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Synthesis and Antioxidant Characteristics of Novel Heterocyclic Derivatives from 2-Thiol-5-Phenyl-1,3,4-Oxadiazole Compounds

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Abstract

The 1,3,4-Oxadiazole-bearing compounds are among the most attractive classes for researchers because of their biological processes. The study used a current show of quinazoline-4-one and oxazine-4-one derivatives (8-13) were synthesized. Firstly; the reaction of benzyl salicylate was reacted with hydrazine hydrate (99%) to give 2-hydroxybenzohydrazide (1) then the produced was reacted with carbon disulfide dissolved in absolute ethanol and potassium hydroxide to make 2-(5-mercapto-1,3,4-oxadiazol-2-yl)phenol (2). After that, compound (2) was treated with ethyl chloroacetate to give ethyl 2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetate (3). Hydrazine hydrate and compound (3) interacted to create 2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio) acetohydrazide (4) next combined with a different aromatic aldehyde substitution in absolute ethanol to produce derivatives of Schiff's bases (5-7). Lastly, preparations were made for the target compounds (8–13) by interacting chemicals (5-7) with anthranilic and salicylic acid. Using [FT-IR, 1H-NMR, and 13C-NMR] and measuring their physical properties, the newly synthesized compounds were recognized. We also examined the potential anti-oxidant properties of produced compounds. According to the obtained data, the synthesized compounds showed different inhibition activities against free radicals. Moreover, compounds (10 and 13) were found to be most effective against DPPH radicals, and higher than that of BHT. It has been concluded that the synthesized compounds have therapeutic potential for diseases mediated by oxidative stress.

Keywords: Antioxidant activities, heterocyclic, oxadiazole, Schiff bases.

1. Introduction

Due to their significant use as primary building blocks for active medicinal components, heterocyclic compounds are of tremendous interest to scientists [1]. Among them, 1,3,4-oxadiazole/thiadiazole derivatives were found to possess several biological activities, such as analgesic, anti-inflammatory [1,2], antibacterial [3], antioxidant [3,4], antifungicidal [5] and more biological characteristics [6]. Recent data has focused on the antiviral, antitubercular, anticancer, anti-inflammatory, antiparasitic, antioxidant, enzymatic inhibitory, antibacterial, and

antifungal potentials of compounds containing a 1,3,4-oxadiazole moiety [7-15]. To treat AIDS-related disorders, ralettegravir, an HIV integrase inhibitor, is administered along with other antiretroviral medications [16]. Fenadiazole treats anxiety and insomnia by having sedative and hypnotic effects [17]. Zibotentan is suggested for the treatment of prostate cancer in particular as well as colorectal, breast, ovarian, lung, and other malignancies [18].

Many substituted quinazoline and oxazine are known to possess diverse biological activities such as antimalarials, hypnotics, anticonvulsants, anti-protozoal agents, bacteriostatic and anti-fungal [19]. Additionally, comparable to a stronger antioxidant action than conventional substances can be produced by the inclusion of certain functional groups. A straightforward and effective approach to synthesize some new quinazoline-4-one and oxazin-4-one derivatives containing 1,3,4-oxadiazole ring is proposed in the current study in light of the significance of the described derivatives as bioactive compounds, as shown in **Figure 1**.

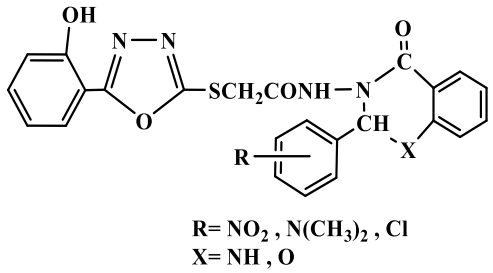


Figure 1. Target molecule using in this work**.**

In vitro models were used in this study to develop a method for producing and testing the antioxidant potency of these novel quinazoline-4-one and oxazin-4-one derivatives containing 1,3,4-oxadiazole ring.

2. Materials and Methods

2.1 Instrumentation

All of the compounds used in this investigation were provided by the chemical companies Merck, BDH, Fluka, and Sigma Aldrich. The Department of Chemistry, College of Science, University of Baghdad, used an FTIR 8400s Fourier transitions infrared spectrometer (Shimadzu, Japan) to record the FTIR spectra using a KBr disc in the 4000-600 cm-1 spectral region. Gallenkamp electrothermal equipment was used to measure the melting point. TLC is a technique used to examine the pureness and homogeneity of synthetic substances. Bruker Ultra-shield (400 MHz) near magnetic resonance was used to record the 1H-NMR and 13C-NMR spectra. Also, the experiment carried out at Tehran University in Iran using DMSO-d6 as a solvent.

2.2 Synthesis of compound

2.2.1 Synthesis of 2-hydroxybenzohydrazide (1)

Excess of hydrazine hydrate (99% 2.5 mL, 0.08 mole) was added to methyl salicylate (10 mL, 0.04 mole) in 50 mL circular bottom flask, and swirled for 2 hours after that refluxed for 20 hours. Then it pours into the petri dish, and the product has been recrystallized using ethanol [20, 21].

2.2.2 Synthesis of 2-(5-mercapto-1,3,4-oxadiazol-2-yl)phenol (2)

Absolute ethanol (50 mL) and potassium hydroxide (2.2 g, 0.03 mole) were collected in a flask with a dry circular bottom. The 2-hydroxybenzohydrazide (6 g, 0.03 mole) was placed and thoroughly mixed into it to make a clear mixture [22, 23]. Excess of carbon disulfide (11 mL, 0.15 mole) was poured to the above-mentioned clear solution and heated gently for (20 h), after checking the finish all H_2S stopped. The excess solvent was dried after which it was chilled to room temperature. The substance was added to water, which was then treated with 5% HCl until the precipitates separated. To obtain the required product, the separated product was rinsed with cool water before being dried.

2.2.3 Synthesis of ethyl 2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetate (3)

Substance (2) (2 g, 0.01 mole) was dissolved in DMF (20 mL) and triethyl amine (1 mL, 0.01 mole). Ethyl chloroacetate (2.4 mL, 0.02 mole) was added dropwise, the reaction mixture was refluxed for 18 h. The excess solvent was concentrated by heating, the obtained product was recrystallized from ethanol [24,25].

2.2.4 Synthesis of 2-(((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetohydrazide (4)

Chemical (3) (1g, 0.003 mole) should be dissolved in absolute ethanol (25 mL) and excess (99%) hydrazine hydrate (0.5 mL, 0.03 mole) was added to the mixture gradually, the reaction was stirred for 4h and refluxed for 24 h and the result was washed several times by ethanol after the solution was put into a petri-dish [26–29].

2.2.5 Synthesis of novel Schiff bases (5-7) from compound (4)

A mixture of compound (4) (1 g, 0.003 mole) in DMSO (10 mL and various aromatic aldehydes (0.003 mole) in absolute ethanol (10 mL). Then, a few drops of glacial acetic acid were allowed to react for eight to twelve hours [30,31].The solvent was evaporated and water was used to wash the resulting precipitate. In **Table 1**, the physical characteristics of chemicals (5-7) were presented.

2.2.6 Synthesis of quinazoline-4-one derivatives (8-10)

To the a 0.0007 mole solutions of Schiff bases (5-7) in THF (20 mL), anthranilic acid (0.1 g, 0,0007 mole) was then added slowly. The mixture was refluxed for (18 hrs.), after completion of the reaction, the solution was cooled to room temperature. After that, $NaHCO_3$ (5%) was added. The precipitate was filtered and recrystallization from ethanol.

2.2.7 Synthesis of oxazin-4-one derivatives (11-13)

Following that, a mixture of Schiff bases (5-7) (0.0003 mole) in THF (20 mL) was slowly supplemented with salicylic acid (0.0003 mole). When the reaction had taken place for 18 hours, the combination was refluxed, and the solution was then chilled to room temperature. Then, $NaHCO_3$ (5%) was added. The precipitate was filtered and recrystallization from ethanol.

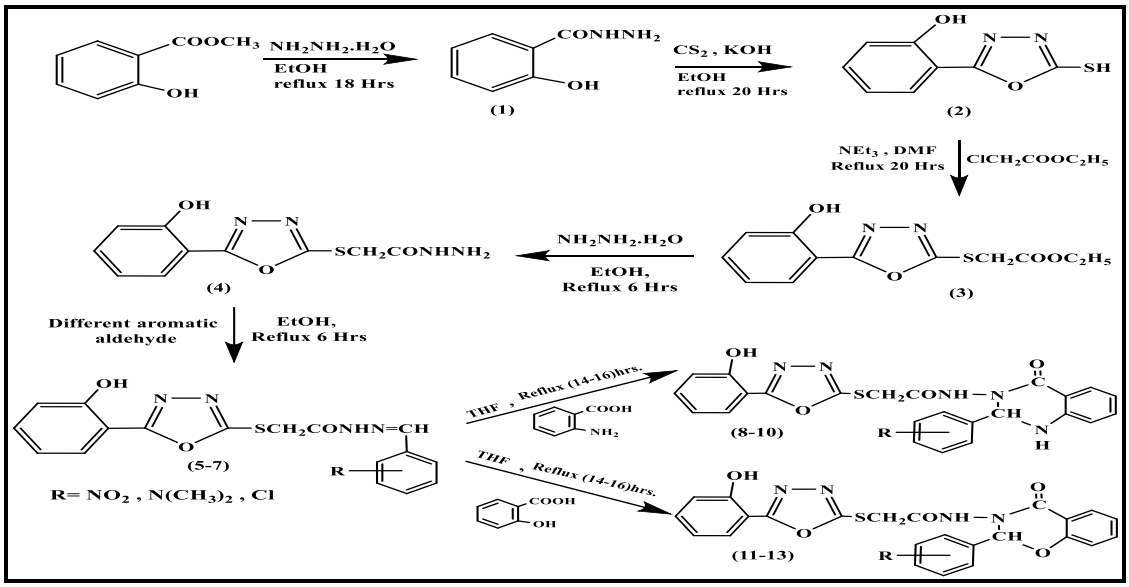
2.2.8 Quantify the antioxidant capacity using the DPPH technique

The 1,1-diphenyl-2-picrylhydrazyl (DPPH) is an effective instrument for assessing a compound's antioxidant capacity and can be used to assess the antioxidant action of synthetic chemicals. One electron is transferred in the process mechanism, and hydrogen atoms are also moved. This experiment was carried out using a modified version of the Meda *et al*., technique [32]. In a nutshell, 0.3 mL of the samples were added in DMSO in addition to various concentrations ranging from 25 to 100 ppm, and 2.7 mL of a 50 ppm methanolic solution containing DPPH was added. All specimens were maintained at room temperature for an hour in the dark. The reduction of DPPH activity was assessed using a U-2900 Hitsechi UV-visible spectrophotometer, which assessed the absorbance at 517 nm. The percentage of inhabitation of DPPH activity was estimated using the next equation: (% Inhibition) $(A_0 - A_E)/A_0 \times 100$

A0 represents the absorbance of the DPPH solution used as the control (without plant extract), and AE represents the absorbance of the DPPH solution with plant extract. Analogous methods were employed to assess ascorbic acid's effectiveness as a DPPH scavenger.

3. Results and Discussion

According to the **Scheme 1**, new heterocyclic ring derivatives were included in this work.



Scheme 1. New heterocyclic ring derivatives.

3.1 Synthesis of 2-hydroxybenzohydrazide (1)

The compound (1) was created by stirring methyl salicylate with 99% hydrazine hydrate in ethanol. FT-IR spectra data for compound (1) shows the existence of the identifiable absorption band at (3319-3269) cm^{-1} belongs to v (NH_2) group asym. and sym. respectively and identifiable absorption band at v(1643) cm^{-1} belongs to v(C=O) of amide group.

3.2 Synthesis of 2-(5-mercapto-1,3,4-oxadiazol-2-yl)phenol (2)

The 2-hydroxybenzohydrazide (1) reacted with carbon disulfide in alkali medium followed by acidification with hydrochloric acid. The FT-IR spectra data [33] for compound (2) showed the appearance of the characteristic absorption band at (1612) cm^{-1} belonging to v (C=N) and characteristic absorption band at (2594) cm^{-1} belonging to v (S-H) and disappearance of the absorption bands (3319-3269) cm^{-1} both of these are asym. and sym. Members of the v (NH_2) group, respective. The ^{1}H-NMR spectra of chemical (2) revealed signals at = (6.96-7.74) ppm resulting from (CH aromatic ring), a singlet single at = (14.56) ppm according to (-SH) proton, and a singlet single at (10.40) ppm according to (-OH) proton. In **Figure 2**, 13C-NMR spectrum of chemical (2) revealed signals at δ= (156.77) ppm, δ=(160.31) ppm, δ= (109.85) ppm, and signals δ= (117.51-133.93) ppm belong to (C-OH), (-N=C) oxadiazole ring carbon, (CH-C=N) and aromatic ring carbon respectively, as shown in **Figure 3**.

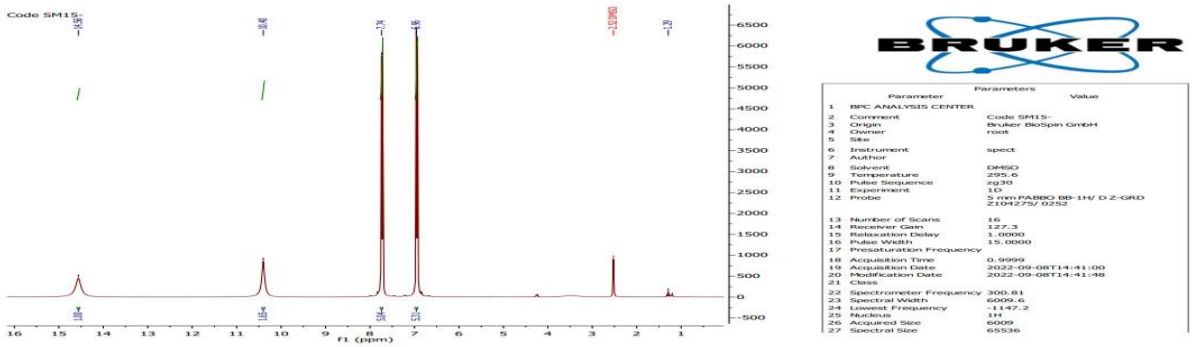


Figure 2. The ^{1}H-NMR of compound (2).

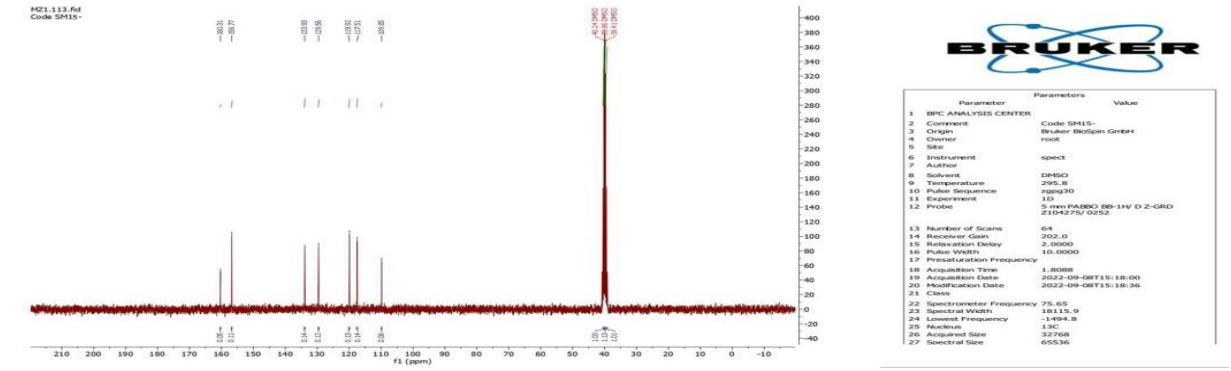


Figure 3. The ^{13}C-NMR of compound (2).

3.3 Synthesis of ethyl 2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetate (3)

In an alkaline medium, compound (2) and ethyl chloroacetate reacted to form compound (3). The FT-IR spectrum for chemical (3) revealed the formation of the particular absorption band at (1743) cm^{-1} that is assigned to v (C=O) of ester and the elimination of the absorption band (2594) cm^{-1} that is assigned to v (S-H).

3.4 Synthesis of 2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetohydrazide (4)

Hydrazine hydrate was used to transform compound (3) into compound (4) in absolute ethanol. The typical absorbance bands for chemical (4) were seen in the FT-IR spectra, and they were found to belong to the v (NH_2) asym. and sym., accordingly an identifiable absorption band at (1674) cm^{-1} belongs to v(C=O) of amide carbonyl group, and the disappearance of the absorption band (1743) cm^{-1} this, as a result of the ester carbonyl group, corresponds to v (C=O). Compound (4)'s ^{1}H-NMR spectra [34] revealed signals between δ= (7.25-7.35) ppm according to (CH aromatic ring), a single at δ= (9.36) ppm according to (-NH) proton, a singlet single at δ= (9.37) ppm according to (-OH) proton, a single at δ= (4.14) ppm according to ($-NH_2$) proton, as in **Figure 4**.

Chemical (4)'s ^{13}C-NMR spectra displayed a signal at δ= (154.16) ppm, δ=(169.53) ppm, δ= (170.22) ppm and signals δ = (128.68-136.75) ppm belong to (C-OH), (-N=C) oxadiazole ring carbon, (CO-NH) and aromatic ring carbon respectively, as shown in **Figure 5**.

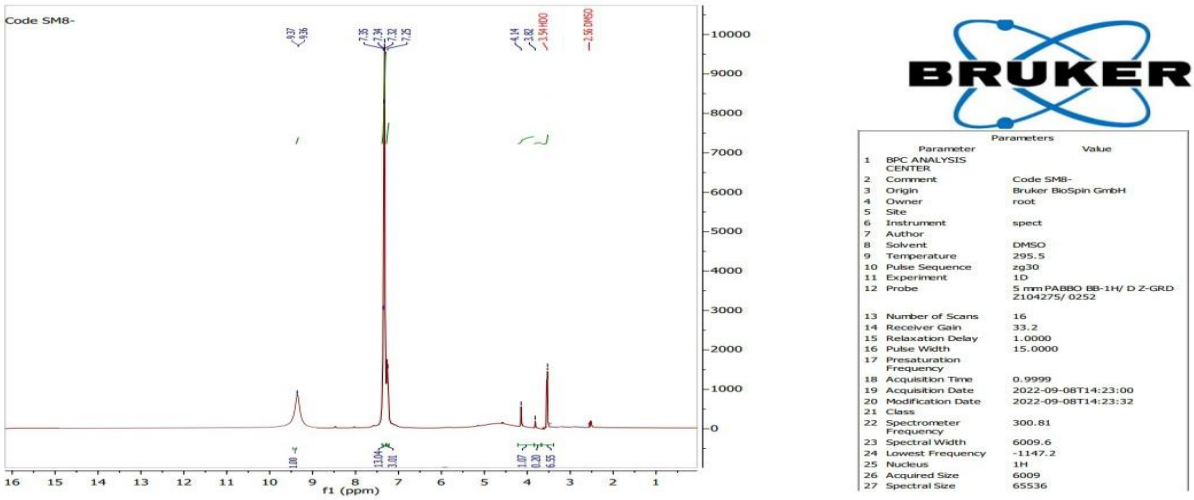


Figure 4. The ^{1}H-NMR of compound (4).

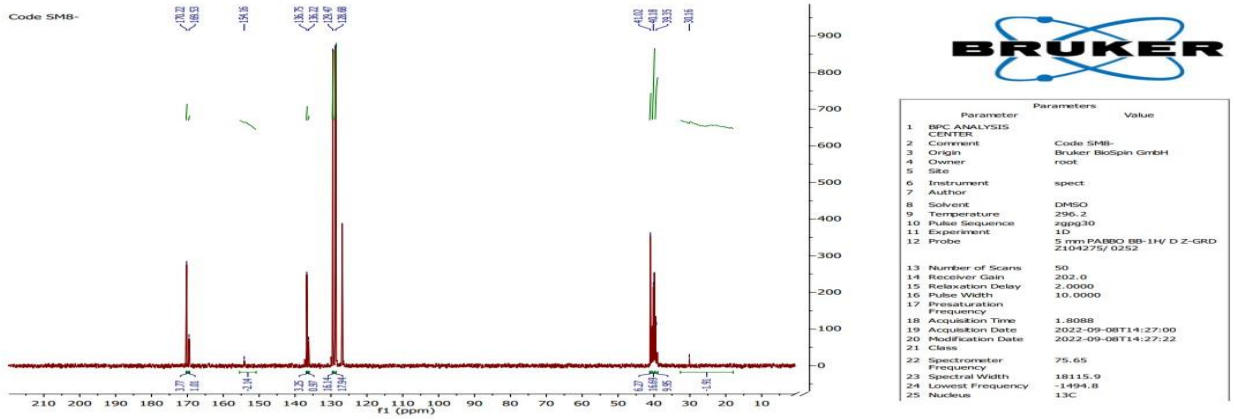


Figure 5. The ^{13}C-NMR of compound (4)

3.5 Synthesis of new Schiff bases (5-7) from chemical (4)

The titled compounds were synthesized from the reaction between compound (4) in DMSO and convenient aromatic aldehydes in absolute ethanol in the presence of glacial acetic acid. **Table 2** contains information on the FT-IR spectra of chemicals (5-7). The ^{1}H-NMR spectrum of compound (5) displayed a singlet signal at δ = (4.03) ppm for (S-CH_2) protons, δ = (11.04) ppm for (-NH) protons, singlet signal at δ = (8.64) ppm because of to (N=CH) imine proton, singlet signal at δ = (9.77) ppm because of to (O-H) protons and multi signals at δ= (7.18-8.39) ppm because of aromatic rings protons, as shown in **Figure 6**.

Chemical (5)'s ^{13}C-NMR spectra displayed a signal at = (40.87) ppm, δ=(146.01) ppm, δ=(168.82) ppm, δ= (174.95) ppm and signals δ = (115.16-138.91) ppm belong to (-SCH_2), (NH-N=C), (-N=C) oxadiazole ring carbon, (CH_2-C=O) and aromatic ring carbon respectively, as shown in **Figure 7**.

The chemical (7)'s ^{1}H-NMR spectrum displayed singlet signals at δ= (4.70) ppm resulting from (S-CH_2) protons, δ= (11.94) ppm because of (-NH) protons, δ= (8.46) ppm because of (N=CH) imine proton, δ= (10.59) ppm because of to (O-H) protons, and δ= (7-7.96) ppm because of aromatic rings protons, as shown in **Figure 8**.

The ^{13}C-NMR spectrum of compound (**7**) showed a signals at δ= (40.84)ppm, δ=(144.55) ppm, δ=(167.02) ppm, δ= (173.86) ppm and signals δ = (117.76-138.21) ppm belong to (-SCH_2),

(NH-N=C), (-N=C) oxadiazole ring carbon, (CH_2-C=O) and aromatic ring carbon respectively, as shown in **Figure 9**.

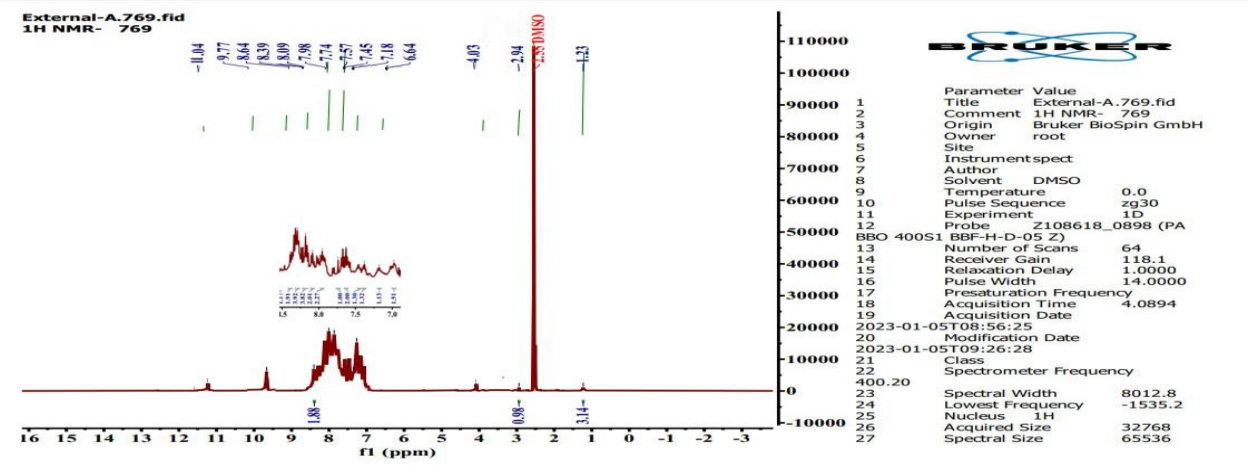


Figure 6. The ^{1}H-NMR of compound (5).

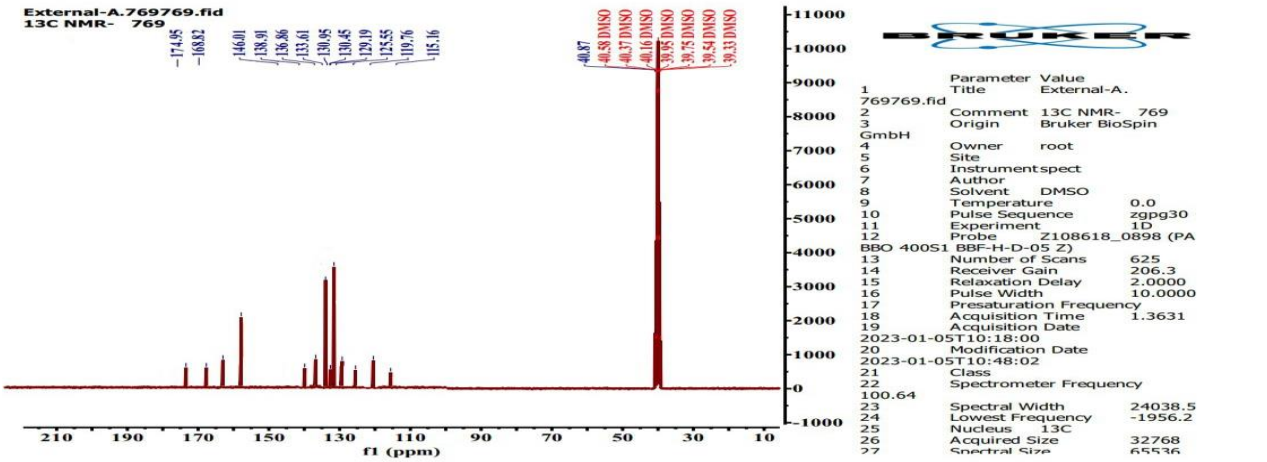


Figure 7. The ^{13}C-NMR of compound (5).

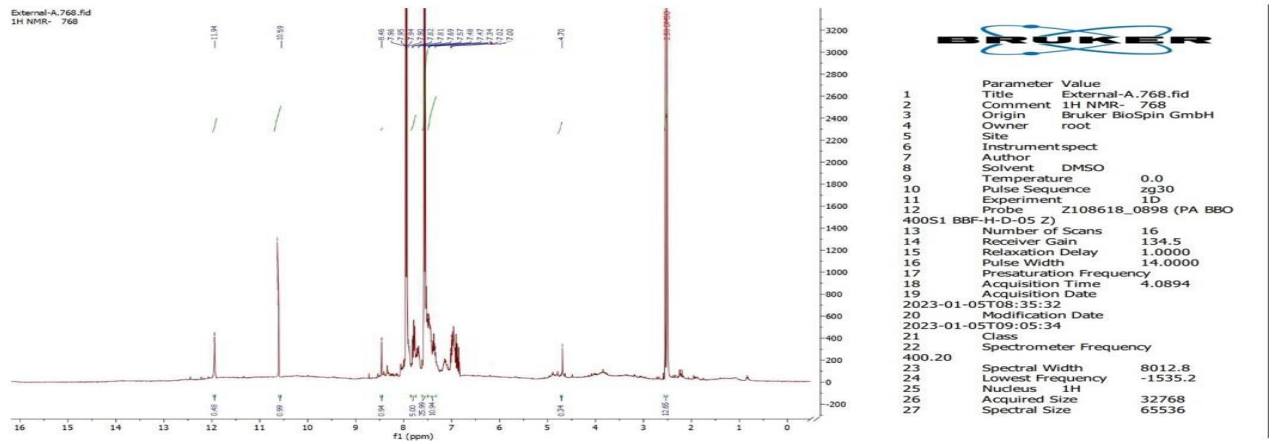


Figure 8. The ^{1}H-NMR of compound (7).

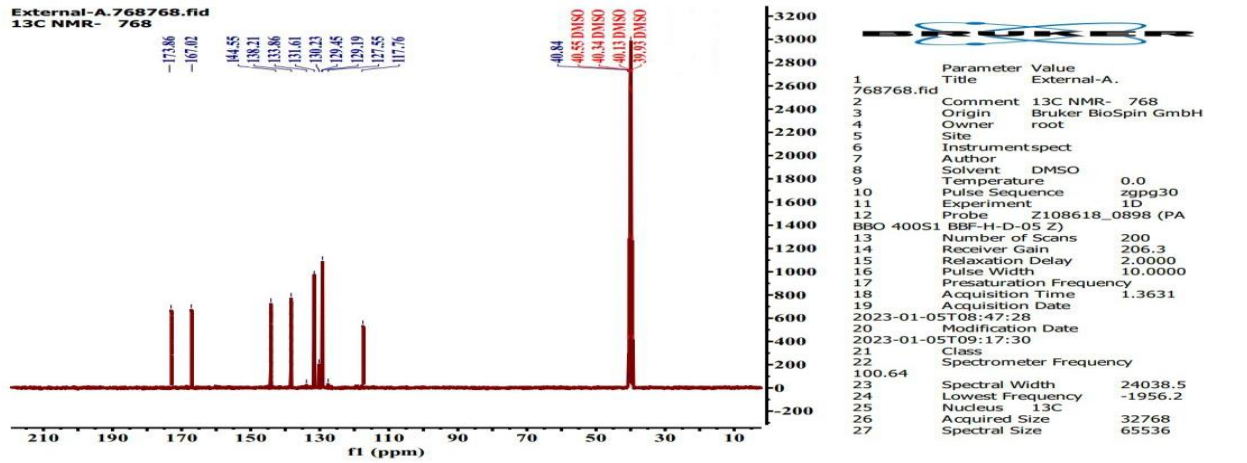


Figure 9. The ^{13}C-NMR of compound (7).

3.5 Synthesis of quinazoline-4-one derivatives (8-10)

Equal amounts of the imine derivatives and anthranilic acid were refluxed in THF to synthesize the quinazoline-4-one derivatives (8–10). Physical characteristics of compounds (8-10) are listed in **Table 1.** The FT-IR spectral data of compounds (8-10) showed the appearance of (N-H) for quinazoline ring stretching band at (3444-3467) cm^{-1}, and the disappearance of (C=N) absorption bands at (1639-1685) cm^{-1}. **Table 3** contains a complete list of the FT-IR spectral data information. Chemical (10)'s ^{1}H-NMR spectra revealed singlet signals at δ= 3.70 ppm due to (-S-CH_2), δ=(6.09) ppm related to (-N-CH-) quinazoline ring proton, and δ=(6.68) ppm related to (-NH-C) quinazoline ring proton, as seen in **Figure 10**, there are multiple signals at δ= (7.53-8.27) ppm because of protons in aromatic rings, a signal at δ= (10.00) ppm because of a proton in the (O=C-NH) amide, and a singlet signal at δ= (9.66) ppm because of (O-H) protons. The chemical (10)'s ^{13}C-NMR spectra displayed a signal at δ=(140.26) ppm, δ=(167.02) ppm, δ= (173.99) ppm, δ= (151.61) ppm and signals δ = (110.29-138.21) ppm belong to (NH-N-CH), (-N=C) oxadiazole ring carbon, (CH_2-C=O), (C=O) amide quinazolin ring and aromatic ring carbon respectively, as shown in **Figure 11**.

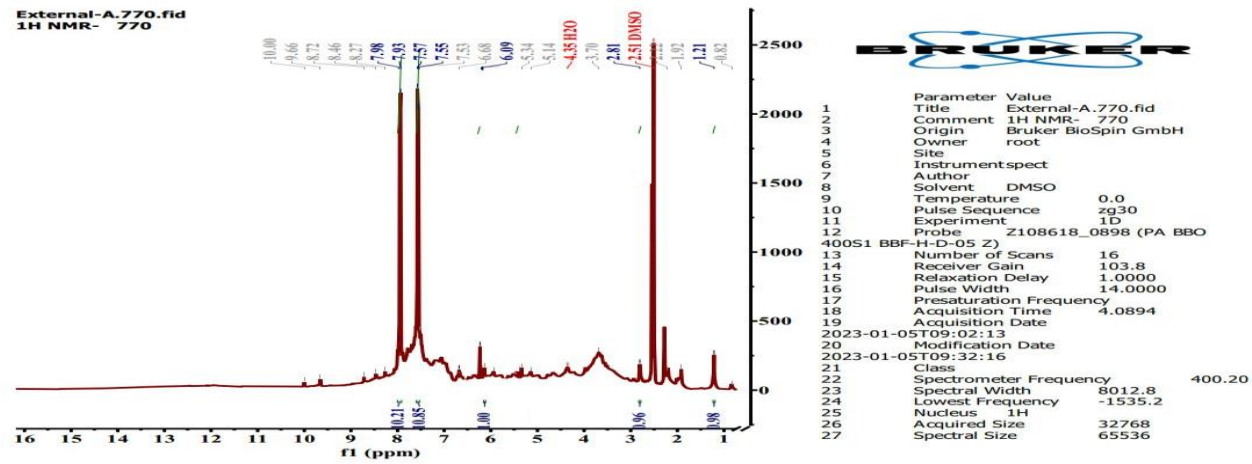


Figure 10. The ^{1}H-NMR of compound (10).

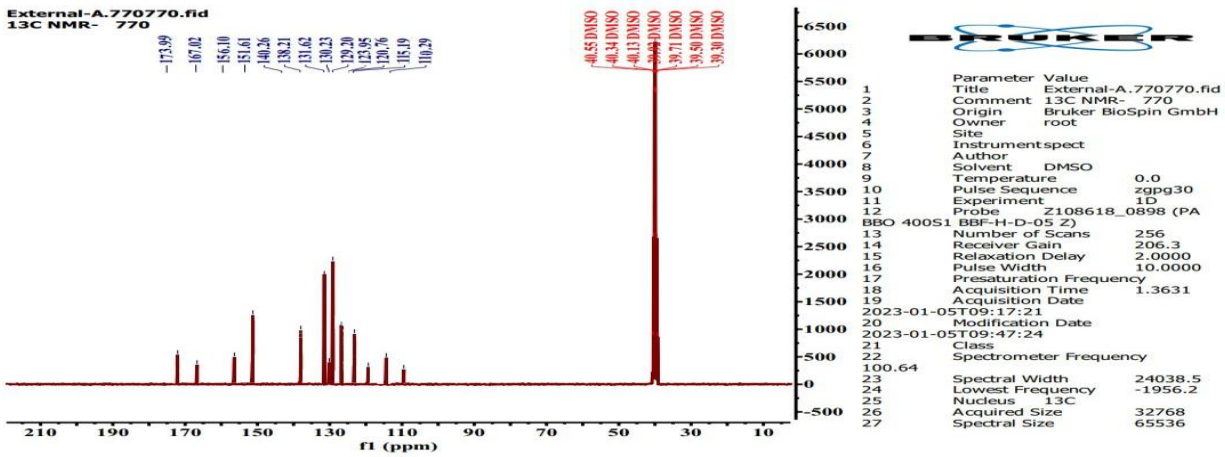


Figure 11. The ^{13}C-NMR of compound (10).

3.6 Synthesis of oxazin-4-one derivatives (11-13)

Equal parts of the imine derivatives and salicylic acid were refluxed in THF to create the oxazin-4-one derivatives (11-13). **Table (1)** lists the physical features of compounds (11–13). Chemicals (11–13)'s FT–IR spectral data [35] revealed the formation of a carbonyl group stretching band at (1650–1683) cm-^{1} and disappearance of (C=N) absorption bands at (1639-1685) cm^{-1}. **Table 3** contains a complete list of the FT-IR spectral data information.

Compound (11)'s ^{1}H-NMR spectrum revealed singlet signals at δ= (3.84) ppm resulting from (S-CH_2), δ= (6.06) ppm because of the (-N-CH-) quinazoline ring proton, and δ= (6.08) ppm because of the (-NH-C-) quinazoline ring proton. There are many signals at δ= (7.16-7.79) ppm caused by aromatic rings protons, a signal at δ= (10.18) ppm caused by a (O=C-NH) amide proton, and a singlet signal at δ= (9.94) ppm caused by (O-H) protons, as illustrated in **Figure 12**. The chemical (11)'s ^{13}C-NMR spectra displayed a signal at δ= (40.85) ppm, δ= (166.95) ppm, δ= (172.95) ppm, δ= (156.16) ppm and signals δ= (117.29-138.26) ppm belong to (CH_2-C=O), (-N=C) oxadiazole ring carbon, (CH_2-C=O), (C=O) amide quinazolin ring and aromatic ring carbon respectively, as shown in **Figure 13**.

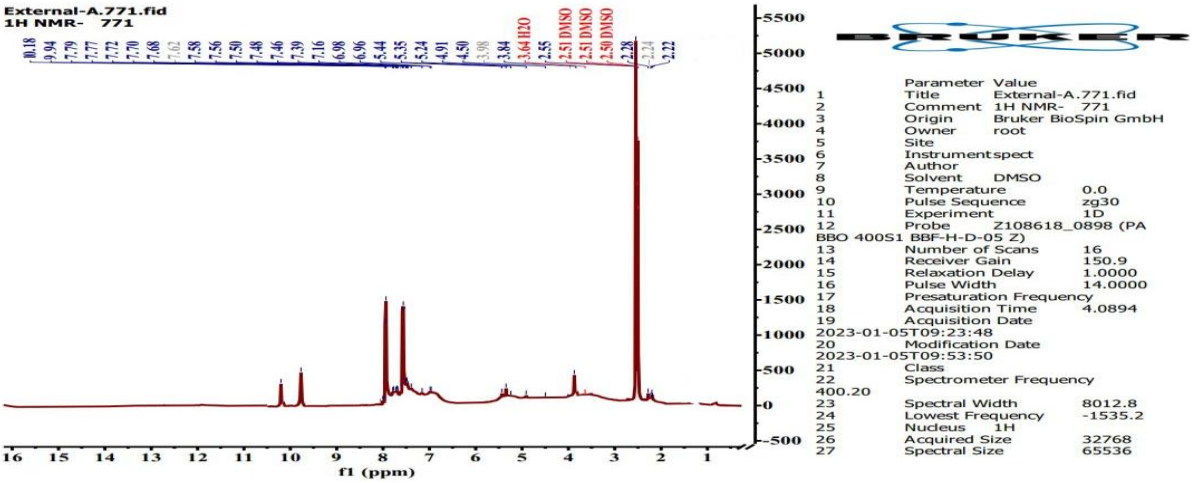


Figure 12. The ^{1}H-NMR of compound (11).

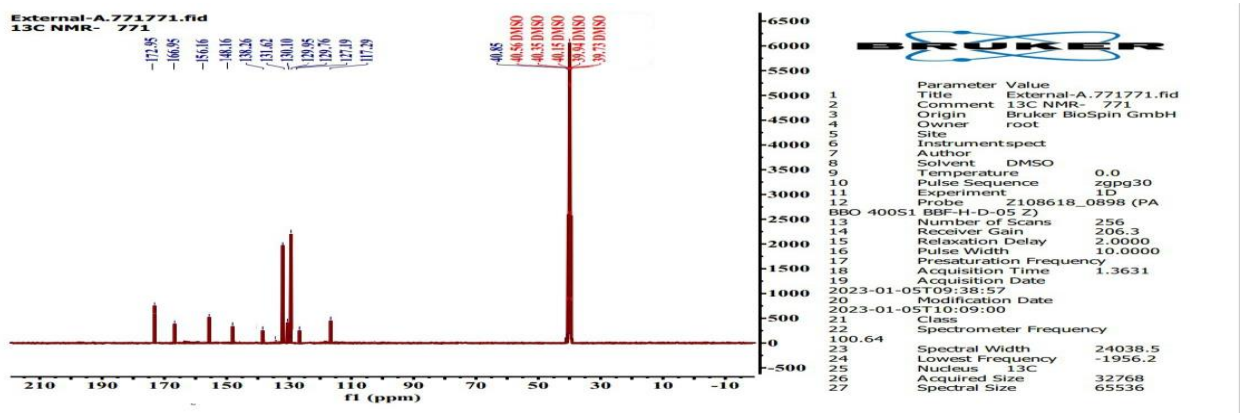


Figure 13. The ^{13}C-NMR of compound (11).

Table 1. Physical properties of compounds (1-13).

NO.	Formula	M.Wt g/mol	M.P. (^{o}C)	Color	Yield %
1	$C_7H_8N_2O_2$	152.15	Oily	Pale brown	86
2	$C_8H_6N_2O_2S$	194.21	204-206	Pale yellow	77
3	$C_{12}H_{12}N_2O_4S$	280.30	Oily	Blackish-green	69
4	$C_{10}H_{10}N_4O_3S$	266.28	Oily	Brown	88
5	$C_{17}H_{13}N_5O_5S$	399.38	280-282	Orange	82
6	$C_{19}H_{19}N_5O_3S$	397.45	232-234	Mustard yellow	83
7	$C_{17}H_{13}ClN_4O_3S$	388.83	162-164	dark brown	80
8	$C_{24}H_{18}N_6O_6S$	518.50	298-300	Yellowish-orange	68
9	$C_{26}H_{24}N_6O_4S$	516.58	268-270	Brown	77
10	$C_{24}H_{18}ClN_5O_4S$	507.95	140-142	Dark beige	75
11	$C_{24}H_{17}N_5O_7S$	519.49	269-271	Orange	72
12	$C_{26}H_{23}N_5O_5S$	517.56	186-188	Reddish- orange	67
13	$C_{24}H_{17}ClN_4O_5S$	508.93	147-149	Light beige	70

Table 2. The FT-IR spectral data (cm^{-1}) of compounds (5-7).

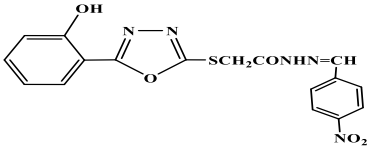
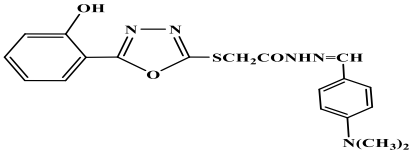
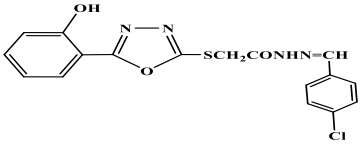
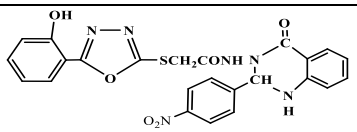
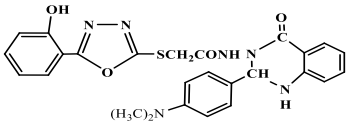
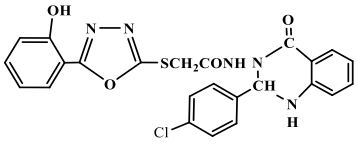
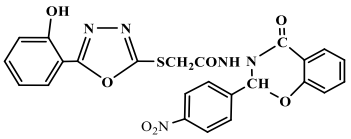
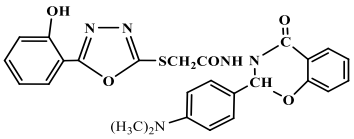
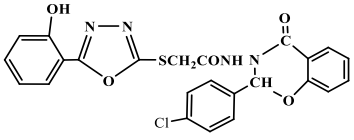
No	Compound structure	FT-IR spectral data (cm^{-1})						
		(O-H)	(N-H)	(C-H) Aliph.	(C=O)	(C=N)	(C=C)	Other Bands
5	 **2-((5-(2-hydroxyphenyl)-1,3,4 oxadiazol-2-yl)thio)-N'-(4-nitrobenzylidene)acetohydrazide**	3429	3188	2945 2840	1683	1639	1521	NO_2 asym. (1521) sym. (1344)
6	 **N'-(4-(dimethylamino)benzylidene)-2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol -2-yl)thio)acetohydrazide**	3433	3195	2966 2864	1685	1639	1554	
7	 **N'-(4-chlorobenzylidene)-2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetohydrazide**	3433	3168	2995 2840	1714	1685	1591	C-Cl 819

Table 3. The FT-IR spectral data (cm^{-1}) of compounds (8-13).

No	Compound structure	FT-IR spectral data (cm^{-1})						
		(O-H)	(N-H)	(C-H) Aliph.	(C=O) Ring	(C=O) Amide	(C=C) Arom.	Other Bands
8	 **2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)-N-(2-(4-nitrophenyl)-4-oxo-1,4-dihydroquinazolin-3(2H)-yl)acetamide**	3444	3276	2977 2937	1701	1605	1575	NO_2 asym. (1521) sym. (1344)
9	 **N-(2-(4-(dimethylamino) phenyl)-4-oxo-1,4-dihydroquinazolin-3(2H)-yl)-2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetamide**	3467	3178	2979 2802	1625	1600	1523	
10	 **N-(2-(4-chlorophenyl)-4-oxo-1,4-dihydroquinazolin-3(2H)-yl)-2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetamide**	3465	3182	2935 2852	1683	1641	1556	C-Cl 759
11	 **2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)-N-(2-(4-nitrophenyl)-4-oxo-2H-benzo[e][1,3]oxazin-3(4H)-yl)acetamide**	3460	3191	2970 2850	1683	1641	1560	NO_2 asym. (1521) sym. (1344)
12	 **N-(2-(4 (dimethylamino) phenyl)-4-oxo-2H-benzo[e][1,3]oxazin-3(4H)-yl)-2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetamide**	3463	3176	2916 2806	1650	1602	1552	
13	 **N-(2-(4-chlorophenyl)-4-oxo-2H-benzo[e][1,3]oxazin-3(4H)-yl)-2-((5-(2-hydroxyphenyl)-1,3,4-oxadiazol-2-yl)thio)acetamide**	3463	3193	2966 2852	1683	1639	1554	(C-Cl) 759

3.8 The DPPH scavenging activity

The radical scavenging activity of the synthesized compounds was measured by using a DPPH assay. According to Pyrzynska and Pkal, the antioxidant chemicals in this assay caused the DPPH radical to change color in this assay from purple to yellow. The reduced DPPH-H is created when the DPPH radical's odd electron pairs with a hydrogen radical from an antioxidant that scavenges free radicals to produce the reduction absorbance [36]. Additionally, according to previous data [37], sulfur compounds have strong antioxidant properties. In this study, compound (10) exhibited the highest antioxidant activities among other quinazoline-4-one compounds. Likewise, compound (13) showed higher antioxidant capacity than other oxazin-4-one derivatives. These results are consistent with those of other studies and suggest that the compounds (10 and 13) have chlorine as the electron-withdrawing substituent on the phenyl ring at position 4, thus exhibiting the highest inhibition [38]. Furthermore, the compounds (9 >12) presented a moderate scavenging activity and their IC50 at 100 ppm were 52.2% and 41.5%, respectively. However, compounds (11 and 8) were found to show lower activities when compared with other synthesized compounds, because of the presence of NO_2 group on their aromatic ring [39]. In this instance, as shown in **Table 4**, certain functional groups and heterocyclic rings unmistakably play a significant role in both enhancing and lowering the antioxidant activity.

This study used butylhydroxytoluene (BHT) and ascorbic acid as positive controls. Thus 9, 10, 12, and 13 at a concentration of 100 ppm presented a greater antioxidant effect than BHT (50 and 100 ppm). In addition, compounds 8 and 11 at a concentration of 100 ppm exhibited antioxidant activities comparable to that of BHT at 100 ppm. On the other hand, at every studied concentration, all synthetic substances displayed weaker antioxidant activity than those observed for ascorbic acid.

Table 4. The DPPH radical scavenging assay.

Synthesized Compounds & Positive Controls	% Scavenging Activity at Different Concentrations			IC_{50}
	25 ppm	50 ppm	100 ppm	
8	7.1 ± 0.3^{f}	12.7 ± 0.9^{fe}	28.1 ± 0.3^{dc}	178.1
9	12.7 ± 0.2^{fe}	27.2 ± 0.7^{dc}	52.2 ± 0.7^{b}	95.2
10	25.1 ± 0.7^{d}	39.5 ± 0.5^{c}	64.8 ± 0.8^{ab}	71.3
11	9.8 ± 0.6^{f}	16.7 ± 0.2^{e}	31.6 ± 0.2^{c}	163.3
12	7.9 ± 0.4^{f}	18.5 ± 0.4^{e}	41.5 ± 0.5^{c}	119.1
13	20.5 ± 0.5^{de}	35.7 ± 0.1^{c}	60.6 ± 0.2^{b}	79.2
Ascorbic acid	65.6 ± 0.1^{ab}	70.2 ± 0.2^{a}	79.6 ± 0.2^{a}	-53.1
BHT	9.1 ± 0.1^{f}	15.1 ± 0.0^{e}	29.6 ± 0.3^{dc}	174.6

*a, b, c means with different superscripts on the same column differ significantly ($p < 0.05$),*Data are expressed as mean ± standard deviation (n = 3),*BHT, Butylated hydroxyl toluene.

4. Conclusion

Quinazoline-4-one and oxazine-4-one derivatives were synthesized, and their antioxidant characteristics were described in the current work. The process made it possible to synthesize a variety of chemicals with various functional groups in good quantities. Utilizing a DPPH radical scavenging experiment, the antioxidant capabilities were evaluated of the substances in this case. The current results showed that the compounds oxadiazole, Cl (10 and 13), and $N(CH_3)_2$ (9 and 12) showed antioxidant capabilities, showing that the group insertion may enable electron donation by the DPPH radical. Since BHT, a well-known antioxidant molecule, had a smaller impact, it may be concluded that both oxadiazole chemicals (10 and 13) with the Cl

group placed in the para-position to the aromatic ring have excellent antioxidant properties. Oxadiazole chemicals like 8 and 11 additionally displayed an overall antioxidant activity comparable to that obtained for the positive control (BHT), demonstrating the antioxidant capacity of the chemicals mentioned above. The findings of the present research allow us to suggest that these compounds be investigated further as a possible approach to therapy for treating oxidative stress-related disorders.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Funding

None.

Ethical Clearance

This study was approved by the scientific committee in the College of Science at the University of Baghdad for approving this study.

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