Short Communication

Irradiation of Tungsten Light: A Useful Energy Source for Synthesis of 4,5-Dihydro-pyrazole-1-carbaldehyde Derivatives

Sainath Zangade*

U. G. Department of Study in Chemistry, Madhavrao Patil ACS College, Palam Dist. Parbhani-431720 (M S) India.

Article history: Received: 31 May 2017; revised: 20 June 2017; accepted: 27 June 2017. Available online: 30 September 2017. DOI: http://dx.doi.org/10.17807/orbital.v9i4.1010

Abstract: In the present communication, reported the easy, convenient route for the synthesis of N-formyl pyrazolines from α,β-unsaturated ketone. The aqueous 2-methoxyethanol was used as reaction media for the synthesis of titled compounds. All synthesized compounds were confirmed on the basis of IR, 1H NMR, 13C NMR and CHN analysis.

Keywords: aqueous 2-methoxyethanol; hydrazine hydrate; irradiation of tungsten light; N-formyl-2-pyrazoline; α,β-unsaturated ketone

1. INTRODUCTION

Amongst five-membered heterocycles, Nitrogen containing heterocyclic compounds represents a wide range of pharmacological applications and pronounced biological properties [1-8]. Pyrazolines are useful synthons in organic chemistry and also important in the development of theory in heterocyclic chemistry [9-10]. A classical synthesis of these compounds involves the condensation of α,β-unsaturated carbonyl compounds with hydrazines [11].

The three components one step synthesis has great current interest towards development of novel synthetic organic compounds. One of the three component one step reaction involve, synthesis of N-formyl pyrazolines in which α,β-unsaturated ketone reacts with hydrazine hydrate and formic acid [12-14]. In view of these observations and in continuation of earlier research work on synthesis of substituted 4,5-dihydro-pyrazole-1-carbaldehyde derivative [15-17], herein first time reported the synthesis of titled compound using irradiation of tungsten light as a useful energy in organic synthesis.

2. MATERIAL AND METHODS

Chemical

All chemicals, solvents and reagents used in the present study were of analytical grade purchased from Sigma, SD Fine, or Spectrochem.

Instrumentation

Melting points were determined in an open capillary tube and are uncorrected. The reactions were carried out in aqueous 2-methoxyethanol solvent (10 mL:10 mL, v/v) using 200 watt tungsten bulb light. Purification of the compounds was indicated using TLC (mixture of ethyl acetate and hexane, 0.20 mL:0.20 mL, vv). IR spectra were recorded in KBr pellets on a Perkin-Elmer FT-IR Shimadzu spectrometer. 1H and 13C NMR spectra were obtained in DMSO-d6 on Avance 300 MHz spectrometer using TMS as an internal standard. The mass spectra were recorded on EI-Shimadzu-GC-MS spectrometer. Elemental analyses were performed on a Carlo Erba 106 Perkin-Elmer model 240 analyzer.

General Procedure for synthesis of 4,5-dihydro-pyrazole-1-carbaldehyde derivative: In 50 mL beaker, a mixture of α,β-unsaturated ketones 1 (0.01 mol), hydrazine hydrate 2 (0.01mmol) and formic acid 3 (0.01 mmol) was dissolved in aqueous 2-methoxyethanol (20 mL) by warming. To this hot
reaction solution acetic acid (0.001 mmol) was added and irradiated under tungsten light (200 Watt) for 40-54 min, and progress of reaction was monitored on TLC. After completion of reaction, the resultant mixture was poured with stirring into water (20 mL). The precipitate formed was filtered through simple buchner funnel under vacuum pressure and crystallized from ethanol to yield 2-pyrazolines (Scheme 1).

5-(4-Fluoro-phenyl)-3-[2-(4-fluoro-phenyl)-vinyl]-4,5-dihydro-pyrazole-1-carbaldehyde. (4a): IR (KBr): 1628 (C=O), 1578 (C=N) cm -1. 1H NMR (300 MHZ, DMSO-d6) δ 3.25 (dd, J = 5.0, 17.8 HZ, 1H, Hα), δ 3.65 (dd, J = 12.0, 17.8 HZ, 1H, Hβ), δ 5.49 (dd, J = 5.1, 12.1 HZ, 1H, Hδ), δ 6.78 (d, J = 16.2 HZ, 1H, Hα), δ 7.17 (d, J = 16.2 HZ, 1H, Hβ), δ 7.31-7.68 (m, 8H, Ar -H), δ 8.90 (s, 1H, CHO). 13C NMR (DMSO-d6) 160.42 (C=O), 143.70 (C=N), 135.28 (Cβ, C=C double bond), 137.67 (C, Ar-C), 135.61 (C, Ar-C) 134.75 (2CH, of two Ar-C), 120.48 (2CH, of two Ar-C) 118.32 (Cβ, C=C double bond), 50.43 (-CH), 38.48 (-CH2). MS m/z: 312  (M+). Anal. Cacld for C18H14F2N2O: C, 69.23; H, 4.48. Found: C, 69.35; H, 5.53.

5-(3-Iodo-4,5-dimethoxy-phenyl)-3-[2-(3-iodo-4,5-dimethoxy-phenyl)-vinyl]-4,5-dihydro-pyrazole-1-carbaldehyde. (4d): IR (KBr): 1632 (C=O), 1585 (C=N) cm-1. 1H NMR (300 MHZ, DMSO-d6) δ 3.76 (s, 12H, four OCH3), δ 3.27 (dd, J = 5.0, 17.8 HZ, 1H, Hα), δ 3.62 (dd, J = 12.0, 17.8 HZ, 1H, Hβ), δ 5.50 (dd, J = 5.1, 12.1 HZ, 1H, Hδ), δ 6.78 (d, J = 16.2 HZ, 1H, Hα), δ 7.17 (d, J = 16.2 HZ, 1H, Hβ), δ 7.31-7.68 (m, 8H, Ar -H), δ 8.90 (s, 1H, CHO). 13C NMR (DMSO-d6) 167.12 (4C of two para Ar-ome) 160.47 (C=O), 143.77 (C=N), 135.30 (Cβ, C=C double bond), 133.67 (C, Ar-C), 135.61 (C, Ar-C) 134.75 (2CH, of two Ar-C), 120.48 (2CH, of two Ar-C) 118.32 (Cβ, C=C double bond), 50.43 (-CH), 38.48 (-CH2). MS m/z: 648 (M+). Anal. Cacld for C22H22O5I2N2: C, 40.74; H, 3.39. Found: C, 40.81; H, 3.43.

3. RESULTS AND DISCUSSION

Recently we reported the synthesis of 2-pyrazolines from 2’-hydroxychalcones in presence of catalytic amount of acetic acid under irradiation of tungsten light [18]. In view these observations we tried to implement the same reaction condition for cyclisation of α,β-unsaturated ketone to afford N-formyl pyrazolines. Initially we attempted the condensation of 1,5-Bis-(4-fluoro-phenyl)-penta-1,4-dien-3-one with hydrazine hydrate and formic acid using acetic acid in aqueous 2-methoxyethanol in combination with irradiation of tungsten light. The reaction went to completion within 40 min and corresponding product 4a obtained in 88% yield (Table 1).

In order to optimize the reaction conditions, we made comparison between by carried out the above reaction through conventional pathway, and we found that the method using irradiation of tungsten light is efficient in terms of clean reaction conditions, not expensive, yields and environmentally eco-friendly.

| Method A | Method B |
|----------|----------|
| Reaction | Yield (%) | M. p. (°C) | Reaction | Reported | Reported |
| Product  | Time (min) |  | time (h) | Yield (%) | M. p. (°C) |
| 4a       | 40        | 88 | 140 | 03 | 79 | 138-140 [16] |
| 4b       | 48        | 86 | 120 | 03 | 80 | 118-120 [16] |
| 4c       | 54        | 83 | 137 | 03 | 76 | 135-137 [16] |
| 4d       | 45        | 90 | 148 | 03 | 83 | 147-149 [16] |

Method A: Irradiation under tungsten light, Aqueous 2-methoxyethanol, AcOH.
Method B: Aqueous2-methoxyethanol, Reflux for 3 h.
4. CONCLUSION

In summary, present communication reported the synthesis of 4,5-dihydro-pyrazole-1-carbaldehyde derivatives starting from α,β-unsaturated ketone in aqueous 2-methoxyethanol under irradiation of tungsten light. The advantage of methods in comparison with classical synthesis, which includes clean reaction procedure, easy isolation of products, short reaction time and no need of special apparatus device.

5. ACKNOWLEDGMENTS

Author is very thankful to Director, Indian Institute of Chemical Technology, Hyderabad for providing spectral analysis.

6. REFERENCES AND NOTES

[1] Girisha, K. S.; Kalluraya, B.; Narayana, V.; Padmashree, P. Eur. J. Med. Chem. 2010, 45, 4640. [CrossRef]
[2] Banday, A. H.; Mir, B. P.; Lone, I. H.; Suri, K. A.; Sampathkumar, H. M. Steroid 2010, 75, 805. [CrossRef]
[3] Kaplancikli, Z. A.; Turan-Zitouni, G.; Ozdemir, A.; Can, O. D.; Chevallet, P. Eur. J. Med. Chem. 2009, 44, 2606. [CrossRef]
[4] Wanare, G.; Aher, R.; Kawathekar, N.; Ranjan, R.; Kaushik, N. K.; Sahal, D. Bioorg. Med. Chem. Lett. 2010, 20, 4675. [CrossRef]
[5] Shivakumar, P. M.; Seenivasan, S. P.; Kumar, V.; Doble, M. Bioorg. Med. Chem. Lett. 2010, 20, 3169. [CrossRef]
[6] Zhang, X. H.; Wu, S. K.; Gao, Z. Q.; Lee, S. T.; Kwong, H. L. Thin Solid Film 2000, 377, 40. [CrossRef]
[7] Ahn, J. H.; Kim, H. M.; Jung, S. H.; Kang, S. K.; Kim, K. R.; Rhode, S. D.; Yang, S. D.; Cheon, H. G.; Kim, S. S. Bioorg. Med. Chem. Lett. 2004, 14, 4461. [CrossRef]
[8] Archana Srivastava, V. K.; Chandra, R.; Kumar, A. Ind. J. Chem. Sec. B. 2002, 41, 2371.
[9] Elguero, J. In Comprehensive Heterocyclic Chemistry. Karlitzky, A. R.; Res, C. W. (Eds.) Pergamon: Oxford, 1984, 5, 167-303.
[10] Elguero, J. In Comprehensive Heterocyclic Chemistry II. Karlitzky, A. R.; Res, C. W.; Scriven, E. F. (Eds.) Pergamon: Oxford, 1996, 3, 1-76.
[11] Seebacher, W.; Michi, G.; Belaj, F.; Brun, R.; Saf, R.; Weis, R. Tetrahedron 2003, 59, 2811. [CrossRef]
[12] Raiford, L. C.; Peterson, W. J. J. Org. Chem. 1937, 1, 544. [CrossRef]
[13] Pramod, S.; Negi, J. S.; Pant, G. J.; Rawant Mohan, S. M.; Budakoti, A. Molbank. 2009. M 614.
[14] Levai, A. J. Heterocycl. Chem. 1998, 35, 13. [CrossRef]
[15] Zangade, S. B.; Shinde, A. T.; Vibhute, A. Y.; Vibhute, Y. B. Pak. J. Chem. 2012, 2, 1. [CrossRef]
[16] Zangade, S. Journal of Progressive Research in Chemistry 2017, 4, 201. [Link]
[17] Zangade, S. International Journal of Green Chemistry and Bioprocess 2017, 7, 1. [Link]
[18] Zangade, S.; Shinde, A.; Patil, A.; Vibhute, Y. Eur. J. Chem. 2012, 3, 208. [CrossRef]