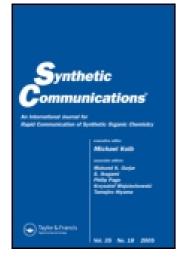
This article was downloaded by: [University of California, San Francisco] On: 26 November 2014, At: 14:39 Publisher: Taylor & Francis Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



# Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry

Publication details, including instructions for authors and subscription information: <u>http://www.tandfonline.com/loi/lsyc20</u>

# Condensation of 2-Pyrone with 3-Aminopyrazolone. A Novel Synthesis of Pyrazolo[3,4-b]pyridines

S. Fadel  $^{a}$  , Y. Hajbi  $^{a}$  , E. M. Rakib  $^{a}$  , M. Khouili  $^{a}$  , M. D. Pujol  $^{b}$  & G. Guillaumet  $^{c}$ 

<sup>a</sup> Laboratoire de Chimie Organique et Analytique , Faculté des Sciences et Techniques , BP 523, 23000, Béni-Mellal, Morocco

<sup>b</sup> Laboratori Química Farmacèutica, Facultat de Farmàcia , Universitat de Barcelona , Barcelona, Spain

<sup>c</sup> Institut de Chimie Organique et Analytique, Université d'Orléans , Rue de Chartres, Orleans, France

Published online: 17 Aug 2006.

To cite this article: S. Fadel, Y. Hajbi, E. M. Rakib, M. Khouili, M. D. Pujol & G. Guillaumet (2004) Condensation of 2-Pyrone with 3-Aminopyrazolone. A Novel Synthesis of Pyrazolo[3,4-b]pyridines, Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry, 34:12, 2195-2204, DOI: <u>10.1081/</u><u>SCC-120038500</u>

To link to this article: http://dx.doi.org/10.1081/SCC-120038500

# PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <a href="http://www.tandfonline.com/page/terms-and-conditions">http://www.tandfonline.com/page/terms-and-conditions</a>

SYNTHETIC COMMUNICATIONS<sup>®</sup> Vol. 34, No. 12, pp. 2195–2204, 2004

# Condensation of 2-Pyrone with 3-Aminopyrazolone. A Novel Synthesis of Pyrazolo[3,4-*b*]pyridines

S. Fadel,<sup>1</sup> Y. Hajbi,<sup>1</sup> E. M. Rakib,<sup>1,\*</sup> M. Khouili,<sup>1</sup> M. D. Pujol,<sup>2</sup> and G. Guillaumet<sup>3</sup>

<sup>1</sup>Laboratoire de Chimie Organique et Analytique, Faculté des Sciences et Techniques, Béni-Mellal, Morocco <sup>2</sup>Laboratori Química Farmacèutica, Facultat de Farmàcia, Universitat de Barcelona, Barcelona, Spain <sup>3</sup>Institut de Chimie Organique et Analytique, Université d'Orléans, Orleans, France

### ABSTRACT

A simple route to the preparation of new heterocyclic systems: pyrazolo [3,4-*b*]pyridines from the easily available 2-pyrone and 3-aminopyrazolone. The structure of the compounds and the mechanism of their formation are reported.

2195

DOI: 10.1081/SCC-120038500 Copyright © 2004 by Marcel Dekker, Inc. 0039-7911 (Print); 1532-2432 (Online) www.dekker.com

<sup>\*</sup>Correspondence: E. M. Rakib, Laboratoire de Chimie Organique et Analytique, Faculté des Sciences et Techniques, BP 523, 23000 Béni-Mellal, Morocco; E-mail: m.rakib@fstbm.ac.ma.

|--|

*Key Words:* Decarboxylation; Esterification; *n*-Butanol; Pyrones; Pyrazolo[3,4-*b*]pyridines.

# **INTRODUCTION**

Pyrazolo[3,4-*b*]pyridines are considered as very interesting compounds and have received considerable attention as result of their biological activity and structural relationship to indoles. A number of pyrazolo[3,4-*b*]pyridines are under intensive development by research groups throughout the world. Several compounds display interesting anxiolytic activity,<sup>[1,2]</sup> are potential biologically active compounds as new inhibitors of xantine oxidases,<sup>[3]</sup> or for treatment of erectile dysfunction.<sup>[4]</sup> Moreover, other pyrazolo[3,4-*b*] pyridines have proved to be active against Gram positive and Gram negative bacteria,<sup>[5]</sup> as cholesterol formation-inhibiting compounds,<sup>[6]</sup> or are promising for the treatment of cataracts associated with diabetis.<sup>[7]</sup>

### **RESULTS AND DISCUSSION**

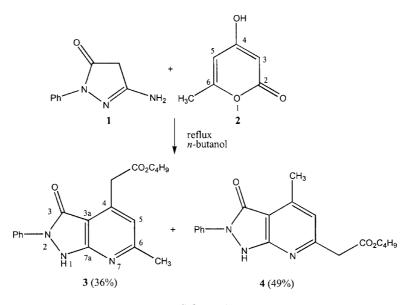
Pyrazolo[3,4-*b*]pyridines have been prepared generally by cyclization reactions starting from different heterocyclic reagent.<sup>[8–12]</sup> As a continuation of our work on the synthesis of pyridine analogs which have potential pharma-cological properties; we investigated the condensation of 2-pyrone with 5-aminopyrazolone. The pyrone derivatives are versatile and increasingly used in a variety of organic syntheses, in particular in the synthesis of new types of heterocyclic compounds. The pyrones are electrophilic and highly reactive toward binucleophiles; their reactivity has been reported in the literature.<sup>[13–19]</sup> We have found that the reaction of 2-pyrone with 5-aminopyrazolone constitutes a facile method for the synthesis of several novel pyrazolo[3,4-*b*]pyridines. Thus, it has been found that condensation of 3-aminopyrazolone **1** with pyrone **2** in refluxing *n*-butanol affords the mixture of two isomeric pyrazolo[3,4-*b*]pyridines **3** and **4** (Sch. 1).

The products **3** and **4** were separated by silica gel chromatography and their structures were assigned by 2D NMR-experiments (HMQC and HMBC). The carbon at 157.0 ppm is assignable as the C-7a, and this carbon shows a cross-peak with the CH<sub>2</sub> at 3.62 ppm. Whereas the methyl group at 2.25 ppm gives a cross-peak to carbon signal at 158.9 ppm corresponding to C-7a. The absence of CH<sub>2</sub> signal due to the methylene protons of the pyrazole **1** in <sup>1</sup>H NMR spectrum of the compounds **3** and **4**, shows that cyclization is carried out on C-4 carbon of the pyrazole ring.

# 2196



ORDER		REPRINTS
-------	--	----------



#### Synthesis of Pyrazolo[3,4-*b*]pyridines

Scheme 1.

The synthesis of the compounds **3** and **4** can be explained by the following mechanism: initial competitive attack of the amino group on C-6 and C-4 of pyrone **2** followed by the opening of the pyranic cycle and formation of the intermediates **[A]** and **[B]**. Butanol (weak nucleophile) plays an important role in this mechanism. These intermediates thus formed undergo an disrotary electrocyclization  $6e\pi$  leading after aromatization of the pyrazolo[3,4-*b*]pyridines **3** and **4** (Sch. 2).

In a classical experiment, 3-aminopyrazolone **1** reacted with pyrone **2** under reflux in *n*-butanol in the presence of catalytic amount of *p*-toluenesulfonic acid, giving two different compounds: pyrazolo[3,4-b]pyridines **3** and **5** (Sch. 3).

The <sup>1</sup>H NMR spectrum of the product **5** revealed two singlets at 2.24 and 2.72 ppm corresponding to the methyl groups, and the peak at 6.54 ppm assignable to CH group of pyridine ring.

The catalytic amount of PTSA is very important in this reaction; the initial attack of the amino group takes place on the C-6 of the pyrone 2 giving the intermediate [A']. The compound obtained cyclizes in two different pathways: decarboxylation or esterification and then intramolecular electrocyclization affording compounds 3 and 5 (Sch. 4). In the presence of PTSA the attack was regioselectively at C-6 of the pyrone.

2197

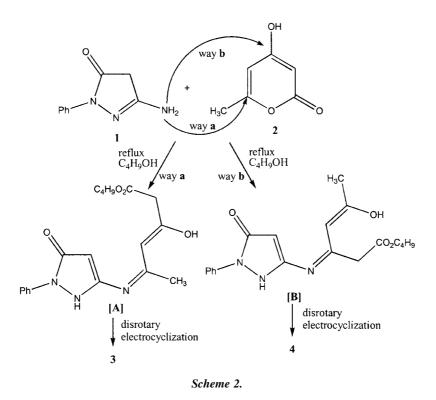


ORDER		REPRINTS
-------	--	----------

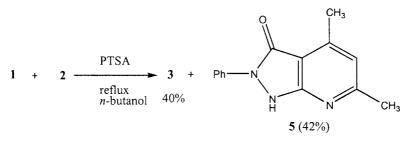
2198

pyrone 2 (Sch. 5).

Fadel et al.



In order to investigate the scope of this reaction, we studied the condensation of the pyrone 2 with the 3-aminopyrazolone in acetic acid. Under these conditions, two products were isolated: product 5 identified in the reaction with backward flow of *n*-butanol with PTSA and the pyrazolo[3,4-*b*]pyridine 6. The formation of 6 suggests the attack of the amino group at C-4 of the



Scheme 3.

Marcel Dekker, Inc. 270 Madison Avenue, New York, New York 10016

ORDER		REPRINTS
-------	--	----------

## ŌН NH<sub>2</sub> ÌC. H<sub>3</sub>C 2 1 *n*-butanol PTSA HO<sub>2</sub>C OF esterification decarboxylation 3 5 disrotary CH<sub>3</sub> disrotary Ph electrocyclization electrocyclization N [A']

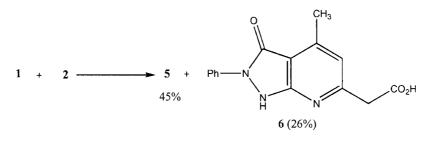
#### Synthesis of Pyrazolo[3,4-*b*]pyridines

Downloaded by [University of California, San Francisco] at 14:39 26 November 2014



When the acetic acid is used as a solvent, the aminopyrazolone attacks directly the carbon on position 4 of pyrone. The intermediate [B'] evolves according to two ways leading after aromatization to the pyrazolopyridines **5** and **6** (Sch. 6).

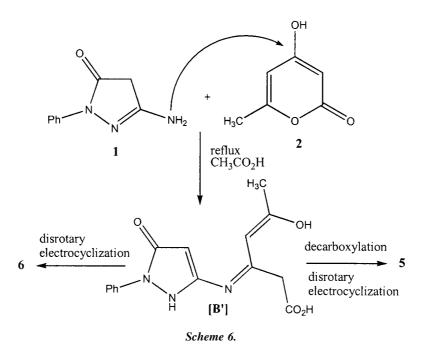
In conclusion, we found that the condensation of pyrone with 3-aminopyrazolone is dependent on the reaction conditions. Whereas in presence of n-butanol condensation is initiated at the C-6 and C-4 carbons of pyrone 2, in n-butanol with PTSA the aminopyrazolone attacks directly the carbon at position 6 of pyrone, and in acetic acid, it is the C-4 position, which is attacked, in the first step.



Scheme 5.

2199

ORDER		REPRINTS
-------	--	----------



## **EXPERIMENTAL**

### **General Instrumentation**

Melting points were determined using a Büchi-Tottoli apparatus and are uncorrected. IR spectra were recorded on a Perkin–Elmer 577 spectrometer using KBr disks, only noteworthy IR absorptions are listed (cm<sup>-1</sup>). <sup>1</sup>H and <sup>13</sup>C NMR spectra were recorded on a Varian Gemini 200 and 300 spectrometer and  $\delta$  values are expressed in ppm; *J* values are given in Hz. HMQC and HMBC data were recorded at 400 Hz (Varian-Unity 400). Multiplicities of <sup>13</sup>C NMR resources were assigned by distortionless enhancement by polarization transfer (DEPT) experiments. Mass spectra were recorded on a Varian MAT 112 spectrometer MS. Elemental analysis data were taken on a Perkin– Elmer 240C elemental analytical instrument. Column chromatography was carried out on SiO<sub>2</sub> (silica gel 60 Merck 0.063–0.200 mm). TLC was carried out on SiO<sub>2</sub> (silica gel 60, F 254 Merck 0.063–0.200 mm) and the spots located with UV light. All solvents were dried or purified by standard methods. All reagents were used as purchased from commercial sources.





#### Synthesis of Pyrazolo[3,4-b]pyridines

Commercial chemicals: 3-aminopyrazolone 1 and 2-pyrone 2 were used without purification.

Synthesis of pyrazolo[3,4-*b*]pyridines 3 and 4. 4-Hydroxy-6-methylpyran-2-one (1.26 g, 10 mmol) was added to a solution of 3-aminopyrazolone (5 mmol) in 50 mL of *n*-butanol. The reaction mixture was refluxed for 48 hr. After evaporation of solvent, the residue was then purified over silica gel column chromatography using a 60:40 mixture of hexane and ethyl acetate as eluent.

**2-(6-Methyl-3-oxo-2-phenyl-2,3-dihydro-1***H***-pyrazolo[3,4-***b***]pyridin-4-yl) acetic acid butylester (3). Yield 36%, orange solid. M.p. 129–131°C; IR: 1620, 1730 (CO), 3010 (NH); <sup>1</sup>H NMR (CDCl<sub>3</sub>): \delta 0.89 (t, J = 7.4 Hz, 3H, CH<sub>3</sub>), 1.32 (m, 2H, CH<sub>2</sub>), 1.54 (m, 2H, CH<sub>2</sub>), 2.74 (s, 3H, CH<sub>3</sub>), 3.62 (s, 2H, CH<sub>2</sub>), 4.06 (t, J = 6.6 Hz, 2H, CH<sub>2</sub>O), 6.86 (s, 1H, H-5), 7.26 (m, 1H, CH), 7.45 (m, 2H, CH), 7.86 (dd, J = 0.8, 8.4 Hz, 2H, CH), 14.01 (s, 1H, NH); <sup>13</sup>C NMR (CDCl<sub>3</sub>): \delta 13.7 (CH<sub>3</sub>), 17.3 (CH<sub>3</sub>), 19.0 (CH<sub>2</sub>), 30.4 (CH<sub>2</sub>), 42.9 (CH<sub>2</sub>), 65.2 (CH<sub>2</sub>O), 109.5 (C-4), 119.5 (CH-5), 119.7, 125.3, 129.0 (5CH), 137.1 (C-1'), 150.8 (C-6), 156.7 (C-3a), 157.0 (C-7a), 159.6 (CON), 169.4 (CO); MS (EI): m/z 339 (M<sup>+</sup>). Anal. Calcd for C<sub>19</sub>H<sub>21</sub>N<sub>3</sub>O<sub>3</sub>: C, 67.24; H, 6.24; N, 12.38. Found: C, 67.34; H, 6.20; N, 12.44.** 

**2-(4-Methyl-3-oxo-2-phenyl-2,3-dihydro-1***H***-pyrazolo[3,4-***b***]pyridin-6-yl) acetic acid butylester (4). Yield 49%, orange solid. M.p. 114–116°C; IR: 1670, 1740 (CO), 2960 (NH); <sup>1</sup>H NMR (CDCl<sub>3</sub>): \delta 0.90 (t, 3H,** *J* **= 7.2 Hz, CH<sub>3</sub>), 1.36 (m, 2H, CH<sub>2</sub>), 1.61 (m, 2H, CH<sub>2</sub>), 2.25 (s, 3H, CH<sub>3</sub>), 4.20 (s, 2H, CH<sub>2</sub>), 4.15 (t,** *J* **= 6.6 Hz, 2H, CH<sub>2</sub>O), 6.74 (s, 1H, H-5), 7.24 (m, 1H, CH), 7.42 (m, 2H, CH), 7.88 (dd,** *J* **= 0.8, 8.2 Hz, 2H, CH), 14.02 (s, 1H, NH); <sup>13</sup>C NMR (CDCl<sub>3</sub>): \delta 13.7 (CH<sub>3</sub>), 19.1 (CH<sub>2</sub>), 23.1 (CH<sub>3</sub>), 30.5 (CH<sub>2</sub>), 35.5 (CH<sub>2</sub>), 65.3 (CH<sub>2</sub>O), 108.3 (C-4), 117.9 (CH-5), 120.0 (2CH), 125.4 (CH), 129.0 (2CH), 137.5 (C-1'), 146.4 (C-6), 155.2 (C-3a), 158.9 (C-7a), 159.7 (CON), 169.8 (CO); MS (EI):** *m***/***z* **339 (M<sup>+</sup>). Anal. Calcd for C<sub>19</sub>H<sub>21</sub>N<sub>3</sub>O<sub>3</sub>: C, 67.24; H, 6.24; N, 12.38. Found: C, 67.18; H, 6.28; N, 12.40.** 

Synthesis of pyrazolo[3,4-*b*]pyridines 3 and 5. To a solution of 4-hydroxy-6-methylpyran-2-one (1.26 g, 10 mmol) and 3-aminopyrazolone 2 (5 mmol) in 40 mL of *n*-butanol was added *p*-toluenesulfonic acid (0.5 mg). The reaction mixture was refluxed for 48 hr. After evaporation of solvent, the residue was then purified over silica gel column chromatography using a 60:40 mixture of hexane and ethyl acetate as eluent. Under these conditions the compound **3** was obtained in 40% yield.

**4,6-Dimethyl-2-phenyl-1,2-dihydro-pyrazolo**[**3,4-***b*]**pyridin-3-one** (**5**). Yield 42%, orange solid. M.p. 199–201°C; IR: 1660 (CO), 3040 (NH); <sup>1</sup>H NMR (CDCl<sub>3</sub>):  $\delta$  2.24 (s, 3H, CH<sub>3</sub>), 2.72 (s, 3H, CH<sub>3</sub>), 6.54 (s, 1H, H-5), 7.20 (m, 1H, CH), 7.42 (m, 2H, CH), 7.94 (dd, J = 1.6, 7.8 Hz, 2H, CH), 13.81 (s, 1H, NH); <sup>13</sup>C NMR (CDCl<sub>3</sub>):  $\delta$  16.6 (CH<sub>3</sub>), 20.9 (CH<sub>3</sub>),

2201



ORDER		REPRINTS
-------	--	----------

108.6 (C-4), 111.8 (CH-5), 118.5 (2CH), 123.8 (1CH), 128.6 (2CH), 139.3 (C-1'), 150.1 (C-6), 153.5 (C-3a), 155.0 (C-7a), 159.1 (CON); MS (EI): m/z 239 (M<sup>+</sup>). Anal. Calcd for C<sub>14</sub>H<sub>13</sub>N<sub>3</sub>O: C, 70.28; H, 5.48; N, 17.56. Found: C, 70.36; H, 5.44; N, 17.50.

**Synthesis of pyrazolo[3,4-***b***]pyridine 5 and 6.** A mixture of 4-hydroxy-6-methylpyran-2-one (126 g, 10 mmol) and 3-aminopyrazolone (5 mmol) in acetic acid (40 mL) was heated under reflux for 30 hr. After evaporation of the solvent, the residue was then purified over silica gel column chromatography using a 30:70 mixture of hexane and ethyl acetate as eluent.

Under these conditions the compound 5 was obtained in 45% yield.

**2-(4-Methyl-3-oxo-2-phenyl-2,3-dihydro-1***H***-pyrazolo[<b>3**,**4**-*b*]pyridin-6-yl) acetic acid (6). Yield 26%, white solid. M.p. 175–177°C; IR: 1690 (CO), 3040 (NH); <sup>1</sup>H NMR (CDCl<sub>3</sub>):  $\delta$  2.24 (s, 3H, CH<sub>3</sub>), 4.06 (s, 2H, CH<sub>2</sub>), 7.17 (m, 1H, CH), 7.33 (s, 1H, H-5), 7.37 (m, 2H, CH), 7.80 (dd, *J* = 1.4, 7.6 Hz, 2H, CH), 9.38 (s, 1H, OH), 13.90 (s, 1H, NH); <sup>13</sup>C NMR (CDCl<sub>3</sub>):  $\delta$  25.0 (CH<sub>3</sub>), 42.5 (CH<sub>2</sub>), 111.6 (C-4), 120.0 (2CH), 122.6 (CH-5), 126.2 (1CH), 130.8 (2CH), 141.3 (C-1'), 151.6 (C-6), 155.2 (C-3a), 157.1 (C-7a), 160.1 (CON), 178.2 (CO); MS (EI): *m*/*z* 283 (M<sup>+</sup>). Anal. Calcd for C<sub>15</sub>H<sub>13</sub>N<sub>3</sub>O<sub>3</sub>: C, 63.60; H, 4.63; N, 14.83. Found: C, 63.66; H, 4.61; N, 14.79.

#### REFERENCES

- Hoehn, H.; Denzel, T. 1H-Pyrazolo[3,4-b]pyridine. Ger. Offen. US Patent 3,755,340, 1973; 25.
- Meiners, B.A.; Salama, A.I. Enhancement of benzodiazepine and GABA binding by the novel anxiolytic, tracazolate. Eur. J. Pharmacol. 1982, 78 (3), 315–322.
- 3. Lynch, B.M.; Khan, M.A.; Teo, H.C.; Pedrotti, F. Pyrazolo[3,4-*b*] pyridines: syntheses, reactions, and nuclear magnetic resonance spectra. Can. J. Chem. **1988**, *66* (3), 420–428.
- Guixue, Y.; Helen, J.M.; Ximao, W.; Jian, W.; Saeho, C.; Gary, D.; Andrew, H.; Ronald, P.; Laurie, S.; Bin, H.; Diane, N.; Leonard, A.; John, K.; John, E.M. Substituted pyrazolopyridines as potent and selective PDE5 inhibitors: potential agents for treatment of erectile dysfunction. J. Med. Chem. **2001**, *44*, 1025–1027.
- El-Dean, A.M.; Aralla, A.A.; Mohamed, T.A.; Geies, A.A. Synthesis of some pyrazolopyridinesulfonamide derivatives. Z. Naturforsch. Teil B: Chem. Sci. 1991, 46 (4), 541–546.
- 6. Fujikama, Y.; Suzuki, M.; Iwasaki, H.; Sakashita, M.; Kitahara, M. Preparation and formulation of pyrazolopyridine-type mevalonolactones as antihyperlipidemics. Eur. Pat. Appl. EP339,358, 1989; 71.

2202





#### Synthesis of Pyrazolo[3,4-b]pyridines

- Abdel Hafed, A.; Awad, I.M.A.; Ahmed, R.A. New heterocyclic substituted pyrazolo[3,4-b]pyridine derivatives. Collect. Czech. Chem. Commun. 1993, 58 (5), 1198–1202.
- 8. Hardy, C.R. The chemistry of pyrazolopyridines. Adv. Heterocycl. Chem. **1984**, *36*, 343–409.
- Molina, P.; Arques, A.; Fresneda, P.M.; Vinader, M.V.; Foces-Foces, M.C.; Hernandez Cano, F. Heterocyclization reactions of conjugated heterocumulenes. Synthesis of pyridine derivatives by a tandem aza-Wittig/electrocyclization strategy. Chem. Ber. **1989**, *122* (2), 307–313.
- Benoit, R.; Dupas, G.; Bourguignon, J.; Quéguiner, G. Facile synthesis of annelated NADH model precursors. Synthesis 1987, (12), 1124–1126.
- Bare, T.M.; McLaren, C.D.; Campbell, J.B.; Firor, J.W.; Resch, J.F.; Walters, C.P.; Salama, A.I.; Meiners, B.A.; Patel, J.B. Synthesis and structure-activity relationships of a series of anxioselective pyrazolopyridine ester and amide anxiolytic agents. J. Med. Chem. **1989**, *32* (12), 2561–2573.
- Sanghvi, Y.S.; Larson, S.B.; Robins, R.K.; Revankar, G.R. A convenient synthesis of pyrazolo[3,4-*b*]pyridine nucleosides by convenient ring-closure procedures. X-ray crystal and molecular structure of 4-amino-1-(α-D-ribofuranoyl)-1,7-dihydropyrazolo[3,4-*b*]pyridin-6-one. J. Chem. Soc., Perkin Trans. I **1990**, (11), 2943–2950.
- El Abbassi, M.; Essassi, E.M.; Fifani, J. New synthesis of 1,5-benzodiazepines from γ-pyrones. Tetrahedron Lett. 1987, 28 (13), 1389–1392.
- El Abbassi, M.; Essassi, E.M.; Fifani, J. Dehydroacetic acid. Precursor in the synthesis of benzodiazepines. Tetrahedron Lett. **1989**, *30* (50), 7069–7070.
- Maàmr, H.; Grech, O.; Sakellariou, R.; Spèziale, V. New method of synthesis of 1,5-benzodiazepin-2-ones from 4-hydroxycoumarin. J. Heterocycl. Chem. **1994**, *31* (2), 509–511.
- Maàmr, H.; Cottet, S.; Tedeschi, C.; Spèziale, V. Reaction of 1,2diamines with 4-hydroxycoumarin. Synthesis of 1,4-diazepin-5-ones. J. Heterocycl. Chem. 1997, 34 (6), 1821–1824.
- 17. El Abbassi, M.; Essassi, E.M.; Fifani, J. Synthesis of new 4-acetonylidene-1,5-benzodiazepin-2-ones III. Condensation of monosubstituted *o*-phenylenediamine with  $\gamma$ -pyrone. Bull. Soc. Chim. Belg. **1997**, 106 (4), 205–210.
- El Kihel, A.; Benchidmi, M.; Essassi, E.M.; Danion-Bougot, R. Reaction of aminobenzimidazoles with 4-hydroxy-6-methyl-2-pyrone and 4-hydroxycoumarin. Synth. Commun. 1999, 29 (14), 2435–2445.

ORDER		REPRINTS
-------	--	----------

 Rakib, E.M.; Benchidmi, M.; Essassi, E.M.; El Bouadili, A.; Khouili, M.; Mark, V.; Pujol, M.D. Reactivity of 7-aminoindazole as a bidendate nucleophile. Heterocycles 2000, 53 (12), 2617–2627.

Received in Poland December 9, 2003

2204



# **Request Permission or Order Reprints Instantly!**

Interested in copying and sharing this article? In most cases, U.S. Copyright Law requires that you get permission from the article's rightsholder before using copyrighted content.

All information and materials found in this article, including but not limited to text, trademarks, patents, logos, graphics and images (the "Materials"), are the copyrighted works and other forms of intellectual property of Marcel Dekker, Inc., or its licensors. All rights not expressly granted are reserved.

Get permission to lawfully reproduce and distribute the Materials or order reprints quickly and painlessly. Simply click on the "Request Permission/ Order Reprints" link below and follow the instructions. Visit the <u>U.S. Copyright Office</u> for information on Fair Use limitations of U.S. copyright law. Please refer to The Association of American Publishers' (AAP) website for guidelines on <u>Fair Use in the Classroom</u>.

The Materials are for your personal use only and cannot be reformatted, reposted, resold or distributed by electronic means or otherwise without permission from Marcel Dekker, Inc. Marcel Dekker, Inc. grants you the limited right to display the Materials only on your personal computer or personal wireless device, and to copy and download single copies of such Materials provided that any copyright, trademark or other notice appearing on such Materials is also retained by, displayed, copied or downloaded as part of the Materials and is not removed or obscured, and provided you do not edit, modify, alter or enhance the Materials. Please refer to our <u>Website</u> User Agreement for more details.

# **Request Permission/Order Reprints**

Reprints of this article can also be ordered at http://www.dekker.com/servlet/product/DOI/101081SCC120038500