Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2012, 4(4):1956-1959

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Application of pfitzinger reaction in the synthesis of quinoline-4-carboxylic acid derivatives of carbazolo and azacarbazolo fused indophenazine

Veena Yadav and Nishant Yadav

Department of Chemistry, Banasthali University, Banasthali (Raj.) (India)

ABSTRACT

*Application of the Pfitzinger reaction on indophenazino fused carbazole **4a** and azacarbazoles **4(b-e)** with isatin **(5)** yielded the corresponding indophenazino fused quinoline-4-carboxylic acid derivatives **6(a-e)** in moderate to good yield. All quinoline-4-carboxylic acid derivatives were characterized on the basis of their microanalysis IR, ^{1}HNMR and MS spectral data.*

Keywords: Indophenazine, carbazoles, azacarbazoles, Pfitzinger reaction.

INTRODUCTION

Indophenazine (indoloquinoxaline) exhibits impressive biological activity and has been used as antimicrobial agent against herpus virus along with potent anticancer effects [1]. The proven record of the cytotoxicity of carbazoles and azacarbazoles [2] reveal that these materials form interesting targets in synthesis, since such structures have potential for development of compounds with antitumor activity that could mimic to the activity of ellipticene. Ellipticene exhibits significant antitumor activity due to its DNA intercalating properties [3]. Quinoline carboxylic acid and their analogues show wide variety of medicinal properties including antitumour [4] , antiviral [5] and antibacterial [6] activities. It has been shown [7] that quinolines exhibit antitumor activity due to the formation of stable complex with DNA. Recent demonstrations [8-11] that quinoline carboxylic acid can be used as potential anti-HIV agents has stimulated further interest on these molecules with yet another perspective.

It has been observed that incorporation of certain bioactive pharmacophores in the existing drug molecules sometimes exert a profound influence on the biological activity of the parent molecules, it was thought of interest to incorporate active pharmacophore like quinoline in indophenzino fused carbazole framework [12] with the hope that it could produce interesting series of compounds with enhanced biological activities. In the present work, we describe the application of Pfitzinger reaction for the synthesis of indophenazino fused quinoline-4-carboxylic acid derivatives **6(a-e)** from isatin **(5)** and appropriate carbonyl compounds **4(a-e)**.

EXPERIMENTAL SECTION

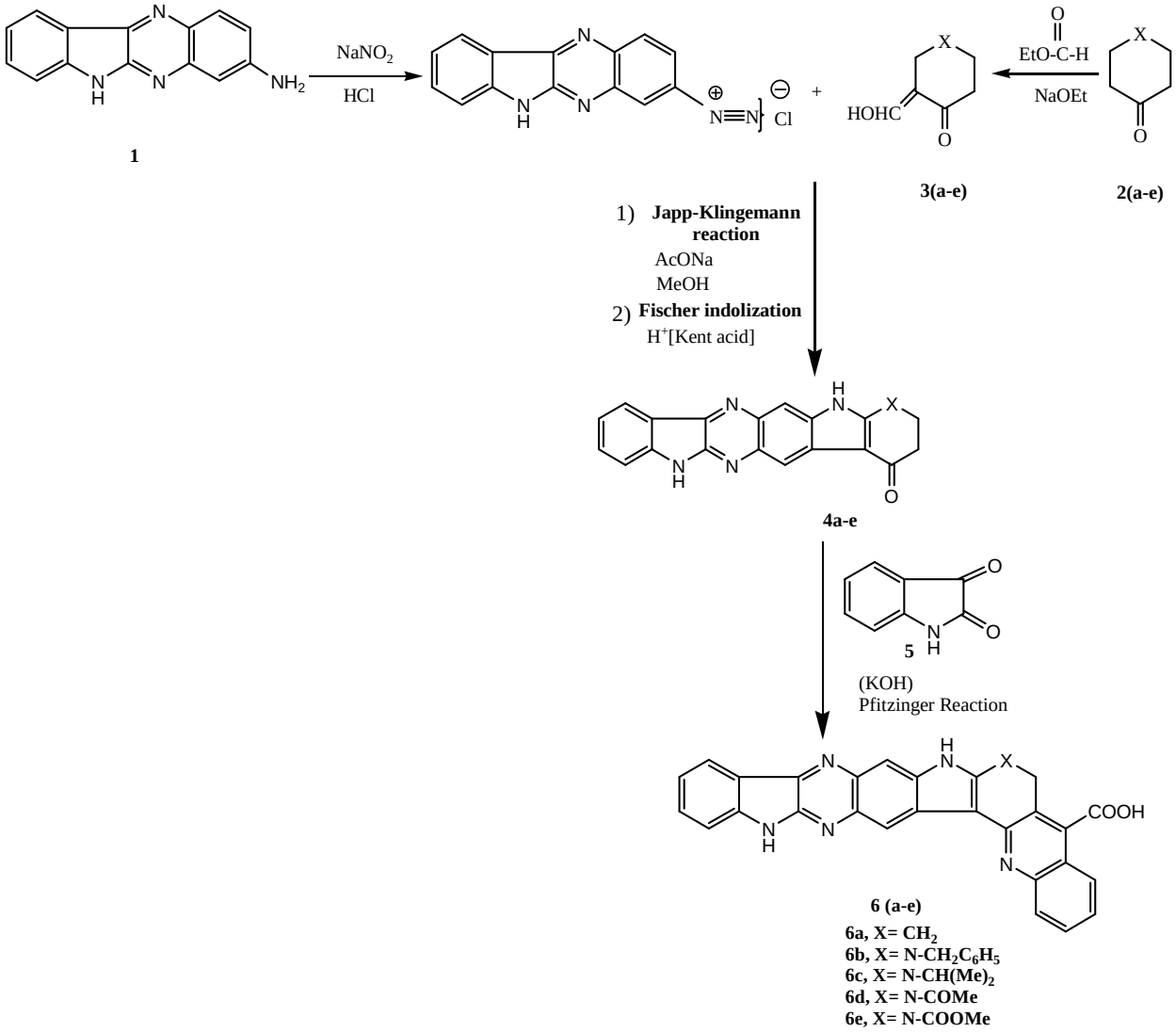
Melting points were determined on an open capillary and are uncorrected. The IR spectra were recorded on Schimadzu FTIR-8400S. ^{1}H NMR spectra were recorded in DMSO-d_6 and $CDCl_3$ on Bruker DRX-300 spectrometer using TMS as internal reference and values are expressed in δ ppm. ^{13}C NMR spectra were measured on a Joel 68.5 MHz instrument. Mass spectra were taken on a Joel SX-102 (EI/CI/FAB) mass spectrometer at 70 eV.

Preparation of quinoline-4-carboxylic acid derivatives 6(a-e) from the ketones 4(a-e):
A solution of ketone **4a** (0.07 mol), isatin **(5)** (0.07 mol) and of potassium hydroxide (0.2 mol) in ethanol (25 ml) was refluxed for 24 hrs. After the distillation of most of the solvent, water was added. The neutral impurities were removed by ether extraction, and the aqueous layer was acidified with acetic acid till neutralization. The brown

coloured precipitate of compound **6a** was collected and recrystallized from ethanol. Compounds **6(b-e)** were prepared by using similar procedure.

6a. Yield: 73%; IR (KBr) cm^{-1}: 3500, 3300, 2900, 1810, 1750, 1480, 1030; ^1H NMR (300 MHz, $CDCl_3$ + DMSO-d_6) δ ppm: 11.0 (1H, s, COOH), 10.1 (2H, s, NH), 9.08(1H,d,CH), 8.30(1H,d,CH), 8.07(2H,s,CH), 7.82-7.00(6H,m,Ar-H), 2.92(2H,t,CH_2, J-8.9Hz), 2.82(2H,t,CH_2, J-8.9Hz); ^{13}C NMR ; 172 (C of COOH), 157.2, 132.5, 28.2, 29.1 (4C of cyclohexene), 147.1, 134.1 (2C of quinoxaline), 128.1, 127.2, 126.7, 121.6, 123.8, 121.7, 120.5, 119.6, 111.0 (9C of Ar-Benzene), 144.8, 137.0, 103.0 (4C of pyrrole), 142.8, 129.6, 129.4 (4Cof quinoxaline); MS: *m/z* 455 [M^+] ; Anal. Calcd. / found for $C_{28}H_{17}N_5O_2$: C, 73.84/73.81, H, 3.76/3.72, N, 15.38 / 15.33.

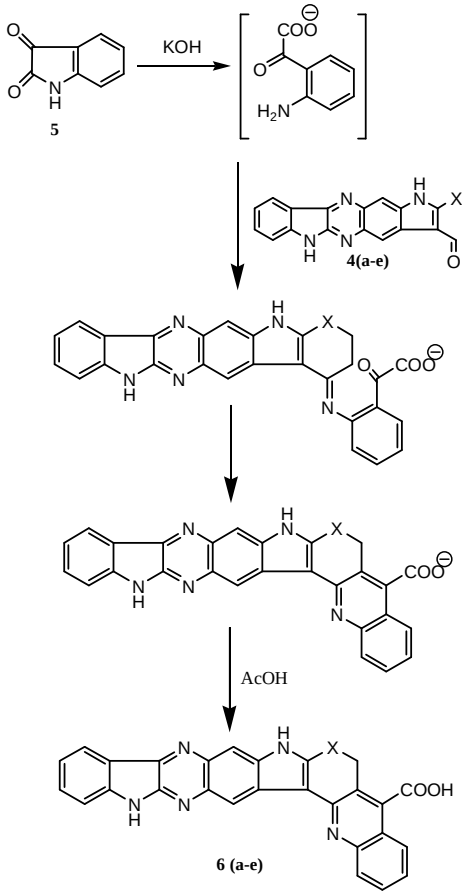
6b. Yield: 65%; IR (KBr) cm^{-1}: 3500, 3300, 2920, 1840, 1750, 1460, 1010; ^1H NMR (300 MHz, $CDCl_3$ + DMSO-d_6) δ ppm: 11.0 (1H, s, COOH), 10.1 (2H, s, NH), 9.08(1H,d,CH), 8.30(1H,d,CH), 8.07(2H,s,CH), 7.82(1H,t,CH_2, J-8.9Hz), 7.76(1H,t,CH_2, J-8.9Hz), 7.55-7.00(9H,m,Ar-H), 4.32(4H,t,CH_2); ^{13}C NMR; 172.0 (1C of COOH), 137.2, 128.3, 128.1, 126.8, 126.7, 128.1, 128.3, 128.1, 126.8, 126.7, 128.1, 123.8, 147.1, 121.6, 111.0, 120.5, 119.0 (14C of Ar-Benzene),127.6, 135.5, 129.4 (4C of pyrrole), 144.8, 134.1, 132.5, 137.2, 121.6 (6C of quinoxaline), 124.0, 102.0 (2C of piperidine), 62.1 (1C of benzyl CH_2); MS: *m/z* 546 [M^+]; Anal. Calcd. / found for $C_{34}H_{22}N_6O_2$: C, 74.71/74.69, H, 4.06/4.01, N, 15.38 / 15.33



Scheme:1

6c. Yield: 62%; IR (KBr) cm^{-1}: 3500, 3300, 2900, 1820, 1750, 1460, 1040; ^1H NMR (300 MHz, $CDCl_3$ + DMSO-d_6) δ ppm: 11.0 (1H, s, COOH), 10.1 (2H, s, NH), 9.08(1H,d,CH), 8.30(1H,d,CH), 8.07(2H,s,CH), 7.82(1H,t,CH_2, J-8.9Hz), 7.76(1H,t,CH_2, J-8.9Hz), 7.55-7.00(4H,m,Ar-H), 4.32(2H,t,CH_2), 2.97(1H,s,CH), 1.05(6H,s,CH_3); ^{13}C NMR; 172.0 (1C of COOH), 137.2, 128.3, 128.1, 126.8, 126.7, 128.1, 128.3, 128.1, 126.8, 126.7, 128.1, 123.8, 147.1, 121.6, 111.0, 120.5, 119.0 (11C of Ar-Benzene),127.6, 135.5, 129.4 (4C of pyrrole), 144.8, 134.1, 132.5,

137.2, 121.6 (6C of quinoxaline), 124.0, 102.0 (2C of piperidine), 52. 5 (C of CH), 21.6 (2C of CH_3); MS: *m/z* 498 [M^+]; Anal. Calcd. / found for $C_{30}H_{22}N_6O_2$: C, 72.28/ 72.24, H, 4.45/ 4.41, N, 16.86 / 16.82.



Scheme:2-Mechanism of formation of 6(a-e) from 4(a-e)

6d. Yield: 70%; IR (KBr) cm^{-1}: 3500, 3300, 2900, 1820, 1750, 1450, 1040; ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6) δ ppm: 11.0 (1H, s, COOH), 10.1 (2H, s, NH), 9.08(1H,d,CH), 8.30(1H,d,CH), 8.07(2H,s,CH), 7.82(1H,t,CH_2, J-8.9Hz), 7.76(1H,t,CH_2, J-8.9Hz), 7.55-7.00(4H,m,Ar-H), 4.64(2H,t,CH_2), 2.02(3H,s,CH_3); ^{13}C NMR; 172.0 (1C of COOH), 166.7 (C of COMe), 137.2, 128.3, 128.1, 126.8, 126.7, 128.1, 128.3, 128.1, 126.8, 126.7, 128.1, 123.8, 147.1, 121.6, 111.0, 120.5, 119.0 (11C of Ar-Benzene),127.6, 135.5, 129.4 (4C of pyrrole), 144.8, 134.1, 132.5, 137.2, 121.6 (6C of quinoxaline), 124.0, 102.0 (2C of piperidine), 15.4 (C of CH_3), MS: *m/z* 498 [M^+]; Anal. Calcd. / found for $C_{29}H_{18}N_6O_3$: C, 69.87/69.84, H, 3.64/3.61, N, 16.86 / 16.82.

6e. Yield: 70%; IR (KBr) cm^{-1}: 3500, 3300, 2900, 1820, 1750, 1450, 1040; ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6) δ ppm: 11.0 (1H, s, COOH), 10.1 (2H, s, NH), 9.08(1H,d,CH), 8.30(1H,d,CH), 8.07(2H,s,CH), 7.82(1H,t,CH_2, J-8.9Hz), 7.76(1H,t,CH_2, J-8.9Hz), 7.55-7.00(4H,m,Ar-H), 4.22(2H,t,CH_2), 3.67(3H,s,CH_3); ^{13}C NMR; 196.5 (C of COOMe), 172.0 (1C of COOH), 156.0 (C of CO), 137.2, 128.3, 128.1, 126.8, 126.7, 128.1, 128.3, 128.1, 126.8, 126.7, 128.1, 123.8, 147.1, 121.6, 111.0, 120.5, 119.0 (11C of Ar-Benzene),127.6, 135.5, 129.4 (4C of pyrrole), 144.8, 134.1, 132.5, 137.2, 121.6 (6C of quinoxaline), 124.0, 102.0 (2C of piperidine), 16.3 (C of CH_3); MS: *m/z* 514 [M^+]; Anal. Calcd. / found for $C_{29}H_{18}N_6O_4$: C, 68.44/68.41, H, 3.45/3.41, N, 16.33 / 16.29.

RESULTS AND DISCUSSION

The synthetic plan that was conceived to the preparation of the materials **6(a-e)** (scheme-1) required it to be accomplished in two stages. The first stage of this strategy involved the conversion of diazotised indophenazine to the indophenazino fused oxocarbazole and oxoazacarbazole derivatives [12] **4(a-e)** respectively. These were realized by the interaction of diazotised indophenazine with 2-hydroxymethylidene cyclohexanone **(3a)** and various N-substituted piperidones **3(b-e)** respectively under the conditions of Japp-Klingemann reaction, followed by the Fischer indolization of the resulting hydrazones with Kent's acid (HCl:AcOH; 1:4 v/v). The compounds **3(a-e)** were inturn obtained, following the reported procedure [15] which consisted of treating cyclohexanone and various N-substituted piperidone with ethyl formate in presence of sodium ethoxide. The second stage of the strategy required

the conversion of **4(a-e)** to the corresponding carbazolo fused quinoline-4carboxylic acid derivatives **6(a-e)**. The Pfitzinger reaction of isatin on compounds containing the $COCH_2$ group is known to provide a very convenient one pot synthetic entry to quinoline-4-carboxylic acid [13] derivatives. It is reported [14] that enolizable ketones show great facility to condense with isatin in strongly alkaline medium to subsequently cyclize to give quinoline products. The procedure developed by Pfitzinger reaction for the preparation of carbazolo and azacarbazolo fused quinoline-4-carboxylic acid derivatives **6(a-e)** from isatin and the carbonyl compounds containing an adjacent methylene group **(Scheme:1)**. The mechanism outlined in **scheme:2** for this reaction is believed to follow the same process previously described in the literature. The data shown in experimental section were found in good agreement to the assigned structures. The nitrogen analysis and all the spectral data shown in experimental section were found in good agreement to the assigned structures. The IR spectrum of all the compounds showed the presence of a strong absorption band near 1750 cm^{-1} for CO group. The presence of carboxylic acid group in **6(a-e)** was ascertained by the appearance of a broad band of OH group in the region of 3500-3400 cm^{-1}. The ^1H NMR spectrum displayed the corresponding peak for OH proton of carboxylic acid in the region of δ 11.0 ppm. The appearance of the M^+ peaks corresponding to their molecular formula in MS spectrum substantiated further the formation of the compounds and unequivocally established their structures.

Acknowledgement

This article is dedicated to Prof. D.Kishore. Authors are thankful to the Director CDRI Lucknow and SAIF Punjab university, Chandigarh for providing the spectral data of the compounds.

REFERENCES

[1] Free Patent Online, Uses of Indoloquinoxaline, *Patent No*-6465466.
[2] Caruso, A.; Sophie, A.; Chiret, V.; Charles, J.; Lancelot, Sinicropi, M. S.; *Molecules*, **2008**, *13*, 1312.
[3] Knolker, H. J.; Reddy, K. R.; *Chem Rev* , **2002**, *102 (11)*, 4303.
[4] Feng, X. U.; Ding, Q.; Yang, K.; Jing, W. G.; *Chinese Chem Lett*, **2006**, *17 (2)*, 187.
[5] Gramik, V. G.; Zhidkava, A. M.; Kiselev, S. S.; Ghohkov, R. G.; Polezhaeva, A. J.; Moshkovshi, M. D.; *Pharm Chem J*, **1978**, *12*, 881.
[6] Nazrullaev, S. S.; Bessanava, I. A.; Akhmedkhodzhaeva, K. S.; *Chem Natural Comp*, **2001**,*37*, 551.
[7] Aravinda, T.; Bhojya, N. H. S.; Prakash, N. H. R.; *International J Peptide Res Therapeutics*, **2009**, *15*, 273.
[8] Grandberg , I. I.; KroKhina, N. F.; Kondrat'ev, M. N.;, *Pharm Chem J*, **1968**, *2*, 37.
[9] Beregi, H.; Pieere Le-D, *US Pat* 3725432, **1973**.
[10] Tandon, V. K.; Yadav, D. B.; Chaturvedi, A. K.; Shukla, P. K.; *Bioorg Med Chem. Lett.*, **2005**, *15*, 3288.
[11] Solankee, A.; Thakor, I.; *Indian J Chem*, **2006,** *45B*, 517.
[12] Yadav, V.; Yadav, N.; *Asian J. Res. Chem*., **2011**, *4*, 441-444.
[13] Shvekhgeimer, M. G. A; *Chem. Hetero Comp*, **2004**, *40*, 257.
[14] Pajouhesh, H.; Parson , R.; Popp, F. D.; *J Pharm Sci*, **2006**,*72*, 318.
[15] Ainsworth, C.; *Org. Synthesis Coll. Vol*- 4, **1963**, 536.