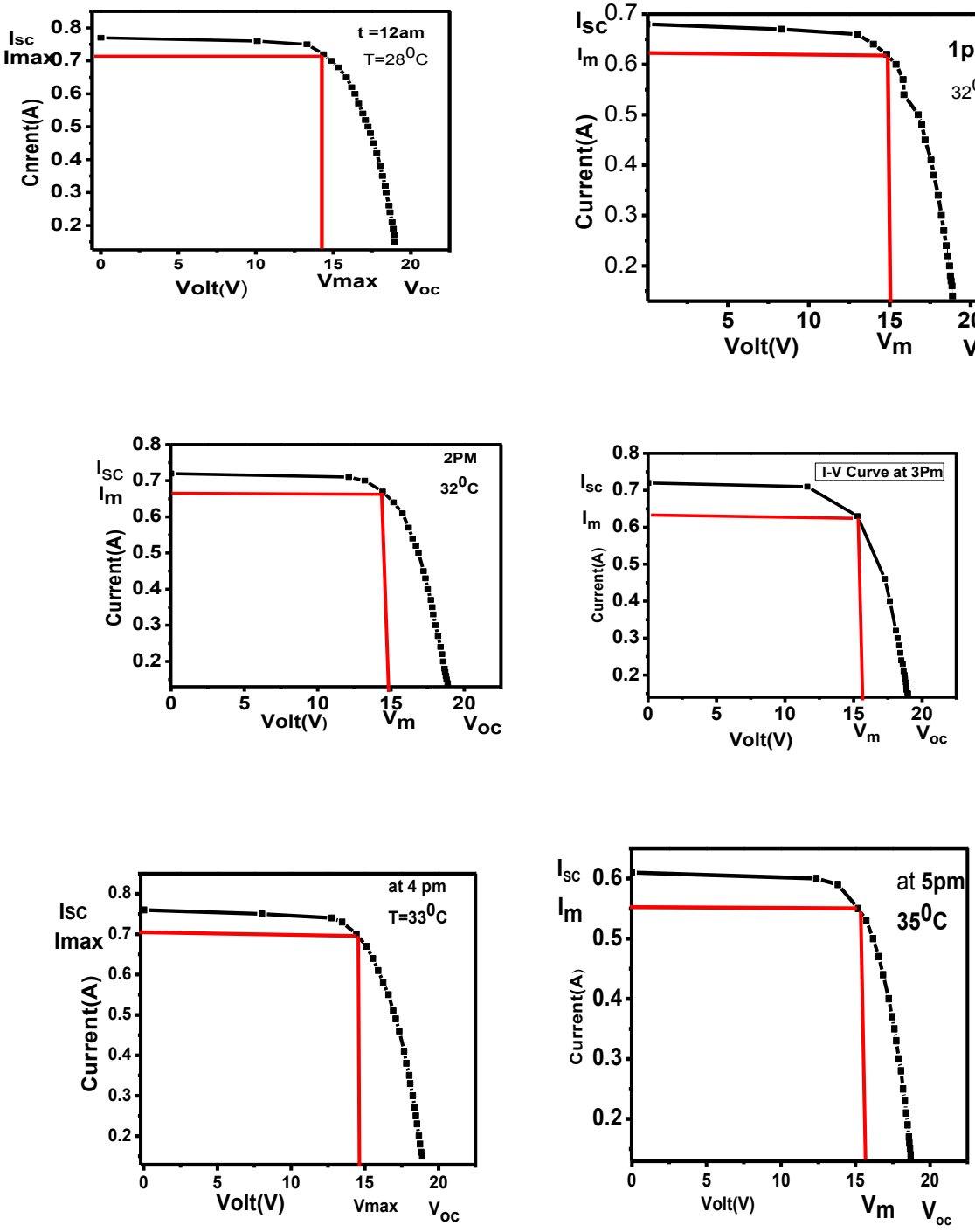


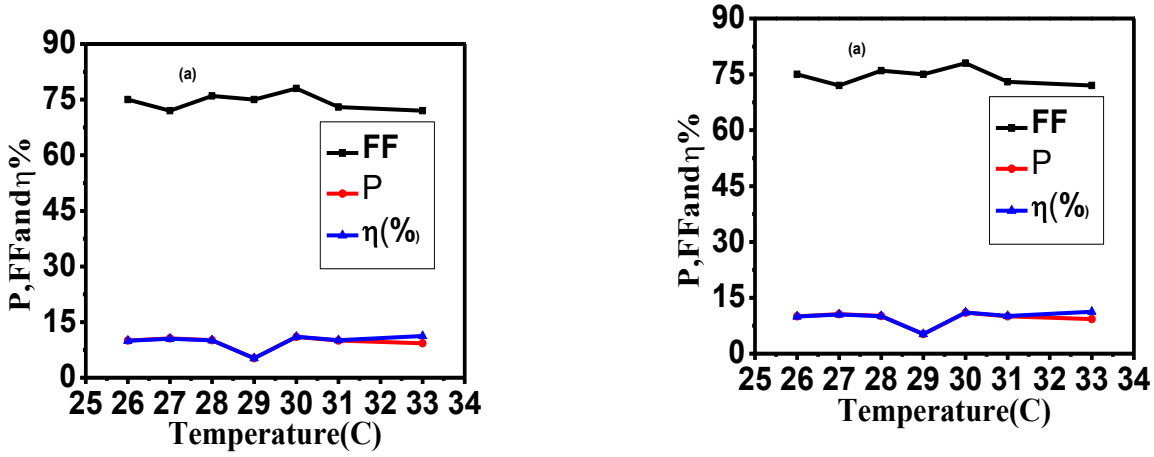
Figure (4): Silicon solar cell I-V Characteristic at Different Temperature during the 2nd day

Table (1): I-V Characteristic vs. Temperature during the1st day

Time	I w/m2	T^0(C)	V_{oc} ±V	I_{sc} $\pm A$	V_{max} ±V	I_{max} $\pm A$	P_{max}	FF	η%
10	500	26	20.2	0.66	16.44	0.61	10.03	75	9.99
11	600	27	19.22	0.76	14.98	0.71	10.64	72	10.52
12	700	28	18.97	0.70	14.29	0.71	10.15	76	10.09
1	800	29	18.97	0.35	14.96	0.35	5.24	75	5.26
2	900	30	19.45	0.73	15.29	0.71	11.02	78	11.06
3	1000	31	19.02	0.72	**15.65**	0.64	10.02	73	10.14
4	900	33	18.94	0.76	**14.65**	0.71	10.41	78	11.28
5	800	33	18.86	0.68	15.2	0.61	9.27	72	9.23

Table (2): I-V Characteristic vs. Temperature during the 2nd day

Time	I w/m^2	T^0(C)	V_{oc} ±V	I_{sc} $\pm A$	V_{max} ±V	I_{max} $\pm A$	P_{max}	FF	η%
10	500	27	19.76	0.67	16.79	0.61	10.03	75	9.95
11	600	30	19.45	0.59	16.20	0.71	10.64	72	10.52
12	700	31	18.93	0.68	15.03	0.71	10.15	76	10.09
1	800	32	18.97	0.78	14. 90	0.35	5.24	75	5.26
2	900	32	18.87	0.73	15.29	0.71	11.02	78	11.06
3	1000	31	18.73	0.72	**15.65**	0.64	10.02	73	10.14
4	900	33	18.80	0.76	**15.04**	0.71	10.41	78	11.28
5	800	35	18.82	0.6	15.2	0.61	9.27	72	9.23



(a) 1st day **(b) 2nd day**

Figure(5): The Variation of Electrical Power (P), Fill Factor (FF) During two Days

4. Discussion

The current-voltage characteristics of a silicon solar cell over two days were revealed and displayed in figure.3 and figure.4, and documented in Table.1 and Table. 2, respectively, in the 299K-308K temperature range. After that, the curves were used to calculate the maximum current, maximum voltage, short circuit current, and open-circuit voltage for a Si solar cell. The current-voltage plots of the cell characteristics are used to determine the performance of the a-Si solar cell (I-V). The (Voc) decreased as the temperature increased, from 20.2 volts at 10 a.m. with a temperature of 26^0 C to 18.86 volts at 5 p.m. with a temperature of 33^0 C. Moreover, the current increased from 0.61 to 0.71, this due to solar intensity increased, the obtained electrical power values of a Si solar cell were extract related to equation (5), The Maximum power Pmax increased from 10.9 to 8.65 as the temperature increased. The corresponding efficiency calculations on the first day alternative from 9.95% to 9.23% and changed from 9.95% to 8.69%

on the second day as shown in equation (6). The efficiency and the fill factor were considered to be acceptable compared to the results obtained by Subhash chander and his research group in [14] and by Swapnil Dubey and his research team in [15]. The optimized efficiency values were found to be about 11.28% at 4 pm. This related to maximum solar intensity and in relations to greatest solar radiation, approximately about 1000w/m^2, this, corresponds to other studies this. result shows that the Western area of Sudan is an ideal area due to high rate of solar intensity for applying solar cell applications, especially En Nahod town.

5. Conclusions

The Si solar cell I-V Characteristics, through two days, were obtained in temperature range from 299K-308K.The temperature and the radiation dependence on the performance of a Si-based photovoltaic cell, as well as the correlations between temperature and PV cell parameters such as open-circuit voltage (V_{OC}), maximum voltage Vmp, and maximum current Vmax. Moreover, the estimated values of the power solar cell and conversion efficiency decreased considerably as temperature increased, while the short-circuit current Isc increased slightly and efficiency increased. On other hand, in comparison, the high efficiency approximates about 11.28% these values were taken at 4 pm found at 900 w/m^2, the corresponding Fill factor and current is about 78 ,0.71 respectively, this clearly prove that this area En Nahod have high radiation.

Acknowledgements

The authors would like to express thanks to Qassim University, Uyuoon Aljwa department of physics and West Kordofan University, faculty of Education, Department of Physics, for providing this research. Thanks also to the solar energy center En Nahud.

Abbreviations

PV: Photovoltaic

Voc: open-circuit voltage

Isc: the short circuit current

Vmp: Maximum Voltage

Rsh: Shunt resistance

I_{max}: Maximum Current

Pmax: Maximum Power

FF: Fill Factor

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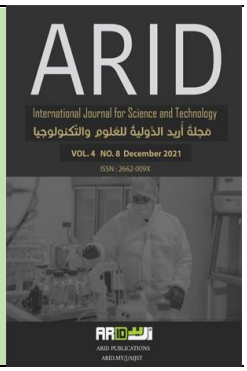

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العدد 8 ، المجلد 4 ، كانون الأول 2021 م

Histopathological study for transplanted Murine adenocarcinoma (AM3) treated by colicins extracted from *Escherichia coil.*(II)

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2 Ministry of Higher Education and Scientific Research / Baghdad / Iraq.
3 Dept. of Biology/ College of Science/ Al-Mustansiyria University / Baghdad / Iraq.

دراسة نسيجية مرضية في خط خلايا سرطانة الغدة اللبنية الفأرية (AM3) المعالجة بالكولسينات المستخلصة من بكتيريا *Escherichia coli*(الجزء الثاني)

هند حسين عبيد[1]* ناهي يوسف ياسين[2] رجوة حسن عيسى[3]

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Abstract

This study investigated the therapeutic effect of four types of colicins (H5, H9, H13 and H19) extracted from *E. coli* in transplanted murine adenocarcinoma (AM3) in female mice, by study histopathological effectsHistopathological examination of treated tumors revealed the presence of large necrotic areas with few cancer cells as well as huge infiltration of inflammatory cells with the presence of capsule and a thick layer of fibrous tissue. The best colicin used was H_5 as the animal reached a state of near cure at a dose of 200 mg / kg / 24 days. Colicins had inhibitory effects on growth of AM_3 cells when injected intratumorally at 200mg/Kg. Percentages of tumor inhibition were (98.79, 90.45, 90.08 and 88.26)% for colicins (H_{19}, H_{13}, H_9 and H_5), respectively. Intraperitoneal injection caused less inhibition, (57.47, 36.25, 60.26 and 35.25)%, respectively using a daily dose of 200mg/Kg for a period of (24) days..

Key Words*:* *E.coli* , colicins, murine adenocarcinoma , AM3 .

الملخص

تم التحري في هذه الدراسة عن التأثير العلاجي لأربعة أنواع من الكولسينات (H19, H13, H9, H5) المستخلصة من بكتيريا *E. coli* في سرطانة الغدة اللبنية الفأرية AM3 المغروسة في أناث الفئران الطبيعية من خلال دراسة التأثيرت النسيجة المرضية. أظهر الفحص النسجي للأورام المعالجة وجود مناطق نخر كبيرة مع قلة عدد الخلايا السرطانية فضلاً عن ارتشاح هائل للخلايا الالتهابية مع وجود طبقة سميكة من النسيج الليفي، وعن أفضل المستخلصات المستخدمة كان كولسين H_5 فقد وصل الحيوان تقريباً إلى حالة الشفاء، وذلك عند المعاملة بجرعة مقدارها 200 ملغرام/كغم/24 يوم. فضلا"عن ذلك وجد أن الكولسينات الأربعة المستخدمة تمتلك تأثيرا" مثبطاً لنمو خلايا سرطان الغدة اللبنية الفأري AM_3 عند استعمال الحقن داخل الورم وبجرعة مقدارها 200 ملغم/كغم، فقد بلغت نسبة تثبيط نمو الورم (98.79، 90.45، 90.08، 88.26)% للكولسينات H_5, H_9, H_{13}, H_{19} على الترتيب. أما الحقن داخل التجويف البريتوني، فإنه سبب أيضاً تأثيراً سمياً في تلك الخلايا لكن بنسب تثبيط نمو أقل مما أعطاه الحقن المباشر داخل الورم فبلغت (57.47، 36.25، 60.26، 53.25)% على الترتيب للكولسينات نفسها عند المعاملة بجرعة مقدارها 200 ملغم/كغم/24 يوماً.

الكلمات المفتاحية: اشيريشيا القولون، كولسينات، سرطان الغدة البنية الفأري؛ AM3.

1. المقدمة:

الورم (Tumor) بصورة عامة هو نمو نسيجي غير طبيعي للخلية، ليس للجسم القدرة على التحكم به والسيطرة عليه، ينشأ نتيجة تعرض تلك الخلية إلى بعض المؤثرات والتغيرات مما يجعلها تختلف عن الخلية الطبيعية التي نشأ منها، كما إنها لا يمكن أن تعود إلى أصلها حتى بعد زوال المسبب وتأثيره، أما مصطلح (Neoplasm) فهو مرادف لمصطلح (Tumor) ويعني نمواً جديدا". تُعد الأورام السرطانية واحدة من أخطر الأمراض التي تواجه حياة الإنسان، فهي تحتل المرتبة الثانية من بين مسببات الموت في العالم بعد أمراض القلب والأوعية الدموية [1]. وقد يتبادر إلى الذهن إن السرطان مرض واحد، لكن في الحقيقة تشير كلمة السرطان إلى حوالي مائة شكل تقريباً من أشكال المرض، لأن الأورام الخبيثة قد تنشأ من أي نسيج في الجسم، وبعض الأنسجة لها القدرة على تشكيل أنماط عديدة من السرطان، فضلاً عن المضاعفات المرضية الثانوية التي تحصل للمريض نتيجة الإصابة به [2,3]. لم يقف الإنسان مكتوف الأيدي أمام سطوة السرطان ليستسلم ويرضى بواقعه، بل سعى العلماء والباحثون منذ اكتشاف هذا المرض الوبال إلى دراسته بجوانبه كلها وكشف أسراره، فلم يعد لغزاً يحيرهم حتى توصلوا إلى أدق الآليات الجزيئية لمعرفة أسباب نشوئه وتطوره وبذلوا جهوداً حثيثة وسخروا طاقاتهم لمواجهة حرب الخلية السرطانية بأسلحة تكون قادرة على قتلها، وتثبيط انقسامها، ومنع انتشارها، وبالتالي إنقاذ حياة الإنسان، فتمّ الكشف عن أنواع مختلفة من المواد المضادة للأورام السرطانية التي تمتلك تأثيراً سمياً قاتلاً والتي نجحت في القضاء على أنواع من هذه الأورام وإطالة فترة حياة المريض، ومنها العلاج الإشعاعي والمواد الكيميائية المضادة للأورام. إلا أنّ هذه العلاجات لم تعطِ الجواب الشافي، لذلك سعى الباحثون إلى اتخاذ سبل أخرى لمحاربة السرطان [4]. فالآمال تعقد على استخدام العلاج المناعي الذي يهدف إلى تقوية وإثارة الجهاز المناعي ضد الخلايا السرطانية للقضاء عليها [3,5]، والعلاج الجيني الذي يرمي إلى إصلاح الخلل الوراثي بالخلية المتضررة أو قتلها دون الضرر بخلايا الجسم الطبيعية [4,6]، وما زالت هذه العلاجات قيد البحث والتطوير والتجريب المختبري آملين أن تصبح علاجاً سريرياً فعالاً لإنقاذ حياة المريض. تشمل العلاجات الكيميائية أنواعاً مختلفة من المركبات، وهي مضادات الفعاليات الأيضية ومضادات الإنقسام الخلوي وعوامل الألكلة والهرمونات والأنزيمات [7] والفيتامينات [8]، فضلاً عن المضادات الحياتية التي تنتج من الأحياء المجهرية [7]. ساهمت الأحياء المجهرية بدورٍ متميزٍ في إنتاج المضادات الحياتية التي تمتلك فعالية مضادة للأورام السرطانية، وبصورة خاصة الجنس Streptomyces الذي ينتمي إلى مجموعة الـ Actinomycetes [9,10]، في حين لا يوجد مضادٌ بكتيري يستعمل سريرياً لهذا الغرض. لكن كانت هناك العديد من الدراسات والبحوث التي اهتمت بموضوع إنتاج مضادات حياتية بكتيرية يطلق عليها البكتريوسينات (Bacteriocins) وتعدّ

الكولسينات أحد أنواعها الرئيسة، فقد وجد أنها تمتلك تأثيراً قاتلاً للخلايا السرطانية داخل وخارج الجسم الحي [10,11]. فالكولسينات هي مضادات بروتينية غير معروفة، تنتج من مختلف أفراد العائلة المعوية (*Enterobacteraceae*) وبصورة رئيسة من بكتيريا *Escherichia coli* وتتمكن من قتل الأنواع القريبة منها [12].تصنع الكولسينات عن طريق نظام إنزيمي متخصص يقع تحت سيطرة جينات يحملها بلازميد الكولسين (Col. plasmid)وفي بعض الأنواع تكون محمولة على الكروموسوم [13,14]، ويعرف حوالي سبعين نوعاً من الكولسينات المشخصة والمدروسة [15]. يعتمد التأثير السمي القاتل للكولسينات في الخلايا السرطانية على نوع الخلايا، ونوع الكولسين، ووقت التعريض والتركيز المستخدم[17,16]. وفيما يخص تأثير هذه المضادات البروتينة في الأورام الصلبة، فقد ثبط كولسين E3 62% من حجم الورم الصلب adenocarcinomaKH. كما ثبطت أنواع أخرى Lymphoma[18]. وتمكن كولسين HSC10 من تقليل عدد العقد الورمية في رئة الفئران المحقونة [10].أما تأثير أربعة أنواع من الكولسينات في سرطانة الغدة اللبنية الفأرية (AM3)، فقد كان للحقن داخل الورم تأثيرا" تثبيطيا" مرتفعا" وصل إلى نسبة مقدارها 98.79% في حين كانت أعلى نسبة تثبيط 57.47% عند المعالجة داخل التجويف البريتوني بجرعة مقدارها 200 ملغرام/كغم [19]. لذلك هدفت هذه الدراسة في جزئها الثاني للتقصي عن التأثير العلاجي للكولسينات داخل النسيج الورمي نفسه، من خلال دراسة نسيجية مرضية للأورام المعالجة لتدعم ما تم الحصول عليه من تثبيط في حجم الورم.

2. المواد وطرائق العمل:

2 1- استخلاص الكولسينات الخام الحرة (غير المرتبطة):

استخلصت أربعة أنواع من الكولسينات الخام الحرة (غير المرتبطة) (H_5 , H_9, H_{13}, H_{19}) من عزلات بكتريا *E.coli* (وهي من بكتريا النبيت الطبيعي المعوي) من براز أشخاص أصحاء، وحسب طريقة [20]، (الموضحة في مخطط 1)، تم قياس الفعالية بطريقة الحفر [12](wells method)، كما حُدد تركيـــــــــــــــــز البروتين الكلـــــي[21].

مخطط (1) : حث و استخلاص الكولسينات الخام الحرة

زرعت العزلات (H_5 , H_9, H_{13}, H_{19}) كل على حدة في أنابيب اِختبار تحوي (6.5) مل وسط Brain Heart infusionB.H.I السائل المعقم ، بدرجة حرارة 37 °م لمدة 18 ساعة .

⇩

حضر وسط (B.H.I السائل + 5% كليسرول) في دوارق مناسبة الحجم، بواقع (250) مل في كل دورق، وعقمت بالموصدة و تركت لتبرد.

⇩

في اليوم التالي، لقح كل وسط محضر في الخطوة (2) بأنبوبة اللقاح المحضرة في خطوة (1) لكل عزلة بكتيرية، حضنت الدوارق في حاضنة هزازة بدرجة 37 م° ليصل عدد الخلايا حوالي (3×10^{8}) خلية / مل، (14 ساعة حضن) بسرعة (150-200) دورة / دقيقة.

⇩

تضاف مادة المايتومايسين – C بتركيز نهائي مقداره (2) مكغم / مل إلى كل دورق، ثم تعاد الدوارق إلى الحاضنة الهزازة لمدة (3) ساعات إضافية.

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تضاف مادة المايتومايسين – C بتركيز نهائي مقداره (2) مكغم / مل الى كل دورق، ثم تعاد الدوارق إلى الحاضنة الهزازة لمدة (3) ساعات إضافية.

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بعد انتهاء فترة الحضن، نبذ المزروع البكتيري لكل دورق على إنفصال بجهاز الطرد المركزي المبرد بدرجة حرارة (4)°م لمدة نصف ساعة، بسرعة 7000 دورة/دقيقة.

⇩

فصل الراشح عن الراسب، وعدت الرواشح المحضرة هي الكولسينات الخام الحرة، قيست الفعالية وتركيز البروتين في كل نوع منها.

2 2 التأثيرات السمية للكولسينات في خط خلايا سرطانة الغدة اللبنية الفأرية (AM3) المغروسة في الفئران المختبرية الطبيعية.

تم إجراء هذه الدراسة لمعرفة التأثير العلاجي للكولسينات في أنموذج اختباري للسرطان في الكائن الحي (Animal Model System) وذلك باتباع الخطوات الآتية:

- ***غرس الخلايا السرطانية:***

تم الحصول على الحيوانات الحاملة للورم (خط خلايا AM3) من المركز العراقي لبحوث السرطان والوراثة الطبية، وهي إناث الفئران البيضاء التي سبق وأن غُرست بها تلك الخلايا السرطانية على أن يكون قطر كتلة الورم ما بين 3-4 سم أو أكثر، وتعد هذه الفئران هي الواهبة للخلايا السرطانية[22]. أما عملية غرس الخلايا فتمت كالآتي:

1 – أخذ الحيوان الحامل للورم وعقمت الكتلة الورمية بالكحول الأثيلي (70%) ثم تم رشف (aspiration) الخلايا السرطانية من تلك الكتلة باستعمال محقنة معقمة عن طريق إدخال إبرة ذات قياس 18 لنحصل على حوالي 3-5 مل من الخلايا السرطانية.

2 – نقلت الخلايا إلى بيكر معقم وأضيف إليها حجم مساوٍ من الـ PBS المعقم، مزجت جيداً وقطعت القطع الكبيرة إن وجدت، ثم غسلت تلك الخلايا عن طريق النبذ المركزي (1000 دورة/ دقيقة/ 10 دقائق/ بدرجة حرارة الغرفة)، أهمل الراشح وعُلق الراسب بحجم مساوٍ من الـPBS المعقم، وهنا تكون الخلايا جاهزة للحقن.

3 – حقنت الخلايا بفئران إناث طبيعية المناعة بحجم 0.25 مل/فأرة باستعمال محقنة طبية ذات أبرة قياس 18، إذ تمّ إدخالها من المنطقة الظهرية الفخذية وتحت الجلد وصولاً إلى المنطقة العنقية فقد حقنت الخلايا وضغطت المنطقة (ماقبل منطقة الحقن) لمنع خروج العالق من فتحة الحقن، ثم عقمت المنطقة.

- ***علاج الأورام السرطانية (المغروسة) بالكولسينات:***

بعد عزل الفئران التي ظهر بها الورم، تم تقسيمها إلى مجموعتين:

1- مجموعة العلاج بالحقن داخل الورم Intra-Tumor (I.T)

ضمت 6 مجاميع ثانوية، كل واحدة منها تحوي 3 فئران، حقنت المجاميع الأربعة الأولى بالكولسينات المحضرة (H_5, H_9, H_{13}, H_{19}) على التوالي بحجم 0.2 مل بتركيز 200 ملغم/كغم أما الخامسة فحقنت بالوسط B.H.I broth كسيطرة موجبة

والأخيرة تركت بدون حقن وعدت كسيطرة سالبة. تم الحقن بجرعة واحدة (I.T) يومياً لمدة 5 أيام متتالية باستعمال محقنة الأنسولين المعقمة، مع مراعاة تعقيم كتلة الورم قبل وبعد الحقن.

2- مجموعة العلاج بالحقن داخل التجويف البريتوني Intra-Peritoneal (I.P)

ضمت 6 مجاميع ثانوية، كل واحدة منها تحوي 3 فئران، حقنت بجرعة واحدة يومياً لمدة 24 يوماً متتالية وفق الآتي:

حقنت المجاميع الأربعة الأولى بالكولسينات H_5, H_9, H_{13}, H_{19}على الترتيب بحجم0.5 مل بتركيز 200 ملغرام/كغم، فيما حقنت المجموعة الخامسة بالوسط الزرعي B.H.I broth كسيطرة موجبة وتركت السادسة بدون حقن كسيطرة سالبة.

* تم قياس حجم الورم باستعمال آلة القياس (القدمة،Vernier Caplipers) ، إذ سجلت قياسات الطول والعرض، واستخرج الحجم حسب المعادلة الآتية[23].

$$V = L * W^2 / 2 \quad \text{..... (1)}$$

حيث إن:

V = حجم الورم بالملم^3

L = الطول

W = العرض

أما حساب النسبة المئوية لتثبيط نمو الورم (Growth Inhibition/GI) فقد تم وفق المعادلة الآتية [24].

$$GI = A\text{-}B/A * 100 \quad \text{..... (2)}$$

حيث إن:

GI = النسبة المئوية لتثبيط نمو الورم.

A = حجم الورم في المجموعة غير المعالجة.

B = حجم الورم في المجموعة المعالجة.

- ***الدراسة النسيجية المجهرية للورم المعالج:***

بعد انتهاء التجربة، تم قتل أحد الحيوانات المعالجة لكل نوع من الكولسينات الأربعة، ثم استخرج الورم المتبقي من جسم الحيوان بعد إزالة الجلد عن المنطقة وقطع ارتباطه بالحيوان، وضع بمحلول الفورمالين (10%)، بعدها تم عمل المقاطع النسيجية التي صبغت بصبغة الهيماتوكسلين- آيوسين[25]، وذلك لدراسة مدى التأثير السمي للكولسينات في خلايا سرطانة الغدة اللبنية الفأرية المزروعة في الحيوان.

3 - النتائج والمناقشة:

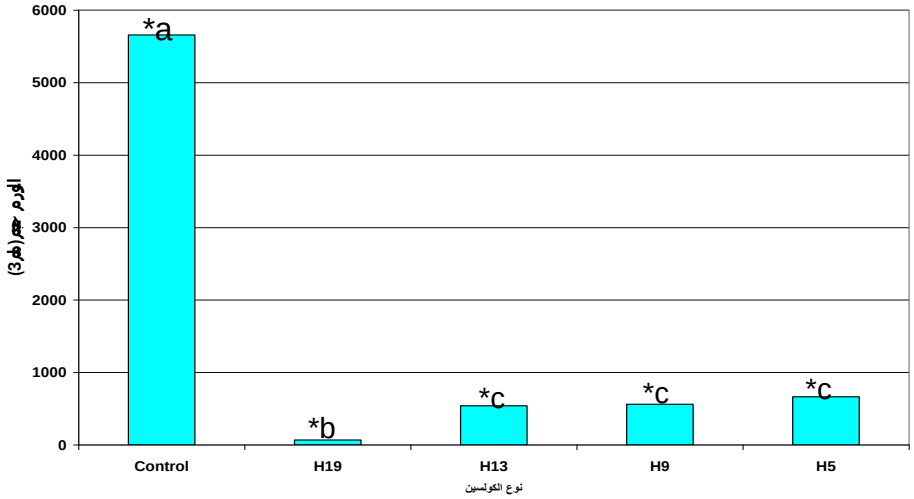
ملاحظة: نتائج تأثير الكولسينات في حجم الورم أدناه؛ هي نفسها منشورة في الجزء الأول من الدراسة من قبل الباحثة نفسها [19] وسيتم الإشارة إليها في هذا البحث(الجزء الثاني) في التأثير النسيجي المرضي لتتكامل الصورة علميا".

حقنت 120 أنثى بخلايا AM3، ظهر الورم بـ45 فأرة أي بنسبة 37.5%، إذ تراوحت الفترة الزمنية لظهوره ما بين 10-20 يوماً، في حين حقق الشمري عام 2003[26] نسبة نجاح وصلت إلى 90-100% في ظهور الأورام المغروسة في الفئران، وبفترة زمنية تراوحت ما بين 3-8 أيام، يعود سبب هذا التباين إلى التباعد الوراثي ما بين الفئران المستخدمة في هذه الدراسة عن الفئران الواهبة للورم، فقد كانت الحيوانات المغروسة من قبل الباحث (الشمري) ناتجة عن التزاوج الداخلي، فضلاً عن دور الجهاز المناعي للمضيف في رفض الخلايا السرطانية الغريبة المغروسة والقضاء عليها، وإلى جانب ذلك فمن المؤكد أن الخلايا السرطانية لم تتمكن من التكيف مع البيئة الجديدة، لذلك لم تستطع النمو وإنشاء الأوعية الدموية (Angiogenesis) مما سبب فقدان حيويتها نتيجة عدم حصولها على الغذاء والأوكسجين [27, 28].

حصل ضمور في حجم الورم، ومن ثم زواله تماماً وبصورة تلقائية في 6 فئران من بين الـ45وبنسبة 13.3% بعد 7 أيام من ظهوره، ويعزى ذلك إلى الأسباب نفسها أعلاه. بعد وصول الكتلة الورمية إلى الحجم المناسب، قُسِّمت الحيوانات إلى مجاميع لغرض البدء بالتجارب العلاجية، باستخدام الجرعة 200 ملغم/كغم التي اعتمدت كجرعة أمينة في الخلايا الطبيعية اعتمادا على نتائج الدليمي[29].

وفيما يخص مجاميع العلاج بالحقن داخل الورم:

عولجت الحيوانات (بخمس) جرع يومية داخل الورم لكل نوعٍ من الكولسينات، مما سبب انخفاضاً معنوياً ($P\leq0.05$) في حجم الكتلة الورمية مقارنةً بالسيطرة التي استمرت فيها الخلايا السرطانية بالنمو والتكاثر، يوضح الشكل (1) معدل حجم الورم لكل معاملة، والتي كانت (68، 540.68، 561، 664) ملم^3 للمواد العلاجية (H_5, H_9, H_{13}, H_{19}) وبنسبة تثبيط نمو مقدارها (98.79، 90.45، 90.08، 88.26)% على الترتيب، في حين وصل حجم الورم بمعاملة السيطرة إلى 5658 ملم^3 لحين موت الحيوان ونهاية التجربة. وجدت هناك فروقاً معنوية بين المعالجة بكولسين (H_{19}) وبين الأنواع الثلاثة الأخرى، والتي لم تعطِ فروقاً عند المقارنة فيما بينها. كما وحصل تثبيط نمو الورم تماماً 100% بأحد الحيوانات المعالجة بالكولسين نفسه. انتهت التجربة عند موت حيوانات السيطرة التي استمرت حياتها لمدة 36 يوماً بعد الغرس، وقد أصيبت بالهزال وسوء الحالة الصحية، بينما كانت حيوانات المجاميع العلاجية تتمتع بنشاط وحيوية رغم حدوث انخفاض الوزن وبقيت على قيد الحياة بنسبة (100%).



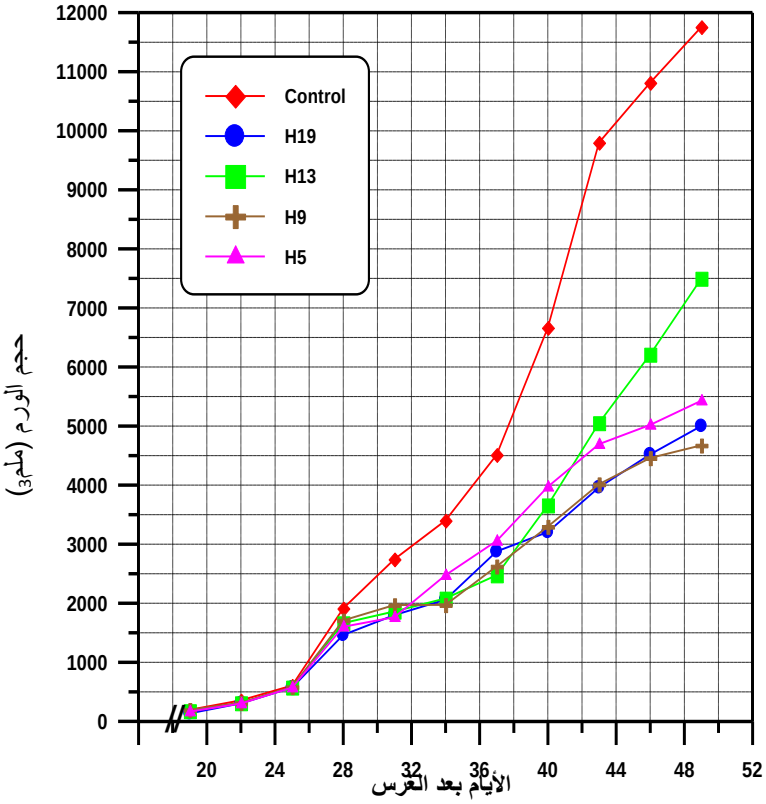
شكل (1): التأثير التثبيطي الناتج عن العلاج بالكولسينات (H_5,H_9, H_{13}, H_{19}) على نمو الورم (خلايا AM-3) عند الحقن داخله (IT)، بجرعة مقدارها (200 ملغم / كغم) لخمسة أيام متتالية.

أما مجاميع العلاج بالحقن داخل التجويف البريتوني:

فقد تم معالجتها بالكولسينات (H_5, H_9, H_{13}, H_{19}) عن طريق الحقن داخل التجويف البريتوني لمدة (24) يوماً متتالية، ونتيجة لذلك حصل تثبيط نمو الخلايا السرطانية (AM3) تمثل بحصول ضمور وتراجع (Regression) واضح بحجم الورم مقارنةً بالسيطرة التي ازداد الحجم فيها بصورة كبيرة (صورة 1)، وكان ذلك واضحاً طيلة فترة نمو الورم.

الصورة(1): مقارنة بين حجم الورم في مجموعة السيطرة (غير المعالجة)، مع حجمه في إحدى المجاميع العلاجية بالكولسينات:
أ- مجموعة السيطرة. ب، ج – مجموعة العلاج.

وكما هو الحال بالعلاج داخل الورم، فقد انتهت التجربة بموت حيوانات السيطرة الذي حصل في اليوم الخمسين من الغرس، وكان معدل حجم الورم فيها قد وصل إلى 11760 ملم^3، في حين وصلت الحجوم بالمجاميع المعالجة إلى (5001، 7497، 4673، 5430) ملم^3، وبنسبة تثبيط نمو مقدارها (57.47، 36.25، 60.26، 53.25)% عند المعاملة بالكولسينات (H_5, H_9, H_{13}, H_{19}) على الترتيب، فضلاً عن ذلك فقد أظهرت نتائج التحليل الإحصائي وجود فروق معنوية ($P\leq0.05$) بين مجموعة السيطرة السالبة والمجاميع العلاجية الأربعة، وبين بعض المجاميع عند مقارنتها مع بعضها البعض كما يوضح الشكل (2).أما الشكل (3) فيوضح خط مسير نمو الورم لكل من السيطرة والمجاميع المعالجة بالكولسينات الأربعة.



شكل (3): تأثير المعالجة بالكولسينات (H_5, H_9, H_{13}, H_{19}) على حجم الورم (خلايا AM-3) طيلة فترة العلاج، عند الحقن داخل التجويف البريتوني.

شكل (2): التأثير التثبيطي الناتج عن العلاج بالكولسينات على نمو الورم (خلايا AM-3) عند الحقن داخل التجويف البريتوني (IP) بجرعة مقدارها (200) ملغم/ كغم من وزن الحيوان لمدة (24) يوماً متتالية

ومن خلال نتائج الدراسة، وجد أن أفضل المستخلصات المستخدمة، هو كولسين H_9 الذي أعطى نسبة تثبيط 60.26%، ثم H_{19}، وبعده H_5، أما أقلها كفاءة فهو H_{13}، فقد كانت النسبة المئوية لتثبيط نمو الورم هي 36.25%.

ويوضح الشكل 3 أن حجم الورم يزداد بالرغم من استخدام العلاجات، إلا أن هناك فرقاً كبيراً عن الزيادة الحاصلة بحجمه في المجموعة غير المعالجة، إذ تتكاثر الخلايا وبسرعة وبدون أي عائق يقف أمامها، في حين سببت المواد العلاجية قتل تلك الخلايا أو مقدار كبير منها وثبطت انقسامها مما نتج عنه ضمور في حجم الكتلة الورمية، فضلاً عن ذلك فإن الحيوانات المعالجة تمتعت بحالة صحية أفضل، وبقيت على قيد الحياة بنسبة 100% لحين نهاية التجربة مقارنةً بالأخرى التي فقدت نشاطها تماماً.

عند مقارنة نسب تثبيط نمو الورم عند الحقن داخل الورم مع الحقن داخل البريتون، وجد أن المعالجة الأولى أكثر كفاءة وفاعلية من الأخرى، فقد أعطت نسب تثبيط مرتفعة حتى باستعمال المستخلص H_{13} الذي كانت نسبة تثبيطه 36.25% عند الحقن I.P، بينما ارتفعت إلى 90.45% بالمعالجة I.T، ربما يعزى سبب ذلك إلى تعرض الخلايا السرطانية إلى المادة العلاجية بصورة مباشرة، فتقوم بقتلها أو تثبيط انقسامها وتكاثرها مما يمنع نموها السريع ويقلل من حجم الورم، فضلاً عن أن كمية وتركيز المضاد البروتيني الذي تتعرض له الخلايا يكون أكثر، على العكس من الحقن I.P الذي يحتاج إلى توزيع داخل الجسم لتصل فيه نسبة معينة إلى الكتلة الورمية قد لا تؤثر بصورة كبيرة على الخلايا الورمية ذات القدرة الكبيرة على الانقسام، لذلك يلحظ عدم حصول أي استجابة للدواء خلال الأسبوع الأول من العلاج، فقد استمر نمو الورم بالزيادة، وبعدها بدأ ظهور التأثير التثبيطي. من جانب آخر، وجد أن هناك صعوبة في السيطرة على الورم عند زيادة حجمه، فتصبح الجرعة المعطاة غير فعالة تجاه أعداد الخلايا الهائلة التي تزداد بصورة سريعة.

لقد توافقت نتائج هذه الدراسة مع الأخرى التي اهتمت بالتحري عن فعالية الكولسينات أو البكتريوسينات بصورة عامة تجاه الأورام الصلبة. تمتلك البكتريوسينات تأثيراً مثبطاً لنمو الورم السرطاني، إذ أنها تساعد في الحد منه ومنع تقدمه (إن لم تؤدِ إلى تثبيط نموه كاملاً) وبصورةٍ معنوية مقارنةً بالسيطرة [30]. إذ تساهم الكولسينات (كولسين HSC_{10} المنقى جزئياً) في تقليل انبثاث (metastasis) الخلايا السرطانية (KHT fibrosarcoma) الفأرية المحقونة داخل البريتون في الفئران، فضلاً عن تقليل أعداد العقد الورمية المتكونة داخل الرئة، كما وجد أن الجرع التي تمتلك تأثيراً في الخلايا السرطانية تسبب تأثيرات سمّية في خلايا نخاع العظم الطبيعية، أما العلاج فإنه يحتاج لجرعات يومية متعددة لأن فعالية الكولسين السمية داخل الجسم الحي لا تتجاوز اليوم الواحد.[31]

إن التأثير العلاجي التثبيطي للكولسينات داخل الجسم الحي يعتمد على تركيز الجرعة المستخدمة وكتلة الورم السرطاني (كثافة الخلايا السرطانية) ونوع الخلايا المعاملة، فاستخدام الجرعة الواطئة 0.095 مكغم/يومياً من كولسين E_3 النقي، يساعد في تثبيط نمو الورم الصلب (HK-adenocarcinoma) بنسبة 49% بعد 20 يوماً كما يزيد من فترة بقاء الحيوان من 16 إلى 28 يوماً، في حين تزداد نسبة التثبيط إلى 75% عند زيادة الجرعة إلى 8.75 مكغم من الكولسين نفس [18]، وكان الباحث نفسه قد توصل إلى امتلاك الكولسينات (E_3, E_2, D, A) والـStaphyllococcin والـPyocin، تأثيراً سمياً مثبطاً لنمو أربعة أنواع من الأورام الصلبة وهي Lymphosarcoma $6C_3$ وLp-2 plasmocytoma وskalski و Lymphoma Nemeth-Kellner، وبنسبٍ مختلفة. فضلاً عن عمل الكولسينات على تثبيط نمو الورم الصلب، فإنه يساعد

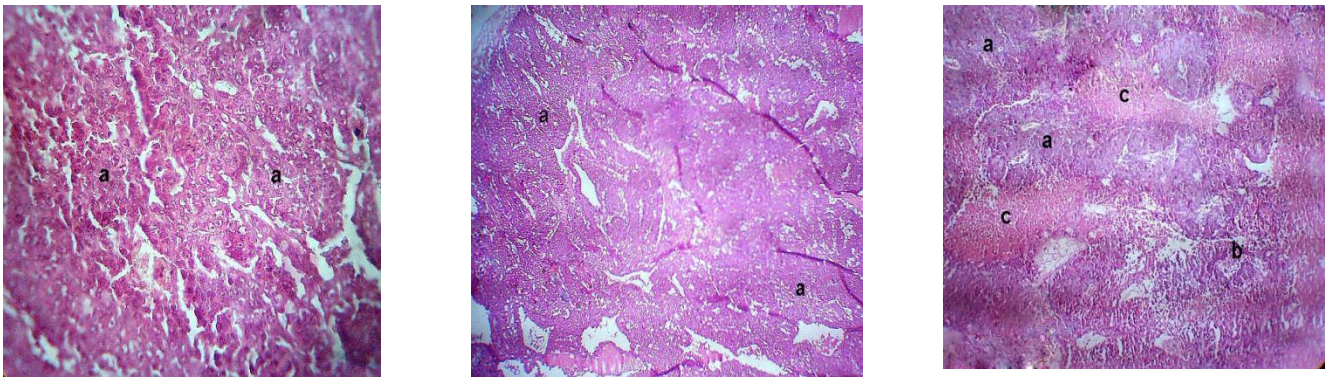
كذلك في إطالة فترة حياة الحيوان المعالج، إذ ازدادت فترة بقاء الحيوانات المصابة بالورم Plasmocytoma والمعالجة بكولسين E_3 النقي من 44 إلى 63 يوماً، أما الأخرى المصابة بـHK-adenocarcinoma والمعالجة بالكولسين نفسه فارتفع من 23 إلى 28 يوماً مع اختزال حجم الورم بنسبة 61%. أما فيما يخص آلية عمل الكولسينات المستخدمة في قتل الخلايا السرطانية، فهي لا تختلف عما هو عليه في البكتيريا، إذ تستهدف الغشاء الخلوي أو المادة الوراثية DNA أو صنع البروتين [16,17]

من النقاط المهمة التي يجب مراعاتها، هو أن يتم علاج الورم وهو بحجمٍ صغير وذلك لأن الخلايا السرطانية تكون في مرحلة انقسام وتكاثر، فتتأثر بالعلاجات المستخدمة، أما عند زيادة حجم الكتلة الورمية فإن عدداً كبيراً من الخلايا يصبح بطور السكون وهنا لن تستجيب لتأثير المواد العلاجية ذات السمية الخلوية [7].

الفحص النسيجي المرضي المجهري للأورام:

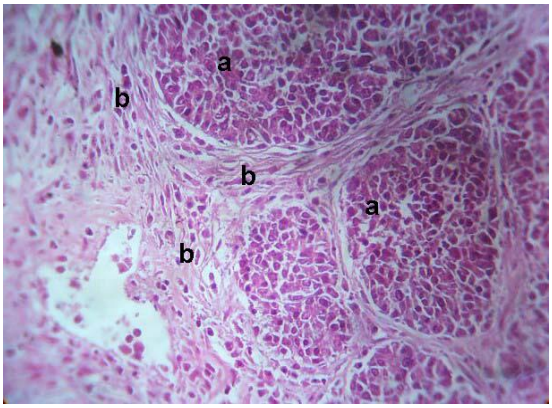
درست أورام الغدة اللبنية الفأرية بإجراء الفحص النسيجي المرضي المجهري للمجاميع المعالجة، وقورنت بمجموعة السيطرة (غير المعالجة)، للتعرف على التغيرات التي سببتها العلاجات المستخدمة، ومنها تم الحصول على النتائج الآتية:

أظهر الفحص النسيجي لمجموعة السيطرة غير المعالجة أن سرطان الغدة اللبنية من النوع الصلب (Solid)، المتألف من عدة طبقات من الخلايا بشكل صفائح (Sheet)، وهي تمثل تكاثر خلايا النسيج الغدي بشكلٍ هائل مع وجود عدد كبير من التراكيب الغدية(glandular structure)، كذلك لوحظ وجود توسع كيسي (Cyst diltation) يحتوي على إفرازات بروتينية، فضلاً عن وجود مواد شبيهة بالحليب تظهر داخل الأسناخ (Duct)، وأظهر الفحص وجود مناطق نخر (Necrosis) تقع في مركز الورم، أما سببه فيعزى إلى كبر حجم الورم وكثرة عدد الخلايا مما يعيق وصول الدم إلى المنطقة مسبباً موت الخلايا هناك، وقد أحيطت الخلايا السرطانية بمحفظة (Capsule) مؤلفة من طبقة خفيفة من النسيج الليفي(Fibrous connective tissue) (الصورة 2).

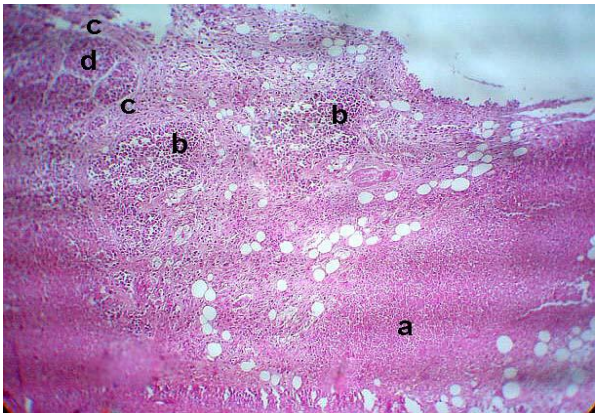


الصورة (2): مقاطع نسيجية في سرطانة الغدة اللبنية الفأرية لخط (AM3) لمجموعة السيطرة (غير المعالجة)، تظهر فيه الخلايا السرطانية بشكل صلد (solid) aوبأعداد هائلة وملاحظة أرتشاح الخلايا الألتهابية b ومنطقة نخرية c(H&E X400)

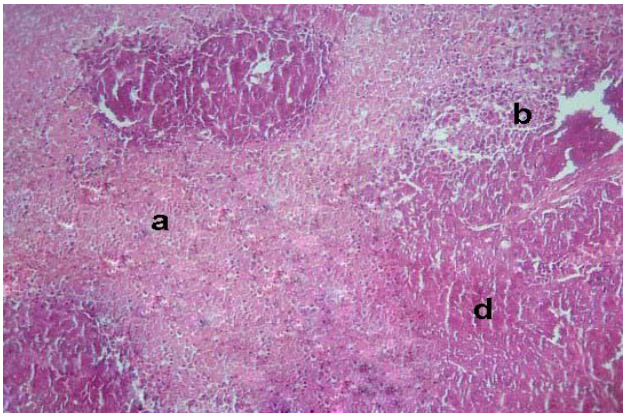
أما التغيرات المرضية في المجاميع العلاجية فقد تشابهت بصورةٍ عامة، وتمثلت بوجود مناطق النخر وارتشاح الخلايا الالتهابية مع إحاطة الورم بطبقة ليفية، أما عند المقارنة بين أنواع المواد العلاجية، فوجد هناك اختلاف كبير في شدة التأثير اعتمد على نوع الكولسين المستعمل. أفضل أنواع المستخلصات تأثيراً كان كولسين H_5، فقد وجدت مناطق كبيرة جداً من النخر مع ارتشاح هائل للخلايا الالتهابية، وهذا يشير إلى حصول تحفيز الإستجابة المناعية ضد الورم، أما الخلايا السرطانية (tumor cells) فقد كانت قليلة جداً، في حين كانت المحفظة كبيرة وتحوي طبقة سميكة جداً من النسيج الليفي، والذي بدوره سبّب عزل الورم عن الجسم، فالحيوان هنا كان في طور الوصول إلى حالة الشفاء (الصورة 3-أ). أما المعالجة بكولسين H_{19}وH_9 فكانت متماثلة التأثير، فقد ظهرت منطقة إلتهابية كبيرة مع وجود مناطق نخر كبيرة أيضاً، ويُلحظ وجود الخلايا السرطانية لكن بمنطقة أصغر قطراً مقارنةً بالسيطرة، أما منطقة التليف فهي أكبر (الصورة 3-ب و5-جـ) وبالرغم من تشابه التأثيرات لكلا النوعين، إلا إن حجم الورم ككل يبدو أصغر عند استخدام كولسين H_9، ورغم أن المستخلصين أعطيا نتائج جيدة، إلا أنها أقل كفاءة من H_5. وأخيراً كان كولسين H_{13} الأقل تأثيراً، فبالرغم من وجود مناطق النخر والخلايا الالتهابية والمحفظة التي كانت أكبر مما هو عليه في السيطرة، إلا أن منطقة الخلايا السرطانية كانت كبيرة الحجم (الصورة 3-د)، وبالعودة إلى نتائج الشكل (2) يلحظ أن كولسين H_{13} كان الأقل قدرةً في تثبيط نمو الورم مقارنةً بالأنواع الثلاثة الأخرى، فقد كانت النسبة المئوية لتثبيط نمو الورم 36.25%.



أ- مجموعة العلاج بالكولسين (H_5): يلحظ وجود الخلايا السرطانية المرتشحة بأعداد هائلة من الخلايا الالتهابية a، ومحاطة بمحفظة سميكة جداً من النسيج الليفي b(H&E X100)

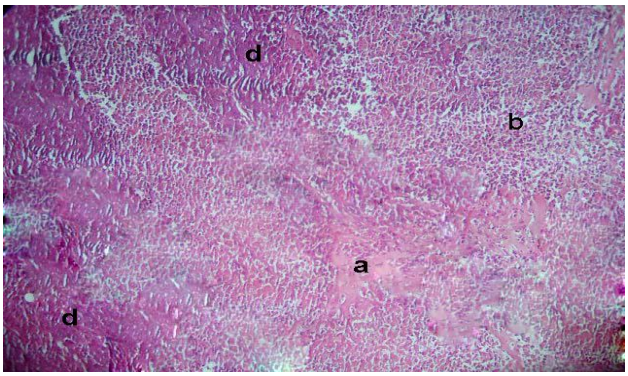


ب- مجموعة العلاج بكولسين (H_{19})



ج- مجموعة العلاج بكولسين (H_9)

يلاحظ وجود مناطق كبيرة من النخر a مع ارتشاح خلايا التهابية bكثيرة، أما منطقة التليف c فهي أكبر مما هو عليه في السيطرة، والخلايا السرطانية dتتواجد بمنطقة أصغر مقارنةً بالسيطرة.



د- مجموعة العلاج بكولسين (H13): يُلحظ وجود مناطق نخر aوخلايا التهابية bومحفظة أكبر مما هو عليه في السيطرة، لكن منطقة الخلايا السرطانية dذات حجم كبير (H&E X400)

الصورة (3): مقاطع نسيجية في سرطانة الغدة اللبنية الفأرية لخط (AM3)، لمجاميع العلاج بالكولسينات، عند الحقن داخل التجويف البريتوني بجرعة (200ملغم/كغم/24 يوماً)، وهي مقارنة بين التأثير العلاجي لكلِ نوع منها

3 - الإستنتاجات:

أستنتج من هذه الدراسة أن الكولسينات المنتجة من بكتيريا اشيريشيا القولون، لها تأثير واضح في علاج سرطانة الغدة اللبنية الفأري من خلال الانخفاض الواضح في حجم كتلة الورم ومن خلال انخفاض عدد الخلايا السرطانية في الفحص النسيجي المرضي؛ فقد وصل الحيوان في أحد المواد العلاجية المستخدمة إلى مرحلة كبيرة من ضمور حجم الورم؛ وهذه النتائج الأولية ممكن أن تقود لاستخدام الكولسينات في علاج الأورام السرطانية كعلاجات مستقبلية واعدة.

قائمة المختصرات

ت	المصطلح العلمي	رمزالأختصار
1	Ahmed Majeed2003	AM3
2	Brain Heart infusion	B.H.I broth
3	Growth Inhibition	GI
4	H_5 , H_9, H_{13}, H_{19}	رموز المستخلصات البكتيرية المستخدمة في الدراسة
5	hematoxylin and eosin	H&E
6	Intra-Peritoneal	I.P
7	Intra-Tumor	I.T

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