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Synthesis, Spectroscopic Investigation, Anti-Bacterial and Antioxidant Activites of Some New Azo-Benzofuran Derivatives

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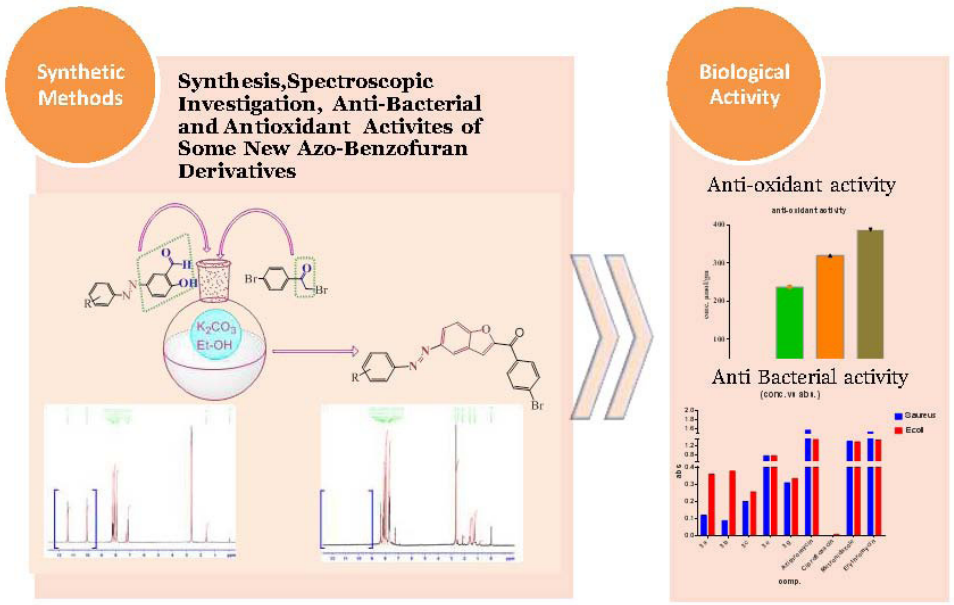

THIS Article deals with the stepwise synthesis and spectroscopic characterization of some new azo benzofuran derivatives, started from the diazotization of substituted aniline coupled with 2-hydroxy benzaldehyde. On reacting of the azo of 2-hydroxy benzaldehyde with p-bromo phenacyl bromide, the benzofuran (**3a-g**) are obtained. The structure of the new benzofuran derivatives have been characterized by using FT-IR, 1H-NMR,13C-NMR and DEPT-135 NMR. The biological activity of some new synthesized compound was obtained by vitro anti oxidant and anti microbial activity with both *Staphylococcus aureus* and *Escherichia coli* .The results showed that the new benzofurans have mild anti oxidant activity compared to the standard ascorbic acid.

Keywords: Synthesis, Diazotization, Benzofurans, Antimicrobial activity, Antioxidant activity.

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Introduction

Most advance in medicine is dependent on innovation in chemistry. More exploitation in implicit chemical research is definitely very important in suppressing disease. Heterocyclic compounds are greatly dispensed in mammalian life, when human depleted as nutrition[1]. Azo group is the organic colorant it consists of (-N=N-) group with aromatic or hetrocyclic constituents[2] [3]. Benzofuran and their derivatives are interested and vital class among heterocyclic compounds[4]. Benzofuran itself is a colorless liquid; it was found in coal tar. It is a main scaffold structure in many of natural and drug compounds[5]. Benzufurans have valuable biological properties such as, anti-tumor[6,7], anti-inflammation[8]3d, 3e, 9c and 9d – were assessed for their anti-inflammatory activity and ulcerogenic liability in vivo. The 3-(pyridin-3-yl, anti-microbial[9,10], anti-proliferative effects[11], and antioxidant[12–14]. The benzofuran ring system particularly the one having functional groups like hydroxyl and acetyl groups are heavily concerned because of their wide appearance in nature and their beneficial biological activities[15]. Due to their broad medicinal applications as mentioned above, in this present study we get interested to design and synthesis of new group of benzofuran compounds functionalized with different azo linkages and assessing their biological activities.

Experimental

Material and Methods

Experimental notes

All chemicals were used in scheme 1 they were obtained from (Fluka, BDH, Riedel-de Haen) Stuart melting point device (SMP3) were used to determine melting point in Salahaddin University-Hawler. IR Affinity-1 Spectrophotometer were used to record FT-IR spectra using Potassium Bromide disc in Salahaddin University-Erbil .Anti-bacterial and anti-oxidant were recorded on SHIMADZU UV-1800 Series single beam UV/ Vis spectrophotometer.

. Bruker 400 MHz ultra-shield were used to run ^{1}H-NMR, ^{13}C-NMR and ^{13}C-DEPT-135 spectrain Jordan University of science & Technology.

lead compound 2- (hydroxy) -5-[substituted] benzaldehydes[16],[17] (1a-g)

A series of 2- hydroxyl azo benzaldehydes (**1a-g**) were synthesized through two steps as illustrated below:

Step1: preparation of the diazonium salts:
Substituted aniline (0.05 mol) was added to 40 mL of 3M HCl. Ice bath used to cool the solution to near 0^{O}C with continues stirring. 25 mL of newly prepared 1M of $NaNO_2$ solution was added slowly to the above solution with maintain the temperature at 0-5^{0}C.

Step2: Coupling process: (coupling of 2- hydroxybenzaldehyde)
2-Hydroxybenzaldehyde (0.05 mol) was added to 100 mL of KOH solution with stirring at 0-5^{o}C. Then, the solution of step 2 was slowly added to the step 1 solution at same low temperature with continues stirring for about 15 minutes until the solid precipitate start to be observed. The reaction mixture was left at low temperature until completion. The colored solid azo-compounds were filtered off, rinsed with water and ethanol few times, then dried under vacuum and recrystallization from toluene to afford the pure azo dyes of 5-(substituted azo)-2-hydroxy benzaldehyde.

2-hydroxy-5-(phenyldiazenyl) benzaldehyde (1a).
(C13H1ON2O2); mp. 128-130°C, with product yield (95%). IR (cm^{-1}) str., 3500-3100 b (-OH), 1653 (C=O), 1602 (C=C), 1571.8 (-N=N-) and 1207 & 1168 (C-O).

2-hydroxy-5-((4-methylphenyl)diazenyl) benzaldehyde (1b).

(C14H12N2O2); mp. 151-152.5°C, with product yield (97.69%). IR (cm^{-1}) str., 3500-3100 b (-OH), 1653 (C=O), 1602 (C=C), 1571.8 (-N=N-) and 1207 & 1168 (C-O).

2-hydroxy-5-((2-chlorophenyl)diazenyl) benzaldehyde (1c).

($C_{13}H_9ClN_2O_2$); mp. 149-150°C, with product yield (95%).IR (cm^{-1}) str., 3400-3100 b (-OH), 1668 (C=O), 1618 (C=C), 1571.8 (-N=N-) and 1205 & 1172 (C-O). ^{1}H-NMR**:** 7.14 (d, 1H, C5), 7.35-7.43 (m,2H, C10,C11), 7.59 (d,1H,C12), 7.79(d,1H,C9) and 8.22-8.25 (m,2H,C3,5), 10.06 (s,1H, CHO) and 11.41(s, 1 H , OH). ^{13}CNMR**:** 118.64**:** C4, 118.7:C9,120.3:C2, 127.35:C7, 130:C10, 130.80**:**C13,131.06**:**C12, 131.77:C5, 135.3**:**C11, 16.14**:**C6, 148.38: C8, 164.22**:**C3, 196.6**:**C**1-**CHO.

2-hydroxy-5-((4-bromophenyl)diazenyl) benzaldehyde (1d).

($C_{13}H_9BrN_2O_2$); mp. 186-188°C, with product yield (97%). IR (cm^{-1}) str., 3400-3100b (-OH) [18], 1664 (C=O), 1616(C=C), 1573.9 (-N=N-) and 1205 & 1170 (C-O).

2-hydroxy-5-((3-chloro-4- methyl-phenyl)-diazenyl) benzaldehyde (1e).

(C14H11ClN2O2); mp. 160-161°C, with product yield (86%). IR (cm^{-1}) str., 3400-3100 b (-OH), 1672 (C=O) and 1602 (C=C), 1575 (-N=N-) and 1286& 1170 (C-O). ^{1}H-NMR**:** 2.30 (s,3H, Ar-CH3), 7.1-8.19(m 6H, Ar-H), 10.03(s, 1H, CHO) and 11.33(s, 1H, OH). ^{13}CNMR**:** 20.14**:**CH3, 118.64**:**C4, 120.34:C2, 122.03:C13, 122.37:C9, 129.4:C7, 130.60**:**C5, 131.30**:**C12, 134.2: C10,11, 139.15**:**C6, 151.44**:**C8, 163.92**:**C3 and 196.44**:**CHO. DEPT-135**:** 20.14**:**CH3, 118.64**:**C4, 122.03:C13, 122.37:C9, 129.4:C7, 130.60**:**C5, 131.30**:**C12 and 196.6**:**CHO.

2-hydroxy-5-((3-methylphenyl)diazenyl) benzaldehyde (1f):

(C13H1ON2O2); mp. 128-130°C, with product yield (95%). IR (cm^{-1}) str., 3500-3100 b (-OH), 1653 (C=O), 1602 (C=C), 1571.8 (-N=N), 1207& 1168 (C-O).

2-hydroxy-5-((4-acetylphenyl)diazenyl) benzaldehyde (1g).

(C15H12N2O3); mp. 181-182.5°C , with a product yield (95%). IR (cm^{-1}) str., 3500- 3100 b (-OH), 1653 (C=O) and 1602 (C=C), 1571.8 (-N=N-) and 1207 & 1168 (C-O). ^{1}H-NMR**:** 2.6(s,3H,C13), 7.14 (d,1H, C5), 7.9-8.24(m,6H ,C3,C6,C9,C9',C10,C10'), 10.06(s, 1H, CHO), 11.39(s, 1H, OH).

((4-bromophenyl)(5-(subistituted phenyldiazenyl) benzofuran-2-yl)methanone (3a-g).

According to the reported procedures[19,20], a series of benzofuran derivatives has been synthesized. Thus, to a mixture of 0.05 mol of substituted azo 2-hydroxy benzaldehyde **1a-g** and 0.05 mol 4-bromophenacyl bromide **(2)** dissolved in absolute ethanol, a solution of 0.1mol of K2CO3 was slowly added and then refluxed for one hour. After completion the reaction mixture was left to down to room temperature then cooled by cold water. The resulted solid products were filtered off and dried under vacuum to obtain the new benzofuran derivatives **(3a-g)**.

(4-bromophenyl)(5-(phenyldiazenyl)benzofuran-2-yl)methanone (3a):

($C_{21}H_{13}BrN_2O_2$); mp. 221-223°C, with product yield 67%. IR (cm^{-1}) str., 1640 (C=O), 1602 (C=C), 1575 (-N=N-) and 1286& 1170 (C-O). ^{1}H-NMR: 7.27(s,1H,C7),7.53(d,2H, C2,2') ,7.68 (d,1H,C12),7.74(d,1H,C17), 7.95(d,4H,C15, 16,J=12), 7.99(D,1H,C11) 8.17(D, 2H, C3,3') and 8.33(S,1H,C9).^{13}CNMR:113.07:C12,116.96:C9,119.3:C7,122.8:C11,127.44:C1,128.4:C15,129.15:C16,131.05:C17,131.14:C2,131.99:C8,135.7:C3, 147:C4,149.7:C10,152.5:C14,153.4:C6,157.3:C9 and 183:C5.

(4-bromophenyl)(5-(p-tolyldiazenyl)benzofuran-2-yl)methanone (3b):

($C_{22}H_{15}BrN_2O_2$); mp. 225-227°C, with product yield (79%). IR (cm^{-1}) str., 1641 (C=O), 1600 (C=C), 1583 (-N=N-), 1280& 1150 (C-O). ^{1}H-NMR: 2.35(s, 3H, C18), 7.25(s,1H,C7),7.30 (D,2H, C2,2'),7.65-7.71(m, 4H, C12,C15,16), 7.96(D,2H,C3,3') 8.14(D, 1H, C11),8.28(S,1H,C9); ^{13}CNMR: 21.8:C18 , 111:C12, 116.95:C9, 118.96:C7, 122.88:C11, 127.3:C1, 128.1:C15, 128.2:C16, 129.79:C2, 131.03:C8, 131.95:C3, 135.7:C17, 142:C4, 150:C10, 151:C14, 153:C6, 157.1:C13, 182:C5.

(4-bromophenyl)(5-((2-chlorophenyl)diazenyl) benzofuran-2-yl)methanone (3c):

($C_{21}H_{12}BrClN_2O_2$); mp. 190-192°C , with product yield (88%). IR (cm^{-1}) str., 1641 (C=O), 1612 (C=C), 1585 (-N=N-) and 1280& 1175 (C-O). ^{1}H-NMR: 7.25(s,1H,C7), 7.39-7.95(m,8H, C2,2' , 3,3',12,16,17,18), 8.2(D,1H,C11,J=12),8.35(S,1H ,C9); ^{13}CNMR: 113.11:C12, 116.88:C9, 117.5:C7, 119.85:C11, 123.27:C19, 127.26:C1, 127.35:C18, 128.3:C15, 130.72:C16, 130.98:C2,131.8:C8, 131.9:C3,135,48 :C17, 147.45:C4, 148.5:C10, 149.88:C14, 153.39:C6, 157.18:C13, 182.73:C5.

(4-bromophenyl)(5-((4-Bromoophenyl)diazenyl) benzofuran-2-yl)methanone (3d):

($C_{21}H_{12}Br_2N_2O_2$); mp. 214-216°C, with product yield (66%). IR (cm^{-1}) str., 1641 (C=O), 1614 (C=C), 1585 (-N=N-) and 1270 & 1150 (C-O).

(4-bromophenyl)(5-((2-chloro-3-methlyphenyl) diazenyl)benzofuran-2-yl)methanone (3e):

($C22H_{14}BrClN_2O_2$); mp. 221-223°C , with product yield (65%). IR (cm^{-1}) str., 1637 (C=O), 1612 (C=C), 1581 (-N=N-), 1274& 1170 (C-O). ^{1}H-NMR:); 2.43(s,3H,C20), 7.12(s,1H,C7),7.39-7.95(m,8H, C2,2' , 3,3',12 ,15,18,19),8.12(D, 1H, C11,J=12),8.70(S,1H,C9).

(4-bromophenyl)(5-((3-methylphenyl)diazenyl) benzofuran-2-yl)methanone (3f):

(C_{22}H15BrN_2O2); mp. 154-156°C, with product yield (86%). IR (cm^{-1}) str., 1641 (C=O), 1614 (C=C), 1585 (-N=N-), 1280& 1170 (C-O). ^{1}H-NMR:); 2.47(s,3H,C20), 7.25(s,1H,C7),7.39-7.95(m,9H, C2,2' , 3,3',12 ,15,17,18,19),8.15(D, 1H,C11,J=12),8.30(S,1H,C9); ^{13}CNMR **:** 21.4:C20, 113.07: C12, 117:C9, 119.2C7,

120.52:C11, 122.91:C19, 123:C15, 127.44:C1, 128.38:C17, 128.99:C18, 130:C2, 131.06:C8, 131.99:C3, 135.61:C4, 139.09:C16, 149.6:C10, 152.57:C14, 153.2:C6, 157.21:C13, 182.7:C5.

(4-bromophenyl)(5-((4-acetylphenyl)diazenyl) benzofuran-2-yl)methanone (3g):

($C_{23}H_{15}BrN_2O_3$); mp. 213-215°C, with product yield (84%). IR (cm^{-1}) str., 1668 (C=O), 1647 (C=C), 1571 (-N=N-), 1286& 1166 (C-O). ^{1}H-NMR:); 2.66(s, 3H, C19), 7.24(s,1H,C7), 7.65(D,2H, C2,2'),7.7(d,1H,C12), 7.97(d,4H ,C15,16), 8.09(D,2H,C3,3') 8.15(D, 1H, C11,),8.39(s,1H,C9); ^{13}CNMR:26.94:C19,113.35:C12,116.95:C9,120.19:C7,122.99:C11,123.06 :C15,127.66:C1,128.6:C16,129.54:C2,131.17:C 8,132.14:C3,135.63:C4,138.65:C17,149.82:C10 ,153.68:C14,154.99:C6,157.7:C13, 182.84:C5, 197.49:C18; DEPT-135: 26.82:C19, 113.23:C12, 116.83:C9, 120.08 :C7, 122.84:C11, 122.92:C15, 129.42:C16, 131.04:C2, 132.01:C3.**Fig (5,6&7).**

Dilution method for Determination of (MIC)
Preparing and standardizing inoculum suspension:

The inoculum has been prepared based on the reported method[21].

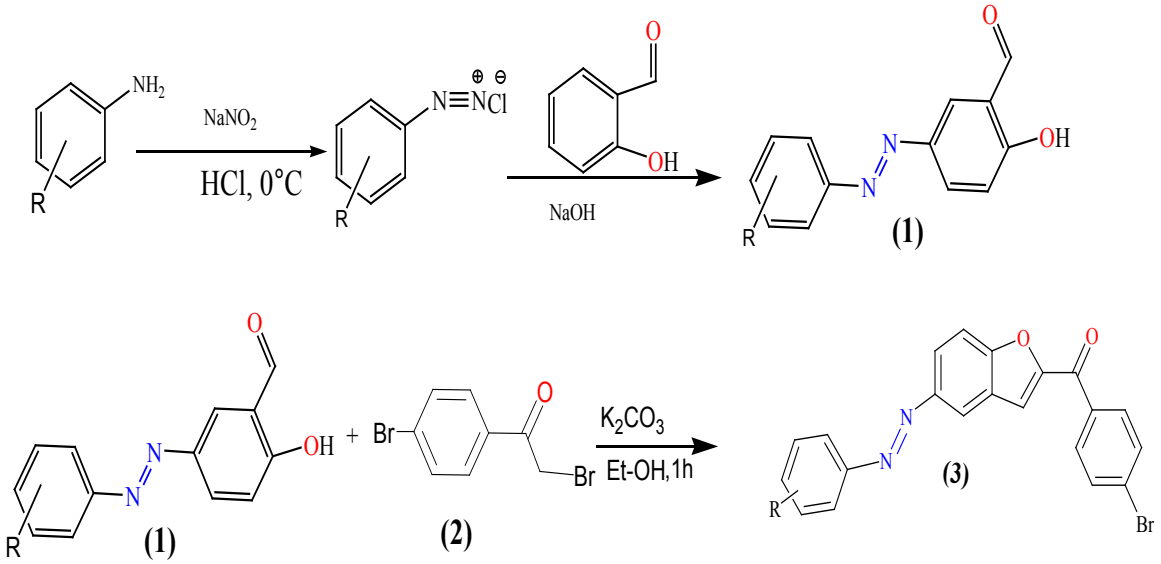
quantifing of Minimum Inhibitory concentration (MIC)[22] Spectrophotometer method was used to determine the MIC of organic compounds at 600nm and the following dilutions were prepared for each compound (200, 400, 600, 800 and 1000) µg/mL.

The MIC of benzofurans was determined compared to a control sample that consisted of 2mL of nutrient broth and 40µL of activated culture of bacterial suspension (see table 1), and incubated at 37^{0}C for 20hrs. The next day OD was recorded as shown in table (3).

DPPH free radical scavenging assay

The antioxidant activity of synthesized benzofurans derivatives were resolved based on its scavenging ability to trap the stable free radical 2,2-diphenyl-2-picryl hydrazyl (DPPH). free radical scavenging was determined according to reported method[23] with some modification. Stock solution of DPPH was freshly prepared in methanol with concentration (4mg/100mL), and kept in dark glass place it in refrigerator for further use. Take its absorbance at .95 (±0.003) at 517 nm. Difference solution of benzofurans compounds with different concentration ranged from (200-800 µg/mL of dioxan were prepared. 1mL of synthesized compound with different concentration (200,400,600 and 800 µg/mL)in dioxan mixed with 4 mL of 0.004% of DPPH alcoholic solution. After incubation in dark at 37 °C for a period half hour the absorbance was recorded at 517nm against blank (methanol, dioxan 2:1)[2], were all measurement made in triplicate and averaged. The percentage of inhibition of DPPH radical scavenging was calculated as follow[24]:

DPPH radical scavenging activity (%)= [1-(Absorbance of sample / Absorbance of control] ×100



Where R , **a** = H, **b** = 4-CH3, **c** = 2-Cl, **d** = 4-Br, **e** = 3-Cl,4-CH3,**f** =3-CH3, **g** = 4- acetyl

Scheme 1. Synthesis route of benzofuran derivatives 3a-g .

TABLE 1. Preparation of test samples.

Stock solution 8000µg/mL (0.04g in 5mL DMSO)				
NO.	**Concentration(µg/mL)**	**Chemical Volume (µL)**	**Nutrient broth volume (mL)**	**Bacterial suspension volume (µL)**
1	200	50	1.91	40
2	400	100	1.86	40
3	600	150	1.81	40
4	800	200	1.76	40
5	1000	250	1.71	40

TABLE 2. Preparation of antibiotics.

Stock solution 5000µg/mL (0.01g in 10mL acetone)				
NO.	**Concentration (µg/mL)**	**antibiotic Volume (µL)**	**Nutrient broth volume (mL)**	**Bacterial suspension volume (µL)**
1	200	0.2	4.7	100
2	400	0.4	4.5	100
3	600	0.6	4.3	100

TABLE 3 . Absorbance or Optical density (OD) for each compound and antibiotics with difference concentrations against Staphylococus aureus as G+Ve and E.Coli as G-Ve.

Concentration of benzofurans (µg/mL) (conc.vs abs.)						
Comp.	**R**	**200**	**400**	**600**	**800**	**1000**
3a	***S.aureus***	0.12	NBG	NBG	NBG	NBG
	E.coli	0.359	0.048	NBG	NBG	NBG
3b	***S.aureus***	0.089	NBG	NBG	NBG	NBG
	E.coli	0.377	NBG	NBG	NBG	NBG
3c	***S.aureus***	0.2	NBG	NBG	NBG	NBG
	E.coli	0.256	0.002	NBG	NBG	NBG
3e	***S.aureus***	0.771	0.576	0.0455	0.24	NBG
	E.coli	0.77	0.637	.214	0.11	NBG
3g	***S.aureus***	0.309	0.0.145	.043	NBG	NBG
	E.coli	0.334	0.050	NBG	NBG	NBG
Azithromycin	***S.aureus***	1.575	0.040	NBG		
	E.coli	1.477	NBG	NBG		
Ciprofloxacin	***S.aureus***	NBG	NBG	NBG		
	E.coli	0.009	NBG	NBG		
Metronidazole	***S.aureus***	1.400	0.035	NBG		
	E.coli	1.374	0.018	NBG		
Erythromycin	***S.aureus***	1.536	NBG	NBG		
	E.coli	1.453	NBG	NBG		

NBG: no bacterial growth

The MIC is the minimum availability of antibacterial agent that totally stops growth of any organism.

The MBC is outlined as the minimum concentration of antibacterial factors that needed to kill 99.9% of the final inoculum after incubation for 24 h.

Results and Discussion

Synthesis and Investigation

The new benzofuran structures **3a-g** have been proved via FT-IR charts which showed a no peaks for the hydroxyl group between 3500-3100cm^{-1}) and and no indication for existence of the aldehyde carbonyl group (C=O). Furthermore, the ^{1}H-NMR spectroscopic characterization confirms again the disappearance of (OH) peak of starting material (See Fig 1 and Fig 8). The ^{13}C NMR spectroscopic study also illustrates the shift of the carbonyl group peak to lower wave number (nearly to 182 ppm), new aromatic peak was also observed. These evidences confirm the structure of benzofurans **3a-g**. Moreover, the disappearance of the tertiary carbon peaks (methine) in ^{13}C-DEPT-135-NMR (Fig. 7) were recognized. This is a further elucidation for the structure of benzofuran compounds.

Anti-bacterial activity of 3a-g:

Two types of bacteria *Staphylococcus aureus as* Gram-positive bacterial strain and *Escherichia coli* as Gram-negative bacterial strain used for screening synthesized benzofuran compounds by dilution method the results indicated in **figure(2)** It showed that benzofurans have higher activity toward *E. coli* than *S. aureus*, almost of the benzofuran compounds (3e) have a highest activity for both types of bacteria, while the other have moderate anti-bacterial activity .

Ferric Reducing Antioxidant Potential (FRAP)

The synthesized benzofurans were examined for their anti-oxidant activity by using Ferric Reducing Antioxidant Power (FRAP)[25,26]. The benzofuran derivatives were capable to reduce the ferric complex with 2,4,6-tripyridyltriazine (TPTZ) as a colorless complex into the ferrous complex with tripyridyltriazine of the violet color at lower pH. The compounds **3a-g** were evaluated for their power to decrease the oxidation number of complexes of TPTZ-Fe(III) to complex of TPTZ-Fe(II). Ascorbic acid has been employed as a standard compound for antioxidant activity. The results showed that the ascorbic equivalent is µmol/١ gm of the synthesized benzofurans as shown in Table 4. This indicate that the title compounds benzofurans showed a moderate anti-oxidant power particularly **3c** which showed the highest anti-oxidant effect compared to othe derivatives while **3f** showed the weakest (fig (3)).

DPPH (2,2-diphenyl-2-picrylhydrazyl hydrate) free radical scavenging assay

The capability of benzofurans to trap DPPH radicals is dependent on their capability to capture of pair and unpaired radicals[27]a reaction that has been previously shown to generate the same set of products deriving from oxidation by mushroom polyphenol oxidase (PPO. The decrease ability of DPPH radical is controlled by the lessening in its absorbance at 5l7 nm, initiated by anti-oxidants. The lessening in absorbance of DPPH radical is brought about by antioxidants, due to the reaction between benzofurans compounds and radicals of DPPH, advances, which results in the searching of the radical by hydrogen gift. It is outwardly recognizable as an adjustment in shading from purple to yellow. Thus, DPPH is generally utilized as a substrate to assess the anti-oxidative action[28].

Ascorbic acid has been employed as a standard compound for antioxidant activity. The results indicated in (µg/mL), the free radical scavenging capability of synthesized benzofuran showed in Fig(4),IC50 is the capability of formed benzofuran to inhibit 50% of DPPH.due to the absence of hydroxyl and electron donating methoxy group the synthesized showed moderate anti-oxidant activity with DPPH[29]. the presentation of electron pulling back group (Br, Cl) substituted in series (3a-g) was suppress improve anti-oxidant activity.the results compared with ascorbic acid as control[30].

Conclusions

The present work involves the formation of benzofuran derivatives with combination of two important medieties benzofuran hetrocyclics and azo groroup. The azo-benzofuran derivatives was synthesized in relatively high yield from the reaction of substituted 2-hydroxy benzaldehyde with 4-bromophencyl bromide in the presence of base. These newly synthesized benzofurans showed a remarkable inhibition effect on both *Staphylococus aureus* as gram positive and *Escherichia coli* as gram negative at concentration 200µg/mL. But some benzofrans derivatives was more resist to growth of *Staphylococus aureus* than *Escherichia coli* . according to the results the benzofuran derivatives it has good activity than azithromycin as anti-biotic control. Finally, the total anti oxidant power and DPPH radical scavenging activity of the benzofurans were determined with different concentration (200-800µg/mL), the results showed in general have a moderate antioxidant activity.

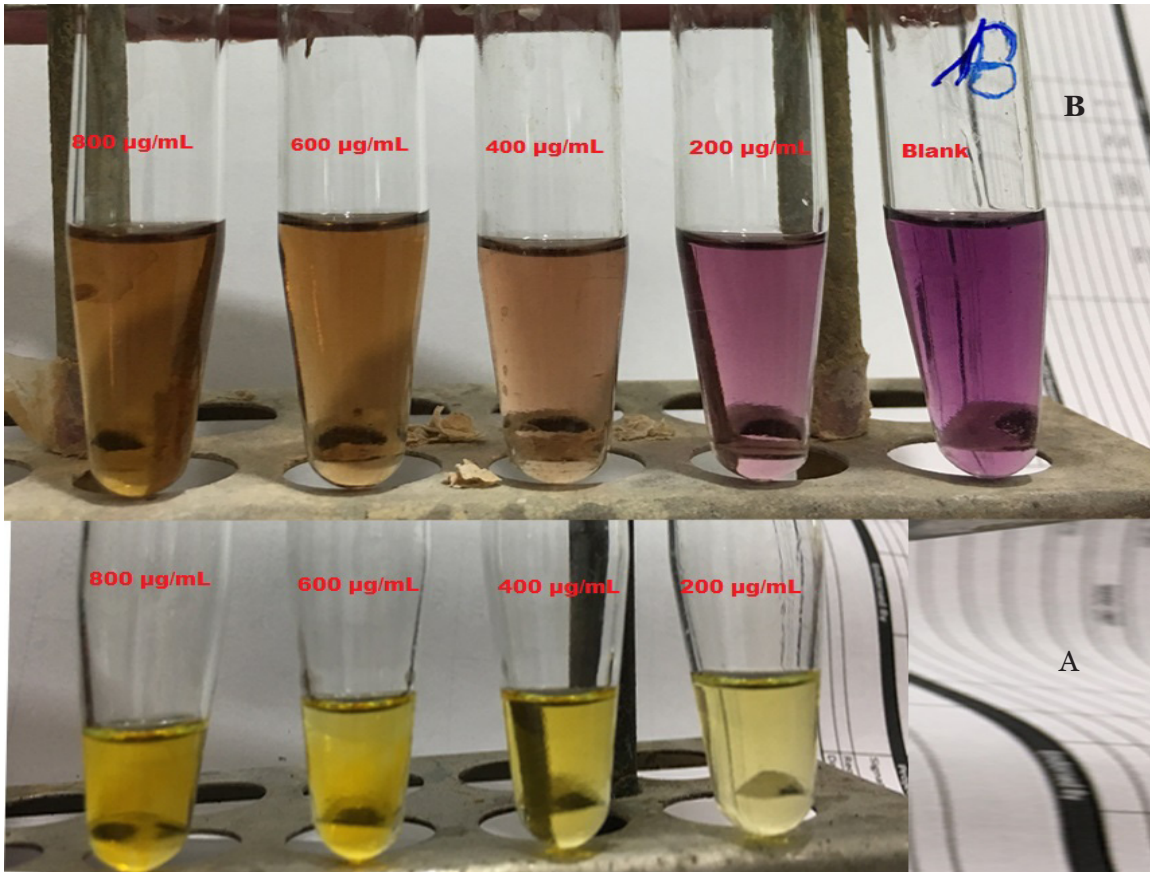


Fig. 1. A=difference concentration of of synthesized compound (3g) B=with DPPH.

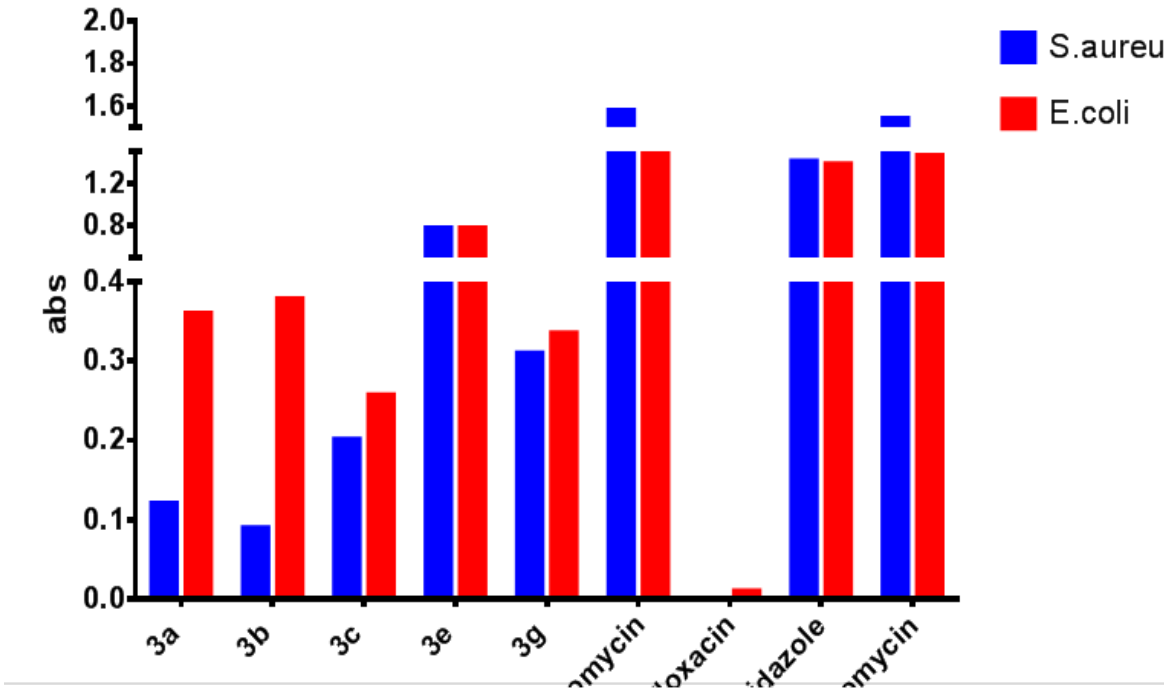


Fig. 2. The anti-bacterial activity of prepared compounds

TABLE 4. Antioxidant activity of the synthesized benzofuran compounds.

Comp.	Abs.	FERAP value (µmol)	µmoL/gm
3a	0.008	0.288	28.8
3b	0.066	2.374	237.4
3c	0.108	3.885	388.5
3f	-----	---	----
3g	0.089	3.200	320

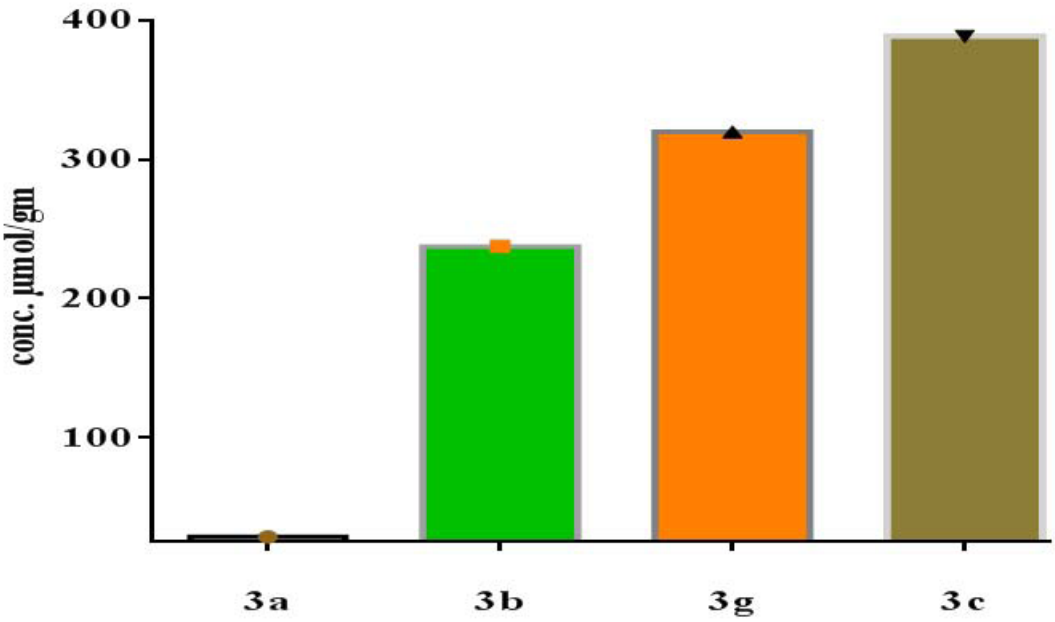


Fig. 3. The anti-oxidant activity of prepared compounds.

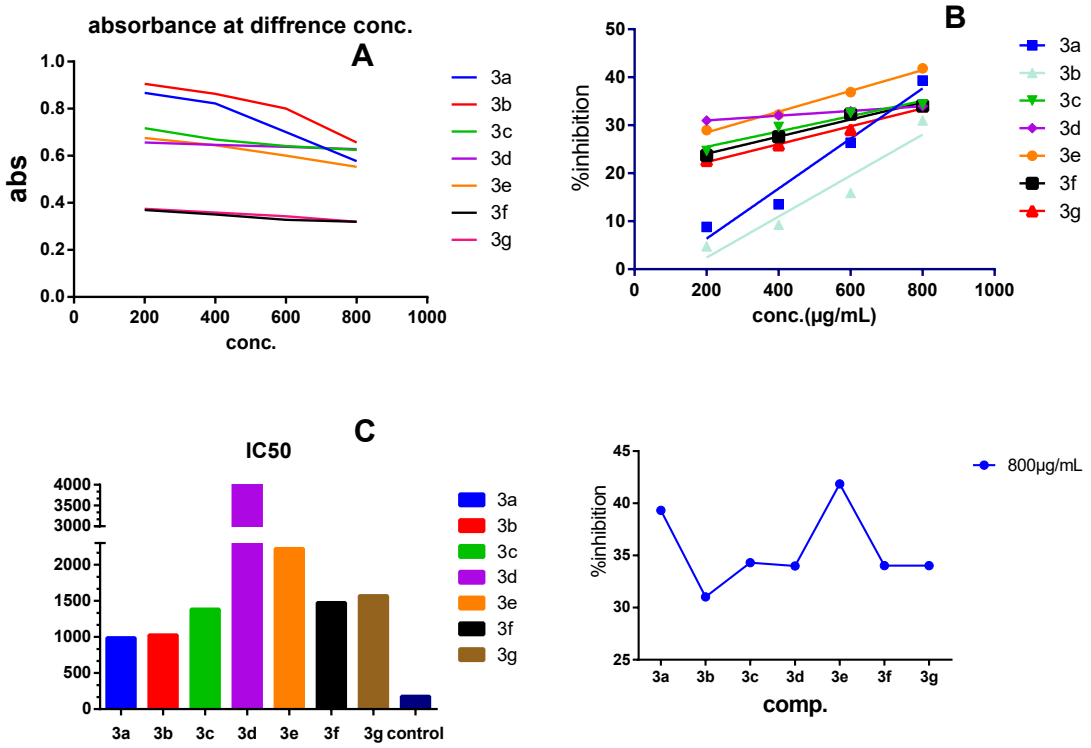


Fig. 4. dpph radical scavenging of benzofuran compounds ,A= different concentration of (3a-g) with mean absorbance(n=3),B= inhibition percentage averaged (n=3) with different concentration, C= IC 50 (is the capability of compound in µg/ml to inhibit 50% of radical DPPH) against synthesized compound comared with control, and D =highest concentration (800 in µg/ml against series of benzofuran derivatives.

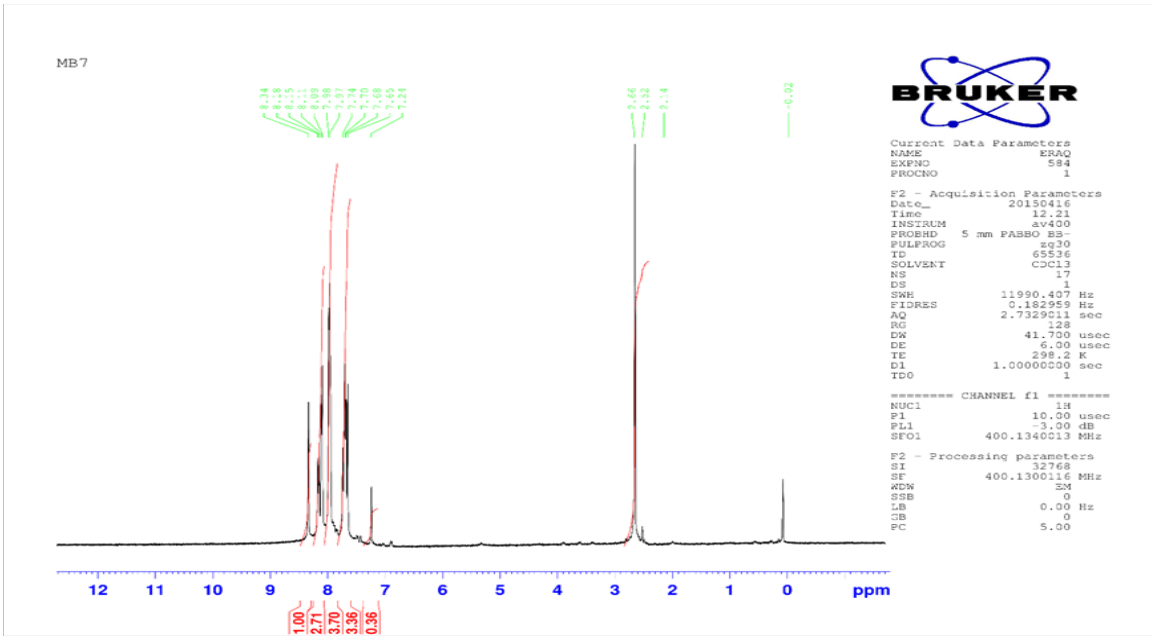


Fig. 5. 1H-NMR spectrum of comp. (3g).

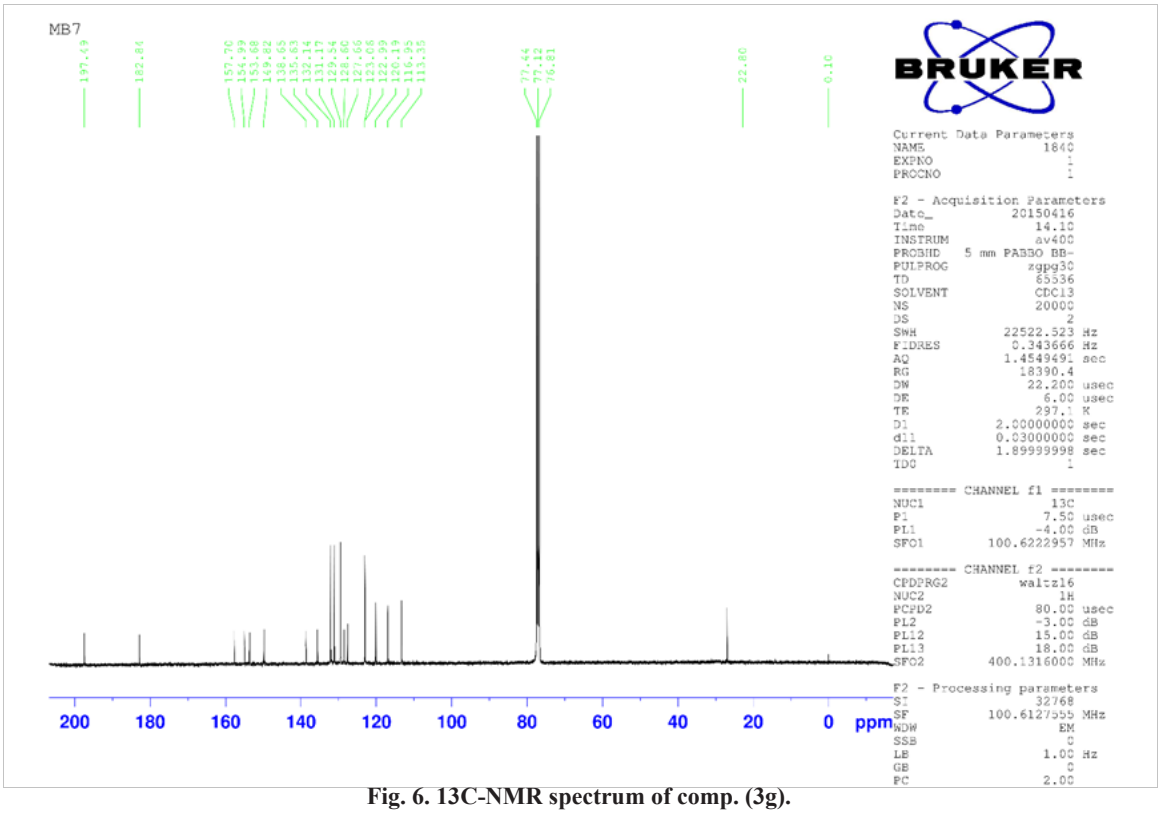


Fig. 6. 13C-NMR spectrum of comp. (3g).

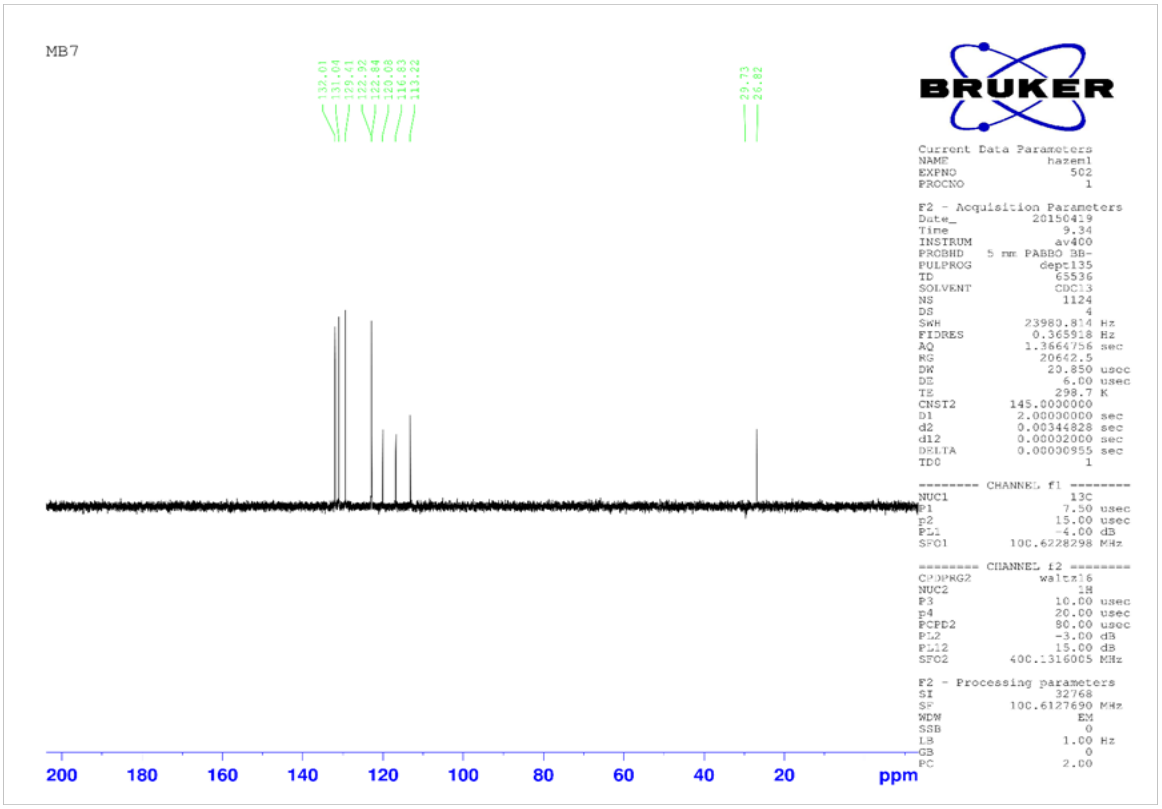


Fig. 7. 13C-DEPT spectrum of comp. (3g).

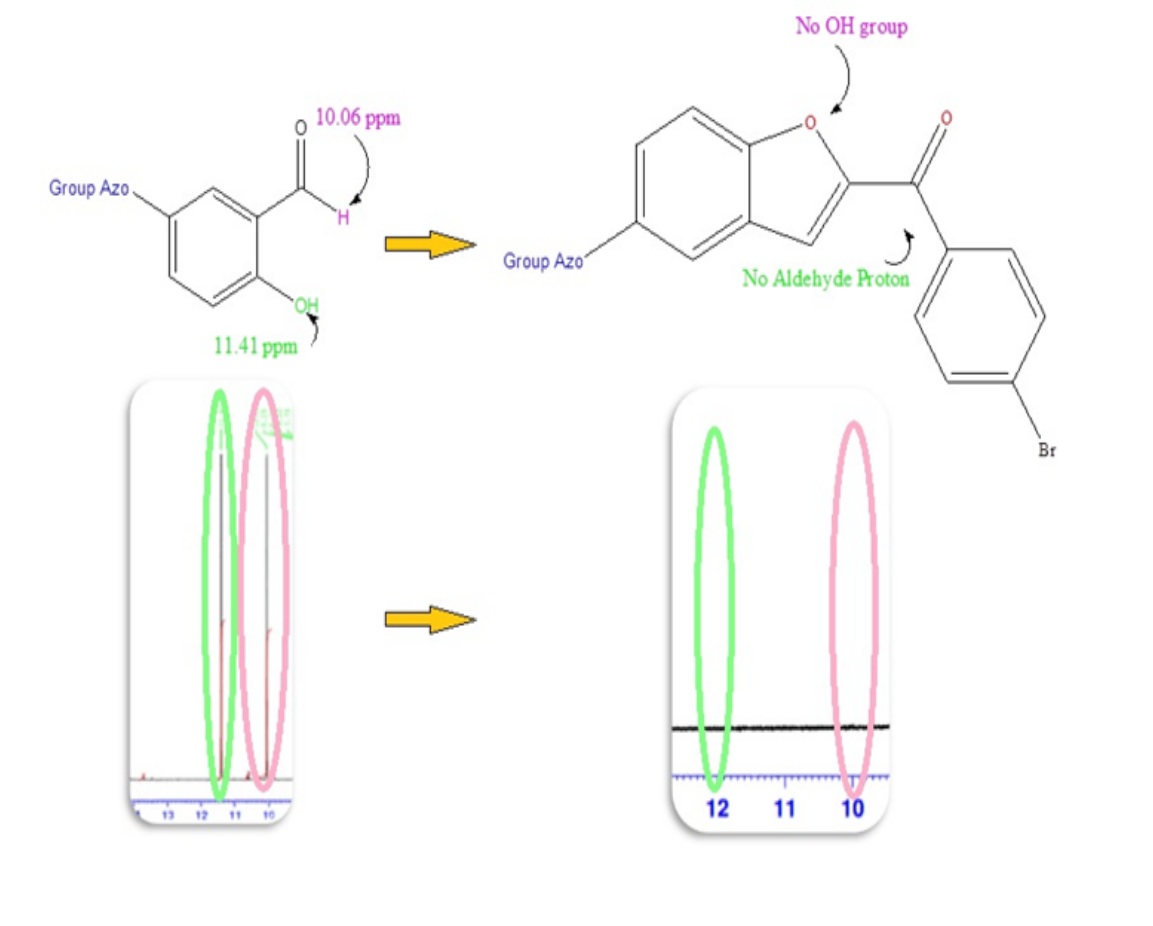


Fig. 8. Disapearence in 1H-NMR of series from(1) to (3a-3g).

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Conflict of Interest

There is no conflict of interest.

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التحضير والتحقيق الطيفي والنشاطات المضادة للبكتيريا ومضادات الأكسدة لبعض مشتقات الآزو-بنزوفوران الجديدة

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تتناول هذه البحث تحضير ودراسة بعض مشتقات البنزوفوران الجديدة، التي بدأت من الديازوتيزيل للأنيلين البديل إلى جانب 2-هيدروكسي بنزالديهايد. عند تفاعل آزو بنزالديهايد 2-هيدروكسي مع 4-بروميد فيناسيل بروميد، يتم الحصول على البنزوفوران3-g). تميزت بنية المشتقات البنزوفورية الجديدة باستخدام FT-IR، 1H-NMR، 13C-NMR و DEPT-135 NMR. تم فحص بعض منتجات البنزوفوران الجديدة بسبب نشاطها المضاد للبكتيريا ومضاد الأكسدة. أظهرت النتائج أن البنزوفيوران الجديد له نشاط معتدل مضاد للأكسدة مقارنةً بحمض الأسكوربيك القياسي.