

Synthesis and Characterization of Some New Pyrazoline Derivatives from Chalcones Bearing Benzofuran Moiety

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Abstract :

1-benzofuran-2-yl-3-(substituted phenyl)-prop-2-ene were prepared by the reaction of 2-acetylbenzofuran with different aromatic aldehydes in the presence of alkali . Reaction of the prepared chalcones (1-5) with phenylhydrazine , 2,4-dinitrophenylhydrazine afforded the corresponding substituted pyrazoline (6-10) , (11-15) respectively . All the prepared compounds have been characterized by FT-IR and UV and some of them by ^1H and ^{13}C -NMR spectra and elemental analysis (C.H.N)

الخلاصة

تضمن البحث تحضير 2-اسيتايل بنزو فيوران والذي استخدم في تحضير جالكونات حاوية على حلقة البنزوفوران وذلك بتكاتفه مع اليزلديهيدات الاروماتية تم مفاعلة الجالكونات (1-5) مع الفينيل هيدرازين و 2,4 داي نيترو فنيل هيدرازين لتحضير معوضات البايرازولين (11-15) و (6-10) أن تراكيب جميع المركبات الناتجة تم تشخيصها بالطرائق الطيفية مثل الأشعة فوق البنفسجية (UV) والأشعة تحت الحمراء (IR) إما طريقتي التشخيص باستعمال طيف الرنين النووي المغناطيسي للبروتون (^1H -NMR) وطيف الرنين النووي المغناطيسي للكربون (^{13}C -NMR) قد أجريت لبعض المركبات المحضرة وكذلك إجراء تحليل العناصر .

1.INTRODUCTION :

Many natural and synthetic products containing heterocyclic ring such as pyrazole , the potent pharmacodynamic nucleus has been reported to possess a wide variety of biological activity such as anti-inflammatory ⁽¹⁾ cardiovascular ⁽²⁾ and antibacterial activities ⁽³⁾ . Also substituted pyrazolines are fluorescent compounds with high quantum yield and are used as optical brighteners and whiteners ⁽⁴⁾ . Various procedures have been developed for synthesis of pyrazoline compounds ⁽⁵⁾ and one of them the use of α,β -unsaturated ketones . In addition to the above , benzofuran derivatives possess a wide range of biological activities such as antimicrobial , antitumor , anti-inflammatory ⁽⁶⁻⁸⁾ . The present study deals with the synthesis of some substituted pyrazolines with phenyl and 2,4-dinitrophenyl groups derived from some benzofuryl chalcones .

2. EXPERIMENTAL :

2.1 : Materials and Instruments

The melting points were recorded by electrothermal apparatus (600) and uncorrected . IR spectra were recorded in KBr on shimadzu FT-IR 8400 s Fourier transform-Infrared spectrophotometer . ^1H -NMR and ^{13}C -NMR were recorded at Aal AL-Bayt University-Jordan using (300 MHz) instrument with DMSO (d₆) as a solvent and TMS as internal standard . The elemental analyses were recorded at the same university above .

2-2-Preparation of 2-acetyl benzofuran ⁽⁹⁾ :

The mixture of salicylaldehyde (0.1 mol , 12.2 gm) , chloroacetone (0.1 mol , 9.20 gm) and potassium carbonate (30 gm) was gently refluxed in dry acetone (150 ml) for 13 hrs . The reaction product after cooling was filtered and the filtrate on the removal of the solvent under

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reduced pressure gave 2-acetylbenzofuran as dark yellow colored solid, recrystallized by ethanol. After drying weight recovered was (9.60 gm), yield (60%) and m.p (68-70) C° lit (70-71) C°.

2-3 : Synthesis of 1-(benzofuran-2-yl)-3-(substituted phenyl)prop-2-ene-1-one (1-5)⁽¹⁰⁾ :

The preparation of compound (1) table (1) has been used as a typical experiment for the reaction.

A mixture of 4-N,N-dimethylbenzaldehyde (0.01 mol, 1.49gm) and 2-acetylbezofuran (0.01 mol, 1.6 gm) were dissolved in minimum amount of ethanolic potassium hydroxide solution (0.02 mol, 1.12 gm) and the mixture was stirred for 2 hrs until the entire mixture became cloudy, then the mixture was poured slowly in to 400 ml of water with constant stirring and kept in refrigerator for 24 hrs. The precipitate obtained was filtered washed and recrystallized from ethanol. After drying weight recovered was (2.26 gm), yield (78%) and m.p (118-120) C°.

2-4:Preparation of 3-(benzofuran-2-yl)-1-phenyl-pyrazoline derivatives⁽¹¹⁾ (6-10) :

The preparation of compound (6) table (2) was been used as a typical experiment for the reaction. A mixture of chalcones (0.01 mol, 2.91)and phenylhydrazine (0.01 mole . 1.08 gm) and (15) ml of glacial acetic acid was heated under reflux for 4 hrs, then the mixture was poured in to ice water (100)ml. The precipitate obtained was filtered washed with water and recrystallized from absolute ethanol. After drying weight recovered was (2.72 gm), yield (71.4 %) and m.p (107-109) C°.

2-5 - Preparation of 3-(benzofuran-2-yl) -1-(2,4-dinitrophenyl) pyrazoline (11-15) :

The preparation of compound (11) Table (3) was used as a typical experiment for the reaction and the synthesis of these compounds was achieved by using the same procedure mentioned in section 2-4.

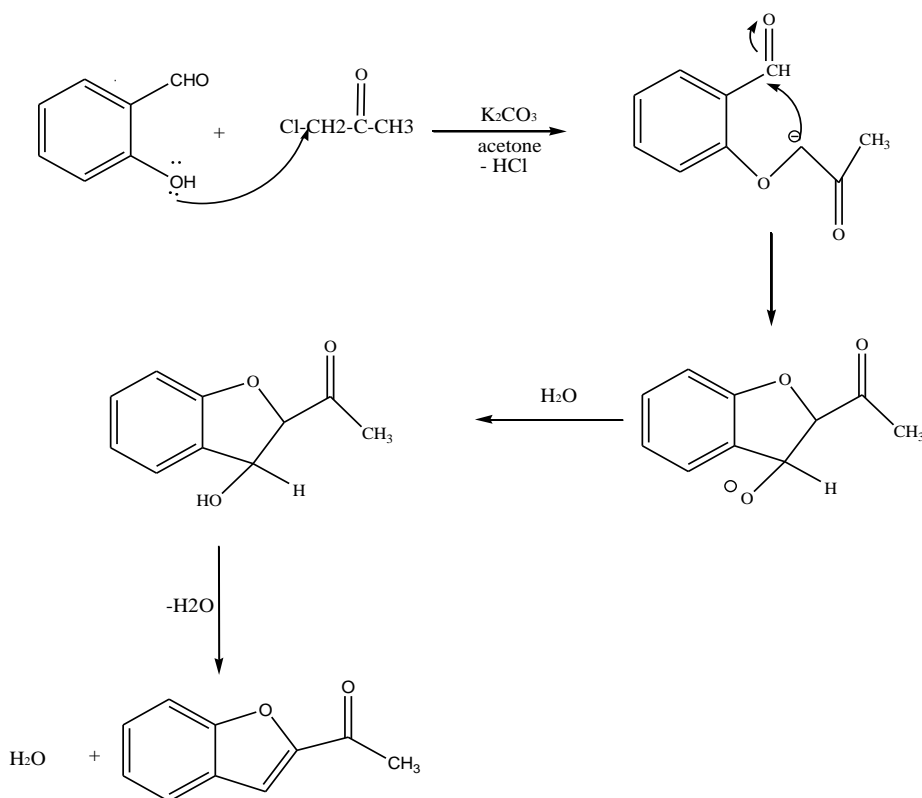
3-RESULTS AND DISCUSSION :

3-1: Preparation of 2-acetylbenzofuran :

The condensation of chloroacetone with salcinaldehyde afforded

2-acetylbenzofuran and the product obtained was identified on the basis of spectral data.

The (IR) spectrum showed bands at (1674)cm⁻¹ related to the stretching vibration of carbonyl group, and a band at (2925) cm⁻¹ referred to the aliphatic (C—H) whereas the band at (3083)cm⁻¹ was due to aromatic (C—H), finally the band at (1076)cm⁻¹ referred to the to (C—O—C) group, the (¹H-NMR) and ¹³C-NMR spectra of the compound is shown in table (6). The mechanism⁽¹²⁾ for the reaction is shown scheme (1) below :



Scheme (1) Reaction of chloroacetone with salicylaldehyde

3.2. Condensation of substituted benzaldehyde with 2- acetylbenzofuran:

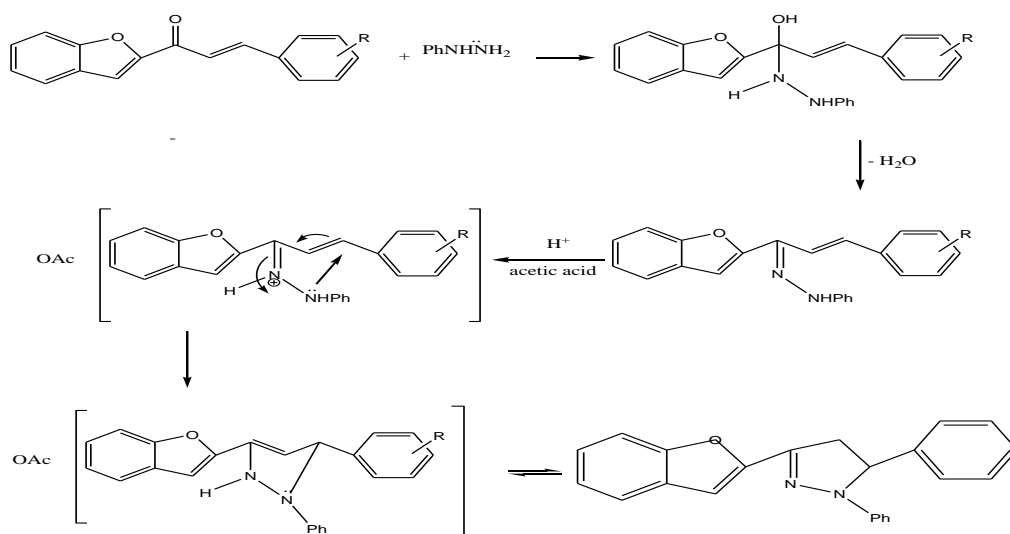
Substituted benzaldehydes were condensed with 2-acetylbenzofuran and afforded the corresponding chalcones (1-5). The structures of the products were confirmed on the bases of spectroscopic evidences including FT- IR and UV Table (4) and ¹H NMR and ¹³C NMR (Table 6) .

3.3. Condensation of benzofuryl chalcones with phenylhydrazine (6-10) :

The condensation of substituted chalcones with phenylhydrazine in acetic acid afforded substituted 3-(benzofuran-2-yl)-2-pyrazoline (6-10) , the reaction Take place in an acetic acid medium to yield the corresponding hydrazone ⁽¹³⁾ .

The role of the acetic acid in this reaction is to protonate the oxygen atom of the carbonyl group , accordingly the carbon atom carries complete positive charge so the attack occurs on the carbon atom . The structure of products were confirmed on the bases of spectroscopic evidences and analysis Tables (5),(6),(7)

The mechanism⁽¹⁴⁾ for the reaction of chalcones with phenyl hydrazine is displayed in scheme (2) :



Scheme (2) Reaction of chalcones with phenylhydrazine

3.4. Condensation of benzofuryl chalcones with 2,4-dinitrophenyl hydrazine (11-15) :

The condensation of chalcones with 2,4 -dinitrophenylhydrazine afforded substituted 3-(benzofuran-2-yl)-2-pyrazoline (11-15) . The structure of products were confirmed on the bases of spectroscopic evidences and analysis , Tables (5) , (6) , (7) .

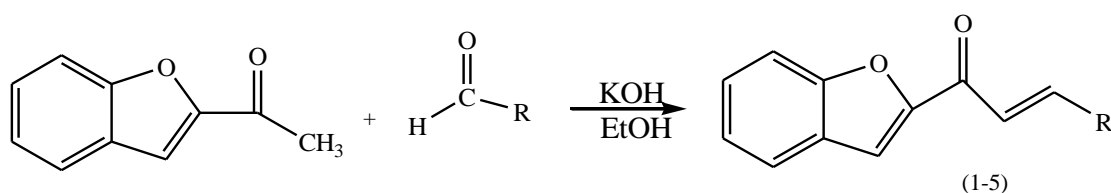
The mechanistic pathway of the reaction is as mentioned in section 3-3 .

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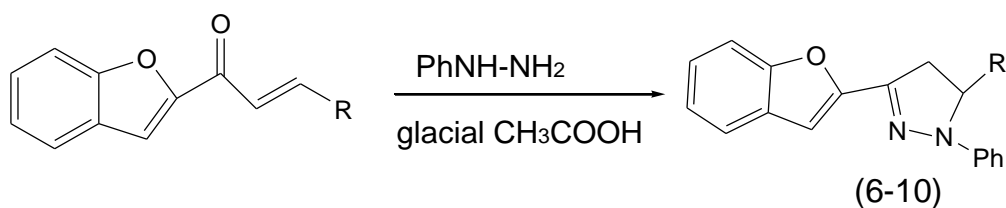
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Table(1) : Physical properties of benzofuran-2-yl chalcones (1-5).



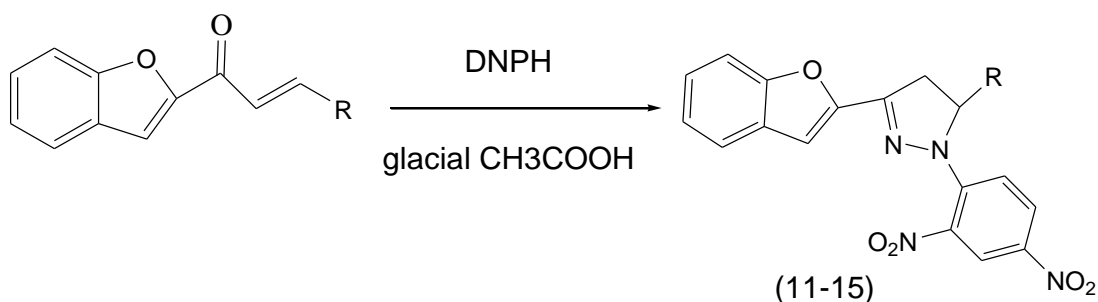
Compd No.	Name of Product	R	m.p(C°)	Color	Yield (%)
1	1-(benzofuran- 2` -yl)-3-(= 4-dimethylaminophenyl)-prop-2-en -1-one		118-120	Reddish orange	78
2	1-(benzofuran- 2` -yl)-3-(2` - furyl)-prop-2-en -1-one		102-104	Brown	75
3	1-(benzofuran- 2` -yl)-3-(= 4-chloro phenyl)-prop-2-en -1-one		110-112 110 ^{lit(82)}	Brown	69
4	1-(benzofuran- 2` -yl)-3-phenyl-prop-2-en -1-one		62-64 64 ^{lit(82)}	Brown pale	80
5	1-(benzofuran- 2` -yl)-3-(= 4-bromo phenyl)-prop-2-en -1-one		124-126	Brownish yellow	70

Table(2) : Physical properties of 3-(benzofuran-2-yl)1-phenyl- pyrazoline derivatives (6-10) .



Compd No.	Name of Product	R	m.p C°	Color	Yield (%)
6	1-phenyl-3-(benzofuran-2-yl)-5-(4-dimethyl amino phenyl) -2-pyrazoline		107-109	Reddish brown	71
7	1-phenyl-3- (benzofuran-2-yl)-5-(furan-2-yl) -2-pyrazoline		78-80	Brownish black	60
8	1-phenyl-3- (benzofuran-2-yl)-5-(4-chloro phenyl) -2-pyrazoline		120-122	Yellowish brown	70
9	1-phenyl-3- (benzofuran-2-yl)-5-phenyl-2-pyrazoline		93-95	Brown	62
10	1-phenyl-3- (benzofuran-2-yl)-5-(4-bromo phenyl) -2-pyrazoline		119-121	Yellowish brown	74

Table(3):Physical properties of 3-(benzofurn-2-yl) substituted 2- pyrazolines (11-15) .



No.	Name of Product	R	m.p °C	Color	Yield (%)
11	1-(2,4-dinitro phenyl) -3-(benzofuran-2-yl)-5-(4-dimethyl amino phenyl) -2-pyrazoline		98-100	Yellowish orange	79
12	1-(2,4-dinitro phenyl) -3-(benzofuran-2-yl)-5-(furan-2-yl) -2-pyrazoline		86-88	Reddish brown	78
13	1-(2,4-dinitro phenyl) -3-(benzofuran-2-yl)-5-(4-chloro phenyl) -2-pyrazoline		140-142	Orange	65
14	1-(2,4-dinitro phenyl) -3-(benzofuran-2-yl)-5-phenyl-2-pyrazoline		90-92	Brownish yellow	81
15	1-(2,4-dinitro phenyl) -3-(benzofuran-2-yl)-5-(4-bromo phenyl) -2-pyrazoline		168-170	Orange	63

Table(4) : Spectral data of substituted chalcones (1-5) .

Compd No.	UV(EtOH) (λ_{max})nm	IR (KBr) , $\nu(\text{cm}^{-1})$				
		C=O	C=C	C \equiv C	C-O-C	Others
1	325	1653	1575	1543	1159	
2	338	1658	1598	1553	1139	
3	372	1664	1612	1592	1139	C—Cl=681
4	361	1666	1606	1551	1139	
5	369	1656	1609	1548	1073	C—Br=583

Table(5): Spectral data of substituted 3-(benzofuran-2-yl)-2- pyrazolines (6-15)

Compd No.	UV(EtOH) (λ_{max})nm	IR (KBr) , $\nu(\text{cm}^{-1})$			
		C=N	C \equiv C	C-O-C	others
6	311	1631	1603	1124	
7	316	1609	1591	1091	
8	351	1655	1615	1141	C —Cl=743
9	291	1607	1585	1145	
10	329	1656	1592	1130	C —Br=581
11	308	1612	1595	1135	NO ₂ asym=1508 NO ₂ sym=1329
12	321	1625	1591	1150	NO ₂ asym=1511 NO ₂ sym=1360
13	341	1613	1603	1131	NO ₂ asym=1535 NO ₂ sym=1361
14	343	1612	1542	1136	NO ₂ asym=1508 NO ₂ sym=1328
15	350	1654	1609	1125	NO ₂ asym=1516 NO ₂ sym=1319

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Table : (6): ¹H NMR and ¹³C NMR data δ (ppm) of syntheses compounds

No comp	Structure	¹ H NMR	¹³ C NMR
		2.502 (for DMSO) 2.558 (3H,s,CH ₃), 3.380 (for H ₂ O), 7.506 (for proton of furan ring), 7.335-7888 (Ar-H, m,4H),	26.886 (of methyl group) , 112.685 (C6) 114.728(C2) , 121.0 (C3) , 124.112 (C4) , 124.460 (C5) , 128 . 875 (C8) , 152.589 (C1) , 155.432 (C7) 188.381 (carbon of carbonyl)
1		2.504 (for DMSO) , 3.349 (for H ₂ O), 3.025 (s , N-(CH ₃) ₂ , 6H) , 7.602 for proton of furan ring, 6.756 (d , 1H , C-2)7.54 (d , 1H , C-3), 7.046-7.570 (m , 9H , ArH),	40.21(carbons of methyl group) , 112.23 (C6 ⁻) 112.66(C3 ⁻ &C5 ⁻),113.93(C1 ⁻) , 116.25(C2 ⁻) 122.07(C2), 123.96 (C3 ⁻)124.43 (C4 ⁻) , 127.62(C5 ⁻) ,128.58 (C2 ⁻ &C6 ⁻) , 131.47(C8 ⁻) , 145.17 (C3), 152.66(C4 ⁻) , 154.53(C7 ⁻) , , 155.54 (C1 ⁻), 178.68 (carbon of carbonyl)
2		2.506 (for DMSO) , 3.427 (for H ₂ O) , 6.697 (d , 1H , C-2) , 7.556 (1H , C-3) 7.101-7.650 (m , 7H , Ar-H), 7.599 (for proton of furan ring conjugated with benzene ring)	112.70 (C3 ⁻) , 113.73 (C4 ⁻) , 114.75 (C6 ⁻),118.27 (C2 ⁻) ,118.88 (C3 ⁻) , , 124.12(C4 ⁻) , 124.51(C5 ⁻) , 127.49 (α carbon), 128.95(C8 ⁻) , 130.38 (β carbon) , 146.99(C5 ⁻) 153.61 (C7 ⁻),. 178.58 (carbon of carbonyl)
3		2.497 (for DMSO) , 3.394 (for H ₂ O) , 6.629(d,1H,C-2), 7.234-7.489 (m , 8H , Ar-H) , 7.556(d,1H,C-3) , 7.588(for proton of furan ring conjugated with benzene ring) ,	112.76 (C6 ⁻) , 115.91(C2 ⁻),123.00(C2), 124.29 (C3 ⁻) , 124.61(C4 ⁻) , 128.47 (C2 ⁻ &C6 ⁻) , 128.77(C3 ⁻ &C5 ⁻) , 131.12(C8 ⁻) , 133.79(C1 ⁻) , 135.84(C4 ⁻) , 142.49 (C3) , , 153.62(C7 ⁻) , 155.82 (C1 ⁻) ,178.80 (carbon of carbonyl) .
13		1.910 (d , C-4, 2H) , 2.080 (t , C-5, 1H), 2.540 (for DMSO) , 3.354 (for H ₂ O) , 6.846 (for proton of furan ring conjugated with benzene ring) , 6.990-8.851 (m , 11H , Ar-H)	39.19(C4) , 53.00(C5) , 112.73(C2 ⁻), 115.95(C3.) , 115.77(C6 ⁻) , 123.07 (C3 ⁻) ,123.59(C4 ⁻) , 124.24(C6.) , 124.59(C5 ⁻) , 127.43(C2 ⁻ &C6 ⁻) , 128.46 (C8 ⁻) , 129.17(C3 ⁻ &C5 ⁻) , 129.48(C5.) ,130.46(C4.) , 132.82(C4 ⁻) , 133.82(C2.) , 135.84(C1.) , 137.11 (C1 ⁻) , 142.47(C1 ⁻) 153.63(C7 ⁻) , 155.83(C3) .

Table(7): Elemental analysis of some prepared compounds [2-4 , 13]

NO of Comp	Molecular formula	Elemental microanalysis (%)(Calculated/Found)		
		C(%)	H(%)	N(%)
2	C ₁₅ H ₁₀ O ₃	77.27	4.03	_____
		77.58	4.31	
3	C ₁₇ H ₁₁ O ₂ Cl	71.88	4.31	_____
		72.21	3.89	
4	C ₁₇ H ₁₂ O ₂	82.36	4.92	_____
		82.25	4.83	
13	C ₂₃ H ₁₅ O ₅ N ₄ Cl	59.23	3.09	11.86
		59.67	3.24	12.10