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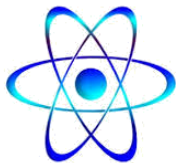
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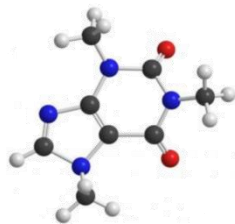
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**Synthesis, Characterization of New Pyrazoline
Derivatives by Al_2O_3 -ONa Solid Base
Catalyst and Study Their biological activity**

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Department of Chemistry
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Synthesis, Characterization of New Pyrazoline Derivatives by Al_2O_3 -ONa Solid Base Catalyst and Study Their biological activity

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Abstract: This work included the synthesis of new derivatives of pyrazoline compounds from the reaction of chalcones with hydrazine via a solid base catalyst (prepared through the reaction of $NaNO_3$ with Al_2O_3 at (300-700) °C to obtain a sodium metal as a solid base catalyst) and using physical and spectroscopic methods as melting point, color, Nuclear magnetic resonance spectroscopy 1H -NMR, ^{13}C -NMR, and FT-IR to confirm the accuracy and validity of the prepared compounds. Biological efficacy was also evaluated on two types of bacteria, *Escherichia coli*, and *Staphylococcus aureus*.

Keywords: Chalcones, Solid base catalyst, Pyrazoline, Biological activity.

1. Introduction

Pyrazoline Recently, researchers have been interested in pyrazoline compounds, as it has great importance in the field of pharmacology as it has demonstrated biological activity. Anticancer [1]; anti-inflammatories [2], anxiolytic [3]; and antioxidant [4]; and antiviral [5]; antifungal [6], antibacterial [7], antimalarial [8]; also shown to be effective against depression [9]. Solid base catalyst Heterogeneous base catalysts are more common and used than acidic catalysts [10] because they are insoluble, easy to separate, and can be used more than once, where significant development was observed in the preparation of solid base catalysts. Their use for biodiesel production [11] and cross-esterification reactions are Faster using essential catalysts compared to those catalyzed with acid catalysts. The effectiveness of these catalysts is evaluated based on surface physical properties such as surface area, pore size, and concentration of active aggregates [12]. Chalcone is a unique α , β -unsaturated carbonyl with biologically active properties and is a precursor of various heterocyclic compounds. Chalcones have attracted particular attention among researchers due to their pharmaceutical properties and easy preparation. Among the worth-declaring activities of chalcones are antioxidant [13], anti-inflammatory [14], anti-cardiac [15], antifungal [16], antimalarial [17], antibacterial [18], anti-osteogenic [19], anticancer [20], anti-HIV [21], antimicrobial [22], anti-tubercular [23], anti-diabetes [24] and antihypertensive activities [25].

2. Experimental

2.1. Material: All chemicals were used through this work purchased from Fluka, Aldrich, BDH Companies.

2.2. Devices used: Melting points were recorded using a measuring device melting point type: Automatic melting point\SMP40 and were uncorrected. Thin layer chromatography (TLC) was carried out using sheet polygram silica- gel as stationary phase, the spots were enhanced using Iodine. Infrared spectra were recorded using FT-IR-600 Fourier- Transform infrared Spectrophotometer by KBr disc and with a scale of (400-4000) cm^{-1} . The nuclear magnetic resonance (1H , ^{13}C -NMR) spectra were measured for the compounds prepared in the laboratories of Sannati Sharif University - Iran, using MS5973 Agilent Technology, Germany Bruker 500 MHz, at 500 MHz, and using (DMSO- d_6) as a solvent.

2.3. Preparation of chalcones derivatives (MH1-MH5) [26,27]

A mixture of 5-Bromo-Indanone (0.01 mol) and aromatic benzaldehyde derivatives (0.01 mol) was dissolved in 30 ml of ethanol in a round-bottomed flask equipped with a magnetic stirrer. Then 10 ml NaOH solution (10%) was added dropwise to the reaction mixture on vigorous stirring for 30 minutes until the solution became turbid. The reaction temperature was maintained between (20-25) °C using a cold-water bath on the magnetic stirrer. After vigorous stirring for (4-5) hours, then neutralized by (10% HCl) and filtered and recrystallized from ethanol. Table (1) shows some physical properties of compounds (MH1-MH5).

2.4. Preparation of the solid basic catalyst Al₂O₃-Ona [28, 29]

The mixture of (1 mol) KNO₃ with (3 mol) Al₂O₃ was then crushed in a mortar, and then appropriate deionized water was added, which can be absorbed by Al₂O₃. After grinding, the mixture was dried at 110 C for one hour and then activated at 600 C for three hours.

2.5. Preparation of pyrazoline (MH6-MH10) [30, 31]

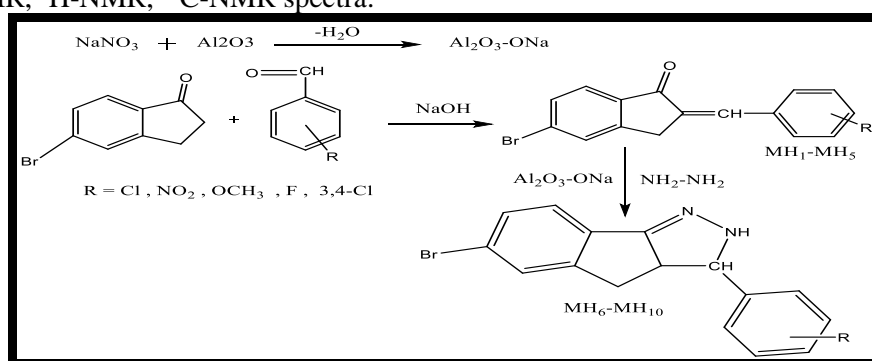
Mixture (0.0015 mol) of chalcone dissolved in (10 mL) of ethanol and (0.00225 mol) of hydrazine dissolved in (10 mL) of with stirred for (30 min), then add (0.225 gm) of solid base catalyst (Al₂O₃-ONa) to it is left with stirring in a water bath for three hours, then filtered and left for 24 hours until a precipitate is formed and recrystallized from ethanol. Table (1) shows some physical properties of the compounds (MH6-MH10).

2.6. Antibacterial activity for prepared compounds (MH1, MH2, MH6, MH8, MH10)

The biological activity has been estimated using the propagation method. In contrast, the biological activity has been evaluated by the Kirby Bauer movement [32], where 0.1 ml of bacterial suspension has spread to the ager Muller Hinton dishes and left for 5 minutes to absorb the rest [33, 34]. After that, holes were prepared for each dish using a Cork Purer and a diameter of (5) mm per hole (0. 1) ml of the designed solutions of the fourth hole using (DMSO) as a control sample and incubated the dishes for (24) hours at 37 °C [35, 36]. The inhibition zone diameters around each hole have been measured in millimeters, depending on the method of Prescott [37].

3. Results and Discussion

In this research, ten compounds were prepared including chalcone derivatives (MH1-MH5) are made by reacting Benzaldehyde substitutes with 5-Bromo-Indanone in ethanol, and prepared five compounds including pyrazoline derivatives (MH6-MH10) are made by reacting chalcone derivatives with hydrazine, as in scheme (1) and characterized by FT-IR, ¹H-NMR, ¹³C-NMR spectra.



Scheme (1): Route of prepared compounds (MH1-MH10)

3.1. Characterization of chalcone (MH1-MH5)

It was confirmed that the reaction of the chalcone derivatives (MH1-MH5) took place by observing the changes in the melting point's physical characteristics and the significant color difference. Also, the chalcone derivatives (MH1-MH5) were diagnosed through infrared (IR) spectra measurements. And the nuclear magnetic resonance spectrum (¹H, ¹³C-NMR), and when studying the infrared spectrum of chalcone derivatives [MH1-MH5], the appearance of an absorption band at the range (3055-3076) cm⁻¹, due to the stretching of the aromatic (CH) bond, with the formation of a decrease, it is clear in the frequency of the ketone carbonyl group (C=O) to appear at the range (1697-1714) cm⁻¹, due to the succession between the carbonyl group and the double bond that occurred at the range (1622-1636) cm⁻¹, which leads to a decrease in the value of the strength constant of the bond it was also observed that two absorption bands appeared at the range (1591-1595) cm⁻¹ and (1452-1510) cm⁻¹ due to the stretching of the aromatic (C=C) bond [38-40]. As shown in Figures (1,2) and Table (2).

The proton nuclear magnetic resonance (¹H-NMR) spectrum of MH1 showed a binary signal at δ=3.78 ppm due to the (CH₂-) group proton attached to the benzene ring and showed a binary signal at δ=6.32 ppm due to the unsaturated α (CH-) group proton and the proton the other at δ=7.24 ppm for the other proton of the β-(CH-) group and several signals in the range δ=(7.25-8.81) ppm due to the protons of the two benzene

rings. As for the solvent protons, a signal appeared at $\delta=2.51$ ppm due to the DMSO protons [41,42]. The $^1\text{H-NMR}$ showed in the figure (3).

The nuclear magnetic resonance spectrum of the carbon isotope ($^{13}\text{C-NMR}$) was measured, where the compound (MH1) showed a signal belonging to the carbon (CH_2) atoms attached to the benzene ring at the ppm range ($\delta=35$), and two signals appeared at the ppm range ($\delta=110-105$) belonging to the carbon of the (CH) α - β group unsaturated respectively. The spectrum showed a signal for the carbonyl carbon atom (C=O) at $\delta=197.49$ ppm. The spectrum also showed a multiple signal at the ppm range ($\delta=120-150$) belonging to the carbon atoms of the benzene ring [43, 44]. The $^{13}\text{C-NMR}$ showed in the figure (4).

3.2. Characterization of Pyrazoline (MH6-MH10)

The (MH6-MH10) compounds were diagnosed by spectral methods, including the infrared (IR) spectrum, as it showed in the spectrum of ray's absorption bands at the range ($1623-1640$) cm^{-1} , returning to (C=N) bonding, and the appearance of bands absorption at the range ($1220-1271$) cm^{-1} refers to the stretching of the (C-N) bond. It was also observed that two absorption bands appeared in the range ($1580-1596$) cm^{-1} , and ($1470-1510$) cm^{-1} due to the stretching bond (C=C) aromatics, as well as absorption bands at (range ($3090-3026-3026$) cm^{-1} dating back to the aromatic (Ar-H) bond and an absorption band at ($1091-1025$) cm^{-1} dating back to the (N-N) bond with the appearance of absorption bands dating back to stretching knots (C-H) aliphatic at the range ($2950-2835$) cm^{-1} [45, 46]. As shown in Figure (5,6) and Table (2).

The $^1\text{H-NMR}$ spectrum of the compound (MH8) showed a binary signal at ($\delta=2.63, 2.52$) ppm due to the protons of the (CH_2) group attached to the benzene ring, and a quadruple signal at $\delta=(3.89-3.85)$ ppm due to the protons of the (CH_2) group pyrazoline and signal triple at ($\delta=4.85$ ppm) due to the (CH) group attached to the amine group, which showed a binary signal at ($\delta=6.71$ ppm) and multiple signals at the range $\delta=(7.21-7.75)$ ppm due to the protons of the aromatic ring, the protons of the solvent (DMSO). It has a single signal in the range ($\delta=0.51$ ppm) [47]. As shown in Figure (7).

The nuclear magnetic resonance ($^{13}\text{C-NMR}$) spectrum of the compound (MH8) showed a signal at displacement ($\delta=30.3$ ppm) belonging to the (CH_2) group attached to the benzene ring and a binary signal at ($\delta=55.1$ ppm) belonging to the (CH_2) group. Pyrazoline and a signal at ($\delta=70.0$ ppm) refer to the (CH) group attached to the amine group, as well as multiple signals at the range ($\delta=1120-160$ ppm), which refer to the carbon of the aromatic ring [48]. As shown in Figure (8).

3.3. Evaluation of Biological activity:

Some of the synthesized compounds (MH1, MH2, MH6, MH8, MH10,) were tested against various strains of bacteria: gram positive bacteria, staphylococcus, aureus, and gram-negative bacteria, Escherichia, coli by cup plate agar diffusion method [49]. The microbial cultures were incubated at (37°C for 8 hur.) and diluted with 0.8% sterile saline. The concentration of solution for used drugs in DMSO, were kept at $100\mu\text{g/mL}$. Amoxiline as control were used. The biological activity was measured by measuring the inhibition diameter of growth of bacteria around the disk in use [50].

Table (1): Physical properties and elemental analysis of prepared compounds (MH1-MH10)

Comp. No.	R	Molecular formula	m.p. $^\circ\text{C}$	Yield%	Color
MH ₁	4-Cl	$\text{C}_{16}\text{H}_{10}\text{BrOCl}$	240-243	67	Whit
MH ₂	4-N ₂ O ₂	$\text{C}_{16}\text{H}_{10}\text{BrO}_3\text{N}$	236-240	65	Dark brown
MH ₃	4-OCH ₃	$\text{C}_{17}\text{H}_{13}\text{BrO}_2$	167-172	73	Yellow
MH ₄	4-F	$\text{C}_{16}\text{H}_{10}\text{BrOF}$	230-234	62	Off whit
MH ₅	3,4-Cl	$\text{C}_{16}\text{H}_9\text{BrOCl}_2$	197-202	71	Whit
MH ₆	4-Cl	$\text{C}_{16}\text{H}_{12}\text{BrClN}_2$	150-152	26	Orange

MH ₇	4-NO ₂	C ₁₆ H ₁₂ BrClN ₃ O ₂	158-160	35	Black
MH ₈	4-OCH ₃	C ₁₇ H ₁₅ BrClN ₂ O	111-115	31	Red
MH ₉	4-F	C ₁₆ H ₁₂ BrClN ₂ F	165-168	29	Yellow
MH ₁₀	3,4-Cl	C ₁₆ H ₁₁ BrCl ₂ N ₂	218-220	40	Brown

Table (3): FT-IR data of prepared compounds (MH1-MH10)

Comp. No.	R	IR (KBr) cm ⁻¹						Others
		v(C-H)	v(C-H)	v C=O	v(C=C)	v(C=C)		
		Arom.	Aliph.		Olphen	Arom.		
MH ₁	Cl	3064	2966, 2906	1699	1622	1591, 1490	v(C-Br) 815, v(C-Cl) 738	
MH ₂	NO ₂	3066	2906, 2802	1695	1614	1599, 1489	v (C-Br) 534	
MH ₃	OCH ₃	3055	292, 2877	1697	1630	1593, 1510	v(C-Br) 819, v(C-O)1255	
MH ₄	F	3076	2919, 2887	1699	1627	1595, 1506	v C-Br) 819, v(C-F) 952	
MH ₅	3,4-Cl	3072	2965, 2846	1714	1624	1591, 1452	v(C-Br) 825, v(C-Cl)1049	
Comp. No.	R	v(C-H)	v(C-H)	v(C=N)	v(C-N)	v(C=C)	Others	
		Arom.	Aliph.			Arom.		
MH ₆	Cl	3026	2848, 2923	1625	1091	1589, 1488	v(C-Br) 819, v(C-Cl) 754	
MH ₇	NO ₂	3073	2906, 2802	1640	1038	1580, 1506	v(C-Br) 832, v(N-O) 1050	
MH ₈	OCH ₃	3062	2835, 2950	1639	1029	1596, 1510	v(C-Br) 823, v(C-O) 1251	
MH ₉	F	3086	2887, 2921	1623	1078	1584, 1478	v(C-Br) 825, v(C-F) 952	
MH ₁₀	3,4-Cl	3068	2846, 2948	11640	1065	1591, 1470	v(C-Br) 829, v(C-Cl) 1020	

Table (3): Antibacterial activity of the prepared compounds (MH1-MH10) and control antibiotic

Comp. No.	<i>E. Coil</i> Conc. mg/ml			<i>Staph. Aureus</i> Conc. mg/ml		
	0.01	0.001	0.0001	0.01	0.001	0.0001
	MH ₁	17	17	17	15	20
MH ₂	10	16	21	21	17	24
MH ₆	15	25	20	10	27	24

MH ₈	9	13	18	20	16	25
MH ₁₀	15	17	23	17	20	22
Amoxicillin	10	12	18	10	20	20

Slight activity 9-12 mm, moderate activity 15-20 mm and high activity 21-25 mm; MIC: minimum inhibition concentration ($\mu\text{g} / \text{mL}$).

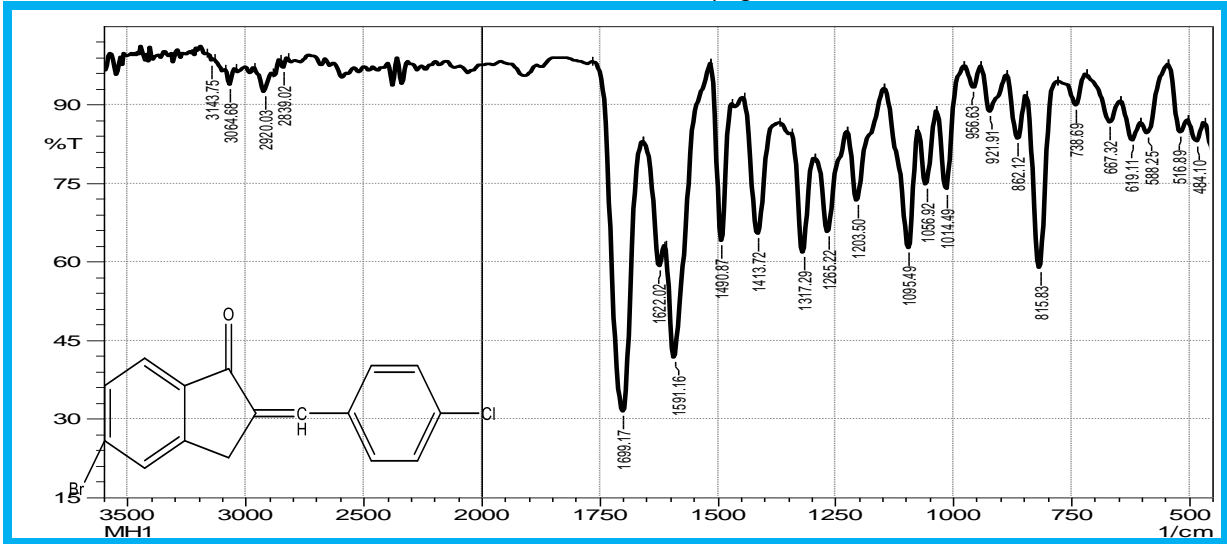


Fig. (1): FT-IR spectrum of compound (MH1)

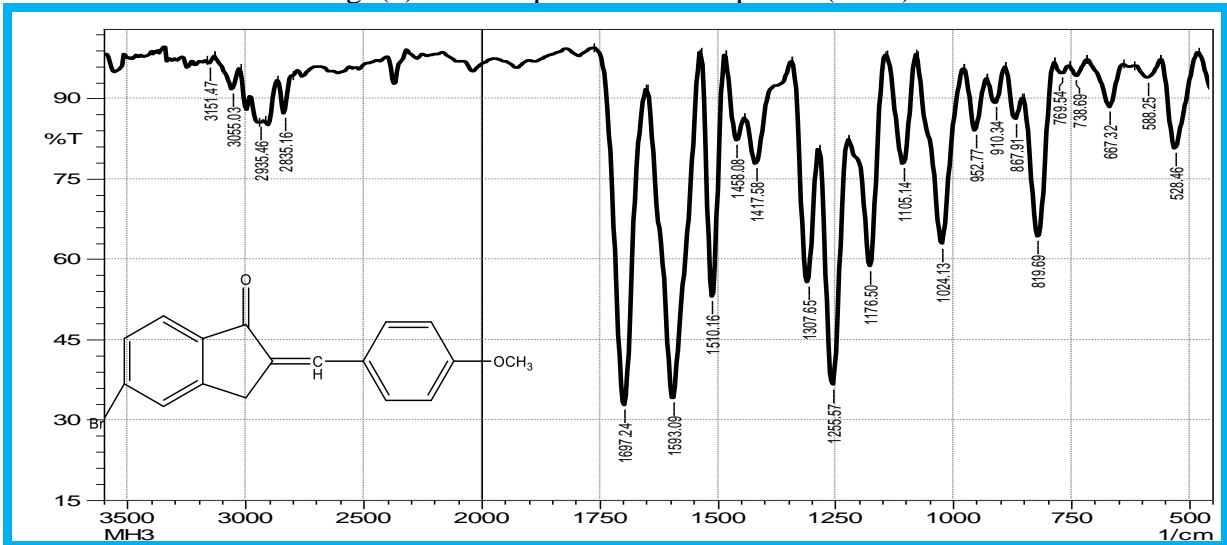


Figure (2): FT-IR spectrum of compound (MH3)

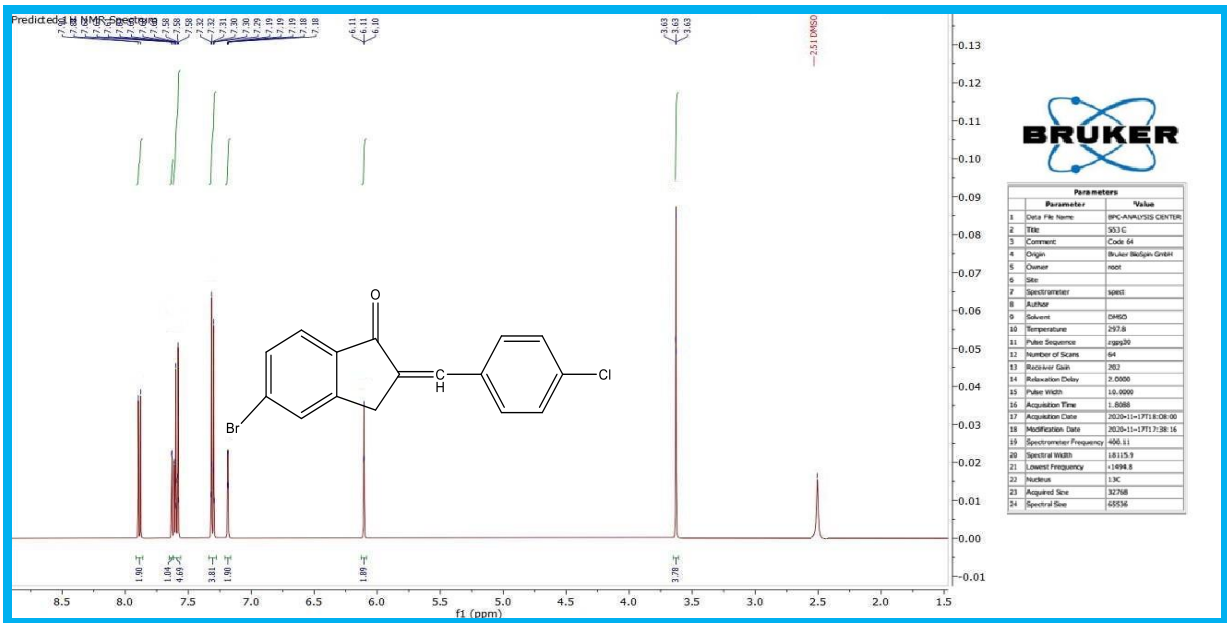


Figure (3): ¹H-NMR spectrum of compound (MH1)

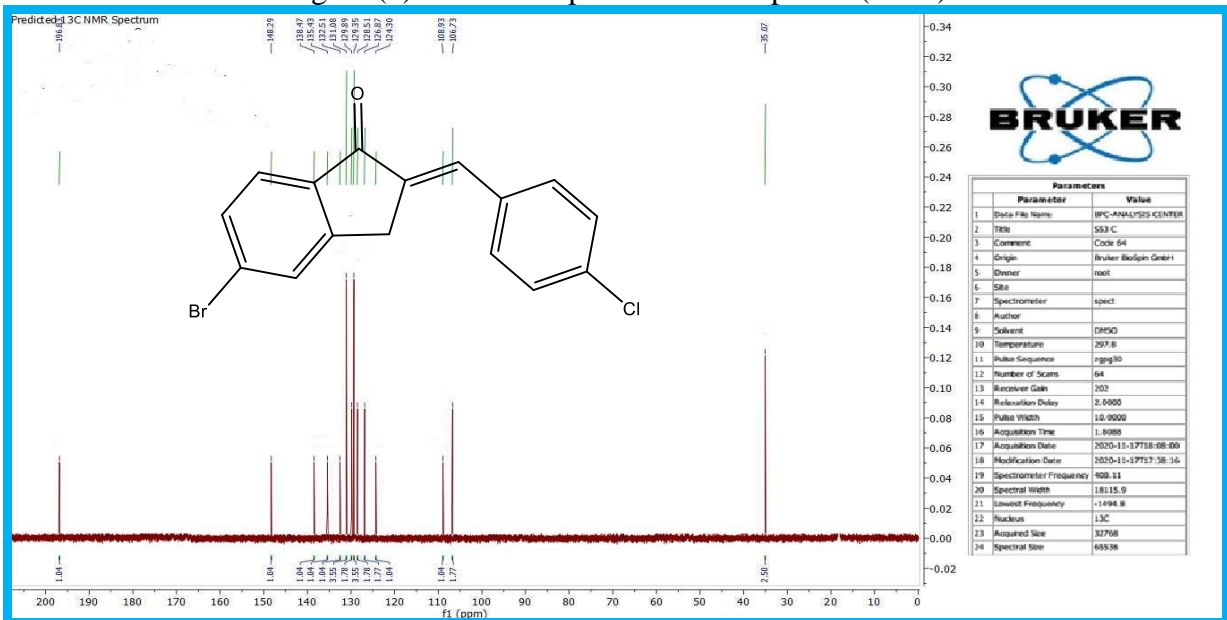


Figure (4): ¹³C-NMR spectrum of compound (MH1)

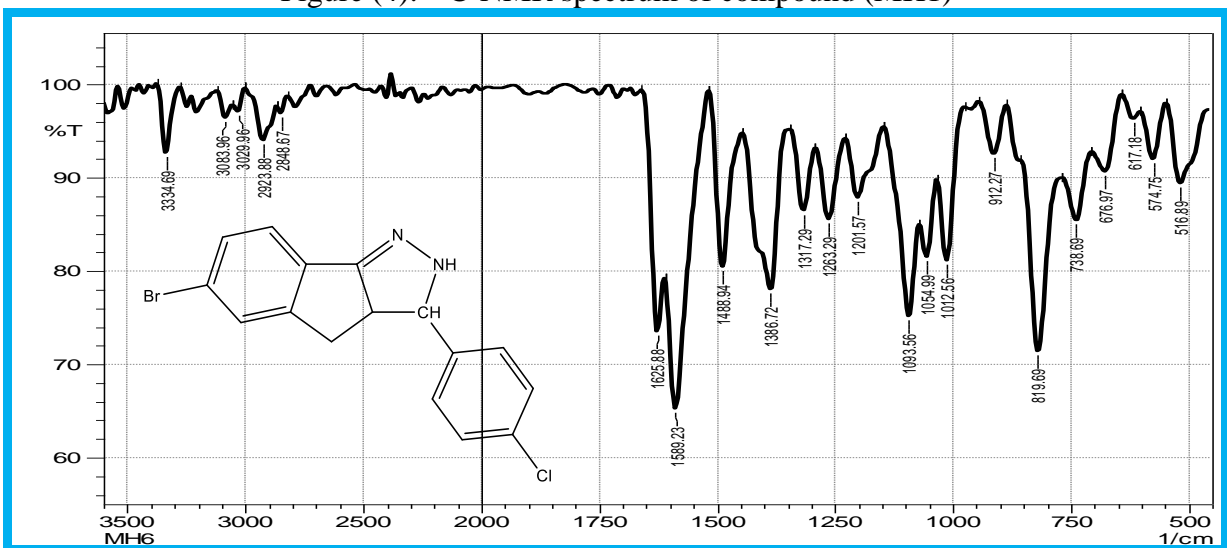


Figure (5): FT-IR spectrum of compound (MH6)

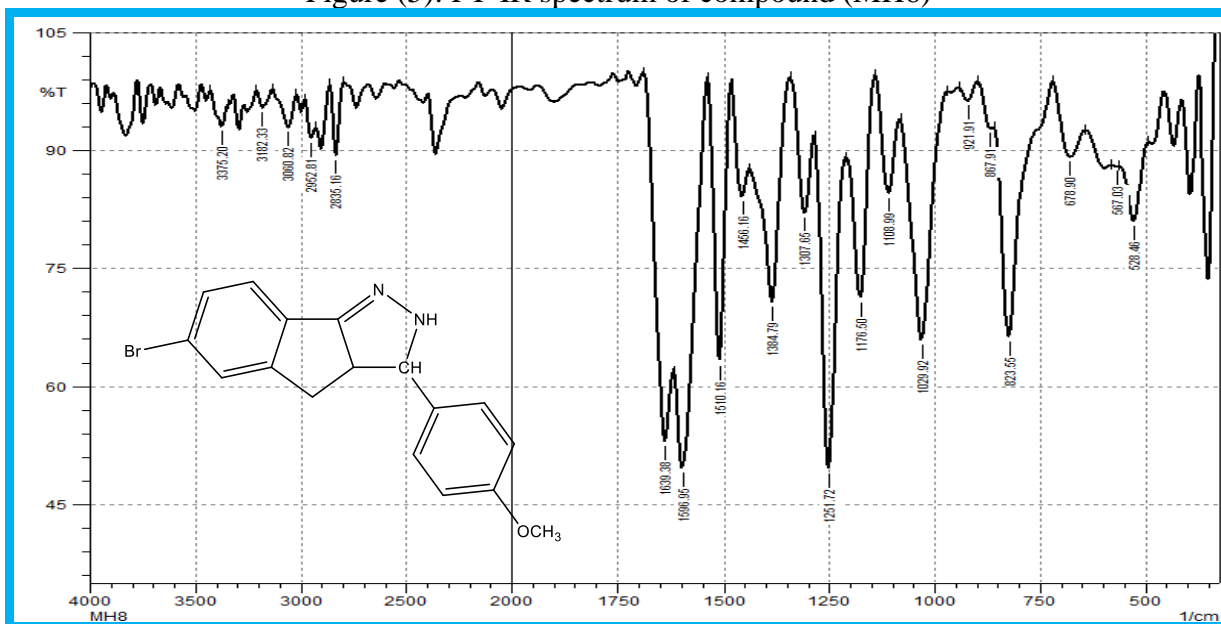


Figure (6): FT-IR spectrum of compound (MH8)

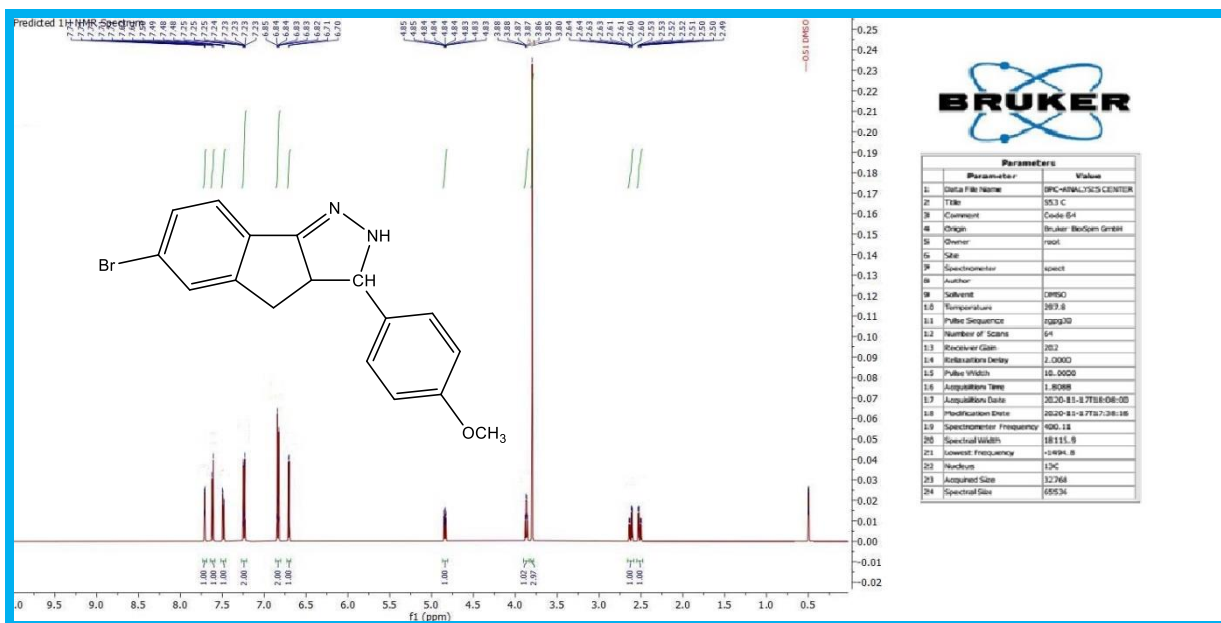
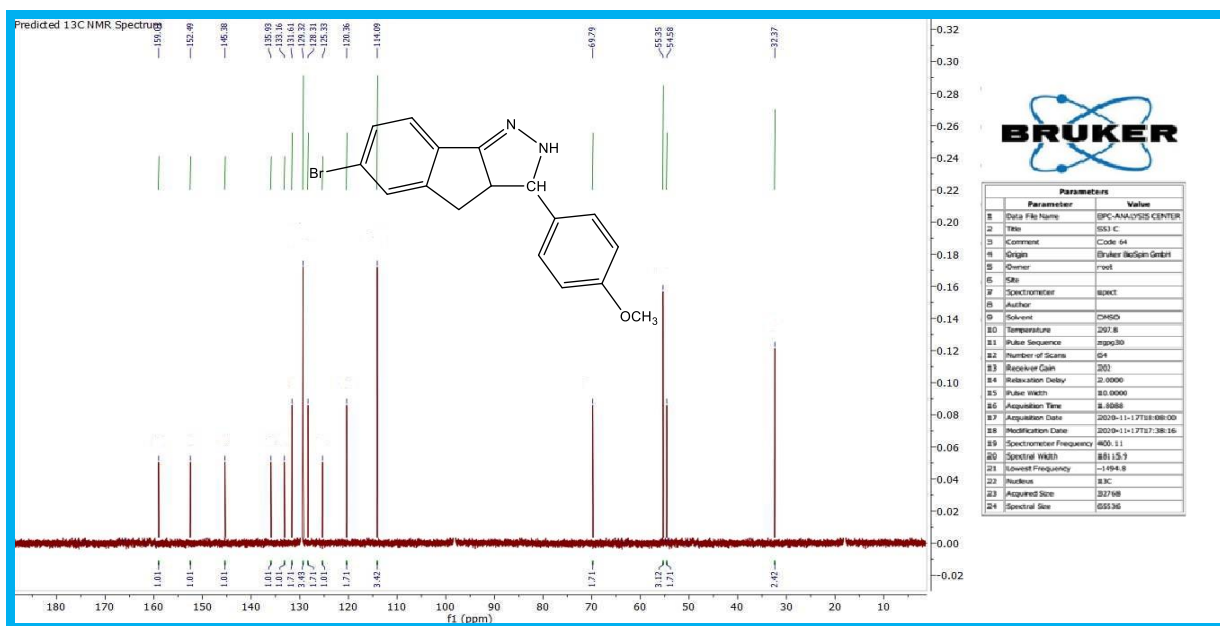


Figure (7): ¹H-NMR spectrum of compound (MH8)

Figure (8): ^{13}C NMR spectrum of compound (MH8)

4. Conclusions: The accuracy and validity of the prepared compounds were confirmed through spectral and physical measurements, where the infrared spectrum proved the presence of active aggregates accurately, and this confirmation increased the nuclear magnetic resonance spectrum of the proton and carbon spectrum, which accurately agreed on the validity of the structures of the prepared compounds. These compounds are stable at laboratory temperature and do not degrade or change color. The prepared compounds showed high and good inhibitory activity against Gram-positive and Gram-negative bacteria, and the results were compared with control samples, which are antibiotics.

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**Synthesis, Characterization and Biological
Activity Evaluation of Some New Pyrimidine
Derivatives by Solid Base Catalyst Al_2O_3 -OBa**

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Abstract:

This work involve the preparation and characterization of new derivatives of pyrimidine compounds from the reaction of chalcones with Thiourea via solid base catalyst (prepared through the reaction of $Ba(NO_3)_2$ with Al_2O_3 at (300-700) °C to obtain metal oxide as a solid base catalyst) and using physical methods. And spectroscopic (melting point, color, product ratio, IR, 1H -NMR, and ^{13}C -NMR), the compositions were confirmed to be correct. The antibacterial activity has been tested in vitro by the disk diffusion assay method against two kinds of bacteria gram positive and gram negative. The minimum inhibitory concentration [MIC] have been determined with the reference of stander drugs, the results showed that the Pyrazoline derivatives are better than growth of both types of bacteria (gram- positive and germ-negative) compared to drug.

Keywords: Chalcones, Solid base catalyst, Al_2O_3 , Pyrimidine, Biological activity.

1. Introduction

pyrimidine Recently researchers have been interested in pyrimidine compounds and their derivatives, due to their importance in the field of pharmacy [1], medicine, and industrial applications. and many previous studies have shown that it has great importance in the medical field, cytotoxic activity [2], activity Analgesics, antimicrobial activity [3,4], anti-inflammatory [5,6], antioxidant activity [7,8], antibacterial activity [9], and anticancer agents [10]. Solid base catalyst the most basic heterogeneous catalysts It is one of the most common and used acid catalysts because it is not soluble and easy to separate and can be used more than once [11]. The effectiveness of these catalysts is evaluated on the basis of the physical properties of the surface such as the surface area, the size of the holes, and the concentration of the active groups [12]. Among the most prominent heterogeneous basic catalysts are alkaline elements, transition elements, and metal oxides [13], as well as the composition of the metallic carbon that carries effective basic groups, which are oxides of the first and second group elements [14]. They are of a basic nature and have limited solubility in polar solutions [15]. Examples of them are sodium oxide, magnesium oxide and calcium oxide, as these oxides contain oxygen ions with a negative charge [16]. Chalcones are important compounds for the preparation of many heterocyclic compounds [17]. The general formula of a chalcone consists of two aromatic rings linked through the α - β system of unsaturated carbonyl compounds [18]. Compounds from electrophilic and nucleophile addition reactions [19]. The importance of these compounds is due to the presence of two (active) functional groups, which are the double bond and the carbonyl group in succession [20]. Due to the presence of these two groups, they are subject to two types of addition 1,4- on the double bond, which is Michael's addition, and Claysen's addition 1,2- on the carbonyl group, and this qualifies it to enter the reactions of preparing the nuclei of heterocyclic rings [21]. Chalcones have many uses in the field of medicine and agriculture [23]. They are used as antioxidants [22], antibacterial activity, antimicrobial activity [24], antioxidant activity [25], antileishmanial [26], and anti-cancer [27].

2. Experimental

2.1. Material: All chemicals were used through this work purchased from Fluka, BDH Companies.

2.2. Devices used: Melting points are uncorrected and were recorded in an open capillary tube on Stuart melting point apparatus. Infrared spectra have been recorded on a Shimadzo FTIR-8100 spectrophotometer using KBr discs—and 1H NMR Spectra have been measured on a MHz spectrometer using DMSO- d_6) as solvent. reaction monitoring and verification of the purity of the compounds was done by TLC on silica gel-percolated alumni sheets (type 60 F254 Merck, Darmstadt, Germany).

2.3. Preparation of chalcones derivatives (JA1-JA5) [28, 29]

Mixture of 5-fluoro indanone (0.006 mol) dissolved in (10 mL) of ethanol with aromatic aldehyde (0.006 mol) dissolved in (10 mL) of ethanol then added to it (10% NaOH) reaction mixture was heated at (40 °C) with stirring for three hours then it is added to crushed ice and left for twenty-four then the medium is neutralized by (10% HCl) and filtered and recrystallized from ethanol. Table (1) shows some physical properties of the compounds (JA1- JA5).

2.4. Preparation of the solid basic catalyst Al_2O_3-OMg [30, 31]

Mixture of KNO_3 (1 mol) and Al_2O_3 (3 mol) were crushed in mortar, and then appropriate deionized water was added which can be absorbed by Al_2O_3 . After grinding, the mixture was dried at 110 °C for one hour, and then activated at 600 °C for three hours.

2.5. Preparation of pyrimidine derivatives (JA6-JA10) [32, 33]

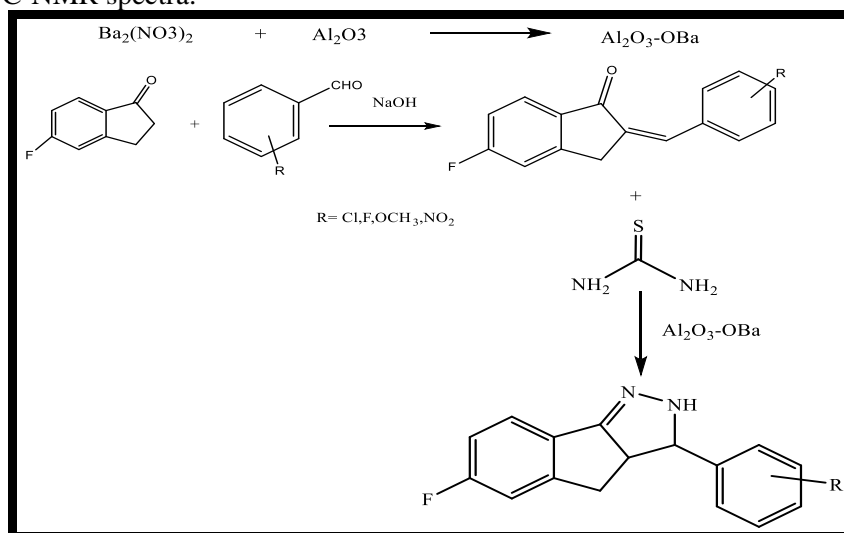
Mixture of equal moles of Chalcone and thiourea, dissolved in (ml10) of ethanol with stirring for 10 minutes, then the catalyst was added (25% of the weight of Chalcone), then the mixture is left in the water bath for 4hr with stirring at a temperature of 40 °C, then the solution is filtered and the filtrate is taken and left to dry. Table (1) shows some physical properties of compounds (JA6-JA10).

2.6. Evaluation of biological activity

The biological activity has been estimated by using the propagation method whereas the biological activity has been estimated by the Kirby Bauer movement [34, 35], where 0.1 ml of bacterial suspension has spread to the agar Muller Hinton dishes and left for 5 minutes to absorb the suspension [36, 37]. After that, holes were prepared for each dish using a Cork Porer and a diameter of (5) mm per hole (0.1 ml) of the prepared solutions of the fourth hole using (Amoxicillin) as a control sample and incubated the dishes for (24) hours at 37 °C. The inhibition zone diameters around each hole has been measured in millimeter, depending on the method of Prescott [38].

3. Results and Discussion

In this research, ten compounds were prepared including chalcone derivatives (JA1-JA5) are made by reacting Benzaldehyde substitutes with 5-fluoro indanone in ethanol, and prepared five compounds including pyrazoline derivatives (JA6-JA10) are made by reacting chalcone derivatives with thiourea, as in scheme (1) and characterized by FT-IR, 1H -NMR, ^{13}C -NMR spectra.



Scheme (1): Route of prepared compounds (JA1-JA10)

3.1. Characterization of chalcone (JA1-JA5)

It was confirmed that the reaction of the chalcone derivatives (JA1-JA5) took place by observing the changes that occurred in the physical characteristics of the melting point and the large change in color. Also, the chalcone derivatives (JA1-JA5) were diagnosed by measuring the infrared spectra (IR) And the nuclear magnetic resonance spectrum (1H , ^{13}C -NMR), and when studying the infrared spectrum of chalcone

derivatives (JA1-JA5), the appearance of an absorption band at the range (3027-3095) cm^{-1} , due to the stretching of the aromatic (CH) bond, with the appearance of a decrease It is clear in the frequency of the ketone carbonyl group (C = O) to appear at the range (1690-1710) cm^{-1} , due to the succession between the carbonyl group and the double bond, which leads to a decrease in the value of the strength constant of the double bond, which reduces its frequency. It is also observed that two absorption bands appear at the range (1575-1599) cm^{-1} and (1476-1499) cm^{-1} belong to the (C=C) aromatics, as shown in Table (2) and figures (1, 2), These results were close to what is found in the literature [39, 40].

When studying the $^1\text{H-NMR}$ spectrum of the compound (JA2) using a solvent (DMSO-d^6), it was observed that a second signal appeared at the locations $\delta=$ (8.188 and 8.169) ppm due to the proton of the (O=C-CH) group adjacent to the carbonyl group, and the appearance of a second signal at the position $\delta=$ (8.018 and 7.979) ppm is attributed to the proton of the second (HC) group adjacent to the benzene ring, the emergence of multiple signals at $\delta=$ (7.113 - 7.967) ppm due to the protons of the aromatic rings, and the emergence of a signal at the position $\delta=$ (2.512) ppm due to the protons of the solvent (DMSO-d^6) [41], and as in Figure (3).

When studying the $^{13}\text{C-NMR}$ spectrum of the compound (JA2) using a solvent (DMSO-d^6), it was observed that a single signal appeared at $\delta=$ (200) ppm due to the carbonyl group (C=O), and a single signal appeared at $\delta=$ (163.47) ppm. It is attributed to the carbons of the (CH) group adjacent to the carbonyl group, and the appearance of a single signal at the position $\delta=$ (141.96) ppm is attributed to the carbons of the (CH) group adjacent to the benzene ring, and the emergence of multiple signals at $\delta=$ (110-150) ppm due to the carbons of the aromatic ring, and the appearance of a signal in $\delta=$ (25) ppm is attributed to the carbon of the solvent (DMSO-d^6), These results were close to what is found in the literature [42,43], and the spectrum is shown in Figure (4).

3.2. Characterization of pyrimidine derivatives (JA6-JA10)

It was confirmed that the reaction of the pyrimidine derivatives (JA6-JA10) occurred by observing the changes in the physical characteristics of the melting point and the significant color change. Also, the pyrimidine derivatives (JA6-JA10) were diagnosed through infrared spectra (IR) measurements.

When studying the infrared (IR) spectrum of pyrimidine derivatives (JA6-JA10), it was observed that absorption bands appeared at the frequency (3160-3200) cm^{-1} due to the bonding of the (NH) bond, and the appearance of an absorption band at the frequency (3024-3091) cm^{-1} , it is due to the stretching of the aromatic (CH) bond, as well as the appearance of two absorption bands at the frequency (2916-2985) cm^{-1} and (2824-2898) cm^{-1} due to the stretching of the aliphatic (C-H) bond, and an absorption band appeared at the frequency (1616-1652) cm^{-1} , it is due to the stretching of the azomethine group (C=N). It was also observed that two absorption bands appear at a frequency (1585-1593) cm^{-1} and (1474-1497) cm^{-1} , which belong to the stretching of the (C=C) aromatic bond [44], as shown in Table (2) and figures (5,6).

the proton nuclear magnetic resonance spectrum of the compound (JA8), it was observed that a single signal appeared in the position $\delta=$ 8.31 ppm attributed to the protons of the (C=NH) group, as well as the appearance of a multiple signal in the position $\delta=$ (7.25-8.27) ppm attributed to the protons Aromatic ring, a single signal at position $\delta=$ 6.65 ppm attributed to a (NH) group proton, a binary signal at position $\delta=$ (4.63, 4.62) ppm attributed to a (CH-S) group proton, and a binary signal at position $\delta=$ (4.33, 4.35) ppm attributed to the proton of the (CH-NH) group, as well as the appearance of a signal at the site $\delta=$ (3.83) ppm attributed to the water protons, and the appearance of a signal at the site $\delta=$ (2.62) ppm attributed to the protons of the solvent (DMSO-d^6) [45], as shown in Figures (7).

When studying the carbon $^{13}\text{C-NMR}$ nuclear magnetic resonance spectrum of the compound (JA8), the compound showed a signal at $\delta=$ 180 ppm belonging to the carbon atom of the methine group C=N, and the signals within the range $\delta=$ (109-146) ppm belong to the carbon atoms of the aromatic system in the compound, as for the carbon atom in the (CH₂) group, it showed a sign at $\delta=$ 57.79 ppm. The compound also showed a signal at $\delta=$ 61.7 ppm due to the carbon atom of the CH group. [46], as shown in Figures (8).

3.3. Evaluation of Biological activity:

Some of the synthesized compounds (JA2, JA3, JA6, JA7, JA9) were tested against various strains of bacteria: gram-positive bacteria *Staphylococcus aureus*, and gram-negative bacteria *Escherichia coli* by cup plate agar diffusion method [47]. The microbial cultures were incubated at (37 °C for 8 hours) and diluted

with 0.8% sterile saline [48]. The solution concentration for used drugs in DMSO was kept at 100µg/mL. Amoxicillin as a negative control was used. The biological activity was measured by measuring the inhibition diameter of the growth of bacteria around the disk in use [49]. as shown in Table (3).

Table (1) Physical properties of the prepared compounds (JA1-JA10)

Comp. No.	R	Molecular formula	m.p. °C	Yield%	Color
JA ₁	2,3-Cl	C ₁₆ H ₉ OCl ₂ F	226-234	68	Gray
JA ₂	4-Cl	C ₁₆ H ₁₀ OClF	193-200	73	Light green
JA ₃	4-F	C ₁₆ H ₁₀ O ₂ F ₂	172-176	75	Light yellow
JA ₄	4-OCH ₃	C ₁₇ H ₁₃ O ₂ F	158-162	66	Yellow
JA ₅	4-NO ₂	C ₁₆ H ₉ NO ₃ F	170-176	70	Dark brown
JA ₆	2,3-Cl	C ₁₇ H ₁₁ FCI ₂ N ₂ S	116-118	40	Whit
JA ₇	4-Cl	C ₁₇ H ₁₂ FCIN ₂ S	232-234	42	Dark brown
JA ₈	4-F	C ₁₇ H ₁₂ F ₂ N ₂ S	187-189	33	Light green
JA ₉	4-OCH ₃	C ₁₈ H ₁₅ FN ₂ SO	177-179	36	Wight
JA ₁₀	4-NO ₂	C ₁₇ H ₁₂ FN ₃ SO ₂	240-242	39	Brown

Table (2): FT-IR data of prepared compounds (JA1-JA10) cm⁻¹

Comp. No.	R	νNH	νC-H		νC=O	ν C=C		Others
			Arom.	Aliph.		νC=N	Arom.	
JA ₁	2,4-Cl	--	3083	2935	1702	1593, 1475	ν(C-F) 1045, ν(C-Cl) 744	
JA ₂	4-Cl	--	3092	2929	1699	1596, 1487	ν(C-F) 1093, ν(C-Cl) 817	
JA ₃	4-F	--	3058	2931	1699	1596, 1475	ν(C-F) 1089, ν(C-F)1033	
JA ₄	4-OCH ₃	--	3095	2979	1701	1592, 1483	ν(C-F) 1072, ν(C-O) 1363	
JA ₅	4-NO ₂	--	3114	2923	1704	1596, 1471	ν(NO ₂) 1342, 1251	
JA ₆	2,4 Cl	3189	2056	2923, 2846	1643	1596, 1489	ν(C-F) 1045, ν(C-Cl) 744	
JA ₇	4-Cl	3196	3073	2980, 2856	1646	1593, 1487	ν(C-F) 1093, ν(C-Cl) 817	
JA ₈	4-F	3195	3060	2941, 2878	1644	1580, 1497	ν(C-F) 1089, ν(C-F)1033	
JA ₉	4-OCH ₃	3184	3064	2927, 2868	1647	1589, 1493	ν(C-F) 1072, ν(C-O) 1363	
JA ₁₀	4-NO ₂	3186	3057	2943, 2876	1652	1597, 1486	ν(NO ₂) 1342, 1251	

Table (3): Inhibitory effectiveness of some prepared compounds (JA2, JA3, JA6, JA7, JA10) and control treatments (antibiotics) on the growth of a number of positive and negative bacteria

Comp. No.	Escherichia coli			Staphylococcus aureus		
	0.0001	0.001	0.01	0.0001	0.001	0.1
JA2	17	15	12	12	0	0
JA3	15	0	12	12	15	17
JA6	15	15	20	0	12	12
JA7	14	17	20	0	12	12
JA10	10	15	17	12	0	0
Amoxicillin	10	16	24	10	20	20

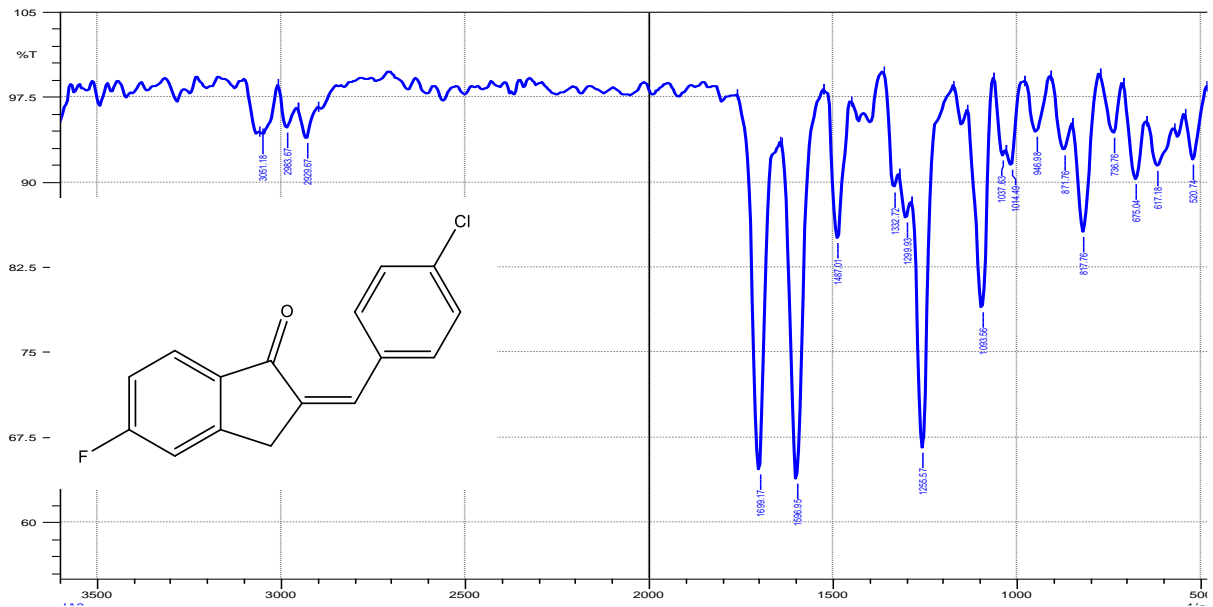


Figure (1): The infrared spectrum of the compound (JA2)

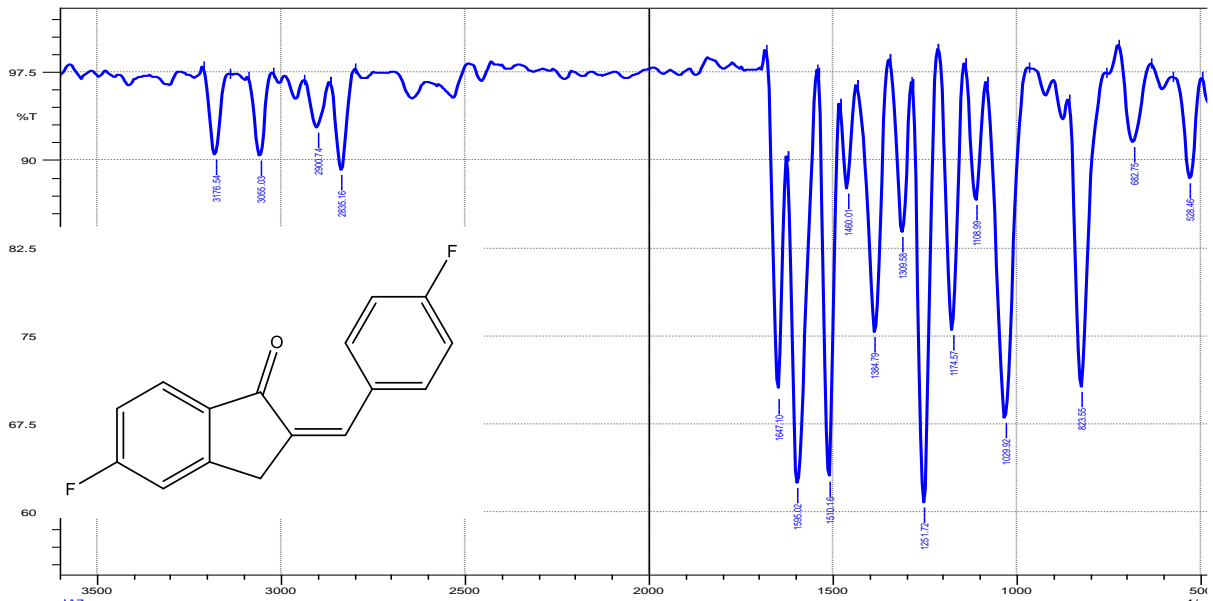


Figure (2): The infrared spectrum of the compound (JA3)

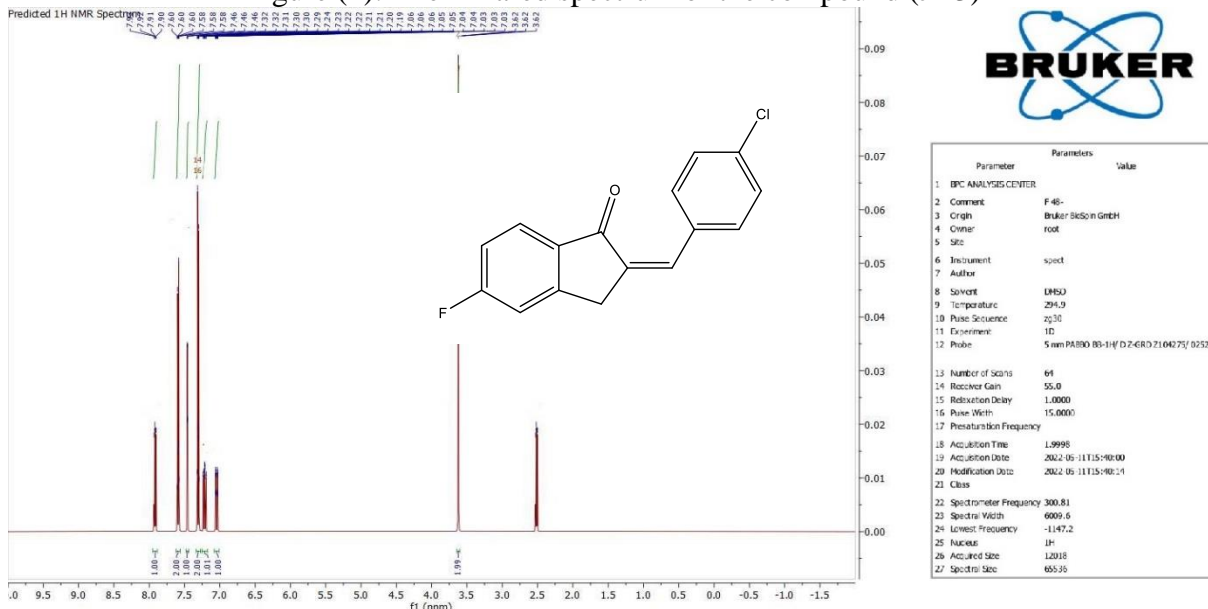


Figure (3): The ¹H-NMR spectrum of the compound (JA2)

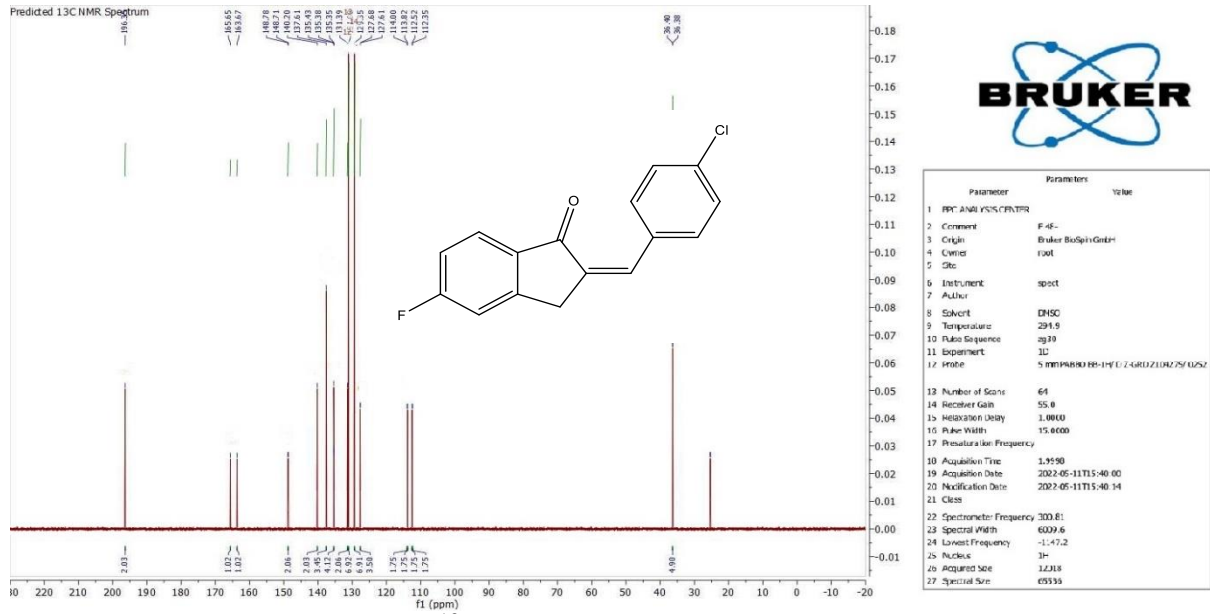


Figure (4): The ¹³C-NMR spectrum of the compound (JA2)

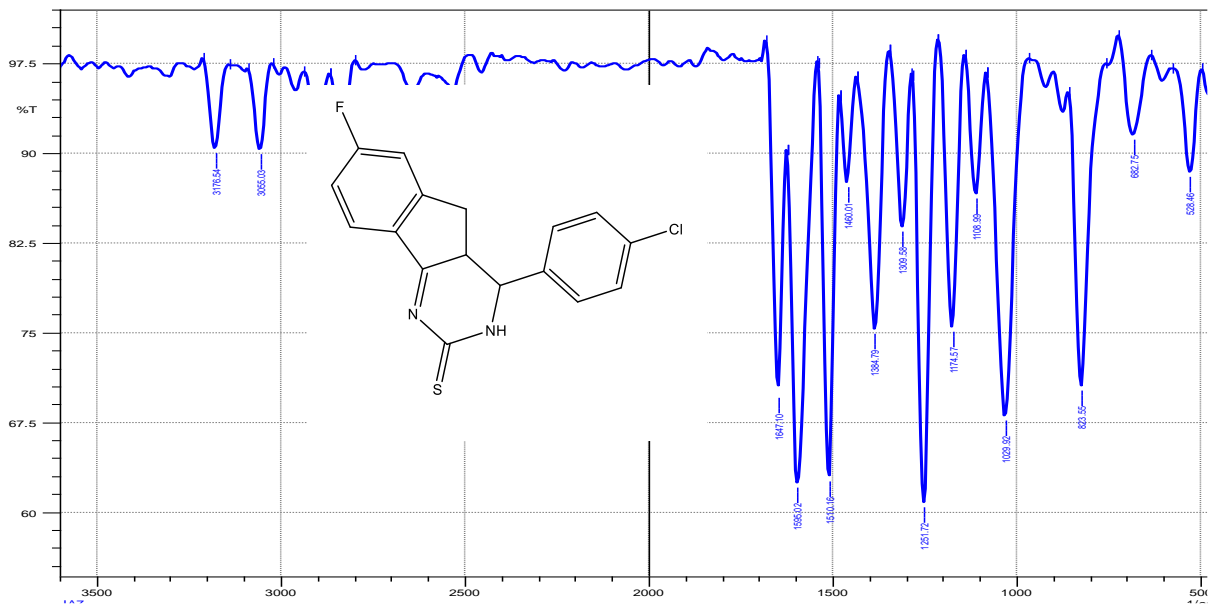


Figure (5): The infrared spectrum of the compound (JA7)

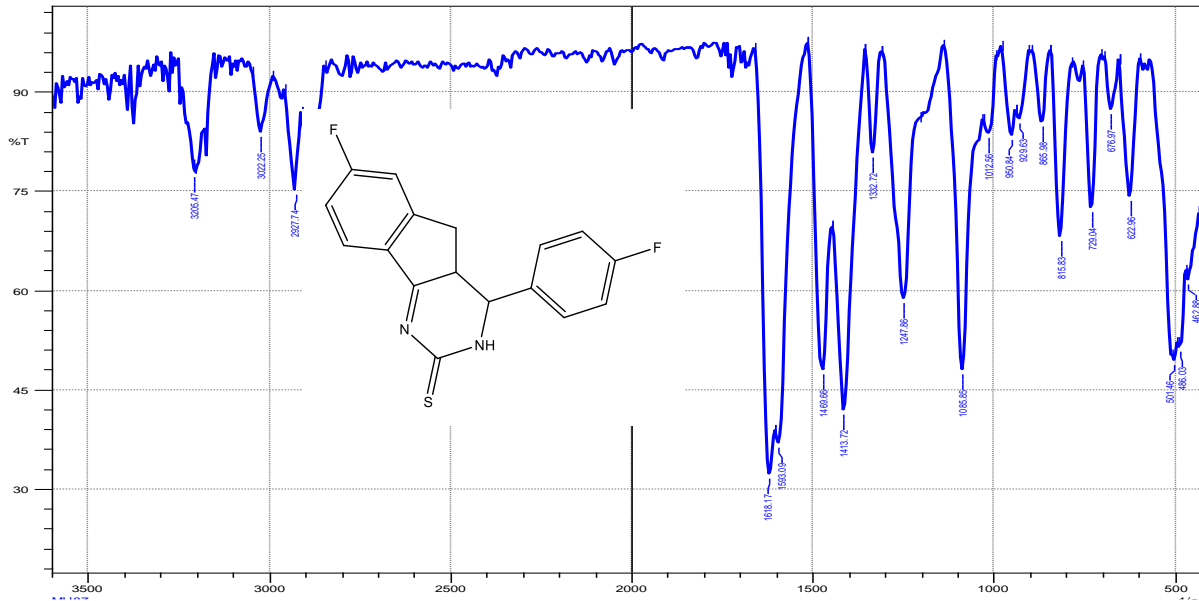


Figure (6): The infrared spectrum of the compound (JA8)

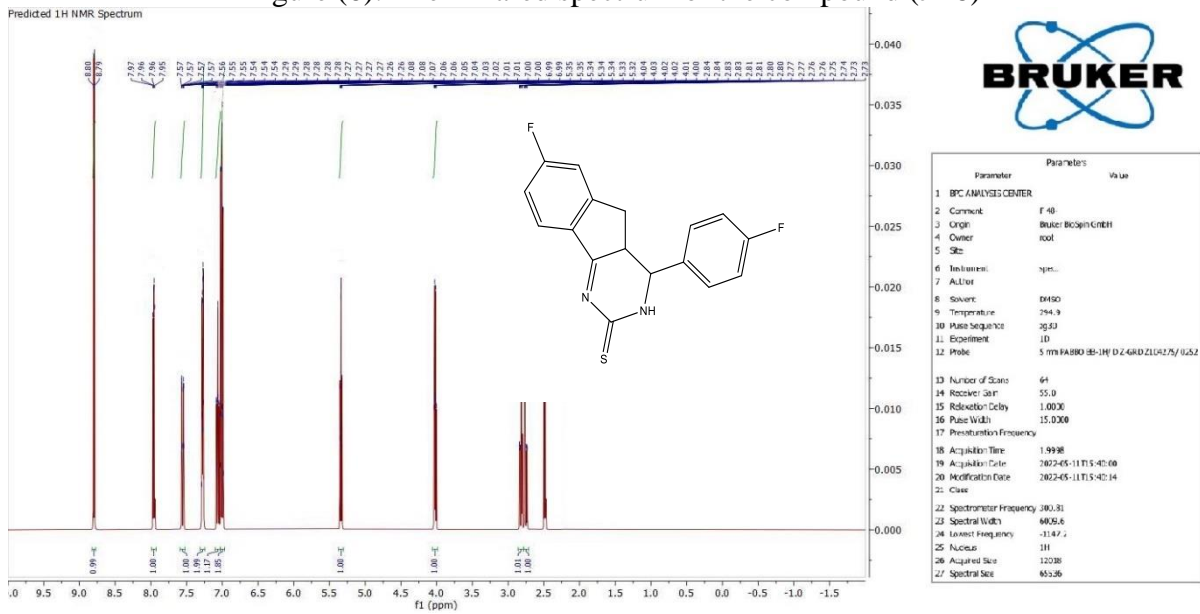


Figure (7): The ¹H-NMR spectrum of the compound (JA8)

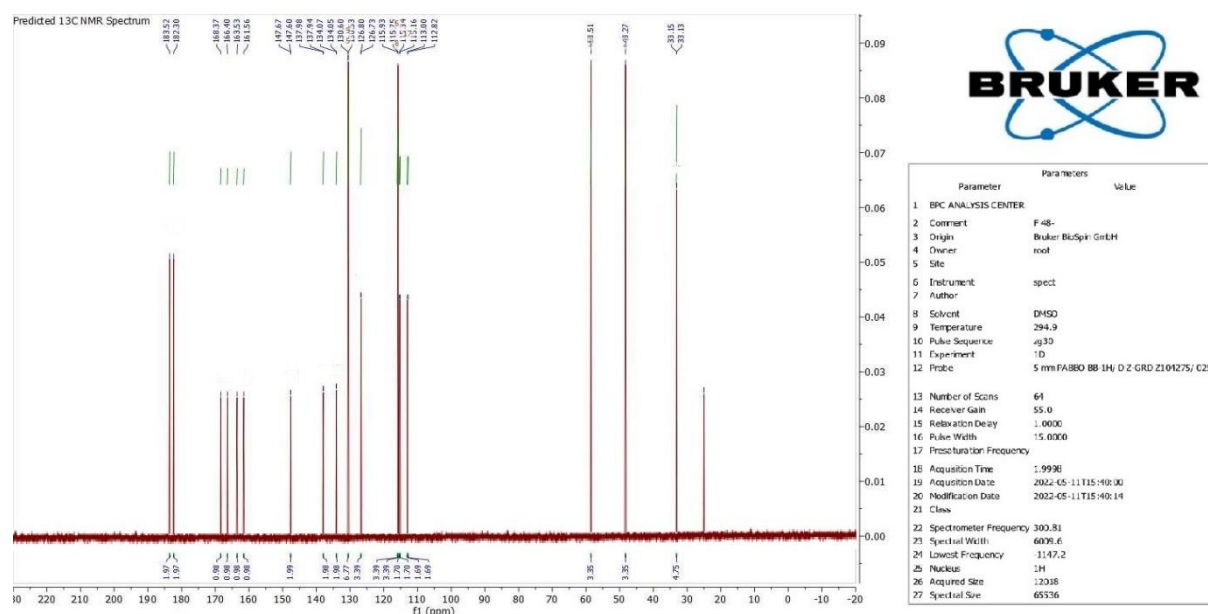


Figure (8): The ^{13}C -NMR spectrum of the compound (JA8)

4. Conclusions: The accuracy and validity of the prepared compounds were confirmed through spectral and physical measurements, where the infrared spectrum proved the presence of active aggregates accurately, and this confirmation increased the nuclear magnetic resonance spectrum of the proton and carbon spectrum, which accurately agreed on the validity of the structures of the prepared compounds. These compounds are stable at laboratory temperature and do not degrade or change color. The prepared compounds showed high and good inhibitory activity against Gram-positive and Gram-negative bacteria, and the results were compared with control samples, which are antibiotics.

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Interconnected Internet of Things-Based Intelligent Fire Protection

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Abstract: Transceivers are the main component of the project. Sensors are built into transmitters. These sensors can pick up on gases, smoke, and other particles in the air. The Arduino in these devices transmits data over Wi-Fi to a receiver. In addition to the traditional bell, the recipient can also receive these readings and see them displayed as an alert on their mobile device. The presence of gas or fire in the area of the transmitters would be indicated by high readings. This means that in addition to the alarm buzzer, the red LED will light up. If the numbers are low, the light will turn green. These devices are strategically positioned in institutions including warehouses, hospitals, and banks. In open spaces, its range can extend to a thousand meters, but it drops down significantly when obstacles like walls and other obstructions are present, making the existence of such devices all the more obvious.

Keywords: Environment, Sustainable Development, and U.S. Miniature Serial Bus Public License Input/Output Universal Serial Bus Surface-mount, automatic voltage regulator, limited-instruction-set Computer Input/Output Modes: Pulse Width Modulation and All Multipurpose.

1. Introduction

Detecting carbon monoxide, fire, smoke, or other fire-associated emergencies with a fire alarm system is a vital safety feature. Smoke and heat detectors can initiate these alarms automatically, or manual fire alarm activation devices, such as pull stations and call points, can trigger them manually. Various types of alarms, including motorized bells, sounders, and horns, can be mounted on walls. Also, these might be speaker strobes that emit an alert and a voice evacuation message telling those within the building to stay away from the lifts. The fire alarm's tone and frequency can range from low to high depending on where you are and who built your device. A siren with alternating frequencies most prevalent variety of fire alarm system in Europe. In the united states of America and Canada, fire alarm electrical devices are referred to as "horns," They may either be set to various codes or continuous. Different volume levels are also available for fire alarm warning devices [1].



Figure 1: United States and Canada fire alarm notifications that are widely utilized

Devices manually actuated are also called break glass stations, fire alarm boxes, manual or simple pull stations, and (in Europe) call points. Devices for manually activating fire alarms are placed at or close to exits and are operated and identified. Pulling a lever or breaking glass is usually needed to start them. Many types of automatically actuated devices respond to different types of detectable changes linked to fires: sprinklers operations for a water-flow detector, combustion products for a smoke detector, thermal energy via convection for the detector of heat, combustion gases for a fire gas detector, and energy via radiation for a flame detector. A new set of inventions can investigate the visible impacts of fire and movement using cameras and computer algorithms in applications where other detection methods are ineffective or hostile [2].

2. Objectives

- 1- Early warning of a fire or gas leak
- 2 Make wireless monitors easy to place in different places
- 3- Alert people to the presence of fire for ease of action before it spreads
- 4- Make the monitoring devices small so that they can be placed in several places and do not require much effort
- 5- Make all sensor sources in one central monitoring direction

3. Software Sections

A typical IDE is Arduino, an acronym for "integrated development environment." a portable program (i.e., it may run on both Windows and Mac computers). It is constructed with C and C++ functions. It's used to code and upload software to Arduino-compatible boards and other manufacturers' development boards using third-party kernels.

The GNU General Public License governs the IDE's code base, version 2. The Arduino Integrated Development Environment (IDE) supports C and C++ with some restrictions on code formatting. The Cabling Project's Software Library is available through the Arduino IDE and includes numerous widely used input and output functions. The main program loop and the sketch are the only two functions that user-written code needs to start them. Using the GNU toolchain that comes included with the IDE release, these functions are compiled and linked with the program stub main () in an executable loop execution program. With the help of the avrdude software included in the Arduino Software Development Kit, Machine-Readable Code is converted into hex-encoded documents in text format that can be loaded by the board firmware's loader and uploaded to the Arduino board. In most cases, Arduino boards are uploaded using Avrdude as an upload tool [3].

Various vendors have begun implementing specialized libre software development environments (kernels) that can draw and share sketches with other Arduino official microcontroller families supported microcontrollers due to the increasing popularity of Arduino as a software platform. The Arduino community started offering early access to a new Arduino Pro IDE with debugging and other advanced features in October 2019. the figure indicates

The image shows a screenshot of the Arduino IDE interface. The window title is "Blink | Arduino 1.8.5". The main text area contains the following code:

```
This example code is in the public domain.  
http://www.arduino.cc/en/Tutorial/Blink  
*/  
  
// the setup function runs once when you press reset or power the board  
void setup() {  
  // initialize digital pin LED_BUILTIN as an output.  
  pinMode(LED_BUILTIN, OUTPUT);  
}  
  
// the loop function runs over and over again forever  
void loop() {  
  digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)  
  delay(1000); // wait for a second  
  digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW  
  delay(1000); // wait for a second  
}
```

The status bar at the bottom indicates "32" and "Arduino/Genuino Uno on COM1".

Figure 2: Arduino IDE Program

4. Hardware Sections

The system includes the Arduino source, the Arduino is considered an open source, where all the sensors are connected to the Arduino, and it is also the main source for the project. The Arduino is connected to a computer via USB to download the programming for the project, or we can also operate it via USB or by battery. The goal of using Arduino is that it is cheap and easy to use.[3][4].

5. ARDUINO

The Arduino company designs and manufactures Microcontroller development boards and kits that can be used to make electronic gadgets. This project aims to create freely available versions of both hardware and software. Both the GNU Lesser General Public License (LGPL) and the GNU General Public License (GPL) apply to the software. At the same time, the company's Products sold in hardware stores carry a CC-BY-SA license. [1], enabling the production of The availability of Arduino boards and programming to anybody. In addition to the official website, authorized dealers also sell Arduino boards. Different microprocessors and controllers are employed in Arduino board designs. These displays showcase an assortment of digital and analog connections for receiving and sending data that can connect several add-on boards (also known as "shields") and circuit boards (used for early-stage development, prototyping, etc. The serial components on these boards have communication ports, some of which can load programs and include Some models feature USB or the Universal Serial Bus. The programs C and C++, sometimes called the "Arduino Language," are used to program microcontrollers. The Arduino projects include an Arduino CLI (command line interface), an integrated programming environment (IDE), and the conventional compiler toolchain for Go development.[3][4] The Arduino project began in 2005 as a teaching tool for interaction design students at the Ivrea School of Interaction Design in Italy. Its goal was to provide a simple and affordable method for amateurs and experts to build devices that use sensors and actuators to interact with the environment. Simple robots, thermostats, and motion detectors are a few examples of these gadgets that are frequently used by novices.

Former watering hole of the project's original developers in Ivrea, Italy, hang out. Origin of the name Arduino. According to the image's title bar. Arduin of Ivrea, Marquis of the March of Ivrea, and King of Italy from 1002 to 1014. as the picture shows.



Figure 3:Arduino UNO SMD R3

6. Why use an Arduino board

Arduino boards have been used in various engineering and technological endeavors. The Arduino software is intuitive for newcomers and seasoned users alike. In addition to Windows and Linux, it also supports Mac OS X. It's used by educators and students alike to create inexpensive scientific instruments that can be used to test fundamental scientific hypotheses. Those interested in doing physical computing might choose from various alternative microcontroller systems. The NetMedia BX-24, the Parallax Basic Stamp, the MIT Handyboard, Phidget, and many others offer similar capabilities.[3] Arduino also simplifies working with microcontrollers, offering advantages to teachers, students, and beginners over other systems.

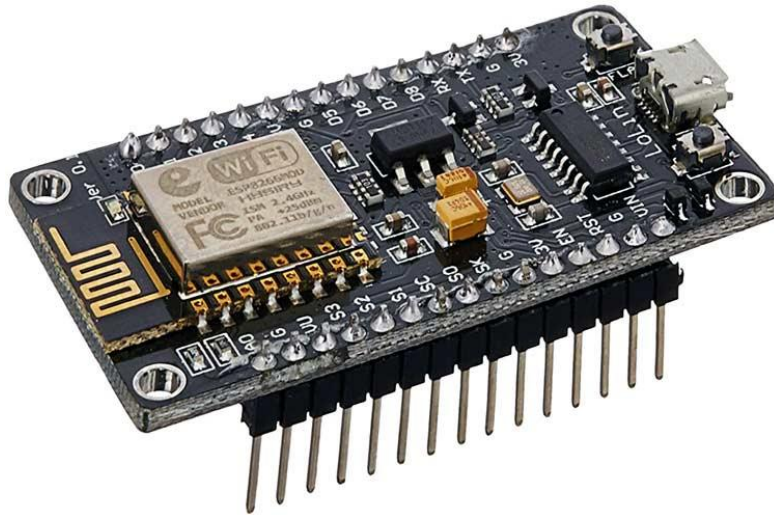
- Cheap
- Cross-platform
- Simple and clean programming environment
- Open source and extensible software
- Open source and scalable hardware

7. Type of Arduino and ESP Boards

The following are examples of Arduino boards:

- Arduino octo (R3)
- Arduino Micro
- Arduino Tiny
- Using Arduino
- LilyPad Arduino Board
- Arduino Bluetooth
- Arduino Diecimila
- RedBoard Arduino Board
- Arduino Mega (R3) Board
- ESP32
- NodeMCU ESP8266WIFI

As the figure shows, we will use the **NodeMCU ESP8266 WIFI** for this project.



8. NodeMCU ESP8266 WIFI

NodeMCU is an open-source firmware that can be designed using a Prototyping board open source. "NodeMCU" is a portmanteau derived from the "node" and "MCU."(microcontroller Unit). The firmware is intended to be referred to as "NodeMCU." and not the corresponding software toolkit. [citation needed] The source code for the firmware and the prototyping boards is freely available. The firmware is scripted in Lua. The eLua project is the foundation for the firmware, which was developed using the Espressif Non-OS SDK for ESP8266. Lua-cjson and SPIFFS are only two of the many open-source projects used. Due to the limited availability of resources, users must pick modules appropriate for their projects and construct firmware accordingly. The addition of ESP32 32-bit support was also implemented.[6][7].

In prototyping hardware, the USB controller is integrated with a flat top board with a microcontroller and a radio receiver utilizing a DIP (Dual In-Line Package) circuit board. It is easy to prototype on a breadboard with DIP format. The design was based primarily on the ESP-12 module of the ESP8266, a Wi-Fi SoC that incorporates the Tensilica Xtensa LX106 core and is extensively utilized in applications of IoT (see associated topics).

9. Part of NodeMCU ESP8266 WIFI

A- Power Requirements:

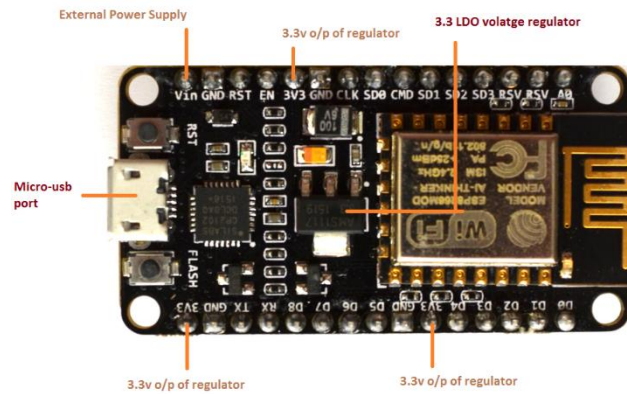
Operating voltage: 2.5 to 3.3 v

Onboard 3.3v 600mA voltage regulation

800mA operating current

20 μ A during sleep mode

. As figure shown



B- Onboard On-Board Controls with a Light-Emitting Diode:

The ESP8266 has two switches; one of them resets the device. One is a reset button for resetting nodemcu, while the other is a flash button for downloading new firmware. According to the illustration, the board may be programmed and features an LED indicator wired to the D0 pin.[7].

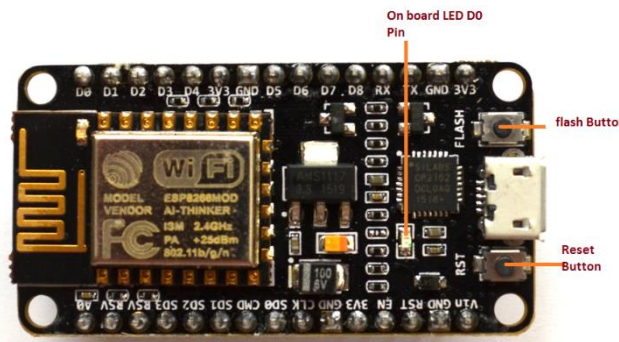


Figure 6: NodeMCU Board Switches and LED Indicator

C-Serial Communication:

The CP2102 USB to UART bridge converter is built into Nodemcu and assists in converting USB signals to serial, enabling your computer to interface with and reprogram the ESP8266 chip. A 4.5Mbps data transfer rate is included as well. as the picture shows.

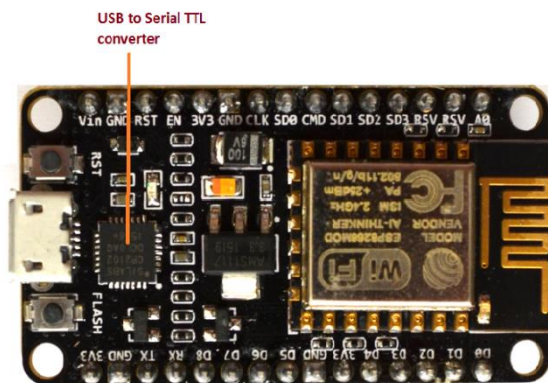


Figure 7: NodeMCU Serial Communication:

D- Input/Output Peripherals and Pins :

Nodemcu Board ESP-6266's 17 general-purpose General Purpose I/O is broken down into several peripheral tasks, for example,

- Uniform Asynchronous Receiver/Transmitter
- The PWM signal is output.
- I2S, I2C, SPI interfaces: connect numerous devices and sensors
- A 10-bit ADC channel
- as figure shown

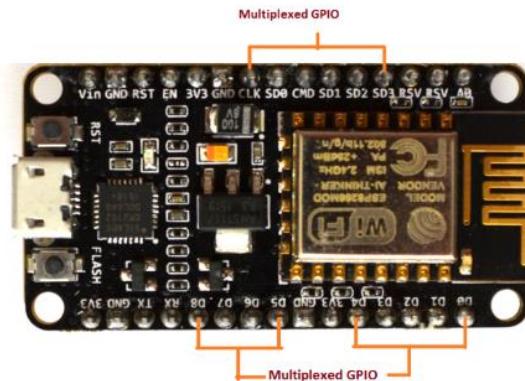


Figure 8: NodeMCU I/O Pins and Peripherals:

E- ESP8266 NodeMCU Pinout:

- **Power Connectors**

There is one VIN pin and three 3.3V pins for power. The ESP8266 and its accessories can be directly powered via the VIN pin if a regulated 5V voltage supply is available. The output of the onboard regulator is the 3.3V pin. These terminals can supply energy to peripherals.

- **Ground**

It's the connection between the ESP8266 NodeMCU board.

- **I2C pins**

Several I2C sensors and accessories in the project are connected using these pins. Support is available for both I2C Enslaver and Slave. Programmable clock frequencies up to 100 kHz are available for the I2C interface feature. It is important to note that the secondary device's slowest clock frequency must be less than the I2C time interval [7].

- **GPIO Pins**

Use of the ESP8266 NodeMCU contains. There are 17 general-purpose input/output (GPIO) ports that can be used for anything from pulse-width modulation, UART, I2S, I2C, IR remote, buttons, and LED lights.

There are various options for each digital enable GPIO, including high impedance, pull-up, and pull-down. It can be set to edge-trigger or level-trigger to generate CPU interruptions when configured as input [6].

- **Sticky-Tip Pins**

The ESP8266 features dual SPIs that can function as either slaves or masters.

These SPIs additionally back the following general-purpose SPI functions:

- 1- 4 SPI-formatted timing modes transmission
- 2- Divide the clock between 80 and 80 MHz.
- 3- FIFO up for 64 bytes

- **Pins for SDIO**

The ESP8266 features a Secure Digital Input/Output Interface (SDIO) to directly program SD cards. There is compatibility with v1.1 of the 4-bit 25 GHz SDIO and v2.0 on the 4-bit 50 GHz SDIO.

- **Pins for PWM**

PWM (pulse width modulation) is used on four channels on the board. It is possible to program PWM outputs to power LEDs and digital motors. The scope of PWM frequency is tuned from 1000-10000 μ s, i.e., between 100 Hz-1 kHz.

- **Anchor Points**

- These are the ESP8266's command pins. These jacks accommodate the chip's WAKE, RST, and EN pins.
- **EN pint**

The ESP8266 processor can be activated by pulling its EN High pin. The chip consumes less energy when it is brought down.

- **RST plug**

By touching the **RST plug**, the ESP8266 chip can be reset.

10. Sensor MQ-135

The MQ-135 gas sensor can identify hazardous chemicals and pollution, including ammonia (NH_3), sulfur (S), benzene (C_6H_6), and CO_2 . This sensor features analog and digital output pins, like the other MQ series gas sensors. The digital pin goes high when the concentration of these gases in the air exceeds the threshold limit. Using the integrated potentiometer, this threshold can be set. The analog output pins generate analog voltages that can calculate the atmospheric concentrations of various gases. The MQ135 air quality sensor module uses 150mA power and runs at 5V. To get results that are indeed accurate, it needs to warm up.[8].



Figure 9: MQ135 Sensor

11. About MQ135 Sensor

One of the MQ series of most often used gas sensors is the MQ135, frequently employed in air quality monitoring apparatus. It features analog and digital outputs and runs between 2.5 and 5.0 volts. Below is a diagram of the MQ135 module's pinout and key parts. Are shown below.[8][9].

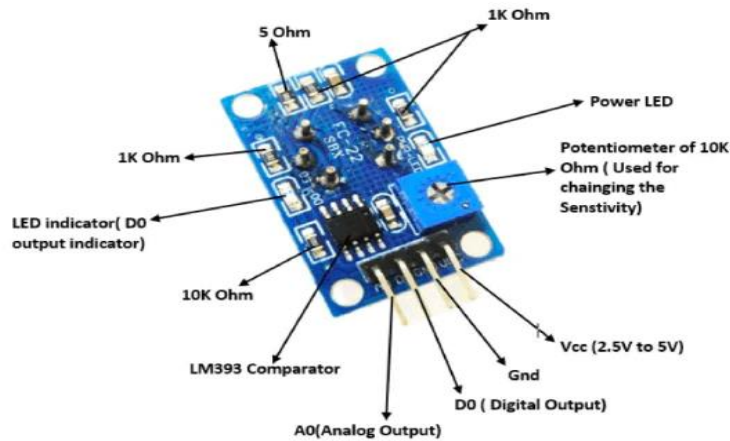


Figure 10: MQ135 Part

Technical Specifications of MQ135 Gas Sensor

Operating voltage ranges from 2.5 to 5.0 volts, with a 150 mA power draw.

- NH₃, NO_x, CO₂, Alcohol, Benzene, and Smoke Detection/Measurement
- 5 V is the typical operating voltage.
- 0 V to 5V (TTL Logic) Digital Output @ 5V Vcc
- 0-5V @ 5V Vcc Analog Output

12. Detect Harmful Gases using Digital Pin:

The digital pins on a sensor's output can recognize dangerous environmental gases. Using a 10k potentiometer, the sensitivity of the digital pins can be adjusted. Indicator LED D0 will activate if gas is found, and the digital pins will switch from logic high to logic low (0V). The MQ135 gas sensor module can also be applied without an external microcontroller due to an onboard-board LM393 comparator IC. Just power up the module and use the potentiometer to set the sensitivity of the digital pin. If the module detects gas, the digital pin will go low. With a simple transistor, this digital pin can be used directly to drive a buzzer or LED.[9].

2.12 Flame Sensor

The sensor that detects and responds to flames or fires is known as a flame detector. Depending on the installation, the response to a detected flame may include deactivating fuel lines (like natural gas or a propane line), sounding an alarm, and triggering the fire suppression system. Flame sensors are often utilized in industrial furnaces as a means of confirming that the furnace is working appropriately, as well as turning off the ignition system. However, they only sometimes directly act beyond informing the control system or operator. As a result of the mechanisms used The flame detector is typically more effective than a smoke or heat detector at detecting the source of a fire. [10]. This flame sensor comprises a 10K-

2N0 resistor SMD package, SMD led-2No, 10K- 1No potentiometer, photodiode,1K-2N0 resistor SMD package, 100nF – 2No capacitor SMD package.

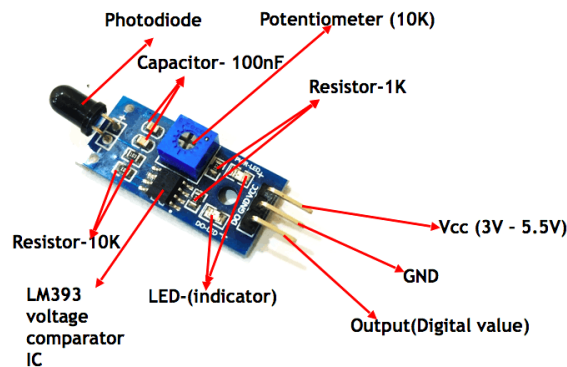


Figure 11: Flame Sensor part

13. Working of IR Flame/Fire Sensor Module

1- A photodiode's resistance decreases when it senses the IR waves emitted by the flame. IR waves generated by fires decrease resistance depending on their intensity. Photodiodes will act as short circuits when flames generate higher IR waves' intensity, offering the minimum resistance to the voltage received. Immediately afterward, the voltage at the non-inverting terminal will decrease and become similar to the potential of the ground. The voltage at the inverting terminal can be changed by varying the pot connected to the inverting terminal. This can be performed to alter the sensor sensitivity. (The module is said to have high sensitivity if the potentiometer is kept at the minimum value. While a module with low sensitivity is one where the potentiometer is set to its maximum value). The inverted terminal's voltage is higher than the other terminal's voltage. the non-inverting terminal at this stage (suppose that the voltage at the GND potential is lower than that at the inverting terminal), which causes the LM393 output to have a low value (0V). At the present stage, Due to the potential difference between its anode and cathode terminals, the indicator LED located between Vcc and Output will begin to glow. Pin 1 of the LM393 provides the output.

2- No IR waves are detected by the photodiode when there is no flame. As a result, the circuit acts as an open circuit and offers maximum resistance to incoming voltage. Then this causes Vcc voltage will be noticeable at the non-inverting terminal.

The LM393's output will be logic high (5V /VCC) as the voltage difference between the inverting and non-inverting terminals increases (compared to Vcc, the inverting terminal has a low voltage). Due to the lack of potential difference between the anode and cathode terminals, the indicator LED connected between Vcc and Output will not glow at this stage. Pin 1 of the LM393 provides the output [10].

14. Flame Sensor Pins

The flame sensor module has a total of 4 pins. Two power pins and two signal pins. The pinout of a flame sensor module is as follows:

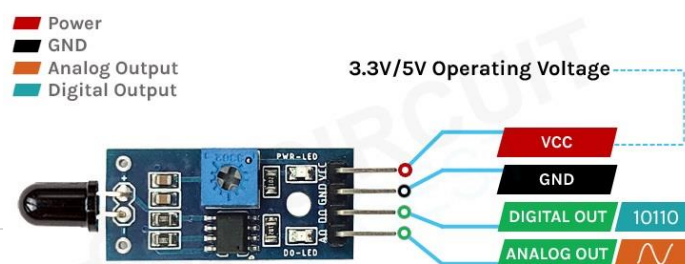


Figure 13: Flame sensor Pin

CC Provides power for the module, Connecting to the 5V pin of the Arduino.

GND Ground Connected to the Ground pin of the Arduino.

DO Digital Output Pin.

AO Analog Output Pin.

2.15 LED (Light emitting diodes)

An unsung hero in the electronics realm is the light-emitting diode, commonly referred to as an LED. The LED is a little lightbulb that fits comfortably into electrical circuits. The big difference between them and ordinary incandescent bulbs is that none of their filaments can burn out, nor do they get very hot mainly. Their illumination is solely caused by electron movement in semiconductors [12].

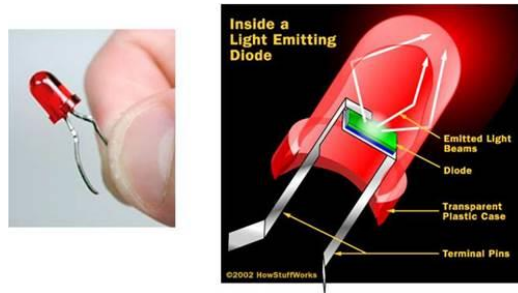


Figure 14: LED (Light emitting diodes)

In 2030, LEDs could reduce general lighting energy consumption by nearly half, preserving energy bucks and emissions of carbon in this procedure. Many lighting applications benefit from their unique characteristics, involving store signs, night lights, traffic lights, exit signs, and holiday lights [12].

16. BUZZER

- The small bell and its sound are also suitable for electronic projects.
- Buzzer voltage (5V).
- The buzzer has two electrodes (positive and negative), which connect the positive with the transmitter to control the Arduino and the negative electrode with the ground on the Arduino Uno.[11]
-



Figure 15: BUZZER

17. RemoteXY Application

1. RemoteXY is an easy way to make and use a mobile GUI for your controller board, which can be controlled from a smartphone or tablet. The system includes:
2. Mobile GUI editor for controller boards at remotexy.com
3. The smartphone App RemoteXY enables a connection to the controller and graphical control. Install the application. [13]

RemoteXY can easily control microcontroller devices by making unique graphical interfaces from mobile applications like Arduino.

Allows RemoteXY :

- Develop any GUI using any combination of control elements for display and decoration. A graphical interface can be created for any task using an online editor to place components on the screen. The web editor is published on the remotexy.com website.
- Once the GUI has been developed, you can access the microcontroller's source code, which implements your interface. The source code structure allows your software to communicate with controls and interfaces. So, it will be simple to include the management system in the function of the item you are constructing.
- Use a graphical interface on a mobile to operate microcontroller devices. For maintaining used mobile applications, use RemoteXY.
- Using one mobile App, With different display management interfaces, you will manage some devices. Since the microcontroller device stores the interface description. as the picture shows.[13]

18. Project circuit diagram

The circuit for the project consists of the NodeMCU ESP8266, and it is considered the main component in the project, which in turn distributes the tasks to the rest of the associated sensors, as in the figure below.

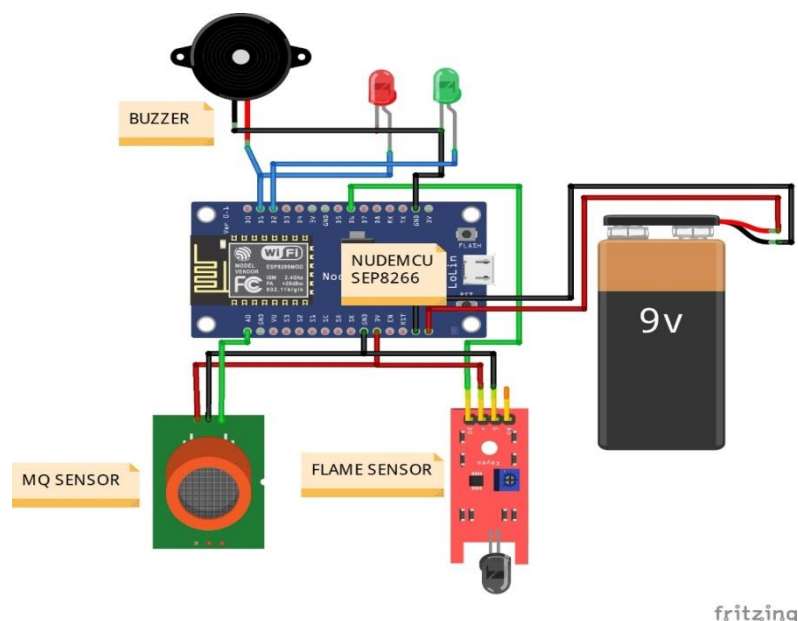


Figure 16: Project circuit diagram

Where a 9V battery powers the circuit, this battery feeds the ESP8266, and the ESP8266 provides the rest of the sensor.

19. MQ-135 Sensor Connection With NodeMCU ESP8266

Port (VCC) is connected to NodeMCU ESP8266 port (3V), port (GND) is connected to NodeMCU ESP8266 port (GND), and the transfer port is sent out through port (OUT). Through the Analog port (A0), the sensor collects data on the air particles and transmits the results to the NodeMCU ESP8266 for processing. As seen in the following diagram, the data is transferred via the analog port.

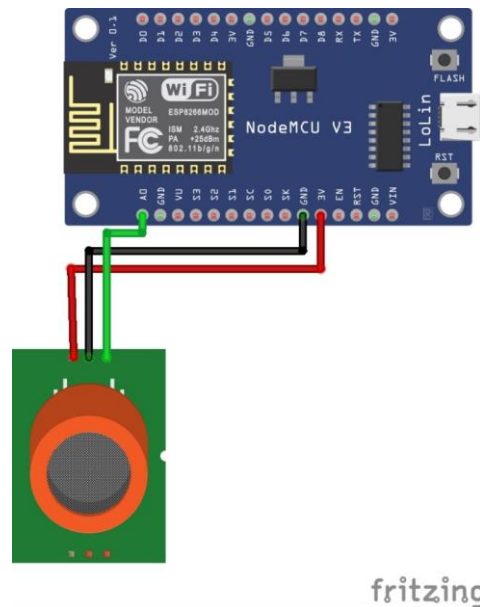


Figure 17: MQ-135 sensor Connection With NodeMCU ESP8266

3.3 Flame Sensor Connection With NodeMCU ESP8266

The flame sensor has three ports (VCC-GND -OUT), a (VCC) port connected to the NodeMCU ESP8266 port (3V), a (GND) port connected to the port (GND) on the NodeMCU ESP8266, and finally, the transport port connected to the NodeMCU ESP8266 sends data via Digital (D6), where the sensor reads the molecules in the air and the flame in front of it and then analyzes it and sends the readings to the NodeMCU ESP8266. The data is transmitted via Wi-Fi through the digital port to the application, as in the diagram below.

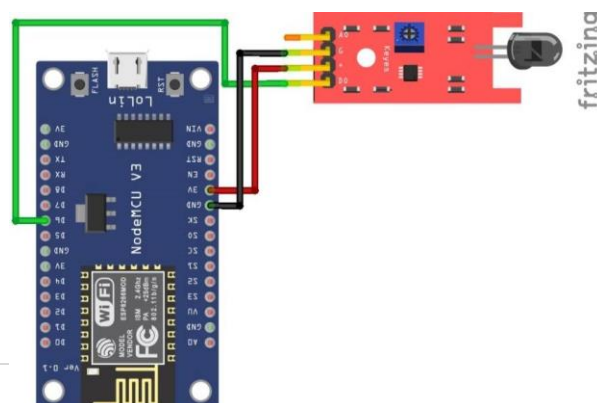


Figure 19 Flame Sensor Connection With NodeMCU ESP8266

21. LEDs and BUZZER Connection With NodeMCU ESP8266

LEDs and buzzers generally contain only two poles (positive and negative), where the positive pole of the red LED is connected to the port (D1) in ESP8266 and the negative pole to the negative pole in (ESP8266), as for the buzzer, it is connected to the red LED because it works when it works For the red LED, as for the green LED, the positive pole is connected to the port (D2) in ESP8266 and the negative bar to the negative in ESP8266 As in the figure below.

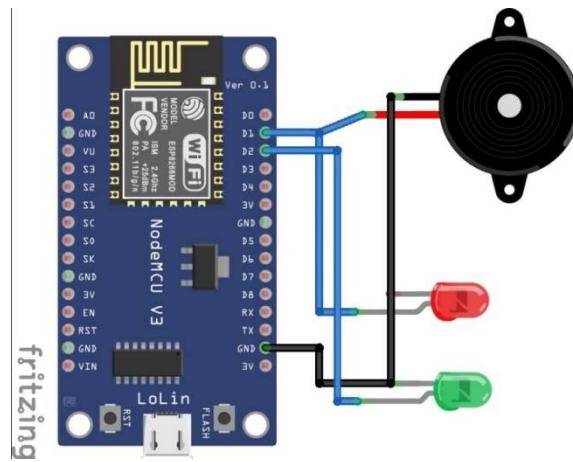


Figure 20:LEDs and BUZZER Connection With NodeMCU ESP8266

22. Power Supply Connection With NodeMCU ESP8266

A battery that can be charged several times has been placed to meet the project's needs in general, as the circuit is equipped with a nine-volt power, connecting the negative and positive poles to ESP8266. At the same time, the rest of the sensors take energy from the ESP8266 directly. As in the figure below

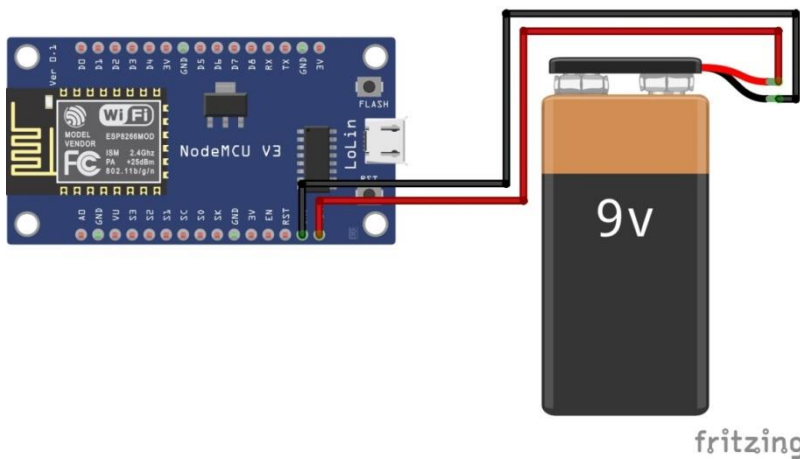


Figure 21: Battery 9v Connection With NodeMCU ESP8266

23. RemoteXY Application

20. RemoteXY is an easy way to make and use a mobile GUI for your controller board, which can be controlled from a smartphone or tablet. The system includes:

21. Mobile GUI editor for controller boards at remotexy.com

22. The smartphone App RemoteXY enables a connection to the controller and graphical control. Install the application. [15]

3.6.1 Notable Features:

- The interface structure is stored in the controller. When connected, there is no interactive download interface with the server. The interface structure is installed from the controller to the mobile AppApp.
- One mobile application to control all your devices. An unlimited number of devices.

3.6.2 Connection types:

1. Cloud-based internet servers.
2. Wi-Fi clients and access points
3. Bluetooth.
4. URL or IP by Ethernet.

RemoteXY can easily control microcontroller devices by making unique graphical interfaces from mobile applications like Arduino.

Allows RemoteXY :

- Develop any GUI using any combination of control elements for display and decoration. A graphical interface can be created for any task using an online editor to place components on the screen. The web editor is published on the remotexy.com website.
- Once the GUI has been developed, you can access the microcontroller's source code, which implements your interface. The source code structure allows your software to communicate with controls and interfaces. So, it will be simple to include the management system in the function of the item you are constructing.
- Use a graphical interface on a mobile to operate microcontroller devices. For maintaining used mobile applications, use RemoteXY.
- Using one mobile App, With different display management interfaces, you will manage some devices. Since the microcontroller device stores the interface description. as the picture shows.

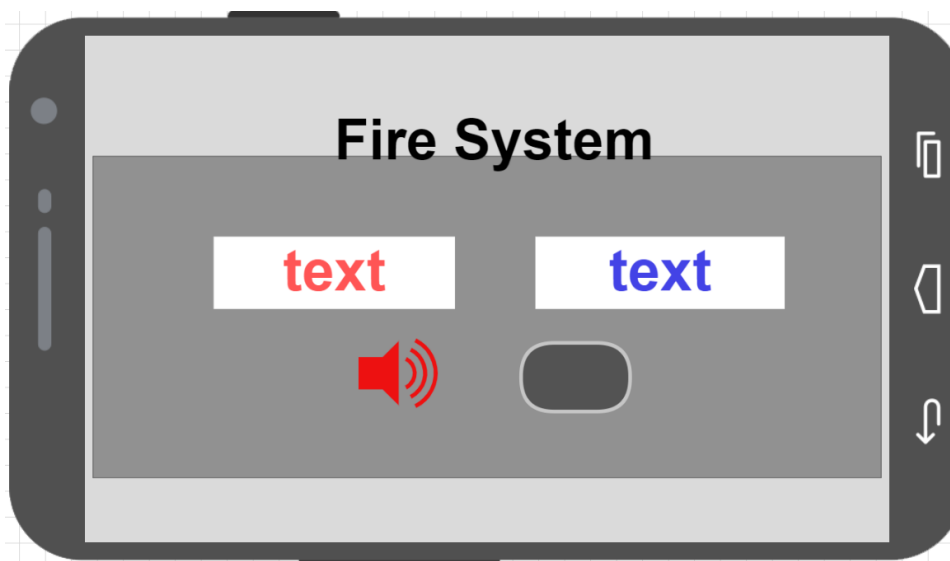


Figure 22: RemoteXY Application Design

24. Text string

Any string information can be shown as text on a mobile screen. This could be the parameter or condition controller's actual value. You must specify the structure's size (in bytes) when using text. RemoteXY will be given a buffer with the selected size. Text lines must end with a 0. Stay within the limit of the variable you choose for text.15]

Settings

- **Variable Names** – the names of text and variables in the microcontroller source code, allowing setting names for C-rule variables.
- **Length** - The number of characters assigned to the string variable. The size of the text buffer automatically adds a single byte terminating zero.

Example Code

Text string passing, you want to insert the string into the corresponding field schema RemoteXY. Strings are zero-terminated. You can create string fields in a variety of ways.
Set any string immediately

```
strcpy (RemoteXY.text_1, "My text");
sprintf (RemoteXY.text_2, "My text");
```

25. Connect from the phone application.

Put RemoteXY on the device you are using. Launch the AppApp and select the Plus (plus) button from the main menu. In the new window, click the tab labeled "Cloud Server Connection." Enter your token in the Device pass field when the pop-up window appears. During Step 3, you made the ticket—type in the token's numerical digits, not the token's name. Please connect by pressing the button. A graphical user interface will launch if you've followed the steps successfully.

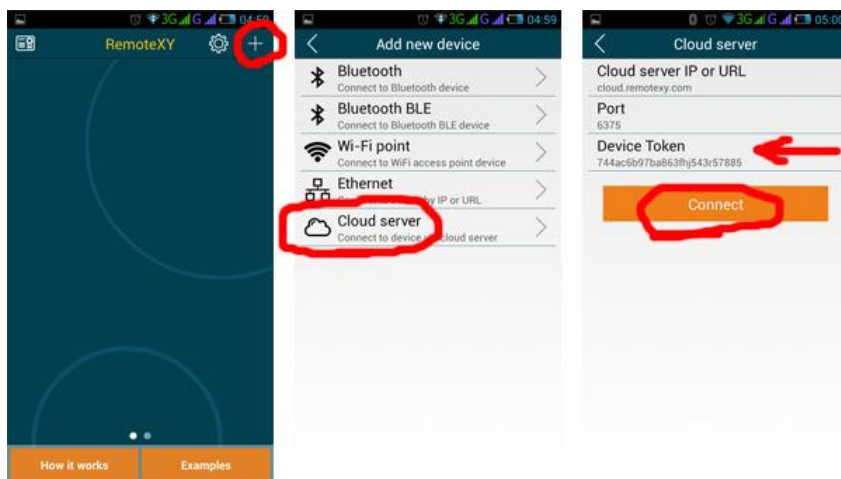


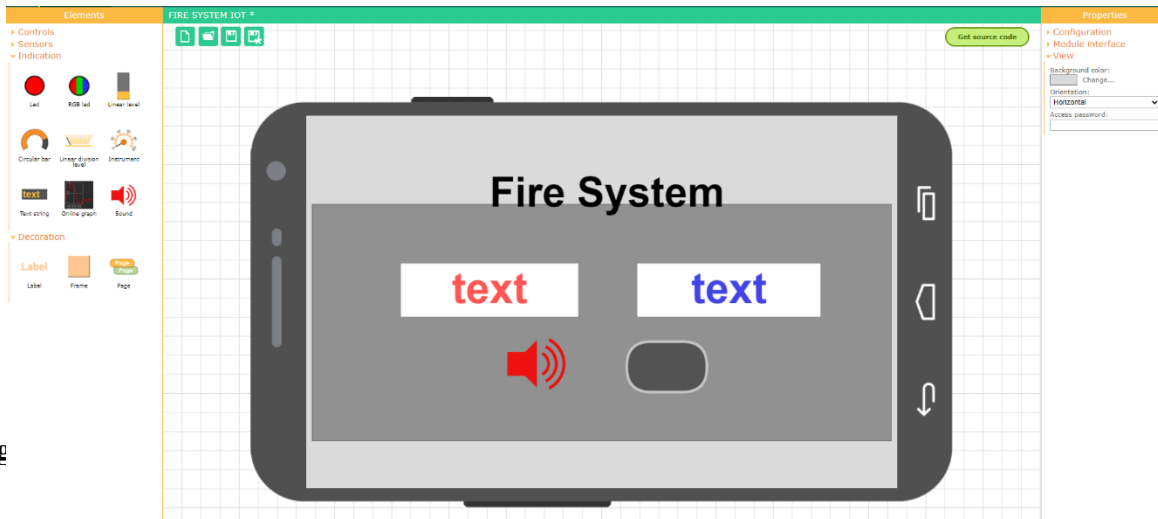
Figure 23 Connect from the mobile application.

26. RemotyXY With NodeMCU ESP8266

- Using a web application, it is simple to create graphical user interfaces and generate the required source code for control boards (ESP8266, Arduino, etc.)
- Mobile applications for Android and iOS allow for Wi-Fi-based or Bluetooth remote control of the remote board.

Step 1: Graphical Interface

Create graphical user interfaces using a straightforward drag-and-drop editor.



Fig

Step 2: Source Code Configuration

In this manner, we instruct RemoteXY that the controller will be the nodeMCU board, the communication module will be the onboard-board ESP8266, and the programming environment will be Arduino. Configuring the module interface section requires defining the SSID that the nodeMCU AP will broadcast. Configuring the module interface section requires defining the SSID that the nodeMCU AP will broadcast.[15]The TCP port on which the nodeMCU server will watch for inbound connections is also specified. Once more, let's examine the open point for simplicity, which means Without authentication, a Wi-Fi network should be available.



Figure 25: Source Code Configuration

A- Run a RemoteXY app on your mobile device and click the + sign at the top

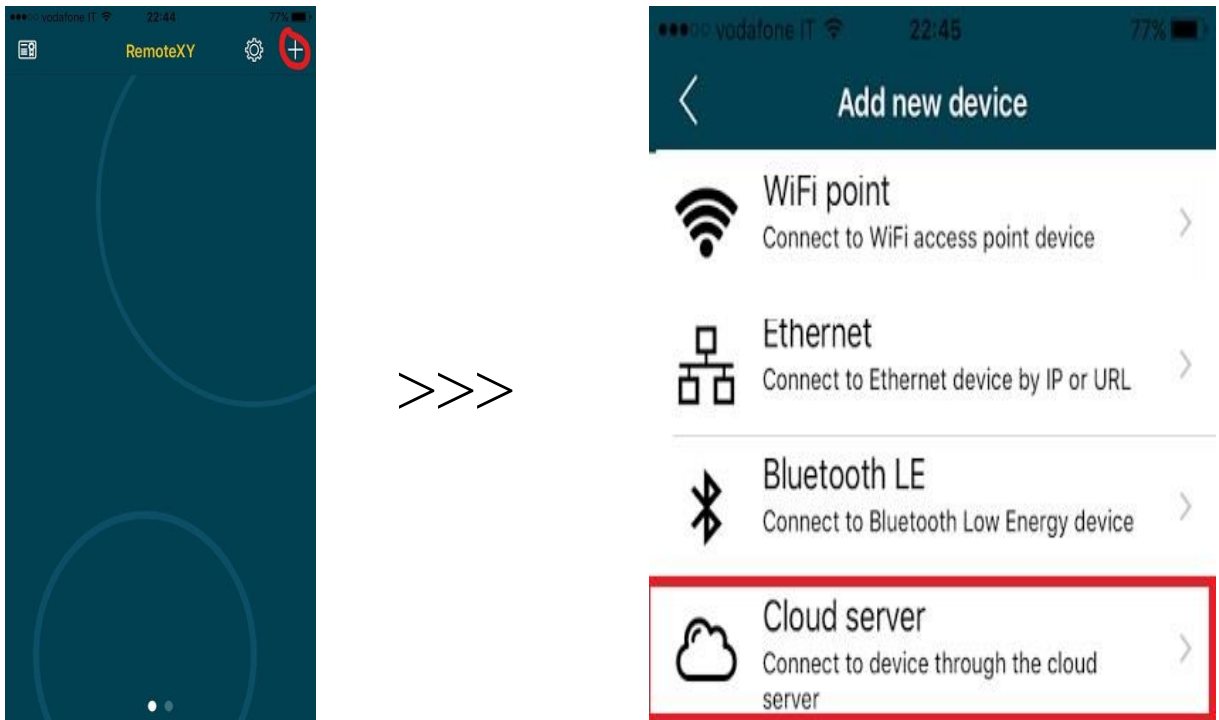
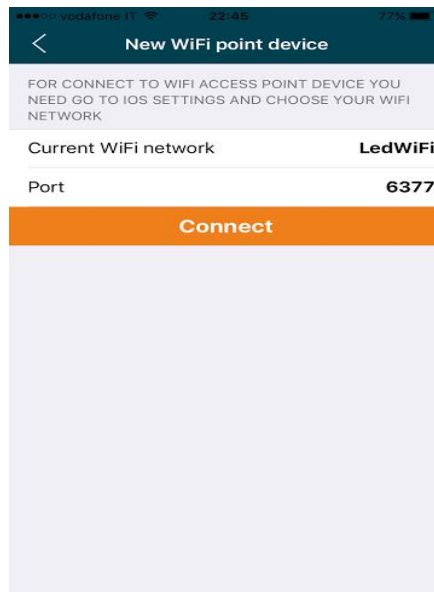


Figure 26 Connection with module

A- Go to the **connect button** and the application relating to the nodeMCU, then get the GUI.



27. Result

The project's results were excellent, as the project was assembled with electronic materials and programmed according to the code we wrote and loaded on the microcontroller. When you open the phone application, the instructions from the project will reach via the cloud to the application to show alerts when there is a fire or gas. The purity of the air is sensed by the (MQ135) sensor. Without fire or gases, the reading is regular, and the green color turns on in the project and the application. And when there is a fire or a specific gas emission, the sensors will sense this fire or gas emission, and thus the red color LED will turn on with the buzzer alarm in the project and the application. As in the figure below:



Figure 30 Result

28. Conclusion

There are many reasons for designing a project to detect toxic and non-toxic gases, as well as to alert if there is a fire in a particular place,

One of the advantages of the project

- 1- It is possible to monitor via the Internet so that you can travel to different places while watching your home
- 2- It can be detected if there is a leak in other gases
- 3 - Contains batteries that can be charged again

29. Future Work

In the future, several other sensors will be added, such as the temperature and humidity sensor, to be also sent through the application, and the project can also be extended from a fixed object to a mobile one that is sent to places containing fires to measure the level of gas leakage or the status of a fire occurring in a specific location

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**Alternating Direction Implicit Method to Find the
Deflection of Elastic Thin Plates**

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Alternating Direction Implicit Method to Find the Deflection of Elastic Thin Plates

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Abstract:

Bi-harmonic equation is governing equation of the deflection of elastic thin plates, in this paper, we are solving the one of elasticity problems which is the deflection problems. We using the Alternating Direction Implicit Method (ADI) to find the deflection of elastic thin plates when the boundary conditions with this problems depend on the kind of supported of the plates (clamped and simply supported).

Key words: Bi-harmonic equation, Alternating Direction Implicit Method (ADI), Deflection, Elastic Thin Plates, Simply Supported, Clamped.

1. Introduction:

There are many of numerical methods to solve elasticity problems, the researchers are used the finite differences method (FDM), finite elements method (FEM), boundary integral equation method (BIE), and other differencing methods like Alternating Direction Implicit Method (ADI). In (1993) Awni is used the (BIE) to find the deflection of elastic thin plates[1], and in (2020) Bushra and Awni are used (ADI) to solve the heat diffusion problem[2]. Dolicanin, Nikolic.in (2010) are used the application of finite difference method to study of the phenomenon in the theory of thin plates[5].

1. Alternating Direction Implicit Method (ADI):

The (ADI) is one of differencing numerical method which is used to solving partial differential equations(p.d.e.) (ellipse, hyperbolic, parabola), the main idea for this method is depend from the two researchers: Rach - ford , Peace – man, in this role they convert the (p.d.e.) to the differencing equations [2][7]. For solving the elasticity problems as in bridges buildings, roads heat diffusion, Gas diffusion,..., we can using this method (ADI method).

2-1. ADI Algorithm:

The main idea in ADI method is isolate the finite differences equations to two parts, with the following steps:

1. Applying Implicit Method toward X-axes.
2. Applying Explicit Method toward Y-axes.

Note: we can begin with the 2nd step instead of 1st step.

2. Application OF ADI Method:

Now, we apply this method to find the deflection of elastic thin plates (which is the bi-harmonic equation).

The general equation which is used is:

$$6p_{i+2,j} - 32p_{i+1,j} + 100p_{i,j} - 32p_{i-1,j} + 6p_{i-2,j} = -6p_{i,j+2} + 32p_{i,j+1} + 32p_{i,j-1} - 6p_{i,j-2} - p_{i+2,j+2} - p_{i-2,j-2} - p_{i-2,j+2} - p_{i+2,j-2} \dots \dots 1$$

This equation (1) is use to find the values of equation on the rows. And we use the following equation to find the values on the columns:

$$6p_{i,j+2} - 32p_{i,j+1} + 100p_{i,j} - 32p_{i,j-1} + 6p_{i,j-2} + p_{i+2,j+2} + p_{i-2,j-2} + p_{i-2,j+2} + p_{i+2,j-2} = -6p_{i+2,j} + 32p_{i+1,j} + 32p_{i-1,j} - 6p_{i-2,j} \dots \dots 2$$

3. Boundary Conditions:

The boundary conditions are depends on the case of supported the edges of the plate, as the cases bellow[9],[1],[5]:

4-1. Clamped Edges:

$$p(w) = 0, w \in S \dots \dots 3$$

$$\frac{\partial p(w)}{\partial n} = 0, w \in S$$

where (S) is the boundary of plate.

4-2. Simply Supported Edges:

$$p(w) = 0, w \in S \dots \dots 4$$

$$\mu_n = 0, w \in S$$

μ_n is the bending moment on the edge.

also these conditions are depend on the shape of plate as bellow:

4-3. Rectangular Plates:

The region can be represent as:

$$B = \left\{ (x, y, z) : 0 \leq x \leq a, 0 \leq y \leq b, -\frac{h}{2} \leq z \leq \frac{h}{2} \right\}$$

h: thin of plate.

4.3.1. Rectangular Plate with Clamped Edge:

The boundary conditions are:

$$p(x, 0) = 0, \frac{\partial p(x, 0)}{\partial y} = 0$$

$$p(x, b) = 0, \frac{\partial p(x, b)}{\partial y} = 0$$

$$p(0, y) = 0, \frac{\partial p(0, y)}{\partial x} = 0$$

$$p(a, y) = 0, \frac{\partial p(a, y)}{\partial x} = 0 \dots \dots 5$$

5. Solving The Bi-Harmonic Equation:

In this section we apply the ADI method to solve homogeneous Bi-harmonic equation:

$$\nabla^4 p = \frac{\partial^4 p}{\partial x^4} + 2 \frac{\partial^4 p}{\partial x^2 \partial y^2} + \frac{\partial^4 p}{\partial y^4} \quad \dots \dots \quad 6$$

And we replace by differencing equation:

$$p_{xxxx} = \frac{p_{i+2,j} - 4p_{i+1,j} + 6p_{i,j} - 4p_{i-1,j} + p_{i-2,j}}{h^4} \quad \dots \dots \quad 7$$

$$p_{yyyy} = \frac{p_{i,j+2} - 4p_{i,j+1} + 6p_{i,j} - 4p_{i,j-1} + p_{i,j-2}}{h^4} \quad \dots \dots \quad 8$$

$$2p_{xxyy} = \frac{p_{i+2,j+2} + p_{i-2,j-2} + 4p_{i,j} + p_{i+2,j-2} + p_{i-2,j+2} - 2p_{i,j+2} - 2p_{i+2,j} - 2p_{i-2,j} - 2p_{i,j-2}}{8h^4} \quad \dots \dots \quad 9$$

The equation(6) become:

$$\begin{aligned} & \frac{p_{i+2,j} - 4p_{i+1,j} + 6p_{i,j} - 4p_{i-1,j} + p_{i-2,j}}{h^4} \\ & + \frac{p_{i+2,j+2} + p_{i-2,j-2} + 4p_{i,j} + p_{i+2,j-2} + p_{i-2,j+2} - 2p_{i,j+2} - 2p_{i+2,j} - 2p_{i-2,j} - 2p_{i,j-2}}{8h^4} \\ & + \frac{p_{i,j+2} - 4p_{i,j+1} + 6p_{i,j} - 4p_{i,j-1} + p_{i,j-2}}{h^4} = 0 \quad \dots \dots \quad 10 \end{aligned}$$

$$\begin{aligned} & \frac{p_{i+2,j-2} + p_{i-2,j+2} + 6p_{i+2,j} - 32p_{i+1,j} + 100p_{i,j} - 32p_{i-1,j} + 6p_{i-2,j} + 6p_{i,j+2}}{8h^4} \\ & - \frac{32p_{i,j+1} - 32p_{i,j-1} + 6p_{i,j-2} + p_{i+2,j+2} + p_{i-2,j-2} + p_{i+2,j-2} + p_{i-2,j+2}}{8h^4} = 0 \end{aligned}$$

After simply:

$$6p_{i+2,j} - 32p_{i+1,j} + 100p_{i,j} - 32p_{i-1,j} + 6p_{i-2,j} + 6p_{i,j+2} - 32p_{i,j+1} - 32p_{i,j-1} + 6p_{i,j-2} + p_{i+2,j+2} + p_{i-1,j-2} + p_{i-2,j+2} + p_{i+2,j-2} = 0 \quad \dots \dots \quad 11$$

We divided the equation (11) by two formulas as below:

$$\begin{aligned} & 6p_{i+2,j} - 32p_{i+1,j} + 100p_{i,j} - 32p_{i-1,j} + 6p_{i-2,j} \\ & = -6p_{i,j+2} + 32p_{i,j+1} + 32p_{i,j-1} - 6p_{i,j-2} - p_{i+2,j+2} - p_{i-2,j-2} - p_{i-2,j+2} \\ & - p_{i+2,j-2} \quad \dots \dots \quad 12 \end{aligned}$$

$$\begin{aligned} & 6p_{i,j+2} - 32p_{i,j+1} + 100p_{i,j} - 32p_{i,j-1} + 6p_{i,j-2} + p_{i+2,j+2} + p_{i-2,j-2} + p_{i-2,j+2} + p_{i+2,j-2} = \\ & -6p_{i+2,j} + 32p_{i+1,j} + 32p_{i-1,j} - 6p_{i-2,j} \quad \dots \dots \quad 13 \end{aligned}$$

$$\begin{aligned} & 6p_{i+2,j}^{(r+1)} - 32p_{i+1,j}^{(r+1)} + 100p_{i,j}^{(r+1)} - 32p_{i-1,j}^{(r+1)} + 6p_{i-2,j}^{(r+1)} \\ & = -6p_{i,j+2}^{(r)} + 32p_{i,j+1}^{(r)} + 32p_{i,j-1}^{(r)} - 6p_{i,j-2}^{(r)} - p_{i+2,j+2}^{(r)} - p_{i-2,j-2}^{(r)} \\ & - p_{i-2,j+2}^{(r)} - p_{i+2,j-2}^{(r)} \quad \dots \dots \quad 14 \end{aligned}$$

$$\begin{aligned} & 6p_{i,j+2}^{(c+1)} - 32p_{i,j+1}^{(c+1)} + 100p_{i,j}^{(c+1)} - 32p_{i,j-1}^{(c+1)} + 6p_{i,j-2}^{(c+1)} + p_{i+2,j+2}^{(c+1)} + p_{i-2,j-2}^{(c+1)} \\ & + p_{i+2,j-2}^{(c+1)} + p_{i-2,j+2}^{(c+1)} \\ & = -6p_{i+2,j}^{(c)} + 32p_{i+1,j}^{(c)} + 32p_{i-1,j}^{(c)} - 6p_{i-2,j}^{(c)} \quad \dots \dots \quad 15 \end{aligned}$$

We using equation.(14) to find the values of node points on rows, and the equation.(15) to find the values on columns.

Example: But we have a thin flexible rectangular plate its dimensions are (2*4), and it applies to the two axes.

When the origin point according to the following data

$$\Delta t = 2 \text{ sec}$$

$$\Delta x = 2$$

Initial conditions

$$t = 0$$

Boundary

$$p(2, t) = 2$$

$$p(t, 8) = 8$$

conditions

That is the plate is edge-fixed, and the applied pressure is lateral pressure.

The solution:

Use the following formula to find the points on all the plane's columns.

$$6p_{i,j+2}^{(c+1)} - 32p_{i,j+1}^{(c+1)} + 100p_{i,j}^{(c+1)} - 32p_{i,j-1}^{(c+1)} + 6p_{i,j-2}^{(c+1)} + p_{i+2,j+2}^{(c+1)} + p_{i-2,j-2}^{(c+1)} + p_{i+2,j-2}^{(c+1)} + p_{i-2,j+2}^{(c+1)} = -6p_{i+2,j}^{(c)} + 32p_{i+1,j}^{(c)} + 32p_{i-1,j}^{(c)} - 6p_{i-2,j}^{(c)} \dots \dots 16$$

To start the solution, We will substitute a value $i=1$ for the first level along the column and for all point values.

The equation will look like this

$$6p_{1,j+2}^{(c+1)} - 32p_{1,j+1}^{(c+1)} + 100p_{1,j}^{(c+1)} - 32p_{1,j-1}^{(c+1)} + p_{3,j+2}^{(c+1)} = -6p_{3,j}^{(c)} + 32p_{2,j}^{(c)} + 32p_{0,j}^{(c)} \dots \dots 17$$

Now we make up $c=0$ and $j=1,2,3$ We get the following equations.

$$6p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 100p_{1,1}^{(1)} - 32p_{1,0}^{(1)} + p_{3,3}^{(1)} = -6p_{3,1}^{(0)} + 32p_{2,1}^{(0)} + 32p_{0,1}^{(0)} \dots \dots 17.1$$

$$6p_{1,4}^{(1)} - 32p_{1,3}^{(1)} + 100p_{1,2}^{(1)} - 32p_{1,1}^{(1)} + 6p_{1,0}^{(1)} + p_{3,4}^{(1)} + p_{3,0}^{(1)} = -6p_{3,2}^{(0)} + 32p_{2,2}^{(0)} + 32p_{0,2}^{(0)} \dots \dots 17.2$$

$$6p_{1,5}^{(1)} - 32p_{1,4}^{(1)} + 100p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 6p_{1,1}^{(1)} + p_{3,5}^{(1)} + p_{3,1}^{(1)} = -6p_{3,3}^{(0)} + 32p_{2,3}^{(0)} + 32p_{0,3}^{(0)} \dots \dots 17.3$$

When substituting the boundary and initial conditions.

$$6p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 100p_{1,1}^{(1)} - 32(0) + 0 = -6(0) + 32(0) + 32(2)$$

$$6p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 100p_{1,1}^{(1)} = 64$$

$$6(0) - 32p_{1,3}^{(1)} + 100p_{1,2}^{(1)} - 32p_{1,1}^{(1)} + 6(0) + 0 + 0 = -6(0) + 32(0) + 32(2)$$

$$-32p_{1,3}^{(1)} + 100p_{1,2}^{(1)} - 32p_{1,1}^{(1)} = 64$$

$$6(0) - 32(0) + 100p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 6p_{1,1}^{(1)} + 0 + 0 = -6(0) + 32(0) + 32(2)$$

$$100p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 6p_{1,1}^{(1)} = 64$$

$$6p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 100p_{1,1}^{(1)} = 64 \dots \dots 18$$

$$-32p_{1,3}^{(1)} + 100p_{1,2}^{(1)} - 32p_{1,1}^{(1)} = 64 \dots \dots 19$$

$$100p_{1,3}^{(1)} - 32p_{1,2}^{(1)} + 6p_{1,1}^{(1)} = 64 \dots \dots 20$$

equation No. (18) and equation No. (20) here Bees

$$94p_{1,1}^{(1)} - 94p_{1,3}^{(1)} = 0$$

$$p_{1,1}^{(1)} = p_{1,3}^{(1)} \dots \dots 21$$

We substitute equation No. (21) into equation No. (19)

$$-32p_{1,3}^{(1)} + 100p_{1,2}^{(1)} - 32(p_{1,3}^{(1)}) = 64$$

$$-64p_{1,3}^{(1)} + 100p_{1,2}^{(1)} = 64$$

$$100p_{1,2}^{(1)} = 64p_{1,3}^{(1)} + 64$$

$$p_{1,2}^{(1)} = 0.64p_{1,3}^{(1)} + 0.64 \quad \dots \dots \quad 22$$

We substitute equation. (21) and (22) into equation No. (19)

$$6p_{1,3}^{(1)} - 32(0.64p_{1,3}^{(1)} + 0.64) + 100p_{1,3}^{(1)} = 64$$

$$85.52p_{1,3}^{(1)} = 84.48$$

$$p_{1,3}^{(1)} = 0.98$$

$$p_{1,1}^{(1)} = 0.98$$

$$p_{1,2}^{(1)} = 0.64(0.98) + 0.64$$

$$p_{1,2}^{(1)} = 1.26$$

Now when we find the values of the points along the row, we use the following formula.

$$6p_{i+2,j}^{(r+1)} - 32p_{i+1,j}^{(r+1)} + 100p_{i,j}^{(r+1)} - 32p_{i-1,j}^{(r+1)} + 6p_{i-2,j}^{(r+1)} \\ = -6p_{i,j+2}^{(r)} + 32p_{i,j+1}^{(r)} + 32p_{i,j-1}^{(r)} - 6p_{i,j-2}^{(r)} - p_{i+2,j+2}^{(r)} - p_{i-2,j-2}^{(r)} \\ - p_{i-2,j+2}^{(r)} - p_{i+2,j-2}^{(r)} \dots \dots 23$$

Instead of r=0 and for the value of j=1

We get

$$6p_{i+2,1}^{(1)} - 32p_{i+1,1}^{(1)} + 100p_{i,1}^{(1)} - 32p_{i-1,1}^{(1)} + 6p_{i-2,1}^{(1)} \\ = -6p_{i,3}^{(0)} + 32p_{i,2}^{(0)} + 32p_{i,0}^{(0)} - p_{i+2,3}^{(0)} - p_{i-2,3}^{(0)} \dots \dots 24$$

Substituting in for the value i=1,2,3 We get the following equations.

$$6p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 100p_{1,1}^{(1)} - 32p_{0,1}^{(1)} = -6p_{1,3}^{(0)} + 32p_{1,2}^{(0)} + 32p_{1,0}^{(0)} - p_{3,3}^{(0)} \dots \dots 24.1$$

$$6p_{4,1}^{(1)} - 32p_{3,1}^{(1)} + 100p_{2,1}^{(1)} - 32p_{1,1}^{(1)} + 6p_{0,1}^{(1)} = -6p_{2,3}^{(0)} + 32p_{2,2}^{(0)} + 32p_{2,0}^{(0)} - p_{4,3}^{(0)} - p_{0,3}^{(0)} \dots \dots 24.2$$

$$6p_{5,1}^{(1)} - 32p_{4,1}^{(1)} + 100p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 6p_{1,1}^{(1)} = -6p_{3,3}^{(0)} + 32p_{3,2}^{(0)} + 32p_{3,0}^{(0)} - p_{5,3}^{(0)} - p_{1,3}^{(0)} \dots \dots 24.3$$

When substituting the boundary and initial conditions.

So the equations become as follows.

$$6p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 100p_{1,1}^{(1)} - 32(2) = -6(0) + 32(0) + 32(0) - 0$$

$$6p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 100p_{1,1}^{(1)} = 64$$

$$6(8) - 32p_{3,1}^{(1)} + 100p_{2,1}^{(1)} - 32p_{1,1}^{(1)} + 6(2) = -6(0) + 32(0) + 32(0) - 8 - 2$$

$$-32p_{3,1}^{(1)} + 100p_{2,1}^{(1)} - 32p_{1,1}^{(1)} = -70$$

$$6(8) - 32(8) + 100p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 6p_{1,1}^{(1)} = -6(0) + 32(0) + 32(0) - 8 - 0$$

$$100p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 6p_{1,1}^{(1)} = 200$$

$$6p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 100p_{1,1}^{(1)} = 64 \quad \dots \dots \quad 25$$

$$-32p_{3,1}^{(1)} + 100p_{2,1}^{(1)} - 32p_{1,1}^{(1)} = -70 \quad \dots \dots \quad 26$$

$$100p_{3,1}^{(1)} - 32p_{2,1}^{(1)} + 6p_{1,1}^{(1)} = 200 \quad \dots \dots \quad 27$$

We solve equation (25) with equation (27) immediately.

$$94p_{1,1}^{(1)} - 94p_{3,1}^{(1)} = -136$$

$$p_{1,1}^{(1)} = p_{3,1}^{(1)} - 1.44 \quad \dots \dots \quad 28$$

Substituting equation (28) into equation (26)

$$-32p_{3,1}^{(1)} + 100p_{2,1}^{(1)} - 32(p_{3,1}^{(1)} - 1.44) = -70$$

$$-64p_{3,1}^{(1)} + 100p_{2,1}^{(1)} = -116.08$$

$$p_{2,1}^{(1)} = 0.64p_{3,1}^{(1)} - 1.16 \quad \dots \dots \quad 29$$

Substitute equation (29) and modified (28) into equation (25)

$$6p_{3,1}^{(1)} - 32(0.64p_{3,1}^{(1)} - 1.16) + 100(p_{3,1}^{(1)} - 1.44) = 64$$

$$85.52p_{3,1}^{(1)} = 64 - 37.12 + 144$$

$$p_{3,1}^{(1)} = \frac{170.88}{85.52}$$

$$p_{3,1}^{(1)} = 1.99$$

$$p_{2,1}^{(1)} = 0.64(1.99) - 1.16$$

$$p_{2,1}^{(1)} = 0.11$$

$$p_{1,1}^{(1)} = 1.99 - 1.44$$

$$p_{1,1}^{(1)} = 0.55$$

In the same way as the solution when applied to the other levels, You get the following point values.

$$p_{2,3}^{(1)} = -0.96$$

$$p_{2,1}^{(1)} = -0.77$$

$$p_{2,2}^{(1)} = -1.03$$

$$p_{3,2}^{(1)} = 1.92$$

$$p_{2,2}^{(1)} = -0.26$$

$$p_{1,2}^{(1)} = 1.16$$

$$p_{3,3}^{(1)} = 2.62$$

$$p_{3,1}^{(1)} = 2.68$$

$$p_{3,2}^{(1)} = 3.61$$

$$p_{3,3}^{(1)} = 3$$

$$p_{2,3}^{(1)} = 0.25$$

$$p_{1,3}^{(1)} = 0.85$$

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تأثير أنواع العبوات علي بعض الخصائص الطبيعية والكيميائية لزيت الزيتون البكر الممتاز أثناء التخزين

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EFFECT of packaging types on some physical properties and chemistry of extra virgin olive oil during storage

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الملخص

تتأثر جودة زيت الزيتون البكر الممتاز بنوعية مواد التعبئة وظروف التخزين من درجات الحرارة والتعرض للضوء والأكسجين والرطوبة ومدة التخزين، لذا هدفت هذه الدراسة الي تقييم مؤشرات الجودة لزيت الزيتون البكر الممتاز المعبأ في عبوات مختلفة هي عبوات بولي ايثلين (بلاستيك) شفاف، عبوات بولي ايثلين (بلاستيك) معتم، زجاج معتم، ومعرضة للضوء وغير المعرضة للضوء لمدة حفظ تصل إلى 180 يوماً في ظروف التخزين الإعتيادية المتبعة في التخزين المنزلي في الفترة من شهر فبراير لغاية شهر أغسطس 2021. وتم تقدير بعض الخصائص الفيزيائية: نسبة المئوية للرطوبة، معامل الإنكسار، الكثافة النوعية، والإختبارات الكيميائية مثل رقم الحموضة، رقم البيروكسيد، وذلك خلال فترات زمنية شملت (عينة المقارنة، عند 60 يوم، عند 120 يوم، عند 180 يوم) وتم تحليل النتائج إحصائياً باستخدام تحليل التباين الثنائي لتقييم الإختلافات المعنوية عند مستوي معنوية ($p < 0.05$). أظهرت النتائج أن الخصائص الطبيعية لزيت الزيتون البكر الممتاز المعبأة في العبوات المختلفة والمحافظة في ظروف التخزين الإعتيادية كانت ضمن الحدود القياسية للمواصفات العالمية والليبية لزيت الزيتون البكر الممتاز. في المقابل في المقابل، بينت نتائج الاختبارات الكيميائية أن رقم الحموضة مقدراً بالجرام لكل 100 جرام لعينة المقارنة 1.79 جم/ 100 جم في حين أن قيم رقم الحموضة لعينات زيت الزيتون تراوحت بين 2.26-2.73 وهذا القيم ضمن حدود زيت الزيتون البكر. كما أشارت النتائج أن أعلى قيمة لرقم البيروكسيد بلغت 25.66 ملي مكافئ O₂/ كجم في عينة الزيت المعرضة للضوء والمعبأة في عبوة الزجاجية الشفافة. وخلصت النتائج أن أفضل العبوات مستخدمة هي الزجاج المعتم وتليها عبوة البلاستيك المعتم، لذا يفضل استبدال العبوات البلاستيكية شائعة الاستخدام في تعبئة زيت الزيتون بالعبوات الزجاجية المعتمة.

الكلمات المفتاحية: أنواع العبوات. جودة الزيت. زيت الزيتون الليبي البكر الممتاز. فترة التخزين.

Abstract

The quality of extra virgin olive oil is affected by the type of packing materials and storage conditions such as temperature, exposure to light, oxygen, humidity and storage period. Therefore, this study aims to evaluate the quality indicators of extra virgin olive oil packed in different packages, which are transparent polyethylene (plastic) packages, opaque polyethylene (plastic) packages, opaque glass, metal which were exposed to light and not

exposed to light for a preservation period of up to 180 days under normal storage conditions used in home storage from February to August 2021. Some physical properties moisture content , refractive index, specific gravity, and chemical tests acidity number, and peroxide number. during periods of time that included (comparison sample, at 60 days , at 120 days, at 180 days) and the results were analyzed statistically using two-way anova analysis of variance to evaluate significant differences at a significant level ($p < 0.05$). The results showed that the physical properties of the extra virgin olive oil packed in different packages and preserved in the usual storage conditions were within the standard limits of the international and Libyan specifications for the extra virgin olive oil. On the other hand, the results of the chemical tests showed that there is a gradual increase in the acidity number and the peroxide number during the storage period. On the other hand, the results of the chemical tests showed that the acidity number estimated in grams for a sample compared to 1.79g /100g, while the values of the acidity number for olive oil samples ranged between 2.26 – 2.73 and these values are within the limits of virgin olive oil. These results also indicated that the highest values of the peroxide number were 25.66 mequivalent O_2 /kg in the oil sample that was exposed to light and packed in transparent glass containers. The results conclude that the best used containers are opaque glass, followed by opaque

plastic packaging, so it is preferable to replace the plastic containers commonly used in filling olive oil with opaque glass containers.

المقدمة

يعتبر زيت الزيتون (الطيب أكله و دهنه) منتج غذائي ذو أهمية صحية و تغذوية و اقتصادية. يوجد في ليبيا حوالي (8 مليون شجرة زيتون). تحتل ليبيا المرتبة 11 عالميا في إنتاج الزيتون. يبلغ الإنتاج السنوي في ليبيا حوالي 188 ألف طن/سنويا من الزيتون (FAOSTAT,2018). و يعرف زيت الزيتون البكر الممتاز (Extra virgin olive oil) أنه "زيت فوق الممتاز في الطعم و الرائحة الناتج من عصر و كبس ثمار الزيتون باستخدام طرق طبيعية، و لا تزيد حموضته الحرة معبرة عنها بحمض الأوليك عن 0.8 جرام / 100 جم" (Codex A,2015). يعتبر زيت الزيتون البكر الممتاز من أفضل أنواع زيت الزيتون من حيث الخصائص التذوقية و الثباتية و التركيب الكيميائي. و يمكن استهلاكه مباشرة نظراً لمحتواه من الأحماض الدهنية الأساسية و الفيتامينات. زيت الزيتون البكر الممتاز ذو فوائد تغذوية و علاجية و تذوقية مقارنة بأنواع زيت الزيتون الأخرى، و تعتمد جودة زيت الزيتون البكر الممتاز على العملية التي تبدأ بنسوج الزيتون و تنتهي بالتعليق. و عليه، من الضروري الحرص ليس فقط على الممارسات الزراعية و المواد الخام و الحصاد و تخزين الفاكهة و استخراج الزيت، ولكن أيضاً على كل عامل يمكن أن يؤثر على جودة الزيت. على وجه الخصوص، الأكسجين و الضوء و درجة الحرارة هي المسؤولة عن ترنخ الزيت نتيجة لتفاعلات الأكسدة و التحلل المائي (Lanza et al.,2015). و يتم إنتاج زيت الزيتون في فترة محددة خلال العام، لكن يستمر استهلاكه طول السنة، لذا يجب أن يتم حفظه بعناية. أن ظروف التخزين و نوع العبوات لهما تأثير علي فترة صلاحية الزيت (Hrnčirik & Fritsche, 2005). الجدير بالذكر يحتوي زيت الزيتون علي مركبات مضادة للأكسدة مثل المركبات الفينولية، الفا توكوفيرول، بيتا توكوفيرول و التي لها دور فعال لمنع حدوث الأكسدة و لها دور في إطالة فترة الحفظ و

ثباتية زيت الزيتون البكر الممتاز (Rahmani & Csallany, 1998). و من جانب آخر، و بسبب المستويات العالية من الأحماض الدهنية غير المشبعة . و أن هنالك العديد من العبوات و الأوعية المستخدمة في تعبئة الزيت الزيتون البكر الممتاز، و أن تتنوع أنواع العبوات المستخدمة في تعبئة زيت الزيتون الليبي المباعة في السوق الليبي يعتبر ذو أهمية علمية و اقتصادية، لذا يتطلب إجراء دراسة بحثية لتحديد مدي تأثير أنواع العبوات و ظروف التخزين (زمن و درجة حرارة و الرطوبة النسبية) على الخصائص و صفات زيت الزيتون (كيميائياً، طبيعياً، حسيماً) و معرفة مدي مطابقة عينة زيت الزيتون البكر الممتاز(عينة البحث) للمواصفات القياسية العالمية و الليبية لزيت الزيتون المعتمدة. يهدف هذا البحث إلي التحقق من تأثير ظروف التخزين (درجة للحرارة، الزمن، الرطوبة النسبية) علي الخصائص الكيميائية و الطبيعية لزيت الزيتون الليبي البكر الممتاز، الي جانب من تأثير أنواع العبوات علي الخصائص الكيميائية و الطبيعية لزيت الزيتون الليبي الممتاز. وتكمن أهمية هذه الدراسة في التعرف علي التغيرات التي تحدث في الخصائص الطبيعية والكيميائية لزيت الزيتون الليبي الممتاز ومعرفة تركيبه من الأحماض الدهنية. حيث تضيف هذه الدراسة معلومات علمية ذات أهمية في تحديد مدي مطابقة زيت الزيتون الليبي الممتاز المحفوظ في عبوات مختلفة مع المواصفات القياسية العالمية والليبية، تتحصل من خلالها علي توصيات علمية لتحديد أفضل أنواع العبوات المستخدمة في حفظ زيت الزيتون الليبي البكر في ظروف التخزين الاعتيادية.

المواد والطرق المستخدمة

تمت هذه الدراسة وفقاً ما يأتي:

الحدود الجغرافية للدراسة: تم شراء عينة زيت الزيتون الليبي البكر الممتاز من معصرة الزيتون موثوق فيها من منطقة سمنو.

الحدود الزمنية للدراسة: موسم إنتاج زيت الزيتون للعام (2021)، وتاريخ العصر والاستخلاص (23 يناير 2021) و تاريخ شراء العينة (1 فبراير 2021).

أنواع العبوات المستخدمة: بلاستيك شفاف، بلاستيك معتم، زجاج شفاف

تم شراء 10 لترات من زيت زيتون الليبي البكر الممتاز من مصدر موثوق فيه وهو (معصرة سمنو لعصر ثمار الزيتون وبيع منتجاته) (الصنف: كراتينا، المصدر: مزرعة مصباح خليفة في بلدة سمنو). تم حفظ عينات زيت الزيتون (1 لتر لكل عبوة) في عبوات مختلفة (بلاستيك شفاف، بلاستيك معتم، زجاج شفاف).

حيث تم الحفظ في مكان جيد التهوية بعيد عن مصدر الضوء المباشر وبعيد عن الرطوبة وأي مصدر ثلوث مثل الغبار أو الحشرات على درجة حرارة الغرفة (حيث تم قياس التغيرات التي تحدث في درجة الحرارة خلال فترة التخزين الاعتيادية).

تم تجهيز مكان إجراء التجارب المعملية (بمعامل كلية علوم الأغذية بجامعة وادي الشاطئ). معمل تحليل الأغذية بقسم جودة وسلامة الأغذية. وحفظت العبوات علي درجة حرارة الغرفة، وتم إجراء الاختبارات الفيزيائية والكيميائية وبعد كل (0 يوم عينة مقارنة، 60، 120، 180 يوم).

التحليل الإحصائي

كل التجارب تمت بإجراء ثلاث تكرارات لضمان الحصول علي تحليل إحصائي جيد للنتائج

تم تحليل النتائج إحصائياً باستخدام تحليل التباين (ANOVA) باستخدام اختبار أقل فرق معنوي ($\alpha=0.05$) لتحديد الفروق المعنوية بين المعاملات المختلفة.

نتائج الدراسة ومناقشتها: الاختبارات الفيزيائية

جدول (1)

يوضح النسبة المئوية للرطوبة لعينات زيت الزيتون المعرضة وغير المعرضة للضوء.

F-stat	القياسات						المرجعية	المتغير	الصف
	بعد 180 يوم		بعد 120 يوم		بعد 60 يوم				
	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي			
							0.20		
0.4	0.00	0.30 ^{Ac}	0.06	0.26 ^{Ab}	0.00	0.20 ^{Aa}		بلاستيك شفاف	عينات معرضة للضوء
	0.00	0.30 ^{Ab}	0.00	0.20 ^{Aa}	0.00	0.20 ^{Aa}		بلاستيك معتم	
	0.00	0.30 ^{Ab}	0.00	0.20 ^{Aa}	0.00	0.20 ^{Aa}		زجاج معتم	
	0.00	0.30 ^a	0.00	0.30 ^a	0.00	0.30 ^{B*}		بلاستيك شفاف	غير المعرضة للضوء
	0.00	0.30 ^a	0.00	0.30 ^a	0.00	0.30 ^{B*}		زجاج معتم	
	0.00	0.20 ^a	0.00	0.20 ^a	0.00	0.20 ^{Aa}		بلاستيك معتم	

النتائج محسوبة علي أساس (المتوسط الحسابي \pm الانحراف المعياري) الحروف المتشابهة تعني لا يوجد فروق معنوية بين المتوسطات. (a) تبين الفروقات في نوع العبوة (A) تبين الفروقات في الزمن.

المحتوى المائي في زيت الزيتون الطازج 0.5% من الوزن (Papadimitriou et al.2013)، و قد تتجاوز في بعض الزيوت الزيتون المستخلصة حديثاً (1.0-1.5%)، و يؤثر عملية الطرد المركزي على محتوى المائي في زيت الزيتون (Guerrini & Parenti,2016).

توضح النتائج المدونة في الجدول رقم (1) تأثير كل من الزمن والعبوة والضوء علي جودة الزيت خلال فترة التخزين، حيث أظهرت نتائج التحليل الإحصائي للرطوبة وجود فروق معنوية بين المتغيرات بالنسبة للعينات المعرضة لضوء فكانت أعلى نسبة بعد 180 يوم لكل العبوات وتعتبر غير مطابقة للمواصفة القياسية الدولية. وكذلك أيضاً توجد فروق معنوية بين المتغيرات بالنسبة للعينات غير المعرضة لضوء فكانت أعلى نسبة في عبوة بلاستيك الشفاف (0.30) وأقل نسبة سجلت في عبوة البلاستيك المعتم (0.2) وتعتبر هذه القيمة مطابقة للمواصفات القياسية والدولية. أما باقي العبوات غير مطابقة للمواصفات القياسية الليبية والدولية التي تنص علي ألا تزيد نسبة الرطوبة عن (0.2%)، وهو الحد المسموح به في

المواصفة القياسية الليبية والدولية وحسب ما تنص عليه المواصفات القياسية الصادرة من (المجلس الدولي لزيت الزيتون (I.O.O.C, 2007). أما باقي العبوات لا توجد بينها فروق معنوية عند مستوي معنوية (p<0.05)

جدول (2)

يوضح معامل الانكسار لعينات زيت الزيتون المعرضة وغير المعرضة للضوء.

F-stat	القياسات						المرجعية	الصف	المتغير
	بعد 180 يوم		بعد 120 يوم		بعد 60 يوم				
	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي			
0.213							1.466		الضوء
	0.0000	1.465 ^{Ab}	0.0000	1.465 ^{Ab}	0.0020	1.465 ^{Ab}		بلاستيك شفاف	عينات معرضة للضوء
	0.0052	1.465 ^{Ab}	0.0001	1.465 ^{Ab}	0.0000	1.466 ^{Ab}		بلاستيك معتم	
	0.0001	1.465 ^{Ab}	0.0001	1.465 ^{Ab}	0.0001	1.466 ^{Ab}		زجاج معتم	
							1.466		الضوء
									غير المعرضة للضوء
	0.0000	1.467 ^{Ab}	0.0000	1.477 ^{Ab}	0.0001	1.477 ^{Ab}		بلاستيك شفاف	
	.00010	1.465 ^{Ab}	0.0001	1.466 ^{Ab}	0.0001	1.467 ^{Ab}		زجاج معتم	
	.00010	1.465 ^{Ab}	0.0000	1.466 ^{Ab}	0.0000	1.467 ^{Ab}		بلاستيك معتم	

النتائج محسوبة علي أساس (المتوسط الحسابي \pm الانحراف المعياري) الحروف المتشابهة تعني لا يوجد فروق معنوية بين المتوسطات. (a) تبين الفروقات في نوع العبوة (A) تبين الفروقات في الزمن. توضح النتائج المدونة أيضا في الجدول (2) تأثير كل من الزمن والضوء والعبوة علي جودة زيت الزيتون أثناء التخزين لمدة 6 أشهر. حيث أظهرت نتائج التحليل الإحصائي بالنسبة لمعامل الانكسار عدم وجود فروق معنوية بين المتغيرات المعرضة لضوء وغير المعرضة لضوء. مع ذلك نلاحظ أن كل المتغيرات سواء المعرضة لضوء وغير المعرضة لضوء واقعة في الحدود المسموح بها طبقاً للمواصفة القياسية والدولية والتي تتراوح نسبة معامل الانكسار (1.4705 – 1.477).

جدول (3)

يوضح الكثافة النوعية لعينات زيت الزيتون المعرضة وغير المعرضة للضوء.

F-stat	القياسات						المرجعية	الصنف	المتغير
	بعد 180 يوم		بعد 120 يوم		بعد 60 يوم				
	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي			
0.139							0.939		
	0.00	^{Aa} 0.852	0.00	^{Aa} 0.852	0.00	^{Aa} 853.0		بلاستيك شفاف	
	0.00	^{Aa} 0.845	0.00	^{Aa} 0.862	0.00	^{Aa} 0.862		بلاستيك معتم	
	0.00	^{Aa} 0.847	0.00	^{Aa} 0.847	0.00	^{Aa} 0.848		زجاج معتم	
								الضوء	
0.139									
	0.00	0.842 ^{Aa}	0.00	0.875 ^{Aa}	0.00	0.876 ^a		بلاستيك شفاف	
	0.00	0.851 ^{Aa}	0.00	0.921 ^{Ba}	0.00	0.922 ^{Ba}		زجاج معتم	
	0.00	0.872 ^{Aa}	0.00	0.872 ^{Aa}	0.00	0.873 ^{Aa}		بلاستيك معتم	
								غير المعرضة للضوء	

النتائج محسوبة علي أساس (المتوسط الحسابي \pm الانحراف المعياري) الحروف المتشابهة تعني لا يوجد فروق معنوية بين المتوسطات. (a) تبين الفروقات في نوع العبوة (A) تبين الفروقات في الزمن.

توضح نتائج أيضا في الجدول (3) قيم الكثافة النوعية للزيت أثناء التخزين. حيث أظهرت نتائج التحليل الإحصائي بالنسبة للكثافة النوعية أنه لا توجد فروق معنوية بين المتغيرات المعرضة للضوء كما لا توجد فروق معنوية أيضا بالنسبة للمتغيرات غير المعرضة للضوء. يعتبر زيت الزيتون ذو كثافة نوعية أقل من الماء، إذ تتراوح لكثافة النوعية لزيت الزيتون (0.910 – 0.916 جرام/سم³) عند درجة حرارة 25 درجة مئوية. قد يعزى انخفاض الكثافة النوعية لزيت الزيتون إلى ارتفاع درجات الحرارة أثناء التخزين (Esteban *et.al.*2012).

الاختبارات الكيميائية:

جدول (4)

يوضح رقم الحموضة لعينات زيت الزيتون المعرضة وغير المعرضة للضوء.

Sig	F	القياسات						المرجعية	الصف	
		بعد 180 يوم		بعد 120 يوم		بعد 60 يوم				
		الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي			
								1.79		
0.005	14.00	0.06	2.53 ^{ab}	0.00	2.40 ^{ab}	0.06	2.33 ^{ab}		بلاستيك شفاف	العينات المعرضة للضوء
0.014	9.50	0.06	2.47 ^{ab}	0.06	2.37 ^{ab}	0.00	2.30 ^{ab}		بلاستيك معتم	
0.004	16.000	0.06	2.67 ^{ab}	0.1000	2.40 ^{ab}	0.00	2.40 ^{ab}		زجاج معتم	
								1.79		
0.016	9.000	0.06	2.53 ^{ab}	0.06	2.43 ^a	0.06	2.33 ^{ab}		بلاستيك شفاف	غير المعرضة للضوء
0.037	6.000	0.06	2.47 ^{ab}	0.0000	2.40 ^{ab}	0.06	2.33 ^{ab}		زجاج معتم	
0.007	13.000	0.06	2.33 ^{ab}	0.0000	2.40 ^{ab}	0.00	2.30 ^{ab}		بلاستيك معتم	

النتائج محسوبة على أساس (المتوسط الحسابي \pm الانحراف المعياري) الحروف المتشابهة تعني لا يوجد فروق معنوية بين المتوسطات. (a) تبين الفروقات في نوع العبوة (A) تبين الفروقات في الزمن.

توضح النتائج المدونة في الجدول (4) تأثير ظروف التخزين وأنواع العبوات على رقم الحموضة حيث بينت النتائج أن رقم الحموضة لعينة الزيت الزيتون البكر الممتاز (المقارنة) بلغت 1.79% مقدرة (% حمض الأوليك) هذه القيمة ضمن حدود الزيت الزيتون البكر حسب مواصفات المجلس الدولي لزيت الزيتون (I. O. O. C, 2007). قد يعزي ارتفاع رقم الحموضة عن قيمة المنصوص عليها في المواصفات القياسية (0.8 جم/100 جم) لزيت الزيتون البكر الممتاز إلى عدة أسباب منها: سوء تداول ثمار الزيتون بعد الحصاد، طول الفترة بين جني ثمار زيت الزيتون وعملية عصر واستخلاص زيت الزيتون (Zarazir et al., 2019). بينت النتائج أعلى نسبة بعد 180 يوم أقل نسبة سجلت بعد 60 يوم. أما بالنسبة للعينات المعرضة للضوء يُلاحظ أن هناك فروق معنوية بين العبوات المعرضة للضوء، فسجلت أعلى نسبة لعبوة الزجاج المعتم وأقل نسبة لعبوة البلاستيك معتم. أما بالنسبة للعينات غير المعرضة للضوء هنالك فروق معنوية بين المتغيرات فسجلت أعلى نسبة لعبوة البلاستيك الشفاف، وسجلت أقل نسبة لعبوة بلاستيك المعتم. وبينت بعض الأبحاث على زيت الزيتون البكر الممتاز أن زيادة وقت التخزين لها تأثير سلبي على معايير جودة زيت الزيتون البكر الممتاز عند تخزينه في الظروف الاعتيادية في عبوات زجاجية والبلاستيكية أدت إلى زيادة الحموضة (Rotond et al. 2021).

جدول (5)

يوضح رقم البروكسيد لعينات زيت الزيتون المعرضة وغير المعرضة للضوء.

Sig	F	القياسات						المرجعية	الصف	المتغير
		بعد 180 يوم		بعد 120 يوم		بعد 60 يوم				
		الانحراف الحسابي	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي	الانحراف المعياري	المتوسط الحسابي			
								10.10		
0.000	96.95 1	0.06	25.66 ^{Ac}	0.06	17.06 ^{Cb}	0.06	14.03 ^{Aa}		بلاستيك شفاف	العينات المعرضة للضوء
0.000	17.14 3	0.06	20.66 ^{Ac}	0.06	14.13 ^{Ab}	0.25	9.26 ^{Ba}		بلاستيك معتم	
0.000	53.90 0	0.11	21.06 ^{Ac}	0.06	18.16 ^{Db}	0.28	16.26 ^{Ca}		زجاج معتم	
0.000	54.04 8	0.10	17.20 ^{Ac}	0.06	14.13 ^{Ab}	0.90	12.86 ^{Aa}		بلاستيك شفاف	غير المعرضة للضوء
0.000	35.24 0	0.10	15.60 ^{Ab}	0.06	13.13 ^{Aa}	0.26	12.10 ^{Aa}		زجاج معتم	
0.000	11.83 5	0.25	15.73 ^{Ab}	0.06	12.13 ^{Aa}	0.02	10.12 ^{Aa}		بلاستيك معتم	

النتائج محسوبة علي أساس (المتوسط الحسابي \pm الانحراف المعياري) الحروف المتشابهة تعني لا يوجد فروق معنوية بين المتوسطات. (a) تبين الفروقات في نوع العبوة (A) تبين الفروقات في الزمن.

يتأكسد زيت الزيتون عند تعرضه لضوء ودرجة الحرارة. ومن خلال عملية التأكسد يحدث ارتباط ما بين ذرات الأكسجين والروابط المزدوجة الموجودة في الأحماض الدهنية متعددة الروابط غير المشبعة مثل اللينولييك و اللولينييك وتتكون الجذور الحرة وجزيئات البيروكسيد. و ينتج عن عملية التأكسد تحطم الأحماض الدهنية وتكون مركبات لها رائحة ونكهة غير مرغوبة تسبب تزنج الزيت تؤثر سلباً على جودة الزيت. هنالك العديد من العوامل التي تعمل على تأكسد الزيت وهي: الحرارة، الضوء و بعض العناصر المعدنية مثل النحاس والحديد. كما أن تحدث عملية التأكسد أثناء تعبئة الزيت الزيتون وخلال فترة التخزين وخاصة عندما يتعرض لظروف غير مناسبة أثناء التخزين (Gargouri et al.2015). يلاحظ من النتائج أن قيم رقم البروكسيد أن هناك فروق معنوية بالنسبة للمتغيرات المعرضة للضوء وكذلك غير المعرضة للضوء، أن هناك ارتفاع تدريجي لرقم البروكسيد كلما زادت مدة التخزين زادت نسبة البروكسيد في الزيت الزيتون. بالنسبة للزمن سجلت أعلى نسبة بعد 180 يوم بالنسبة للعينات المعرضة للضوء سجلت أعلى نسبة لعبوة بلاستيك الشفاف (25.66) وأقل نسبة لعبوة بلاستيك المعتم (20.66). وهذه النسب غير مطابقة للمواصفات القياسية الليبية والدولية. أما بالنسبة للعينات غير المعرضة سجلت أعلى نسبة لعبوة بلاستيك الشفاف (17.20) وأقل نسبة لعبوة الزجاج المعتم (15.60) وهذه النسب واقعة في

الحدود المسموح بها طبقاً للمواصفات القياسية الليبية والدولية التي تنص علي ألا تتعدى نسبة البروكسيد عن 20 مللي مكافئ/كجم زيت.

الاستنتاجات والتوصيات

بناءً على نتائج الدراسة الحالية، يمكن أن نستنتج ما يلي: يتضح من ارتفاع قيم رقم الحموضة مقدرة بالجم/100 جم لعينة المقارنة (0.05 ± 1.79)، وتراوحت قيم رقم الحموضة في عينات زيت الزيتون وفقاً لظروف التخزين الاعتيادية بين ($0.05 \pm 2.33 - 0.05 \pm 2.67$)، هي أعلى من قيمة رقم الحموضة لزيت الزيتون البكر الممتاز وفقاً للمواصفات القياسية (0.8 جم/100 جم)، قد يعزي ذلك إلي المعاملات بعد الحصاد وأثناء العصر واستخلاص زيت الزيتون والتي تؤثر في جودة الزيت، أو بسبب خلط زيت زيتون الموسم الماضي مع زيت زيتون الموسم الحالي، وعليه فأن عينات الزيت المستخدمة في هذا البحث تندرج تحت صنف (زيت الزيتون البكر العادي *Ordinary virgin olive oil*) وليس زيت الزيتون البكر الممتاز (*Extra virgin olive oil*).

حدوث تدهور في معايير الجودة زيت الزيتون في ظل ظروف التخزين الاعتيادية للعينات المعرضة للضوء وغير المعرضة للضوء وخاصة في الأشهر 6-7 بسبب إرتفاع درجات الحرارة خلال فترة التخزين.

أظهرت النتائج أن أفضل العبوات المستخدمة هي الزجاج المعتم ويليه البلاستيك المعتم.

توصي الدراسة إلى الحاجة إلى مزيد من الدراسات لتوضيح تأثير حفظ الزيتون البكر الممتاز من مناطق زراعية مختلفة في ليبيا، ودراسة تأثير ظروف تخزين مع مراعاة الفراغ الرأسي في العبوات المستخدمة، ودراسة هجر المواد اللدائنية من العبوات اللدائنية الشائع استخدامها في تعبئة زيت الزيتون الليبي.

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Identification of natural products in *Pimpinella armena* L. in Sulaymaniyah - northern Iraq by GC-MASS

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Identification of natural products in *Pimpinella armena* L. in Sulaymaniyah - northern Iraq by GC-MASS

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summary

This study aimed to evaluate the chemical analysis of the methanolic extract of *Pimpinella armena* leaves by using GC-MS. The results showed the presence of alkaloids, sterols, flavonoids, glycosides, fatty acids, terpenoids, phenols and carbohydrates, as well as GC-MS analysis revealed the presence of 20 biological compounds in the methanolic extract. Fatty acids 10-Octadecenoic acid methyl ester and Heptadecanoic acid, 9-methyl-, methyl ester possessed The highest percentage, as reached 30.24% and 20.44% respectively, while the rest of the terpene compounds varied in their presence percentage in the leaves extract.

Keywords: Methanolic extract, *Pimpinella armena* leaves, GC-MS analysis

Introduction

Flowering plants make up at least 95% of all vascular plants on Earth. The tent family has a global distribution, as it is found mainly in the temperate and northern regions (Airy Shaw and Willis, 1973). Most plants of Umbelliferae (Apiaceae) are herbaceous plants rarely shrubs (Heywood, 1976). This family is considered one of the most important flowering plant families, and it includes a large number of genera and species.(Judd *et al.*,1990) mentioned that this family is widespread in tropical and temperate regions, it includes 400 genera and 4250 species. Ghazanfar and McDaniel (2016) mentioned that this family is the fifth largest plant family in Iraq and it is represented by approximately 67 genera and 155 species.

This family is considered one of the economically important families because many of them are used as food, such as *Anethum graveolens* L., or as sweeteners such as *Foeniculum*

vulgare Mill, also this family is a source of gum, perfumes, and a few of its species are used for adornment (Al-Rawi, 1987; Judd *et al.*, 1990). Plants are a storehouse of primary metabolism products that are essential for nutrition such as carbohydrates, proteins, etc. Secondary metabolites are the active ingredients in plants. Secondary metabolites are produced from primary metabolites and used by plants as defense materials to protect themselves from stress, and other organisms and as a means of adapting to their environment. These metabolites are of great importance as antioxidants through their antibacterial and antiviral activity and also contribute to raising the human immune system efficiency (Monisha and Balliah,2015; Hill,1952; Campos,2019). The secondary metabolites groups are distinguished by their various chemical compositions such as phenols, flavonoids, saponins, steroids, coumarins, terpenes, alkaloids, glycosides, tannins, etc. (Campos,2019). In general, flavonoids are used in several therapeutic and pharmacological aspects (Huang *et al.*, 2014). They are used as antioxidants, anti-cancer and anti-inflammatory, and are also used in the treatment of heart diseases. The plants produce about 12,000 types of alkaloids (Ziegler and facchini,2008). the alkaloids show vital activity as an antioxidant and antibacterial (Czapski *et al.*,2014; Karou *et al.*,2006). Glycosides are also used as antiviral substances (Afolabi *et al.*,2007; Qadir,2015). In the current study, the active ingredients were detected in the secondary metabolites of *Pimpinella armena*. This species was recorded for the first time in the Iraqi flora (Ameen, 2021). It is known in some Turkey regions as Anason and is used as a sedative and repellent for gases. (Özdemir and Alpınar, 2015) The methanolic extract of this plant was analyzed using GC-MAS technology to detect some bioactive components . This study aimed to evaluate the chemical analysis of the methanolic extract of *Pimpinella armena* leaves by using GC-Mass

Materials and methods

Sample collection

The wild plants were collected through field trips to Mount Izmar in Sulaymaniyah - northern Iraq For the period from 1-6/2022. The leaves of the *Pimpinella armena* plant were obtained. The leaves were dried with room temperature and then grind by an electric mill for obtaining Leaves powder.

Alcoholic extract preparation

To prepare the extract, 50 g of leaves powder was mixed with 500 ml of Ethanol alcohol at a concentration of 70% in a Erlenmeyer flask capacity of 1000 ml. The flask was closed with cotton and aluminum foil, then placed in a shaking incubator and left for 24 hours at room temperature. The mixture was filtered by using several layers of medical gauze to remove fibers after that it was centrifuged at a speed of 3000 r/min for 10 minutes, then the extract was filtered using type Whatman filter papers no.1.0 to obtain a clear solution for use in gas chromatography–mass spectrometry (GC-MS) (Hernández-Pérez *et al.*, 1994).

GC-Mass analysis

The analysis was carried out by using the GC-MS device model A7820 from Agelint company, and the analysis conditions were as follows:

- Colum: Hp-5ms ultra Inert (30m length x)
- 250 nm diameter x 0.25 µm inside diameter
- Injection volume: 1 µl
- Pressure: 11.933 psi
- GC inlet line temperature: 250 C
- Aux heaters temperature: 310 C
- Carrier Gas: He 99.99%
- Injection Temperature: 250 C
- Injection type: splitless
- Scan range: m/z 50-500
- Oven Program:
- Ramp1: 50 C Hold 1 min., Ramp1: 50 C to 150 C, 5 C/ min
- Ramp2: 150 C to 280 C, 8 C/min
- Time amounted to about 37 min

Results and Discussion

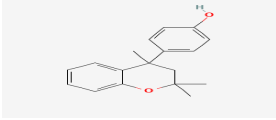
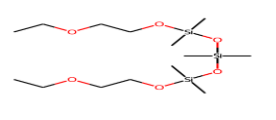
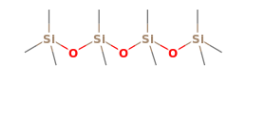
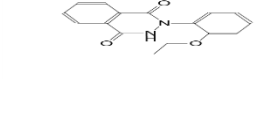
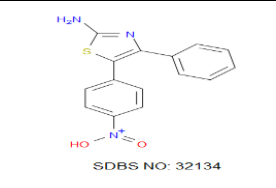

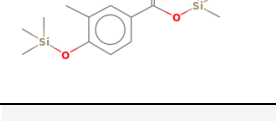
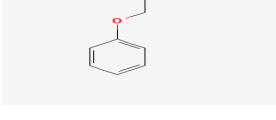
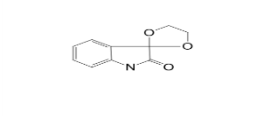
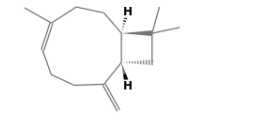
The results showed the presence of active chemical compounds in the alcoholic extract of *Pimpinella armena* leaves, which were detected by gas chromatography-mass spectrometry technique as in Tab. 1 and 2. The detection results showed the presence of 20 active compounds in the leaf extract as in Fig. 1, and the detection results also confirmed that a group of fatty acids had given the highest percentages. The fatty acid 10-Octadecenoic acid, methyl ester showed a percentage of 30.24% at the 24 minute of the detention time, while the fatty acid Heptadecanoic acid, 9-methyl-, methyl ester showed a percentage of 20.44% at the 21.7th minutes of the detention time. The detection results also showed the presence of many volatile oils, as the compound Longifolene-(V4) showed a high concentration of 20.04% at the 14.6th minutes of retention time, it is one of the sesquiterpenoid compounds. The rest of the terpene compounds also varied in their presence in the leaf extract, as they gave the following compounds (Phenyl buta-2,3-dienyl ether, Thujone 1'-o-Tolylprop-2-en-1-one, Bicyclo[7.2.0]undec-4-ene,4,11,11-trimethyl-8-methylene-, Caryophyllene oxide) percentages ranged between (0.35-6.82)%, most of them were sesquiterpenoid. The extract also contained phenolic compounds, flavonoids, and alkaloids, as the compound Trimethylsilyl3-methyl-4-[(trimethylsilyl) oxy] benzoate gave the lowest percentage as it reached 0.28% at the 9.5th minute of the detention time. The compounds (7,7,9,9,11,11-Hexamethyl-3,6,8,10,12,15-hexaoxa-7,9,11-trisilaheptad) and Tetrasiloxane, desmethyl- and (Cyclotetrasiloxane, octamethyl-) have medical importance, as well as many compounds that are repeated in different time periods. MS-GC analysis showed the presence of many active compounds containing hydroxyl groups, carbonyl groups and double bonds, these compounds have various biological activities such as antioxidants and anti-microbials. The appearance frequency of Fatty acid methyl esters at the highest levels in the extract may be due to the high percentage of esterified fatty acids in plants of the umbelliferae family (Knothe and Steidley 2019). The biological activities of these compounds are vital indicators of the medicinal efficacy of these plants, as well as some of them have various pharmacological activities (do Nascimento Santos *et al.*, 2018). Alfekaiki (2018) proved that the fatty acids extracted from the oil of *Pimpinella anisum* L. have a positive effect as antioxidants. The

sesquiterpenoid constitutes the largest percentage among the active compounds, as Paksoy *et al.*, (2016) confirmed that the oils extracted from some species of the umbrella family have biological activity as an antimicrobial, as well as Mehrabanjoubani *et al.*, (2021) confirmed the oils were extracted from some species of *Pimpinella anisum* L. act as effective antioxidants.


Table 1: compounds identified from methanol extract of leaves of *Pimpinella armena* and Phytochemicals, Retention time and % peak Area

Peak No	Compound	Phytochemicals	Retention time	Area(%)
1.	Phenol, 4-(3,4-dihydro-2,2,4-trimethyl-2H-1-benzopyran-4-yl)-	Phenol	5.9	1.895
2.	7,7,9,9,11,11-Hexamethyl-3,6,8,10,12,15-hexaoxa-7,9,11-trisilaheptad	Polymer	6.1	2.194
3.	Tetrasiloxane, decamethyl-	Polymer	6.2	0.388
4.	Phthalazine-1,4(2H,3H)-dione, 2-(2-ethoxyphenyl)-	Alkaloids	6.3	0.952
5.	5-(p-Nitrophenyl)-4-phenyl-2-thiazolamine	Alkaloids	6.8	0.350
6.	Cyclotetrasiloxane, octamethyl-	Polymer	9.3	2.643
7.	Trimethylsilyl 3-methyl-4-[(trimethylsilyl)oxy]benzoate	Flavonoids	9.5	0.285
8.	Phenyl buta-2,3-dienyl ether	monoterpene	11.0	0.352
9.	Spiro[1,3-dioxolane-2,3'-[3H]indol]-2'(1'H)-one	Alkaloids	12.5	1.541
10.	Bicyclo[7.2.0]undec-4-ene,4,11,11-trimethyl-8-methylene-	essential oil	13.4	3.089
11.	5,8,11,14-Eicosatetraenoic acid, methyl ester, (all-Z)-	fatty acid	13.9	0.622
12.	Longifolene-(V4)	sesquiterpenoid	14.6	20.046
13.	1-o-Tolylprop-2-en-1-one	monoterpene	15.2	1.039
14.	Benzene, (3-methyl-2-butenyl)-	Alkane	15.4	1.298
15.	Caryophyllene oxide	Sesquiterpenoid	16.5	4.387
16.	Caryophyllene oxide	Sesquiterpenoid	16.6	6.822
17.	6-(3,5-Dimethyl-1H-pyrazol-1-yl)-N-benzyl-1,2,4,5-tetrazine-3-amine	Alkaloids	18.0	0.695

Table 2. Chemical formulas and compositions of the separated compounds

Peak No	Compound	structure	formula
1.	Phenol, 4-(3,4-dihydro-2,2,4-trimethyl-2H-1-benzopyran-4-yl)-		$C_{18}H_{20}O_2$
2.	7,7,9,9,11,11-Hexamethyl-3,6,8,10,12,15-hexaoxa-7,9,11-trisilaheptad		$C_{14}H_{36}O_6Si_3$
3.	Tetrasiloxane, decamethyl-		$C_{10}H_{30}O_3Si_4$
4.	Phthalazine-1,4(2H,3H)-dione, 2-(2-ethoxyphenyl)-		$C_{16}H_{14}N_2O_3$
5.	5-(p-Nitrophenyl)-4-phenyl-2-thiazolamine	 SDBS NO: 32134	$C_{15}H_{11}N_3O_2S$
6.	Cyclotetrasiloxane, octamethyl-		$C_8H_{24}O_4Si_4$
7.	Trimethylsilyl 3-methyl-4-[(trimethylsilyl)oxy]benzoate		$C_{14}H_{24}O_3Si_2$
8.	Phenyl buta-2,3-dienyl ether		$C_{10}H_{10}O$
9.	Spiro[1,3-dioxolane-2,3'-[3H]indol]-2'(1'H)-one		$C_{10}H_9NO_3$
10.	Bicyclo[7.2.0]undec-4-ene,4,11,11-trimethyl-8-methylene-		$C_{15}H_{24}$

11.	5,8,11,14-Eicosatetraenoic acid, methyl ester, (all-Z)-		$C_{21}H_{34}O_2$
12.	Longifolene-(V4)		$C_{15}H_{24}$
13.	1-o-Tolylprop-2-en-1-one		$C_{10}H_{10}O$
14.	Benzene, (3-methyl-2-butenyl)-		$C_{11}H_{14}$
15.	Caryophyllene oxide		$C_{15}H_{24}O$
16.	Caryophyllene oxide		$C_{15}H_{24}O$
17.	6-(3,5-Dimethyl-1H-pyrazol-1-yl)-N-benzyl-1,2,4,5-tetrazine-3-amine		$C_7H_8N_6O$
18.	Thujone		$C_{10}H_{16}O$
19	Heptadecanoic acid, 9-methyl-, methyl ester		$C_{19}H_{38}O_2$

20	10-Octadecenoic acid, methyl ester		$C_{19}H_{36}O_2$
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It is clear from the foregoing that the tentacle family is of great importance in terms of its active components and its effective biological importance

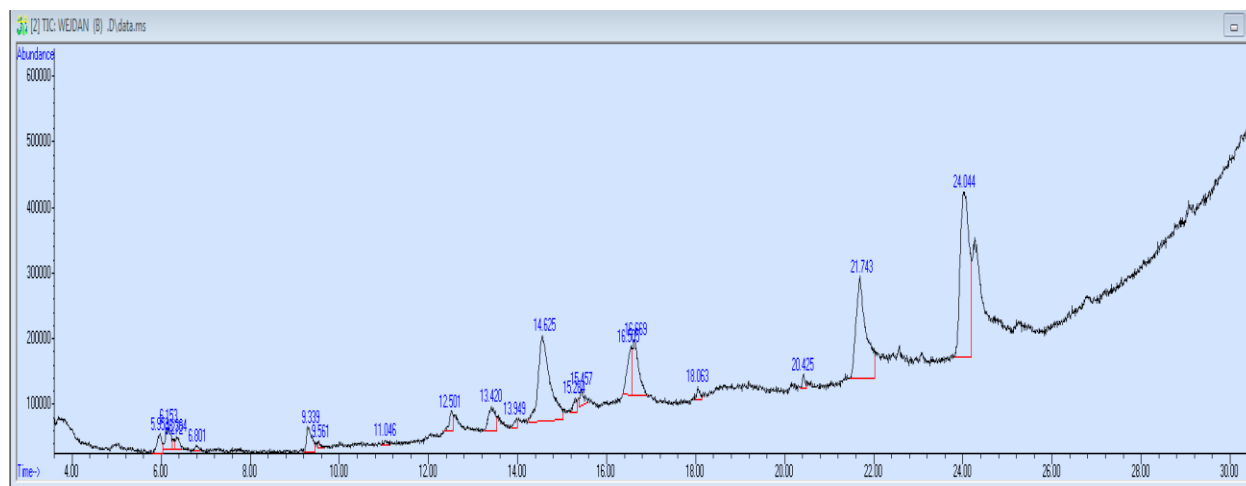


Fig. 1 GC–

MS total ion chromatograms of compounds identified from methanol extract of leaves of *Pimpinella armena*.

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Attack of AES Ciphertext by using innovated Heuristic Model Based on Strawberry Algorithm

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1- ABSTRACT

With the development of cyber security and the emergence of an urgent need to access information in any way, even if it is not authorized in various conflicts between countries, the importance of research in the field of attacking the secure texts has emerged remarkably recently. Meta-heuristic(MH) algorithms are a kind of adaptive algorithms to solve a wide range of optimization problems that are difficult to solve using traditional methods, which have proven highly effective in this domain, including the problems of attacking encrypted texts and breaking them in a reasonable time. This paper will proposed a new approach based on strawberry Algorithm(SA)for attacking the AES cipher texts to find the encryption key. The traditional algorithms used to attack the ciphers encrypted with different encryption methods suffer from their lack of intelligence to reach the plain text in a reasonable time. Therefore, this paper aims to achieve two goals, the first goal is to design an approach based on the strawberry algorithm to attack encrypted texts using the AES algorithm, and the second goal is to measure the effectiveness of the proposed approach compared to other attacking methods. The proposed approach comprises four phases; initialize the population of virtual AES encryption key using randomly manner, creating both of key, best array, search to find the encryption key elements using an adaptive strawberry algorithm and finally, measuring the proposed approach effectiveness in comparing to other attacking methods. The results showed a remarkable progress for proposed search algorithm compared to other cipher-breaking methods in terms of the time taken to break the cipher and access the plain text by 60%. The use of unconventional and intelligent methods achieves satisfactory results in acceptable and reasonable time.

Keyword:- Encryption, Plaintext, Ciphertext, Heuristic, strawberry, cryptanalysis.

1. INTRODUCTION

The field of data security has witnessed a remarkable development in recent times to preserve the confidentiality of sensitive data, such as data that has a bearing on the military and economic security of countries, and so on from other aspects of a high degree of importance. On the contrary, countries, especially developed ones, seek to build smart and sophisticated systems to attack this protected data in order to obtain data that helps them attack hostile countries in unauthorized ways. The cyber-attacks that some countries and some business companies have been exposed to are a good example of this. As a result of all of the above, an urgent need has emerged to build smart and powerful systems for cyber-attack and access to the required data at an appropriate and reasonable time to achieve the desired goal.

Cryptography is the science that highlights the means of secure communication between two sides. Accordingly, the encryption system includes two folds, one known as encryption and the other as decryption which they are two opposite parts in terms of purpose and steps. The aim of the first part is to encode important and sensitive data in a way that is difficult to access without a license. As for the second part of the system, it studies the methods through which it is possible to access the secure data without needing to know the key or the method in which data was encoded in order to cut off road against unauthorized access[1]. This paper present an improvement intelligent approach which based on Strawberry Algorithm(SA) which is one of meta-heuristic algorithms in order to attack the texts that were encrypted by using AES algorithm.

A decryption process has a key goal centered on how to get the plaintext from the ciphertext without having to know the encryption key. On the other words, there are three strategy types can be used to achieve the attack any ciphertext. These cryptanalysis strategies can be classified based on their requirements into attack based on ciphertext-only, attack based on the plaintext only and attack depend on the ciphertext and part of plaintext [2]. The strategy of this study approach is similar to the third strategies.

One of the block cipher that is symmetrical and sometimes is called as the Rijndael algorithm is the AES algorithm [3]. One of the advantages of the AES algorithm is its ability

to work with three different sizes of encryption keys 128, 192, 256 to break the ciphertext(128 bits) and convert it to plaintext(128 bits)[4]. This is the feature that made the AES algorithm more security exponentially stronger than the DES algorithm that uses a 56-bit encryption key [5]. The ciphertexts that the proposed approach of this paper try to break them were encrypted by using AES algorithm.

On the other side, one of the procedures that is designed to search for reasonable solutions to various complex optimization problems is called as a metaheuristics Which falls under the branch of computer science and mathematical optimization.

On the other side, one procedures that is designed to search for reasonable solutions to various complex optimization problems is called as a metaheuristics Which falls under the branch of computer science and mathematical optimization[6]. One of the important features that distinguish this type of algorithm is its ability to find solutions to a wide range of complex optimization problems by making some assumptions that are suitable for the process of finding them. On the other words, metaheuristic algorithm can be consider as a framework to represent the optimization problem and finding the solution for it. There is no guarantee of obtaining globally optimal solutions in a given class of problems when using metaheuristic algorithms compared to iterative methods and optimization algorithms. It should be noted that the process of obtaining optimal solutions in general in a particular class of problems is not guaranteed compared to other iterative methods, but there is guaranteed to obtain a good solution. ÷n addition, one of the characteristics that characterize this type of optimization algorithm is the so-called random optimization, it's using provides a time shortening in reaching a solution as well as safety from not falling into local optima and escaping to global optima[7]. These aforementioned attributes that characterized metaheuristic algorithms made it imperative to use one of them to find solutions to optimization problems in the field of cryptanalysis because of its importance in reducing the time required to reach the real encryption key. Therefore, this paper is used Strawberry Algorithm(SA) to achieve this purpose.

2. RELATED WORKS

S. Ahmed Tariq in [8], use the operator of Mutation in order to improve the PSO which was named later Mutation PSO (MPSO). The reason that prompted the researcher to use the mutation is that it is an effective tool to sustain the momentum and diversification within the population. The two types of substitution and classic cipher substitution were attacked using the developed algorithm. The obtained experimental results show the high stub of the developed algorithm in terms of key recovered amount from the classical ciphers and the fitness functions values compared with PSO, improved 2-opt PSO and simulated annealing PSO[8].

Singh et al. in [9], proposed a new algorithm used to break single surrogate ciphers based on the firefly algorithm. To determine the potential fitness function values, the English language statistical data were used. The experimental results showed a better ability of the developed algorithm with large ciphertexts.

T. K Manish and et al. in[10], This paper proposed an improved cryptography mathematical model. In this model, three level of encryption are used. In the first level, by using the given text, the Ciphertext1. While, second level will be used to generate the Ciphertext2 from the Ciphertext1 by treating it using genetic algorithm. finally, the third level will be used in order to make the Ciphertext2 more strong via treating it using an effective randomness manner to create Ciphertext3.

A. Seeven et al. in [11], A framework for determining the appropriate encryption algorithm will be proposed by this paper. On the other hand, in this study, through the use of metaheuristic algorithms, the relative strength of executing lightweight block ciphers will be measured. The experimental results showed the similarity of both the LWC algorithms and the AES algorithm in terms of encryption strength, despite the simplicity of building the LWC algorithm. Furthermore, comparing with the AES, it's execution is considered faster with less resources.

D. Kamil and B. Urszula in[12], proposed an approach to an analytical attack based on a number of metaheuristic algorithms. In this approach, both Differential Coding Analysis (DC) and Memory Algorithms (MA) methods will be used which improve the local search based on Simulated Annealing (SA). The effectiveness of the proposed analytic attack on the

set of ciphertexts will be checked which are created via using DES (data encryption standard) which has been reduced rounds to six rounds only. Guess the subkey is the target of the attack from which the final key is guessed.

T. Osmani and et al. in [13], conducted a study to determine the effect of some factors on the work of the GA algorithm, for example the time it takes to complete a certain number of iterations, through which it is possible to determine the number of generations that can be generated at a specific time. Through this, it becomes possible to determine the size of individuals that will be acceptable for GA. In addition to the possibility of proposing a number of fitness functions, only one of which will lead to the best results.

4- STRAWBERRY ALGORITHM

The strawberry algorithm is one of the metaheuristic algorithms inspired by nature. In fact, it is a reflection of the strawberry plant's behavior in order to access water and food. This behavior has been transformed into a framework to solve many complex optimization problems by controlling the factors that lead to reaching the goal [14]. The most important characteristic of this algorithm is its basic components in its ability to search locally (the root) and search globally (the runner) in order to reach water and food (the target) [15]. The process of pairing these two types of research gave it a high ability to reach the optimal solution faster.

In the strawberry plant, the basic idea depends on the existence of both roots and runners that will determine the path of research and ensure its convergence to reach the optimal solution [16]. The global search for the optimal solution is represented by the runners because they cover a wide area of the search space, while the local search is represented by the roots that search for the solution within a limited area of the search space. The research process is repeated to reach the optimal solution continuously, and in each iteration the mother plant gives birth to a plant bearing the same characteristics in order to preserve the offspring. Figure 1 illustrates the strawberry plant [17].

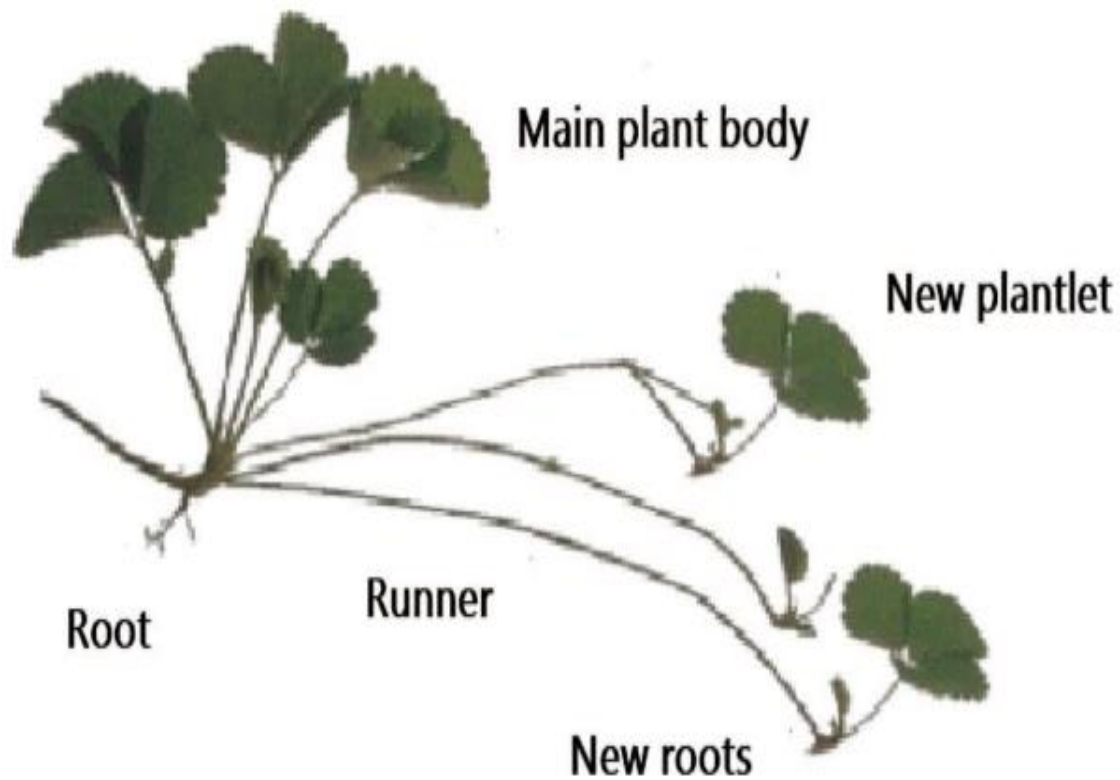
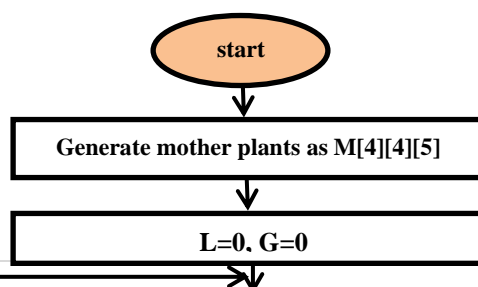


Figure 1 shows Strawberry plant.

5- The proposed Improved Strawberry Algorithm

The improved strawberry algorithm of this paper comprised on four main phases, which are the population(mother plants) randomly generation, create both of roots and runners arrays, selection of new mother plants depending on the value of the fitness function will be computed for each element of the roots and runners arrays, finding the best array which represent the desired resulted key respectively. The next part will preview these phases in more details. The block diagram of developed strawberry algorithm will be illustrated in figure 2.



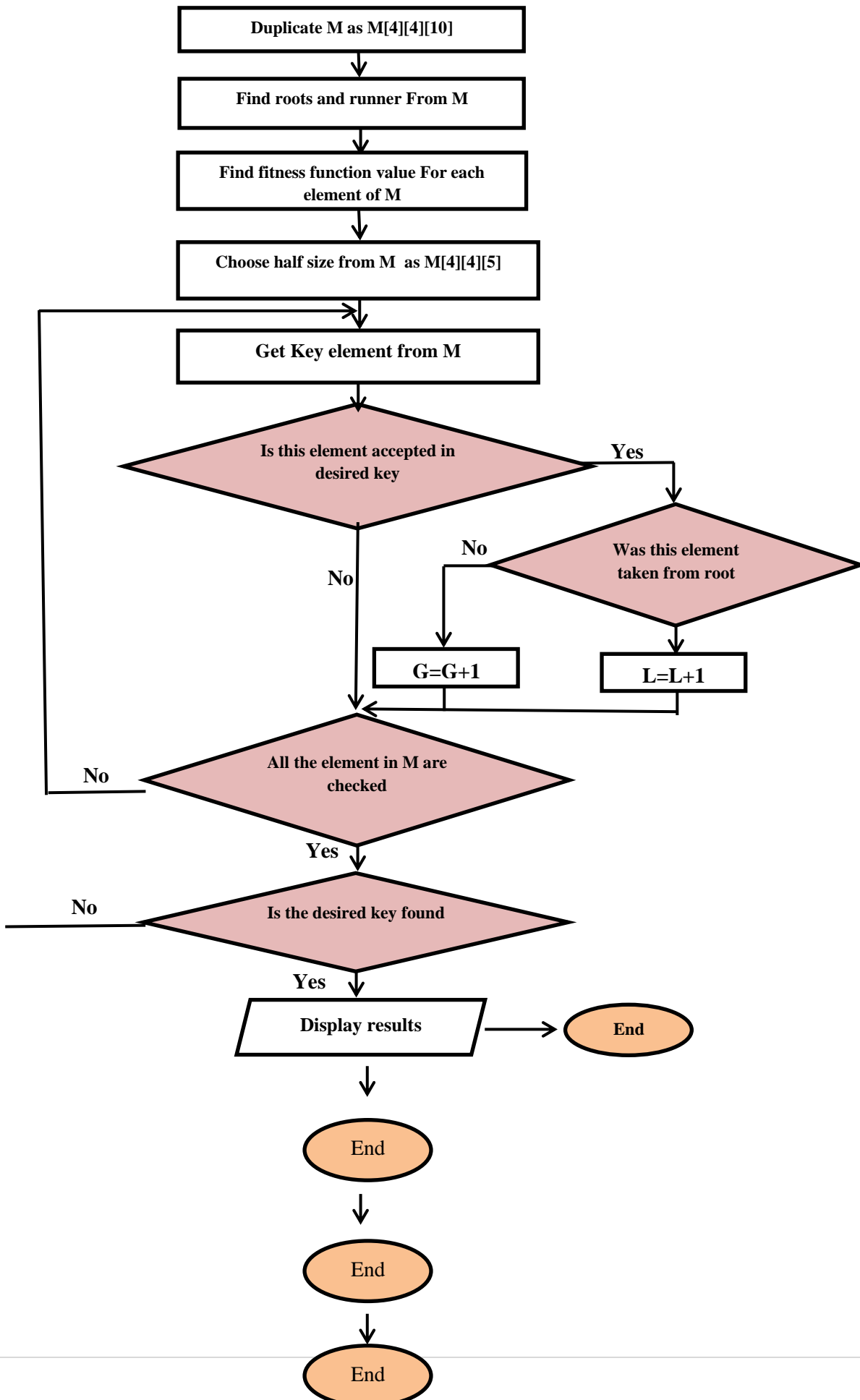


Figure 2 The block diagram of developed strawberry algorithm

i. Population generating

The first stage of the improved algorithm in this study is called a population generating. Five strawberry plants mother $M[4][4][5]$ had been generated in this phase. Each one from these plants represents virtual encryption key which will be represented as $4*4$ array of bytes. Every array element represents one of virtual key's element. The virtual key element consists of eight bits of randomly generated binary numbers. In addition, the Best array $B[4][4]$ needs to be created as $4*4$ array in order to save the best elements of virtual key which have best fitness function value that will be found nextly.

ii. Create roots and runners arrays

The second phase of the developed SBA of this paper comprised preparing $M[4][4][10]$ which is 10 of two $4*4$ arrays of bytes to save the elements of roots and runners respectively which will be generated from the 5 mother plants that were previously generated in the first phase. The second stage of the developed algorithm for this paper will involve the preparation of the root and runners matrices, five matrices of $4 * 4$ each one. These arrays will be used to store the root and runners elements that will be generated from the mother plants that were randomly generated in the first stage. Each root array will be generated by changing the value of one bit within an element of the mother plant array, in which case the change will not be significant (local search). As for the runner array, it will be created by changing the values in five locations for each element of the mother plant array, and here the change will be significant (global research).

In addition, the variables L (Localization variable) and G (Globalization variable) will be declared and given an initial value of zero for each one.

iii. Choosing half Size from the preparing mother plants ($M[4][4][10]$)

In this stage of developed SBA, only five arrays from the ten mother plants ($M[4][4][10]$) need to be selected after computing the value of fitness function for each element in $M[4][4][10]$ to use them in this selection process. The five mother plants that have highest fitness function values will be used to search for the real encryption key.

iv. Searching for the Best encryption key within the selection virtual keys

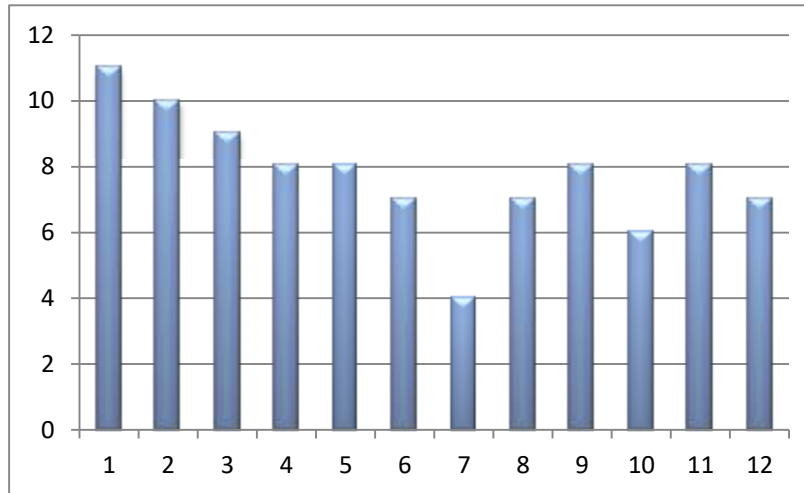
The elements of the five selection mother plants will be searched respectively to find the real elements of the encrypted key. In each cycle of search, the element of one mother plant will be search to ensure if it best or not. If the plant element is best then it will be saved in key best array and add 1 to L value if the plant is root else add 1 to G value if the selection plant is runner. The plant array element would be better if it successfully break the corresponding ciphertext element to find the plaintext. This searching process will be stopped if all the elements of the best encryption key is obtained. Otherwise, the searching process will continue until all the selection plant arrays $M[4][4][5]$ are checked. Now, at this moment, if all the elements of the encryption key are not obtained, 10 new mother plants matrices will be generated and the subsequent steps will be repeated again until the appropriate encryption key is obtained.

6. Results representation and evaluation

The effectiveness of the developed strawberry algorithm of this paper will gauge in this part in order to find the decryption key to analysis the AES ciphertext. In this phase, the developed strawberry algorithm is used to break 12 AES ciphertexts by using 16 default keys with size $4*4$ to obtain the corresponding explicit texts to them. The effectiveness of the developed strawberry algorithm will be checked by conducting many simulations for analyzing AES code to get the real encryption key.

Table1 shows the results of simulation that were carry out in order to obtain an encryption key to analysis 12 AES ciphertext and finding the corresponding plaintexts to them. This table shows that the range of required cycles were ranged between 4 - 11 cycles. The highest cycles number was needed to find the encryption key for the seventh ciphertext. on the other side, the lowest number of cycles were required at the first ciphertext. on the other hand, 7 cycles represented the average number of cycles that were required to find all AES ciphertexts that were used in these simulations. figure 3 shows these simulations.

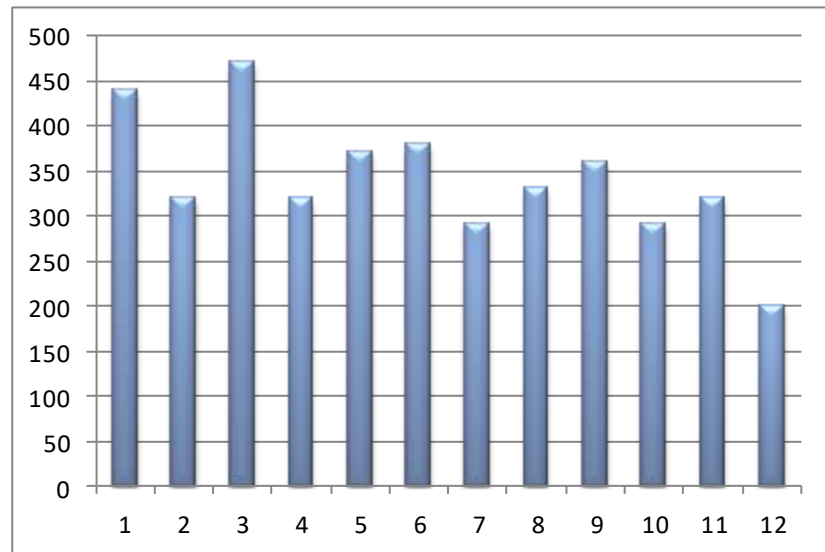
Number of cycles for improved SA algorithm



Number of text	Number of cycles
1	11
2	10
3	9
4	8
5	8
6	7
7	4
8	7
9	8
10	6
11	8
12	7

On the other hand, the largest number of intermediate keys obtained to reach the real encryption key was at the sixth plaintext, while the least number was at the twelfth plaintext, table 2 clearly shows the results of the simulations that were conducted for that. Figure 4 presents these results.

Number of text	Number of intermediate keys
1	440
2	320
3	470
4	320
5	370
6	380
7	290
8	330
9	360
10	290
11	320
12	200



To verify the effectiveness of the developed strawberry algorithm, the results of the simulations using the developed strawberry algorithm to reach the real encryption key to break a number of encrypted texts using the AES algorithm were compared with the simulation results obtained using the ants algorithm to reach the real encryption key to break the same set of texts. The results showed a high efficiency of the strawberry algorithm in terms of the number of search cycles needed to reach the real encryption key, where the number of cycles ranged between 4 - 11, while the number ranged between 5160 - 6520 in the ant algorithm. Table 3 and figure 4 illustrate that.

Number of text	No. of innovated cycles	Number of text	No. of Ant colony cycles
1	11	1	163
2	10	2	122
3	9	3	106
4	8	4	92
5	8	5	77
6	7	6	66
7	4	7	59
8	7	8	50
9	8	9	43
10	6	10	42
11	8	11	42
12	7	12	41

Table 3 shows the number of cycles to find an encrypted key for SBA and ACO.

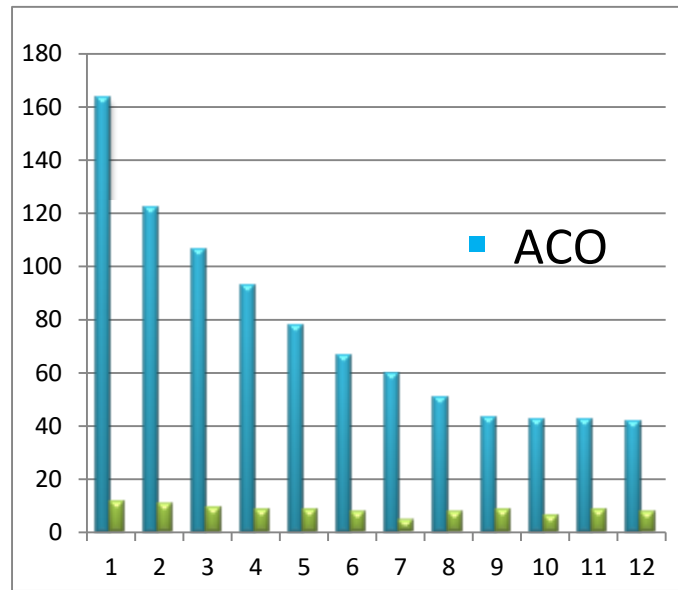


Figure 4 shows the number of cycles to find an encrypted key for SBA and ACO

On the other hand, the developed research paper algorithm showed unparalleled effectiveness in reducing the number of intermediate keys that appear during the search process to reach the real encryption key, as the number of these intermediate keys ranged between 200 - 470 while their number ranged between 5160 – 652. Table 4 and figure 5 illustrate that. Reducing the number of search cycles as well as the number of intermediate keys lead to reduce the period of time that is required in order to break the ciphertext and finding the real encryption key Which is a critical factor in how effective the cipher-breaking algorithm is.

Number of text	No. of innovated algorithm browsed keys	Number of text	No. of Ant colony browsed keys
1	440	1	6520
2	320	2	6100
3	470	3	6360
4	320	4	6440
5	370	5	6160
6	380	6	5940
7	290	7	5900
8	330	8	5500
9	360	9	5160
10	290	10	5460
11	320	11	5880
12	200	12	5150

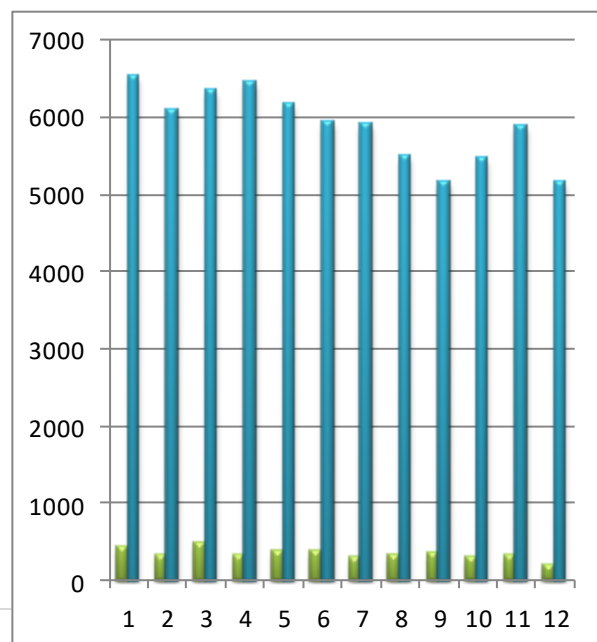


Figure 5 shows the number of browsed keys to find an encrypted key for SBA and ACO.

5. Conclusion

One of the most important sciences that has been focused on in the field of scientific research recently because of its importance in preserving important data from unauthorized access is the science of data encryption. This science has two completely opposite directions: encryption and decryption. Studying the direction of decryption has many benefits that can be summed up in knowing the attacking methods adopted by attackers of encrypted texts to break them by analyzing them to obtain the encryption key in order to address the gaps and weak-points that attackers may exploit and building a strong encryption algorithms that are difficult to penetrate. This paper presents an developed algorithm from the Strawberry algorithm for breaking AES code. The strawberry algorithm is one of the metaheuristic algorithms that simulates the behavior of the strawberry plant to reach its goal of obtaining water or food.

The developed algorithm of this study is used to break 12 AES codes to find the encryption key. The results of breaking these 12 codes simulations show, that the number of search cycles are ranged between 4-11. While, the number of intermediate encryption key that were appeared until getting the real encryption key are ranged between 200 to 470. The comparison that was made between the results of the simulations that were made to attack the 12 texts of AES using the developed SBA with the results of the simulations to attack the same 12 texts using the ACO algorithm showed the high efficiency of the developed algorithm in terms of the number of search cycles and the number of encryption keys intermediate keys that appears when each text is decrypted down to the real encryption key.

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**تأثير المتعضيات الفعالة EM Effective Microorganisms
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قسم علوم الحياة / كلية التربية للبنات / جامعة تكريت / العراق

ملخص :

هدفت الدراسة الحالية إلى التعريف بالمتعضيات الفعالة Effective Microorganisms ومكوناتها ، وبيان تأثيرها ودورها بعملية التحلل الحيوي للأسماك النافقة ، ودراسة لبعض العوامل الفيزيائية ، والكيميائية ، والبيولوجية المتمثلة بقيم درجات الحرارة ، والأس الهيدروجيني ، وأعداد عصيات حامض اللبنيك أثناء عملية التحلل الحيوي بطريقة التخمير ، باستخدام المنتج الحيوي الطبيعي Effective Microorganisms EM ، بالإضافة إلى معرفة سرعة التفكك الكلية ، والمدة الزمنية ، وكفاءة عملية التحلل الحيوي ، وقد تم إجراء البحث للفترة من آذار ولغاية ايار من العام 2022 ، لغرض دراسة إعادة تدوير الأسماك النافقة ، إذ تم تصميم وتنفيذ احواض معالجة بتقانة إعادة التدوير من قبل الباحثة ، أعدت لهذا الغرض ، وقد أبدت احواض المعالجة المصنعة لتقانة إعادة التدوير كفاءة عالية في تحلل المواد المخمرة من الأسماك النافقة ، وكان لإضافة المتعضيات الفعالة EM الى المواد المخمرة من الأسماك النافقة الأثر الكبير والواضح في تحسين كفاءة عملية التخمير من حيث عملية التحلل بنسبة 50% وبوقت قياسي اقل من المجموعة التخمير الاعتيادي ، فقد كان لارتفاع معدلات درجات الحرارة والتي سجلت أعلى معدلاتها في اليوم العشرين من التجربة والتي بلغت 70 م° ، مترافقة مع انخفاض لدرجة الأس الهيدروجيني بمعدل 4.8 والتي تعتبر من العوامل البيئية المهمة والتي كان لها الدور الفاعل في تسريع عملية التحلل والتفكك للمواد العضوية، ويعود سبب ذلك الى زيادة اعداد ونشاط الاحياء المجهرية المحبة للحرارة ، الأمر الذي أدى الى وصولها لمرحلة التبريد والنضوج النهائي بوقت مبكر لا يتجاوز الخمس وعشرون يوماً بالمقارنة مع مجموعة التخمير الاعتيادي .

الكلمات المفتاحية : المنتج الحيوي الطبيعي EM ، الأسماك النافقة ، التخمير .

Abstract:

The study aimed at defining elective microorganisms and their components , showing their impact and role in the process of biodegradation of dead fish , and studying some physical factors.

Evaluates the temperature , pH , and numbers of lactic acid sticks during the biodegradation process by fermentation method using the natural biological product Effective Microorganisms EM , in addition to knowing the total disintegration speed , the time duration , and the efficiency of the biodegradation process , and then conducting the research for the period From March to May of the year 2022 , for the purpose of studying the recycling of dead fish , as treatment ponds using recycling technology were designed

and implemented by the researcher and prepared for this purpose , and treatment ponds manufactured using recycling technology showed high efficiency in decomposing fermented materials from dead fish . Adding the active EM organisms to the fermented materials of the dead fish had a significant and clear effect in improving the efficiency of the fermentation process in terms of the decomposition process by 50% and in a shorter record time than the normal fermentation group . 70C , accompanied by a decrease in the pH at a rate of 4.8, which is considered one of the important environmental factors that had an effective role in legislating the process of decomposition and disintegration of organic matter , and the reason for this is due to the increase in the number and activity of heat – loving microorganisms , which led to their reaching the stage of cooling and final ripening Early bots not exceeding twenty – five days compared to the normal fermentation group

Keywords : Effective Microorganisms , composting , dead fish

أهداف البحث :

1. معالجة وإعادة تدوير الأسماك النافقة باعتبارها ملوثاً عضوياً ضاراً بالبيئة ، وإنتاج مواد آمنة على الصحة والبيئة .
2. دراسة ظروف التخمر والتحلل الحيوي للصفات الحيوية والفيزيائية والكيميائية بتقانة إعادة التدوير

1. المقدمة : Introduction

الثروة السمكية بشكل عام من أهم مصادر الغذاء وعنصر مهم في تحقيق مفهوم الأمن الغذائي ، فضلاً عن كونها مصدراً مهماً وأحد السبل الداعمة للاقتصاد المحلي والوطني ، وإن ظاهرة نفوق الأسماك الجماعية من الظواهر المؤثرة في الاقتصاد السمكي ودعم الغذاء *et al Ababneh* , 2020 ; Petriki and Ziqrati ; 2020 ; Wall ; 2019 ; Hassantabar 2020 *et al* . (2021) وبغض النظر عن موقع أو طبيعة المنطقة المتأثرة بنفوق الأسماك ، فإن الضرر الناتج عن هذا النفوق يمكن أن يمتد إلى قطاعات الصحة العامة والاقتصاد والبيئة ، خاصة مع تكرار عمليات النفوق وامتداد الضرر للكائنات الحية غير السمكية باعتبارها جزءاً من السلسلة الغذائية ، وتعد طريقة التحلل الحيوي من أهم الطرق المستخدمة في معالجة المادة العضوية للحيوانات النافقة وهي عملية اختزال حيوي في ظل ظروف جيدة وعلى مراحل متعددة *et al Kalbasi* (2019 , Yoon , 2005 ; Allen and Mark , 2019) .

تعتمد عملية التخمر على العديد من العوامل الفيزيائية والكيميائية منها درجة الحرارة ، والأس الهيدروجيني pH هي مفاتيح نجاح عملية التخمر ، لضمان عملية سريعة ومثالية ، كذلك تتمثل مزايا طريقة التحلل الحيوي في أنها منخفضة التكلفة وأمنة بيولوجياً ونظراً لحقيقة أن الجثث الميتة لا يتم نقلها إلى مكان آخر بالإضافة إلى كون المنتج النهائي مفيد لتعديل التربة *et al Kalbasi* . (2006) .

2. استعراض المراجع : Literature Review

تتعلق القضايا البيئية بتأثيرات أنشطة الإنسان الضارة على البيئة ، إلا أن المحافظة عليها تعد ممارسات مهمة هدفها الأساس حماية البيئة سواء على المستوى الفردي أو المجتمعي أو الحكومي لصالح البشر والبيئة على حد سواء من خلال معالجة تأثير مفاهيم حماية البيئة إذ يعد التحطم البيئي الذي ينشأ عن أنشطة الإنسان مشكلة عالمية مستمرة ، مع التوقعات بزيادة كبيرة في إجمالي سكان الكوكب إلى 9.6 بليون نسمة بحلول عام 2050 ، إذ ستكون التأثيرات البشرية على الأرض بطرق عديدة ، كالإحتباس الحراري والتحطم في نظم البيئة المستمر منذ 50 عاماً ، والذي يرجع سببه الرئيسي إلى الأنشطة البشرية ، الأمر الذي أدى الى زيادة الكوارث المناخية والبيئية وبصورة ملحوظة خلال العقد الماضيين (الدوري، 2019).

أثارت الأمراض إشكالية كبيرة للإنسان والحيوانات ، مثل الماشية ، والدجاج ، والأسماك ، من العمل بالتربية الطبيعية الى المكثفة ، أدى ذلك إلى زيادة ظهور وانتشار سريعين للعديد من العوامل المرضية في البيئة ، وتتضاعف الآثار الجانبية للأمراض بسبب السرعة التي ينتشر بها التلوث داخل البنايات التي تضم البشر والحيوانات عن طريق مياه الشرب والري والتغذية والمواد المشتركة بين الإنسان والحيوانات ، والتي ترتبط بصورة أخرى بالبيئة (Eccleston, 2010).

عُرف (Cunningham et al, 2007) التلوث بأنه تغير كيميائي، وفيزيائي، أو بيولوجي يؤثر في صحة بقاء أو نشاط الأحياء ، أو يؤدي إلى تغيير غير مرغوب فيه ، أو إنه أي تغيير في الخصائص الفيزيائية ، والكيميائية ، أو البيولوجية للبيئة ويكون كافي لإحداث الضرر في الصحة العامة والأنظمة البيئية المختلفة .

2-1 تعريف المتعضيات الفعالة EM:

تم استخدام كلمة الأحياء المجهرية الفعالة بعدة طرق على مر السنين ، حيث استخدم في الأصل لوصف المواد التي تنتجها كائنات أحادية الخلية One protozoae ، كالأميبا Amoeba ، والسوطيات Flagellate ، والهدبيات Ciliate ، أو البوغيات Sporozoon ، والتي يتم تحفيزها بواسطة كائنات أخرى (Lilly and Stillwell , 1965) ، واستخدم بعدها لوصف مكملات الأعلاف الحيوانية التي كان لها تأثير مفيد على الحيوان المضيف من خلال التأثير على الفلورا الطبيعية في الأمعاء (Parker , 1974).

عرف العالم الياباني (Higa , 1993) المتعضيات الفعالة على أنها مستنبت من كائنات حية دقيقة معينة يتم زرعها في الحيوان لضمان التأسيس الفعال للمجموعات المعوية لكل من الكائنات المفيدة والممرضة ، يرجع اكتشاف المنتج الحيوي الطبيعي (EM) Effective Microorganisms الى البروفسور الياباني تيرو هيغا ، عالم الأحياء الدقيقة في المزارع العضوية في جامعة ريوكيوس في أوكيناوا- اليابان ، حيث تم اكتشافها عرضياً أثناء البحث عن الجوانب المفيدة لسلاسل معزولة من الكائنات المجهرية على تكوين التربة ونمو النبات في عام 1982 ، حيث تتألف من تركيبة مختلفة من الكائنات المجهرية المتألقة والمتآزررة مع بعضها البعض والتي تعمل على تخفيف التلوث في المياه (Higa , 1996).

يتكون المنتج الحيوي الطبيعي (EM) Effective Microorganisms من مجموعة واسعة من الكائنات الحية الدقيقة الفعالة والمفيدة وغير مؤذية ، وهي معززة للإنتاج من خلال عملية طبيعية ، وهي ليست مصنعة كيميائياً ، أو مطورة جينياً ، أو محورة وراثياً ، وهي مكونة بشكل سائل ولها تطبيقات

واسعة النطاق وبدون أية آثار سلبية عند استخدامها ، وهي مفيدة للبشر ، والبيئة ، والحيوانات ، والنباتات (Higa , 1996) وتتألف من :

1. عصيات حمض اللبن : Lactic Acid Bacilli .
2. جراثيم التمثيل الضوئي : Photosynthetic Bacteria .
3. الفطريات : Fermenting Fungi .
4. الفطار الشعاعي : Actinomycetes .
5. الخمائر : Candida Uitis .



صورة (1) المنتج الحيوي الطبيعي EM

2-2 الأهمية البيئية للمتعضيات الفعالة :

لقد أدت الكثير من الممارسات الحياتية في الآونة الأخيرة ، والتي تستند إلى استخدام المواد الكيميائية والبيولوجية إلى خلق أزمة وتحد جديد للبشرية نتيجة التحطم في النظم البيئية ، والآثار السلبية الطويلة الأمد على الأنظمة الحياتية نتيجة للتغيرات التي يشهدها العالم بشكل عام Kengo (and Hui – lian , 2000) .

وقد دعت كيوسي للزراعة الطبيعية Kyusei Nature Farming في عام 1935 إلى توقع هذا المأزق الناجم عن نقص الأغذية أو من الأغذية الضارة والفقر ، والمرض ، والصراع الناجم عن ذلك ، وتوقعت أن تتسبب مشكلة سكان العالم الذين يتزايد عددهم بسرعة في إحداث تغيرات بيئية عالمية لا يمكن حلها عن طريق توسيع نطاق النظام الحالي (Higa , 1996) .

لقد أدى استخدام النيتروجين في مجالات عديدة كالثروة الحيوانية والأسمدة وغيرها من الصناعات وعدم تصريف المياه بشكل آمن ، إلى تلويث المياه بهذا العنصر وزيادة تراكيزه عن معدلاته الطبيعية الأمر الذي أدى إلى تغيير التوازن البيئي ومؤدياً إلى نمو الطحالب بكثافة على حساب الأنواع الأخرى ، مما يعني موت النباتات المائية ، نتيجة لانخفاض مستويات الأوكسجين في المياه ، وارتفاع كبريتيد الهيدروجين ، يؤدي ذلك بالقضاء على الأسماك والنباتات (Kengo and Hui , 2000) .

بالرغم من الحلول الكثيرة التي وضعت للحد من أنواع التلوث البيئية إلا إنها باتت محدودة الاستخدام بسبب التكاليف المادية وصعوبة تطبيقها بسبب القوانين الأمر الذي أدى إلى لفت الأنظار للبحث عن حلول من قوة الطبيعة تتعدى حدود فهم الإنسان ، سهولة التطبيق ، وأمنة بيئياً حيث استخدمت الكائنات الحية الدقيقة الفعالة التي اكتشفت في أوكليناوا – اليابان عام 1970 من أجل الإدارة البيئية ، وتمتلك الأحياء الدقيقة المتواجدة بشكل طبيعي القدرة على الحد من السمية البيولوجية للمياه العادمة والتغلب على الروائح الكريهة ، وبالتالي تم استخدام المتعضيات الفعالة (EM) في المرافق الحضرية في أوكليناوا – اليابان لتطهير مياه الصرف الصحي .

3 - المواد وطرائق العمل : Methods & Materials

أجريت هذه التجربة في جامعة تكريت – كلية التربية للبنات – قسم علوم الحياة للفترة ابتداءً من شهر آذار – 2022 ولغاية شهر أيار - 2022 ، واستخدمت فيها أسماك نهريّة نافقة بأنواع وأحجام متنوعة تم جمعها من أماكن متعددة ضمن محافظة صلاح الدين ، إذ استخدمت فيها مادة نشارة الخشب والقش (التبن) ، وأنابيب بلاستيكية مثقبة بقياس أنج واحد ، وأغطية بلاستيكية ، والمنتج الحيوي الطبيعي الحاوي على الأحياء الدقيقة الفعالة EM1 ، وحوض تجربة عملية التخمير العضوي والذي تم تمييزه من خلال طلائه باللون الأصفر أما الحوض باللون الأخضر مخصص لتجربة التخمير الطبيعي (الاعتيادي) وكما موضح بالصورة (1) وكالاتي :

1. تم وضع طبقة من نشارة الخشب أسفل قاعدة الحوض وفوق المشبك المعدني مباشرة وبارتفاع 15سم
2. تم فرش طبقة من القش (التبن) فوق طبقة نشارة الخشب مباشرة بارتفاع 5 سم .
3. تم وضع طبقة من جثث الأسماك النافقة فوق طبقتي نشارة الخشب والقش وبارتفاع 10 سم ، ومن ثم يمرر خلالها الأنابيب البلاستيكية المثقبة بقياس أنج بين طبقة القش وجثث الأسماك النافقة لتزويدها بالهواء لأجراء عملية التهوية .
4. تم تغطية جثث الأسماك النافقة بطبقة من القش (التبن) وبارتفاع 5 سم ، ثم تليها الطبقة النهائية فرشاة نشارة الخشب وبارتفاع 15سم .
5. تم تخفيف المنتج الحيوي (EM1) بإضافة لترين من الماء المقطر إلى 50 مل من المنتج الحيوي ، ويرش به جميع الطبقات التي تم ذكرها ، ويعد المنتج الحيوي المنشط EM1 يحتوي على الكائنات الحية المجهرية النشطة الفعالة في تسريع وتقليص عملية التحلل والتفكك الكلية ، حيث يحتوي على خمس مجموعات من الأحياء الدقيقة الفعالة Effective Microorganisms المتكونة من عصيات حامض اللبنيك ، وجراثيم التمثيل الضوئي ، والفطريات ، والفطار الشعاعي ، والخمائر.

6. تم وضع الغطاء البلاستيكي ويتم تغطية الحوض لمنع الروائح ، والحشرات ، والحيوانات التي قد تنقل الجثث النافقة وتنقل التلوث إلى مكان آخر ، وهذا الغطاء يسمح للهواء بالمرور إلى داخل كومة التخمر العضوي .
7. تم متابعة مراحل التخمر العضوي بانتظام وتسجيل درجة الحرارة ومراقبة الرطوبة ومراقبة التغيير في اللون كذلك سحب السوائل المترسحة الناتجة من عملية التخمر وضمان سلامة الغطاء البلاستيكي وأجراء التقليبات والتصليلات للمكونات حسب الضرورة وقياس درجة الحمضية والتوصيلية الكهربائية ، بالإضافة إلى تأمين التهوية اللازمة لمكونات التخمر من خلال ضخ الهواء في أنابيب التهوية للمساعدة بالإسراع في عملية التخمر ، أجراء الفحوصات حقلياً ومختبرياً.
8. اما بخصوص تجربة التخمر الطبيعي (الاعتيادي) فتم استخدام نفس المواد والأجهزة المذكورة أعلاه ، إلا إنه تركت مكونات عملية التخمر دون إضافة اية مادة ,



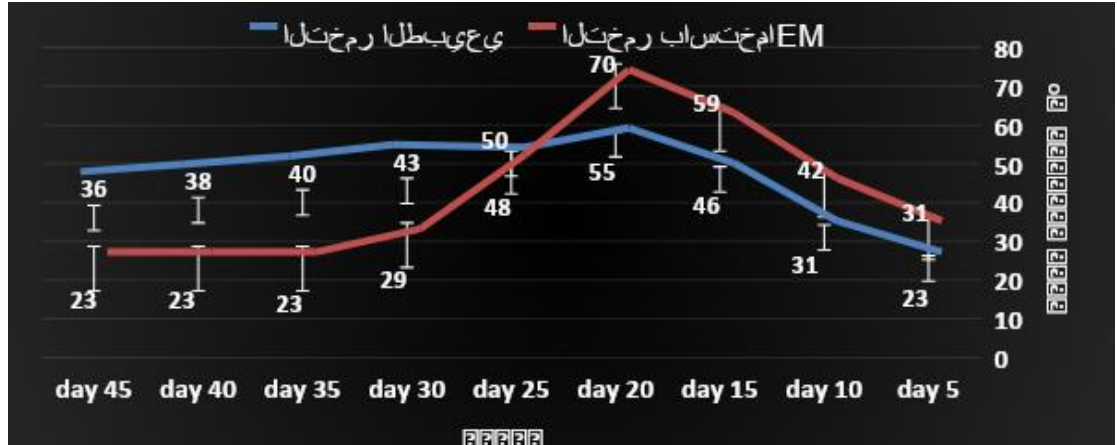
صورة (2) تصميم وصنيع أحواض التخمر .

4-النتائج والمناقشة: Discussion & Results

1-4 درجة الحرارة : Temperature

أشارت نتائج درجات الحرارة عند القراءة الأولى وبعد مرور خمسة أيام من بدء عملية التحلل العضوي للأسماك النافقة إنها قد سجلت 23 م° بدون إضافة المنتج الحيوي الطبيعي Effective EM Microorganisms بتجربة التخمر الطبيعي (الاعتيادي) ، في حين كانت درجة الحرارة 31 م° عند إضافة المنتج الحيوي الطبيعي Effective Microorganisms EM, ثم ارتفعت درجات الحرارة باستمرار عملية التخمر العضوي ، إلا إن المعاملة بإضافة المتعضيات الفعالة EM قد أعطت حرارة أعلى ، وكانت أعلى مستوى لدرجات الحرارة عند اليوم العشرين إذ بلغت 70 م° ، في حين إن المعاملة غير المضاف إليها المتعضيات الفعالة EM بلغت أقصى درجة لها في اليوم العشرين إذ بلغت 55 م° من بدء التجربة ، ثم بدأت درجات الحرارة بالانخفاض باستمرار عمليات التحلل ، وإن الانخفاض كان حاداً في المعاملة المضاف إليها المتعضيات الفعالة EM إذ بلغت 29 م° عند اليوم الثلاثين ، في حين بلغت درجة الحرارة للمعاملة غير المضاف إليها المتعضيات الفعالة EM 43 م° في نفس اليوم ، وهذا يؤشر سرعة التحلل في تجربة المعاملة المضاف إليها المتعضيات الفعالة EM ، وإن أقل درجة حرارة هي 23 م° للأيام ، الخامس والثلاثين ، والأربعين ، والخامس والأربعين للمعاملة المضاف إليها EM ، وهي

أقل من درجات حرارة العينات لتجربة التخمير الطبيعي غير المضاف إليها الـ EM إذ بلغت 36 م° عند اليوم الخامس والأربعون ، يلاحظ وجود تغير في درجات الحرارة ما بين تجربتي التخمير للمعاملة المضاف إليها المنتج الحيوي الطبيعي الـ EM وبين معاملة التخمير الطبيعي (الاعتيادي) الغير مضاف إليها الـ EM ذلك من خلال سرعة تفكك وتحلل أعلى من أقل من تجربة التخمير الطبيعي (الاعتيادي) بالإضافة إلى وصولها إلى مرحلة التبريد والنضوج النهائي بفترة زمنية) بفارق زمني وقدره خمس وعشرون يوماً ، وكما موضح في الشكل (1).

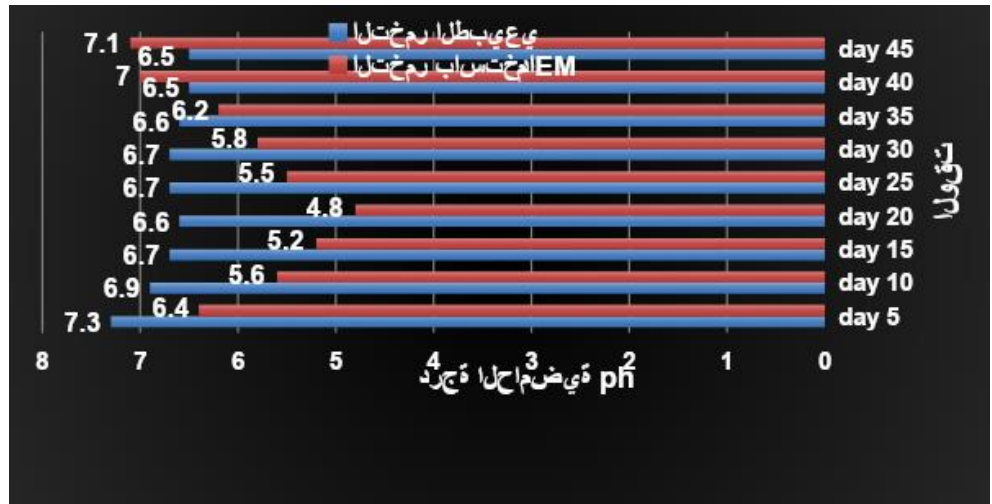


شكل (1) معدل درجات الحرارة خلال عملية التخمير .

2-4 الأس الهيدروجيني : pH

يعبر عن الأس الهيدروجيني pH بأنه اللوغاريتم السالب لتركيز أيون الهيدروجين ، ويتأثر بالغازات الذائبة مثل غاز ثنائي أكسيد الكربون ، وكبريتيد الهيدروجين ، والأمونيا ، وأن هناك ترابطاً ما بين درجة الأس الهيدروجيني والأحياء المجهرية ، حيث إن زيادة قيم الأس الهيدروجيني عن الحد الطبيعي يؤثر في معيشة تلك الأحياء (الفتلاوي , 2007) .

يوضح الشكل (2) إن قيم الأس الهيدروجيني عند اليوم الخامس من بدء التجربة كان يميل إلى القاعدية الضعيفة في المعاملة غير المضاف إليها الـ EM التخمير الطبيعي (الاعتيادي) إذ بلغت درجة الحمضية 7.3 pH ، في حين إن المعاملة المضاف إليها الـ Effective Microorganisms EM أعطت 6.4 pH لنفس الفترة ، ثم يلاحظ أيضاً انخفاض قيم الأس الهيدروجيني pH بمرور الوقت لمعاملة التحلل الطبيعي إذ بلغت أقل قيمة لها 6.5 pH لكلا من اليوم الأربعين والخامس والأربعين ، في حين إن المعاملة المضاف إليها الـ EM حققت أدنى قيمة pH عند اليوم العشرين إذ بلغت 4.8 وهو حامضي ، ثم بدأت بالارتفاع التدريجي ولغاية اليوم الخامس والأربعون إذ كانت الـ pH لمعاملة التخمير الطبيعي قد سجلت 6.5 pH ، أمّا المعاملة المضاف إليها الـ EM بلغت 7 و 7.1 عند اليوم الأربعين والخامس والأربعين على التوالي ، أي انتهاء عملية التحلل أعلى من أقل من تجربة التخمير الطبيعي (الاعتيادي) تجربة التخمير الطبيعي (الاعتيادي) بالإضافة إلى وصولها إلى مرحلة التبريد والنضوج النهائي و بفارق زمني وقدره خمس وعشرون يوماً .



الشكل (2): معدل درجة الحمضية ال pH خلال عملية التخمير .

اللون : Color

لدى الانتهاء من مرحلة التحلل الحيوي للمواد العضوية (عملية تخمير المخلفات العضوية لإعادة تدوير الأسماك النافقة) تكون مكونات عملية التخمير ذات لون أسود وأقرب ما يكون منه اللون البني وملمس ناعم ورائحتها تشبه رائحة التربة والموضح بالصورة (3) , وهذا يؤشر بأن عملية التخمير والتحلل العضوي وصلت لمرحلة التبريد والنضوج وهذا يتفق مع الدراسات والتطبيقات المتعلقة بالمخلفات العضوية والنباتية (2010 ، جوهر) .



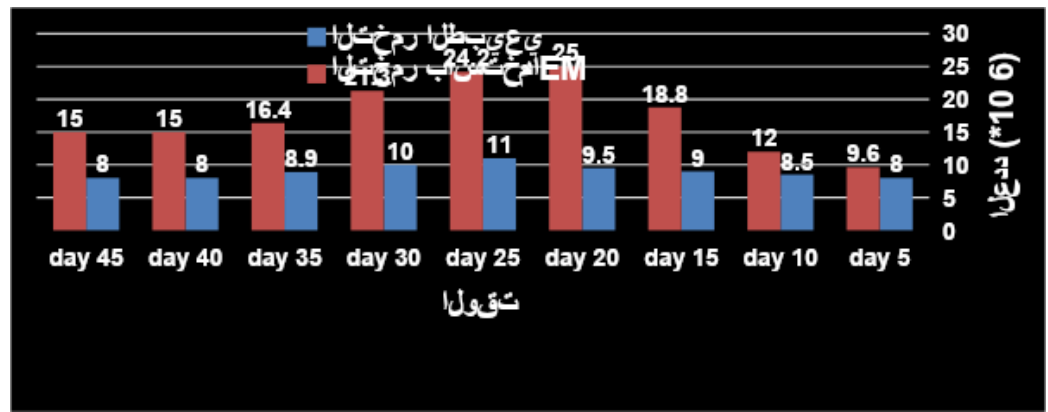
الصورة (3) المراحل الأولى والنهائية لعملية تخمير الأسماك النافقة .

3-4 عصيات حامض اللبنيك : (LAB) Lactic Acid Bacilli

تعد عصيات حامض اللبنيك (LAB) Lactic Acid Bacilli كائنات حية مجهرية محبة للحرارة وتفضل درجات الحرارة المرتفعة وتستخدم هذه الخاصية بالسيطرة على عملية الانهيار السريع والفعال لتحلل الجلد والأنسجة ، بالإضافة إلى الإنزيمات التي تكسر الجزيئات المعقدة مثل الكيراتين ، والتي تعد من بين الأنزيمات المستخدمة على نطاق واسع في الصناعات الكيميائية والطبية (Ichida,2001) .

أظهرت نتائج عصابات حامض اللبنيك LAB Lactic Acid Bacillus والمبينة بالشكل (3) إن أعداد LAB عند القراءة الأولى بعد مرور خمسة أيام من عملية التحلل قد كانت أقل درجة سجلتها المعاملة المضاف إليها المنتج الحيوي الطبيعي Effective Microorganisms EM إذ بلغت $10^6 \times 9.6$ خلية/غم ، بينما بلغت أعداد LAB للمعاملة غير المضاف إليها الـ EM طريقة التخمير الطبيعي $10^6 \times 8$ خلية / غم من نفس اليوم ، ثم بدأت أعداد LAB بالارتفاع بشكل تدريجي لتبلغ أعداد المعاملة المضاف إليها الـ EM ذروتها في اليوم العشرين من التجربة وسجلت أعدادها أعلى مستوى لها إذ بلغت $10^6 \times 25$ خلية /غم ، وهي درجة مثالية ومفضلة لأنها تؤدي إلى تسريع عملية الأنسجة وتفككها واستبعاد الأنواع البكتيرية الأخرى ، في حين سجلت المعاملة غير مضاف إليها الـ EM 9.5×10^6 خلية / غم من نفس اليوم ، إذ إن عصابات حامض اللبنيك من الكائنات الدقيقة المحبة للحرارة وتفضل درجات الحرارة المرتفعة (Yoon et al., 2019)

ثم فيما بعد بدأت أعداد LAB بالانخفاض لتسجل المعاملة المضاف إليها EM إذ بلغت $10^6 \times 15$ خلية / غم عند اليومين الأربعين والخامس والأربعين ، وأعطت المعاملة غير المضاف إليها الـ EM 8×10^6 خلية / غم من نفس الأيام ، مما يؤشر انتهاء عملية التحلل .



شكل (3) اعداد عصابات حامض اللبنيك خلال عملية التخمير .

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الحساسية الإشعاعية واستحداث العقم الجنسي

عند تشيع عذاري الذبابة المنزلية

Musca domestica

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الحساسية الإشعاعية واستحداث العقم الجنسي عند تشعيع عذارى الذبابة المنزلية

Musca domestica

Radiosensitivity and the development of sexual infertility when irradiating pupae *Musca domestica*

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الملخص

أظهرت نتائج دراسة تأثير أشعة جاما في عذارى الذبابة المنزلية, أن للإشعاع تأثيراً سلبياً واضحاً في القدرة التكاثرية للبالغات البازغة من العذارى المشعشعة. أدى التعرض لأشعة جاما الى انخفاض معدل البيض الفاقس بزيادة الفترة الزمنية للتعرض, وانخفاض عدد اليرقات المتعذره, وانخفاض عدد العذارى البازغة, وزيادة معدل البالغات المشوهة بزيادة المدة الزمنية للتعرض وتبين أن تشعيع العذارى بجرعة 400KBq بفترة زمنية 25 دقيقة ينتج عنه ذكور عقيمة جنسياً بصورة كاملة ويمكن استخدامها ضمن برنامج تقنية الحشرات العقيمة لمكافحة هذه الآفة.

كلمات مفتاحية : الذبابة المنزلية الحساسية الإشعاعية, العقم المستحدث .

Abstract

The results of the study of the effect of gamma rays in housefly virgins showed that radiation has a pronounced negative effect on the reproductive ability of adults bred from irradiated virgins. The effect of Kama radiation on members of the first generation is to reduce the rate of hatched eggs by increasing the exposure time period, reducing the number of unable larvae, reducing the number of emerging virgins, and increasing the rate of deformed adults by increasing the exposure time period. It turned out that irradiation of virgins at a dose of 20 gy with a time period of 25 minutes results in completely sexually

sterile males and can be used within the Sterile Insect Technique program to combat this pest.

Keywords: housefly, radiation sensitivity, neonatal infertility

1-1 مقدمة

تنتمي الذبابة المنزلية *Musca domestica L.* التابعة لعائلة Muscidae والتي تنتمي الى رتبة ذات الجناحين Diptera اذا تعد من أكثر النواقل ذات الأهمية الطبية والبيطرية المسببة للأمراض (Giliomee و Achiano,2005) تكون لها القدرة عالية في نقل مسببات الأمراض ميكانيكيا وتنتشر بشكل واسع في جميع انحاء العالم, وتعد الذبابة المنزلية من اخطر الآفات الحشرية لقدرتها على حمل ونقل اخطر الأمراض اذا تشير التقديرات الى ان الذباب ناقل لمئة مسببا مرضيا (Patrica and Claudio,2008) اذ تعد الذبابة المنزلية ناقل ميكانيكيا للعديد من المسببات المرضية الواقعة في الأماكن الملوثة بوساطة ارجلها وشعيراتها أجزائها وبهذا تعد ناقل ميكانيكي للأمراض وتتمكن من نقل البكتريا, الفطريات, الطفيليات والفايروسات ومن الأمراض التي تنقلها(الكوليرا, التيفوئيد, والإسهال الصيفي للأطفال الديرينتاريا, وجمرة الرمد الخبيثة والزحار الاميبي) (Lejeune, 2009), بينت ألداسات الحديثة ان الذبابة المنزلية تكون حاملة لفيروس انفلونزا الطيور الذي يشكل تهديد للإنسان والدواجن والثروة الحيوانية. وان انتشار الأمراض المعوية في المناطق الريفية والحضرية يكون بسبب الوفرة الموسمية للذبابة المنزلية (Khan et al,2013).

نظراً لما تشكله الذبابة المنزلية من اهمية كبيرة للإنسان من الناحية الطبية والاقتصادية اذ ان القضاء على هذه الحشرة يعني إبادة الكثير من الأمراض التي يسببها أو ينقلها. لذا فقد حظي باهتمام كبيراً في مجال مكافحته (Khan and Islam,2006).

2-1 مواد البحث وطرائقه

1-2-1 تهيئة المستعمرة الحشرية

جمعت كمالات الذبابة المنزلية من احد المناطق السكنية في محافظة صلاح الدين / تكريت بواسطة شبكه صنعت من قماش التول ثم نقلت الى اقفاص خشبية ذات ابعاد (50x50) ذات قاعدة خشبية وغلفت الطبقة العليا والجوانب بمشبك شبابيك ناعم صورة رقم (1) ووضع غذاء للحشرة مكون من الحليب والسكر بنسبة (1:1) ومذابة في 20 مل من الماء المقطر وتم وضعه في اطباق بتري ووضع في وسط الطبق قطعة من القطن لكي يمنع التصاق الحشرة (Hazfez, 1949), ووضع قفص التربية في ظروف مختبريه ملائمة بدرجة حرارة (2±30) م ورطوبة نسبية (5±70)% لحين الحصول على مستعمرة من الحشرة لغرض الدراسة.



2-2-1 وصف مصدر الإشعاع صورة رقم (1-1) صندوق تربية الحشرة

استعمل مصدر لأشعة كاما عنصر السيزيوم 137 (SC137) الموجود في قسم الفيزياء في كلية التربية للعلوم الصرفة بمقدار جرعة إشعاعية 400KBq بمدد زمنية (5,10,15,20,25) دقيقة, لطور العذراء.

3-1 حساسية الطور عذراء لأشعة كاما

استخدمت ثلاثة أطباق بتيرية ذات قطر 9 سم يحتوي على 10 غرام من الوسط الغذائي وضع في كل طبق 30 عذراء لكل معاملة فضلا عن معامل السيطرة (بدون تعريضها للإشعاع) تم تعريض العذراء الى جرعة إشعاعية بمقدار 400KBq ولمدد زمنية مختلفة (5,10,15,20,25) دقيقة ثم احكم غلق الأطباق البترية من الأعلى برابط مطاط محكم بعد ان علمت بورق (Label) سجل عليها المدة الزمنية للتعرض وتاريخها ثم وضعت بالحاضنة بدرجة حرارة (30) ورطوبة (70) تم متابعة الاطباق يوميا لتسجيل النتائج لأجل الوصول الى دور البالغة .

4-1 النتائج والمناقشة

1-4-1 حساسية أفراد الجيل الأول F1 لأشعة كاما

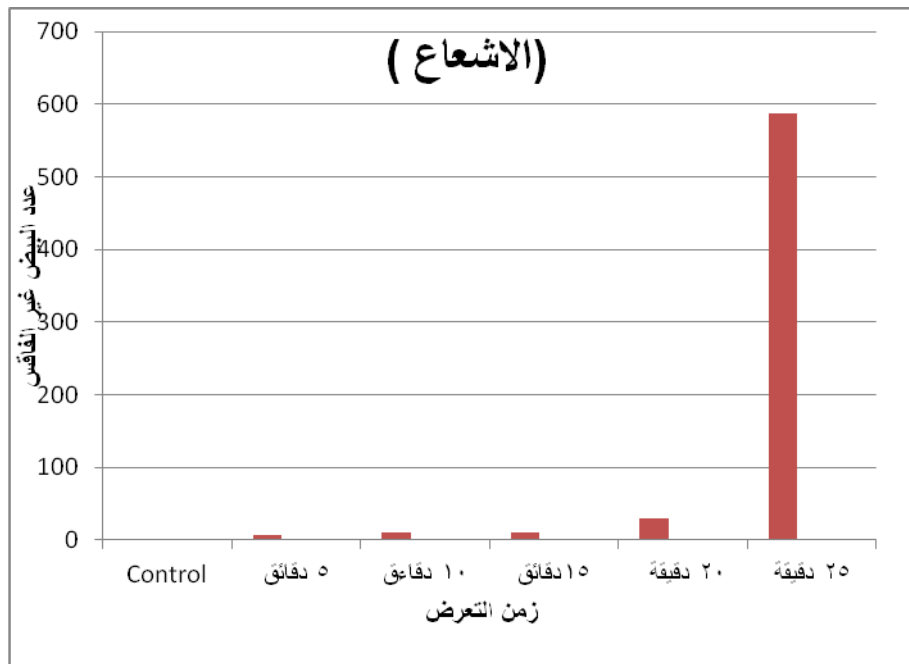
جمعت العذارى المشعشة من أوعية التربية حسب المدد الزمنية بعد بزوغ البالغات المعاملة تم فصل الذكور عن الإناث ثم تركت الذكور المشعشة لتتزاوج مع إناث برية غير مشعشة اخذ البيض الناتج الموضوع في طبق بتري قطرة 9 سم ووضع بالحاضنة في ظروف التربية السابقة. تم متابعتها يوميا لتسجيل النتائج، تم حساب عدد البيض الموضوع ونسب عدم الفقس والنسبة المئوية لليرقات والعذارى الهالكة ونسب بزوغ البالغات الطبيعية والمشوهة.

2-4-1 تأثير الإشعاع المؤين على أفراد الجيل الأول الناتج من تزاوج ذكور مشعشة مع إناث طبيعية

يؤثر الإشعاع تأثيراً سلباً على أفراد الجيل الأول الناتج من تزاوج ذكور مشعشعة مع إناث غير مشعشعة من الطور العذري إذ انخفض معدل عدد البيض الفاقس للذكور المشعشعة المتزاوجة مع إناث غير مشعشعة لجميع المعاملات . يلاحظ من الجدول (1) وشكل (1-1) ارتفاع عدد البيض الغير الفاقس بزيادة الفترة الزمنية للتعرض للإشعاع إذ سجل عدد البيض الغير فاقس 7,10,10,30 بيضة , لزمن تعرض 5,10,15,20 دقيقة على التوالي. كان أعلى معدل لعدم الفقس كان 100% عند مدة تعرض 25 دقيقة .

جدول (1) تأثير التشعيع على أفراد الجيل الأول الناتج من تزاوج ذكر مشعع بالطور العذراء مع انثى غير مشعشعة بجرعة اشعاعية مقدارها (400KBq)

النسبة المئوية	عدد البالغات المشوه	النسبة المئوية	عدد البالغات الطبيعية	النسبة المئوية	عدد العذراوات الناتجة	النسبة المئوية	عدد اليرقات الناتجة	النسبة المئوية	عدد للبيض غير الفاقس	النسبة المئوية	عدد للبيض الموضوع	الزمن
عدد البالغات المشوه	عدد البالغات المشوه	عدد البالغات الطبيعية الناتجة	عدد البالغات الطبيعية الناتجة	عدد العذراوات الناتجة	عدد العذراوات الناتجة	عدد اليرقات الناتجة	عدد اليرقات الناتجة	عدد للبيض غير الفاقس	عدد للبيض غير الفاقس	%	عدد للبيض الموضوع	
0	0	100	560	98	565	99	576	0	0	100	588	control
b	b	A	a	a	A	a	a	e	e	a	a	
0	0	93	544	97	550	98	566	1	7	98	585	5 دقيقة
b	b	B	b	a	A	ab	ab	c	d	a	a	
0	0	90	540	97	545	97	560	2	10	98	588	10 دقيقة
b	b	B	b	ab	Ab	bc	bc	c	c	a	a	
1	2	85	520	96	530	96	553	2	10	97	588	15 دقيقة
a	a	C	c	b	b	c	c	c	c	a	a	
2	3	80	470	91	485	93	535	5	30	90	588	20 دقيقة
a	a	D	d	c	c	d	d	b	b	a	a	
0	0	0	0	0	0	0	0	100	588	0	588	25 دقيقة
b	b	E	e	d	d	e	e	a	a	b	a	



شكل رقم 1 تأثير زمن التعرض على نسبة البيض غير الملقح بجرعة إشعاع مقدارها (400KBq)

من المحتمل ان يكون السبب في ذلك الى اختلاف الحساسية الإشعاعية لمراحل عملية تكوين الحيامن لدى الذكور, فمثلا تكون الجرعات الواطئة من الإشعاع في الذكور كافية للتأثير في خلايا المولدة للنطف في حين تؤثر الجرعة العالية على أرومات النطف مما يؤدي الى تكوين نطف متكسرة أو مشوهة يصعب عليها الانتقال الى الحافظة المنوية لدى الإناث , أو إعادة ترتيب الصبغيات التي تؤدي الى عدم التوازن الوراثي في الأمشاج أو يكون له تأثير غير مباشر في كفاءة الجهاز التناسلي لدى الحشرة المعرضة للإشعاع الأمر الذي يؤدي الى انخفاض في عدد البيض الموضوع ونسبة فقسه. (Makee and Saour,2001).

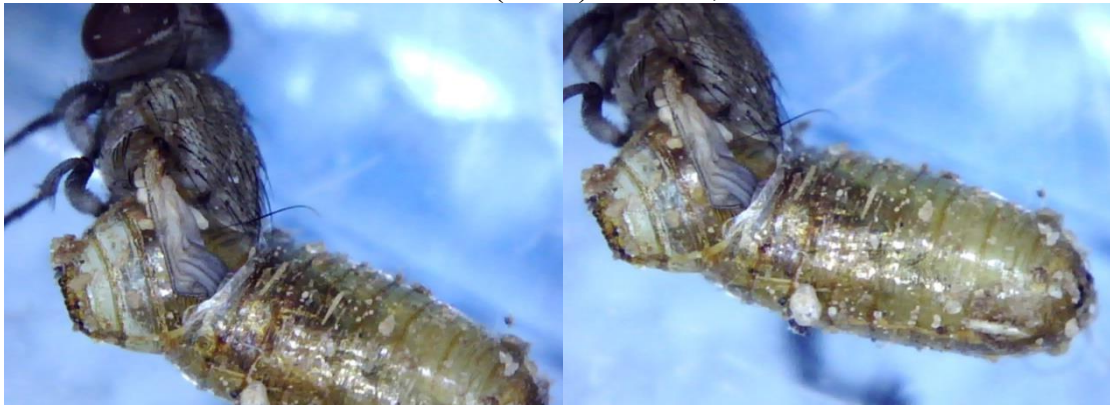
قد يفسر ارتفاع نسب هلاك البيض وامتداد تأثيرات الإشعاع السلبية إلى الأدوار اللاحقة لتأثر المادة الوراثية لخلايا الجنين التي كانت في حالة انقسامات متتابعة مسيطر عليها من قبل الحامض النووي DNA إذ يكون في أوج نشاطه خلال تلك المدة من خلال عملية الاستنساخ (Transcription) والترجمة (Translation) وبالتالي حدوث الطفرات المميتة (Lethal mutations) أو تلف في الجزيئات الحيوية الناتجة لاسيما البروتينات والأنزيمات ويصعب على الخلايا إصلاح الضرر كما أن الإشعاع يحدث تغيرات أو تلف في أجزاء من DNA الخلايا لاسيما تلك التي تمتلك آليات ضعيفة لإصلاح نفسها أو حدوث تغيرات في عملية استنساخ DNA الخلايا عند التعرض لهذا الإشعاع ، وقد تحدث هذه التغيرات في وقت سريع Landry, وجماعته, (1997)

كما بينت النتائج جدول(1) انخفاض معدل النسبة المئوية لليرقات المتعدرة مع ازدياد فترة التعرض للأشعة (10,15,20,25) دقيقة اذ سجلت (0,93,96,97) % على التوالي بالمقارنة مع معامل السيطرة الذي سجل 99%. ربما يعود سبب ذلك الى إمكانية انتقال التأثير السلبي للإشعاع عبر الخلايا الجسمية المسؤولة عن تكوين تراكيب وأعضاء اليرقة خلال النمو الجنيني. ان ازدياد معدل فترة التعرض للأشعة يزيد معدل التسمم أو التثبيط في جسم الكائن الحي حيث ان لزيادة تركيز اي مادة مؤثره ولو بكميات قليلة يمكن ان يزيد من احتمالية وصولها الى بعض المواقع المهمة في الكائن الحي فضلا عن صعوبة التخلص منها في عمليات الأيض المختلفة مما يؤدي الى موت الكائن الحي أو أضعاف

نشاطه وهناك احتمال حدوث تغيرات أو تلف في أجزاء من DNA الخلايا الحية خلال مرحلة التحول الشكلي وهذا ما أشار إليه (Suttle,2004)

كما بينت النتائج جدول (1) انخفاض معدل النسبة المئوية لبزوغ البالغات مع زيادة مدة التعرض للأشعة إذ سجلت (0,91,96,97,97) % في زمن تعرض (25,20,15,10,5) دقيقة بالمقارنة مع معامل السيطرة الذي سجل (99%) .وقد يعزى السبب في ذلك الى استمرار تأثير الإشعاع في أفراد الجيل الأول لتأثيره في المراكز العصبية للحشرة وأسباب وراثية ناجمة عن إعادة ترتيب الكروموسومات وبالتالي عدم التوازن الوراثي .الطويل,وجماعةه,(2001).

أظهرت النتائج ان أعلى نسبة للبالغات المشوهة كانت 3.2 % عند مدة تعرضها الى 20,15 دقيقة على التوالي . يعزى السبب في ذلك الى حدوث تغيرات أثناء عملية انقسام الحمض النووي للخلايا المعرضة لهذه الأشعة وان بعض مستويات هذا التغير تحدث نتيجة تلف الحمض النووي DNA والذي يعد من أكثر الأجزاء تضررا بالإضافة الى تلف البروتينات وبعض الجزيئات ذات الأهمية في الخلايا المعرضة للإشعاع ، وقد يعود هذا التأثير الى حدوث طفرة نتيجة التعرض للإشعاع تعرف بالطفرة المحدثّة (Spontaneous mutation)، حيث تعتبر الأشعة من المطفرات الفيزيائية بسبب استبدال الأحماض الأمينية المتجاورة داخل سلسلة الببتيد و حدوث اضرار بسلسلة النيوكليوتيدات الحامض النووي للخلية بفعل الإشعاع وبالتالي ارتفاع معدلات البالغات المشوهة وانخفاض في نسب البزوغ.ان لزيادة مدة التعرض للأشعة تأثيرات سلبية واضحة من خلال ارتفاع نسب الهلاك في العذارى ومعدل البالغات المشوهة وانخفاض معدل البالغات البازغة السليمة وهذا ما أشار إليه Annie ,وجماعةه. (2002) .



شكل (2-1) بالغات مشوهة

تنفق هذه الدراسة مع ما توصل إليه الربيعي وجماعته , (2012). عند دراسته لاستحداث العقم في الذبابة المنزلية, وتوصل الى انخفاض عدد البيض الموضوع ونسب فقسه وتأثيرا متزايدا لموت العذراء وارتفاع بزوغ البالغات الغير طبيعية عند تزاوج عذارى ذكور مشعشة مع إناث طبيعية والمعرضة إلى جرعات إشعاعية متصاعدة . وحدث العقم الجنسي التام عند جرعة 30 غراي .

تنفق هذه الدراسة مع ما توصل إليه Khan, Islam (2006) عند دراسة استحداث العقم لدى الذبابة المنزلية وتوصل الى انخفاض عدد البيض الموضوع ونسب فقسه وتأثيرا متزايدا لموت العذراء وارتفاع بزوغ البالغات الغير طبيعية عند تزاوج عذارى ذكور مشعشة مع إناث طبيعية المعرضة الى جرعات اشعاعية مختلفة وحدث العقم الجنسي التام لدى الذكور عند جرعة 40 غراي .

تتفق هذه الدراسة مع ما توصل إليه (Makee and Saour, 2001). عند دراسته للعقم الموروث في عثة درنات البطاطا , وتوصل الى انخفاض عدد البيض الموضوع ونسب فقسه عند تزاوج ذكور مشعشعة مع إناث طبيعية وعزى ذلك الى التأثير في قابلية التزاوج وتكرار التزاوج لدى الذكور المشعشعة المتزاوجة مع إناث طبيعية .

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**Study the Effect of Concentration on Fabricated
Fiber Polymer PVDF Using Electrospinning**

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Abstract:

Electrospun is characterized into four types of polymers polyvinylidene fluoride (PVDF). Single polymer performance uses only one form of polymer solution designed for electrospinning technical, with specific porosity, a very high surface-to-volume ratio, etc. Therefore in this work the researcher indicated the effect of sensitive parameters on fabricate of fibers with concentration (16%PVDF W/W%) dissolved by solvents, dimethylformamide (DMF), Dimethylsulfoxide (DMSO), and Acetone in the ratios of (1/4, 3/1, 1/2, 2/3, and 1/3V/V%). The results of SEM appearances that the fabrication of fibers PVDF were with agglomerate, solidifications, beads, and free-beads. Then, showed that the perfect ratio is (DMSO/Acetone: 1/3V/V%) fabricated fiber with diameter (9.167nm), which can use in modifications and fillers in addition to other materials.

Keywords: Fiber Polymer PVDF, DMF, DMSO, Acetone, Electrospun, SEM

Introduction

The technique of electrospinning is a unique approach by applied electrostatic forces (high voltage) to produce fine fibers as of micrometer towards nanometer scale. It has fibers with lesser pore size, a high specific surface area, and etc. So, an electrospun nanofibrous technique has befitted the principal selection of air filters in the period of coronavirus disease (COVID–19), due to the increasingly risky air pollution towards safety has practical investigate hotspot [1, 2].

Polyvinylidene Fluoride (PVDF) has unique piezoelectric properties, and molecular configurations that can used in the field of energy harvesting owed to its including five different phases semi- crystalline, where (ϵ , δ , α , γ , and β) are the best electrically poled and

mechanically stretched to get the (β -phase) which is required to improving its piezoelectric properties therefore, be able to apply in self- piezoelectric energy harvesting devices [3, 4].

As electric force overcomes the surface tension (Taylor cone) charged jet is formed. In the function of polymer solution becomes coagulated viscosity /molecular weight increases to a threshold that cause can't be practical against formation of perfect fibers using the typical electrospinning technique [5-7].

The morphology, besides diameter is confirmed as a means of structuring fiber characteristics that adjusting to solution properties. Although, this is one of sensitive scrutinized factors in fabrication of nanofibrous. In addition to the electric field, it is indicate how material and solution performs modify in fabrications of more reformed nanostructures. The use of a solvent, polymer, or/ and additives with higher conductivity invariably modifies flexible alterability of the electrospinning jet. Fig. (1) confirmation the factors that add to structured, and fabrication perfect fibers [8].

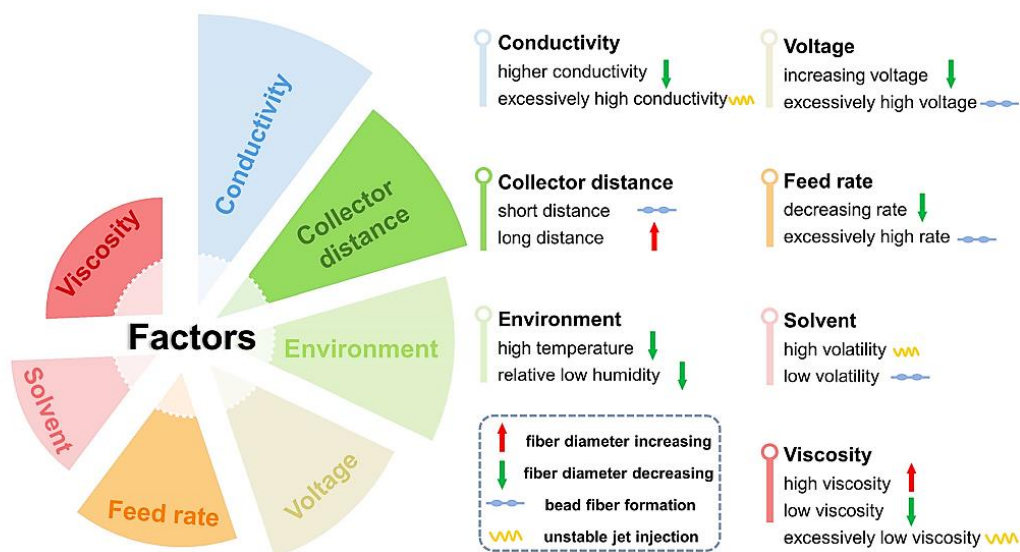


Fig. (1): Confirmation of the parameters that fabricated perfect fibers [8]

This paper's indicated to explore the electrospinning's sensitive factors that use for fabricated PVDF, then, confirm the perfect conditions to achieve beads-free, beads, or solidifications PVDF Nanofibers, using the optimization technique SEM.

Experimental:

Materials and Method:

PVDF with $M_w=534000$ g/mole powder, dimethylfluoride (DMF), Dimethylsulfoxide (DMSO), and Acetone within purity (99.8% from Sigma-Aldrich). In this work, powder PVDF dissolve by mixtures solvent DMF/Acetone, where, the solution stirring at room temperature for about (1 hour). Then, solution resulted put in (3 ml) plastic syringe which was located inside a syringe pump. A high voltage in the range (15-18 Kv) was applied to the needle. The numbers of providers of a rate flow solution was adjusted to attain a balanced fluid jet. A grounded substrate was used to assemble the fabricated nanofibers at a distance from (10-15 cm), as of the tip of the needle.

Result and Desiccation:

Characterization Fibers PVDF Using SEM:

The surface morphologies and shapes of nanofibers PVDF were confirmed by SEM. Where, the properties of electrospun technique be able to enhance fabricated fibers with beaded or no bead by adjusting the effective environments such as the composition of the solution, ambient factors, fabricating parameters, etc. [9, 10].

Fig. 2(a) image of influenced of fiber with concentration (16% PVDF W/W%) was dissolved using solvents (DMF/Acetone: 1/4V/V%), showed dense pieces (solidifications) and no appearance of the fibers, just weak, invisible threads, which indicates the heterogeneity of the solution resulting from the solution preparation process since the jet from the needle out as dense polymer and very difficult to reach to a substrate to fabricate homogenizes fibers [11].

Fig. 2(b)—(c) illustration structure with concentration (16% PVDF) was dissolved by (DMF/Acetone: 3/1V/V%) purely as a point places aggregated in clustered integer because not all the polymer was dissolve therefore, the prepared solution is hardly thick and it's very difficult to withdraw the solution and overcoming the surface tensile strength, it did not produce a clear or homogeneous fiber [12].

Consequently, Fig. 2(d) confirmation (16%PVDF) was dissolved by (DMF/Acetone: 1/2V/V %) since the high voltage uniform was applied as a result, the resultant electric field force must stretch the surface tension of the cone jet, generating an unstable aerosol distribution, causing in a temporary mode that agreement with reference [13].

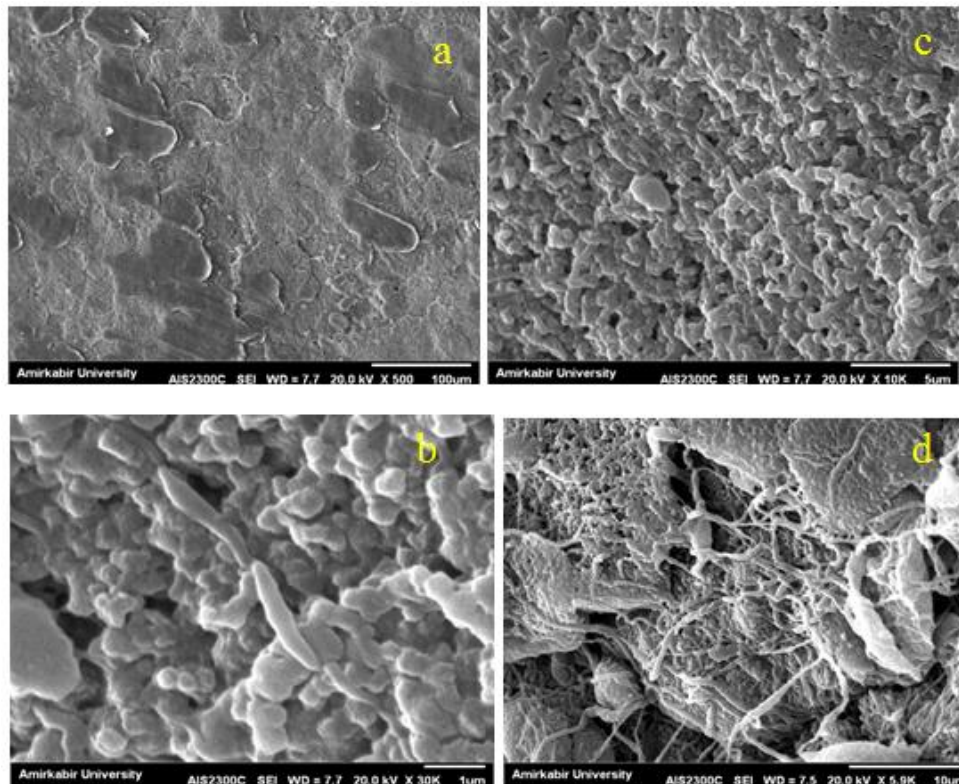


Fig. (2): SEM appearance PVDF fibers dissolve with different ratios of solvents

However, in Fig. 3(a)—(c) containing SEM images 16%PVDF which dissolved by (DMF/Acetone: 2/3V:V%) within different magnifications that conform that the character is including a clear aggregate of small amounts of beads, the distribution is irregular and nonalignment [14].

Then, Fig. 3(d) demonstration complete that the balance of the parameters rat flow, distance between substrate and needle, high voltage, and the preservation of the environmental conditions in laboratory, such as humidity, temperature, and others, have been proven for all the attempts mentioned by the researcher (1/3V:V) after the solvents were changed to (DMSO/ Acetone) is in perfect distribution, and alignment with mean diameter (9.167 nm),

its formed a distinct, identifiable, stable, and the absence of beads due to DMSO is high polarity, in addition to its low toxicity risks compared to DMF [15].

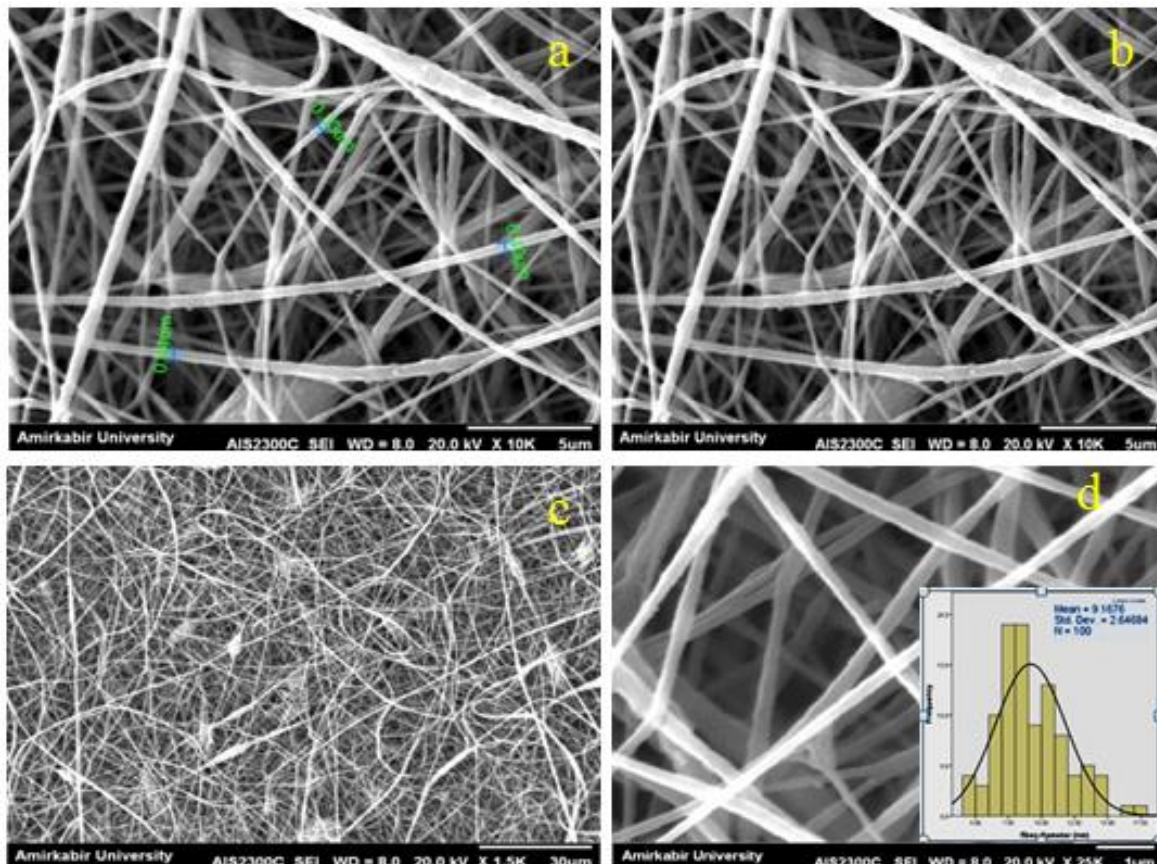


Fig. (3): SEM illustration 16%PVDF fiber (a-c) with a small number of beads, (d) without beads

Conclusion:

Through this study the researcher was concluded that the electrospinning technique is a good method for obtaining synthetic polymer fibers. Where, the results of scanning electron microscope (SEM) showed that the nature of the surface and shapes depend on the concentration of the polymer, the solvents, and their types. Wherever, the images showed agglomerations of beads on the surface at a concentration of solvents [1/4, 3/1, 1/2, and 2/3V/V%: (DMF/Acetone)]. While the best results were obtained is in a concentration of (1/3V/V%: DMSO/Acetone) performed free- beads fibers, more alignment, and lowered diameter (9.167nm).

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