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Synthesis and antimicrobial activities of novel pyrazoles

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ABSTRACT

1-benzoyl-3-methyl-4-(2-substituted phenyl hydrazono)-1H-pyrazol-5(4H)-one ***(4a-f)*** *obtained by reaction between various ethyl-2-substituted phenyl hydrazono-3-oxobutyrate* ***(2a-f)*** *condensation with benzohydrazide* ***(3).*** *The structures of all these compounds* ***(4a-f)*** *were recognized on basis of analytical and spectral data. The novel synthesized compounds were estimated for their antimicrobial activity against various bacteria and fungi.*

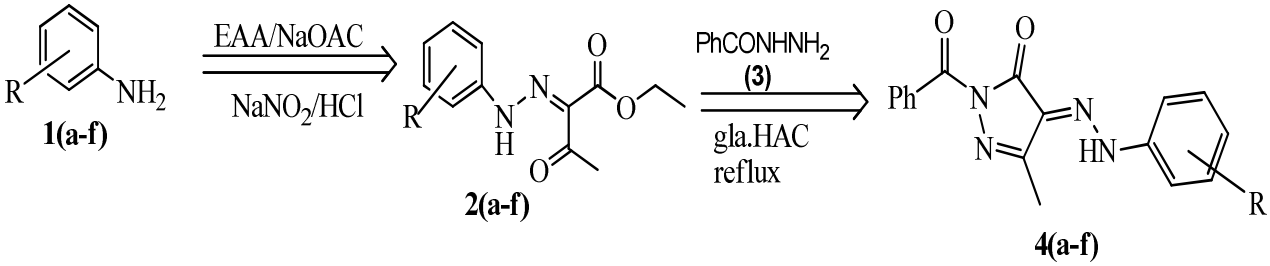
Key Words: pyrazolinone, benzohydrazide, spectral studies, antimicrobial activity.

INTRODUCTION

The arylazopyrazoles are generally prepared by combination of aryl-azo-ethyl actoacetate derivatives and hydrazine derivatives [1-6].Hydrazide and their heterocyclised products display diverse biological activities including antibacterial, antifungicidal, analgesic, anti-inflammatory properties [7-21]. These heterocyclic systems find wide use in medicine, agriculture and industry. The hydrazides, isonicotinyl hydrazide (i.e.isoniazid) of isonicotinic acid, are keystone of modern treatment of tuberculosis. [22] Isoniazid is bacteriostatic in resting bacilli but bactericidal for actively dividing Mycobacterium tuberculosis. It is suggested that it inhibits biosynthesis of mycotic acids, which are important constituents of the mycobacterial cell wall.[23] Hence, it was thought of interest to merge both of arylazopyrazole and isonicotinyl hydrazide moieties which may enhance the drug activity of compounds to some extent, or they might possess some of the above mentioned biological activities. From this point of view, the objective of the present work is to prepare new derivatives of isonicotinyl hydrazide containing arylazopyrazole moiety. Hence the present communication comprises the synthesis of 1-benzoyl-3-methyl-4-(2- substituted phenyl hydrazono)-1H-pyrazol-5(4H)-one **(4a-f).** The synthetic approach is shown in scheme-1.

MATERIALS AND METHODS

Melting points were determined in open capillary tubes and were uncorrected. The IR spectra were recorded in KBr pellets on a Nicolet 400D spectrometer and ^{1}H NMR spectra were recorded in DMSO with TMS as internal standard on a Bruker spectrometer at 400 MHz and 100 MHz, respectively.



Where,R= (a) 4-H; (b) 2-CH_3; (c) 4-CH_3;
(d) 4-Br; (e) 4-Cl; (f) 4-OH

Scheme-1

Synthesis of ethyl-2-substituted phenyl hydrazono-3-oxobutyrate (2a-f)

Substituted aniline **(1a-f)** (0.01mole) was dissolved in a mixture of HCl (8ml) and water (6ml) and cooled to 0˚C in ice bath. To it a cold aqueous solution of sodium nitrate (0.03mole) was added. The diazonium salt solution was filtered into a cooled solution of ethyl acto acetate (0.01mole) and sodium acetate (0.12mole) in ethanol (50ml). The resulting solid was washed with water and recrystallized from aq.alcohol. The yields, melting points and other characterization data of these compounds are given in Table -1.

Table 1. Physical and Analytical Data of the Compounds Synthesized (2a-f)

Compound No.	Molecular Formula (Mol.wt.)	Yield %	Elemental Analysis					
			C%		H%		N%	
			Calcd.	Found	Calcd.	Found	Calcd.	Found
2a	$C_{12}H_{14}N_2O_3$ (234)	69	61.53	61.52	6.02	6.00	11.90	11.89
2b	$C_{13}H_{16}N_2O_3$ (248)	66	62.89	62.87	6.50	6.48	11.28	11.26
2c	$C_{13}H_{16}N_2O_3$ (248)	67	62.89	62.86	6.50	6.49	11.28	11.25
2d	$C_{12}H_{13}N_2O_3Br$ (313)	63	46.03	46.01	4.18	4.16	8.95	8.94
2e	$C_{12}H_{13}N_2O_3Cl$ (268.5)	64	53.64	53.62	4.88	4.87	10.43	10.42
2f	$C_{12}H_{14}N_2O_4$ (250)	66	57.59	57.57	5.64	5.63	11.19	11.18

Synthesis of 1-benzoyl-3-methyl-4-(2- substituted phenylhydrazono)-1H-pyrazol-5(4H)-one (4a-f).

To ethyl-2-substituted phenyl hydrazono-3-oxobutyrate **(2a-f)** (0.002mole) dissolved in glacial acetic acid (20ml), a solution of benzohydrazide **(3)** (0.002mole) in 25ml of glacial acetic acid was added and the mixture was refluxed for 10-12 hrs. It was then cooled and allowed to stand overnight. The resulting solid was filtered off, dried and crystallized from methanol. The yields, melting points and other characterization data of these compounds are given in Table -2.

Table 2. Physical and Analytical Data of The Compounds Synthesized (4a-f)

Compound No.	Molecular Formula	Yield %	Elemental Analysis					
			C%		H%		N%	
			Calcd.	Found	Calcd.	Found	Calcd.	Found
4a	$C_{17}H_{14}N_4O_2$ (306)	59	66.66	66.64	4.61	4.60	18.29	18.28
4b	$C_{18}H_{16}N_4O_2$ (320)	56	67.49	67.48	5.03	5.02	17.49	17.47
4c	$C_{18}H_{16}N_4O_2$ (320)	51	67.49	67.47	5.03	5.01	17.49	17.48
4d	$C_{17}H_{13}N_4O_2Br$ (384)	53	53.00	52.98	3.40	3.38	14.54	14.53
4e	$C_{17}H_{13}N_4O_2Cl$ (340.5)	57	9.92	9.91	3.85	3.84	16.44	16.42
4f	$C_{17}H_{14}N_4O_4$ (322)	54	63.35	63.34	4.38	4.37	17.38	17.36

BIOLOGICAL SCREENING

ANTIBACTERIAL ACTIVITIES

Antibacterial activities of all the compounds were studied (E. coli, S.aureus, P. vulgaris and P. aregenosa) at a concentration of 50µg/ml by agar cup plate method.[24] Methanol system was used as control in this method. Under similar conditions, using tetracycline as a standard for comparison, we carried out a control experiment. The area of inhibition was measured in millimeters. Compounds 4e and 4f were found more toxic for microbes. Other compounds were found to be less or moderately active than tetracycline. (Table -3)

Table 3. Antibacterial Activity of Compounds (4a-f)

Compounds No.	Zone of Inhibition(mm)			
	E. coli	***S.aureus***	***P. vulgaris***	***P. aregenosa***
4a	56	45	69	52
4b	53	46	72	59
4c	65	44	74	69
4d	64	48	76	67
4e	69	49	80	75
4f	72	50	78	73
Tetracycline	79	55	87	76

ANTIFUNGAL ACTIVITY

The fungicidal activity of all the compounds **(4a-f)** was studied at 1000 ppm concentration in vitro plant pathogenic organisms listed in Table-4. The antifungal activities of all the samples were measured on each of these plant pathogenic strains on potato dextrose agar (PDA) medium. Such a PDA medium contained potato 200 gms, dextrose 20gms, agar 20 gms and water 1 litre five days old cultures were employed. The compounds to be tested were suspended (1000ppm) in a PDA medium and autoclaved at 120° C for 15 min. at 15 atm pressure. These medium were poured into sterile Petri plate and the organisms were inoculated after cooling the Petri plate. The percentage inhabitation for fungi was calculated after 5 days using the formula given below.

Percentage of inhibition = 100(X-Y) / X

Where, X: Area of colony in control plate
Y: Area of colony in test plate

The fungicidal activity all compounds **(4a-f)** are shown in Table-4.

Table 4. Antifungal Activity of Compounds (4a-f)

Compounds No.	***C. albicans***	***Penicillium Ex.***	***A. niger***	***Trichothesium Sp.***
4a	60	59	67	56
4b	58	58	62	61
4c	63	56	58	68
4d	64	58	61	66
4e	70	61	68	69
4f	71	60	69	68

RESULTS AND DISCUSSION

It was observed that ethyl-2-substituted phenyl hydrazono-3-oxobutyrate **(2a-f)** condensation with benzohydrazide **(3)** to gave 1-benzoyl-3-methyl-4-(2-substituted phenyl hydrazono)-1H-pyrazol-5(4H)-one **(4a-f).**

The structures of **(2a-f)** were confirmed by elemental analysis and IR spectra showing an absorption band at 1620-1640 cm^{-1}(C=N), 3030-3080 cm^{-1}(C-H of Ar.), 2815-2850 cm^{-1} (-OCH_2), 2950, 1370 cm^{-1} (-CH_3, CH_2),1695-1750 cm^{-1}(C=O).

^{1}H NMR (400MHz , DMSO - d_6 ,δ / *ppm*) : 1.25(t,3H,CH_3), 2.35 (s,3H,$COCH_3$), 4.29 (q, 2H,$COCH_2$), 11.62 (s,1H,NH); (2a): 6.89-7.37 (s,5H,ArH); (2b): 2.36 (s,3H,CH_3) , 6.74-7.19 (s,4H,ArH) ; (2c): 2.37 (s,3H,CH_3) , 6.76-7.23 (s,4H,ArH) ; (2d): 6.56-7.38 (s,4H,ArH) ; (2e): 7.11-7.26 (s,4H,ArH) ; (2f): 3.92(s,1H,OH),7.82-8.12(s,4H,ArH).The C, H, N analysis data of all compounds are presented in Table -1.

The IR spectra of **(4a-f)** are 1624-1640 cm^{-1}(C=N), 3030-3088 cm^{-1} (C-H of Ar.), 2960, 1380 cm^{-1} (-CH_3), 1705-1765(C=O), 3330 and 3155 cm^{-1}(NH), and 1585, 1548, and 1530 cm^{-1} (C=C).

^{1}H NMR (400MHz , DMSO - d_6 ,δ / *ppm*) : 2.42(s,3H,CH_3), 11.62 (s,1H,NH); (4a): 6.90-8.92(s,9H,ArH); (4b): 2.24 (s,3H,CH_3) , 6.84-8.92 (s,8H,ArH) ; (4c): 2.26 (s,3H,CH_3) , 6.82-8.85 (s,8H,ArH) ; (4d): 6.85-8.93 (s,8H,ArH) ; (4e): 7.24-8.94 (s,8H,ArH) ; (4f): 3.92 (s,1H,OH),27.90-8.92(s,8H,ArH). The C, H, N analysis data of all compounds are presented in Table -2.

The examination of data reveals that the elemental contents are consistent with the predicted structure shown in Scheme-1. The IR data also direct for assignment of the predicted structure. The examination of antibacterial activity data reveals that the compounds 4e and 4f are found more active against the bacteria.

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