EFFICIENT SYNTHESIS OF NEW FUNCTIONALIZED 2-(HETARYL)THIAZOLES

Bondock, S (Bondock, Samir)[1,2]; El-Azab, H (El-Azab, Hossam)[1]; Kandeel, EEM (Kandeel, Ez-Eldin M.)[1]; Metwally, MA (Metwally, Mohamed A.)[1]

Abstract

An efficient synthesis of the hitherto unknown ring system, 2-heteroaryl-thiazoles, is described via the reaction of 3-oxo-N-(4-phenylthiazol-2-yl) butanamide (1) with diazotized heterocyclic amine, phenyl isothiocyanate, dimethylformamide-dimethylacetal, and hydrazine hydrate, and the reaction of 2-chloro-N-(4-phenylthiazol-2-yl) acetamide (13) with some sulfur nucleophiles and malononitrile. The structures of the compounds prepared were determined by analytical and spectral analyses.

Source: SYNTHETIC COMMUNICATIONS Volume: 43 Issue: 1 Pages: 59-71 DOI: 10.1080/00397911.2011.591036 Published: 2013

Author Keywords: Japp-Klingmann; phenyl isothiocyanate; pyrazole; pyridine; thiazole

KeyWords Plus: DERIVATIVES; THIAZOLE; HETEROCYCLES; 2-AMINOTHIAZOLES; INHIBITORS; ETHYL

Reprint Address: Bondock, S (reprint author), Mansoura Univ, Dept Chem, Fac Sci, ET-35516 Mansoura, Egypt.

Addresses:
[1] Mansoura Univ, Dept Chem, Fac Sci, ET-35516 Mansoura, Egypt
[2] King Khalid Univ, Dept Chem, Fac Sci, Abha, Saudi Arabia

E-mail Address: Bondock@mans.edu.eg

Publisher: TAYLOR & FRANCIS INC, 325 CHESTNUT ST, SUITE 800, PHILADELPHIA, PA 19106 USA

Web of Science Categories: Chemistry, Organic

A Concise Diastereoselective Photochemical Synthesis of 3-Hydroxyfuran-2(3H)-ones

Bondock, S (Bondock, Samir)

Abstract

The photocycloaddition of alkyl phenylglyoxylates to allylic alcohols leads to oxetanes 3ah with high to moderate (2R*,4R*)-diastereoselectivity that can be easily ring-opened to give 3-hydroxyfuran-2(3H)-ones 4ab.

Source: JOURNAL OF HETEROCYCLIC CHEMISTRY Volume: 49 Issue: 3 Pages: 555-560 DOI: 10.1002/jhet.810 Published: MAY 2012

KeyWords Plus: PATERNO-BUCHI REACTION; ALPHA-KETO ESTERS; CHIRAL ALLYLIC ALCOHOLS; ALKYL PHENYLGLYOXYLATES; CARBONYL-COMPOUNDS; ENE REACTION; PHOTOCYCLOADDITION; 5-METHOXYOXAZOLES; ALDEHYDES; OXETANES

Reprint Address: Bondock, S (reprint author), Mansoura Univ, Fac Sci, Dept Chem, ET-35516 Mansoura, Egypt.

Addresses:
[1] Mansoura Univ, Fac Sci, Dept Chem, ET-35516 Mansoura, Egypt

E-mail Address: Bondock@mans.edu.eg

Publisher: WILEY-BLACKWELL, 111 RIVER ST, HOBOKEN 07030-5774, NJ USA

Web of Science Categories: Chemistry, Organic

Synthesis and chemical transformations of azonine derivatives

Fadda, AA (Fadda, Ahmed A.)[1]; Afsah, EM (Afsah, Elsayed M.)[1];

Bondock, S (Bondock, Samir)[1]; Hammouda, MM (Hammouda, Mohamed M.)[1]

Source: TETRAHEDRON Volume: 68 Issue: 9 Pages: 2081-2091 DOI: 10.1016/j.tet.2011.12.016 Published: MAR 4 2012

Author Keywords: Azonines; Benzoazonines; Medium ring nitrogen; Heterocycles

KeyWords Plus: ANGIOTENSIN CONVERTING ENZYME; RING NITROGEN-HETEROCYCLES; MEDIUM-SIZED RINGS; STRUCTURAL ASSIGNMENT; ACID-DERIVATIVES; ALKALOIDS; EXPANSION; AGENTS; REARRANGEMENT; CONDENSATION

Reprint Address: Fadda, AA (reprint author), Mansoura Univ, Fac Sci, Dept Chem, ET-35516 Mansoura, Egypt.

Addresses:
[1] Mansoura Univ, Fac Sci, Dept Chem, ET-35516 Mansoura, Egypt

E-mail Address: afadda2@yahoo.com

Publisher: PERGAMON-ELSEVIER SCIENCE LTD, THE BOULEVARD, LANGFORD LANE, KIDLINGTON, OXFORD OX5 1GB, ENGLAND

Web of Science Categories: Chemistry, Organic

Research Areas: Chemistry

References:

1-M. Alvarez, J.A. Joule

Alkaloids, Chemistry and Biology, Vol. 57Academic, San Diego (2001) p 235

2-C.M. Bertha, M. Ellis, J.L. Flippen-Anderson, F. Porreca, R.B. Rothman, P. Davis, H. Xu, K. Becketts, K.C. Rice

J. Med. Chem., 39 (1996), p. 2081

3-D. Iliopoulou, C. Vagias, C. Harvala, V. Roussis

Phytochemistry, 59 (2002), p. 111

4 R.J. Harrison, S.M. Gowan, L.R. Kelland, S. Needle

Bioorg. Med. Chem. Lett., 9 (1999), p. 2463

5 J.W.H. Watthey, T. Gavin, M. Desai

J. Med. Chem., 27 (1984), p. 816

6 J. Sicher

Prog. Stereochem., 3 (1962), p. 202

7 G. Illuminati, L. Mandolin

Acc. Chem. Res., 14 (1981), p. 95

8 U.K. Bandarage, M.E. Kuehne, S.D. Glick

Tetrahedron, 55 (1999), p. 9405

9 T. Shirahama, T. Kohno, T. Kaijima, Y. Nagoka, D. Morimoto, K. Hirata, S. Uesato

Chem. Pharm. Bull., 54 (2006), p. 665

10 R. Shaw, M. Anderson, T. Gallagher

Synlett (1990), p. 584

11 N.J. Leonard, M. Oki, S. Chiavarelli

J. Am. Chem. Soc., 77 (1955), p. 6241

12 N.J. Leonard, T. Sato

J. Org. Chem., 34 (1969), p. 1066

13 J.B. Bremner, D.F. Perkins

Tetrahedron, 61 (2005), p. 2659

14 T. Ikemoto, T. Ito, A. Nishiguchi, K. Tomimatsu

Tetrahedron Lett., 45 (2004), p. 9335

15 M. Seto, K. Aikawa, N. Miyamoto, Y. Aramaki, N. Kanzaki, K. Takashima, Y. Kuze, Y. Iizawa, M. Baba, M. Shiraishi

J. Med. Chem., 49 (2006), p. 2037

16 H.G. Theuns, H.B.M. Lenting, C.A. Salemink, H. Tanaka, M. Shibata, K. Ito, R.J.J.C. Lousberg

Heterocycles, 22 (1984), p. 2007

17 G. Orzalesi, R. Seller, R.L. Vittory, F. Innocent, G. Grandolini

J. Heterocycl. Chem., 14 (1977), p. 733

18 S. Casadio, G. Pala, A. Mantegani, E. Marazzi-Uberti, G. Coppi, C. Turba

J. Med. Chem., 13 (1970), p. 1092

19 B. Pecherer, R.C. Sunbury, A. Brossi

J. Med. Chem., 12 (1969), p. 149

20 S. Shiotani, T. Kometani, K. Mitsuhashi, T. Nozawa, A. Kurobe, O. Futsukaichi

J. Med. Chem., 19 (1976), p. 803

21 Y. Horiguchi, S. Sakuma, H. Suzuki, T. Sano

Heterocycles, 53 (2000), p. 1305

22 M. Tanemura, S. Kaiho, K. Mizuno, I. Matsunaga, S. Hata, M. Shindo

Yakugaku Zasshi, 105 (1985), p. 659

23 K. Hayashi, S. Inoue, H. Shimizu, A. Kobayashi, M. Ishizaki, Y. Matsuoka, K. Nishitani, H. Hara

Heterocycles, 65 (2005), p. 1

24 M.D. Thompson

J. Heterocycl. Chem., 23 (1986), p. 1545

Synthesis and antitumor evaluation of some new 1,3,4-oxadiazole-based heterocycles

Bondock, S (Bondock, Samir)[1,2]; Adel, S (Adel, Shymaa)[1]; Etman, HA (Etman, Hassan A.)[1]; Badria, FA (Badria, Farid A.)[3]

Abstract

The synthetic strategies and characterization of some novel 1,3,4-oxadiazole derivatives carrying different pharmacophores and heterocyclic rings that are relevant to potential antitumor and cytotoxic activities are described. The antitumor activities of the newly synthesized compounds were evaluated according to the protocol of the National Cancer Institute (NCI) in-vitro disease-oriented human cells screening panel assay. The results revealed that five compounds, namely 2, 7a, ha, 12b, and 17; displayed promising in-vitro antitumor activity in the 4-cell lines assay. Incorporating a thiazole ring to 1,3,4-oxadiazole skeleton resulted in better antitumor activities than those displayed by the pyrazole and thiophene ring systems. Transformation of 1,3,4-oxadiazole 2 to N-(6-amino-7H-pyrazolo[5,1-c][1,2,4] triazol-3-yl)benzamide (15) diminished the antitumor activity. (C) 2011 Elsevier Masson SAS. All rights reserved.

Author Keywords: 1,3,4-Oxadiazole; Pyrazole; Thiazole; Thiophene; Antitumor activity

KeyWords Plus: MICROWAVE IRRADIATION; SUBSTITUTED PYRAZOLYL-1,3,4-OXADIAZOLES; ANTIMICROBIAL ACTIVITY; CONVENIENT SYNTHESIS; ANTICANCER AGENTS; DERIVATIVES; PYRAZOLYL-1,2,4-TRIAZOLES; 1,3,4-THIADIAZOLES; INHIBITORS; THIAZOLE

Reprint Address: Bondock, S (reprint author), Mansoura Univ, Fac Sci, Dept Chem, El Gomhuria St, ET-35516 Mansoura, Egypt.

Addresses:
[1] Mansoura Univ, Fac Sci, Dept Chem, ET-35516 Mansoura, Egypt
[2] King Khalid Univ, Fac Sci, Dept Chem, Abha 9004, Saudi Arabia
[3] Mansoura Univ, Fac Pharm, Dept Pharmacognosy, ET-35516 Mansoura, Egypt

E-mail Address: Bondock@mans.edu.eg

Publisher: ELSEVIER FRANCE-EDITIONS SCIENTIFIQUES MEDICALES ELSEVIER, 23 RUE LINOIS,

References

[1] T.M.C. Tan, Y. Chen, K.H. Kong, J. Bai, Y. Li, S.G. Lim, T.H. Ang, Y. Lam

Antivir. Res., 71 (2006), pp. 7–14

[2] S.L. Gaonkar, K.M.L. Rai, B. Prabhuswamy

Eur. J. Med. Chem., 41 (2006), pp. 841–846

[3] A.S. Aboraia, H.M. Abdel-Rahman, N.M. Mahfouz, M.A. Gendy

Bioorg. Med. Chem., 14 (2006), pp. 1236–1246

[4] Y. Li, J. Liu, H. Zhang, X. Yang, Z. Liu

Bioorg. Med. Chem. Lett., 16 (2006), pp. 2278–2282

[5] C. Loetchutinat, F. Chau, S. Mankhetkorn

Chem. Pharm. Bull., 51 (2003), pp. 728–730

[6] A.H. Abadi, A.A.H. Eissa, G.S. Hassan

Chem. Pharm. Bull., 51 (2003), pp. 838–844

[7] B.G. Szczepankiewicz, G. Liu, H.-S. Jae, A.S. Tasker, I.W. Gunawardana, T.W. von Geldern, S.L. Gwaltney, J.R. Wu-Wong, L. Gehrke, W.J. Chiou, R.B. Credo, J.D. Alder, M.A. Nukkala, N.A. Zielinski, K. Jarvis, K.W. Mollison, D.J. Frost, J.L. Bauch, Y.H. Hui, A.K. Claiborne, Q. Li, S.H. Rosenberg

J. Med. Chem., 44 (2001), pp. 4416–4430

[8] D. Kumar, S. Sundaree, E.O. Johnson, K. Shah

Bioorg. Med. Chem. Lett., 19 (2009), pp. 4492–4494

[9] M.T. Khan, M.I. Choudhary, K.M. Khan, M. Rani, A.U. Rahman

Bioorg. Med. Chem., 13 (2005), pp. 3385–3395

[10] J.T. Palmer, B.L. Hirschbein, H. Cheung, J. McCarter, J.W. Janc, W.Z. Yu, G. Wesolowski

Bioorg. Med. Chem. Lett., 16 (2006), pp. 2909–2914

[11] R.N. Warrener

Eur. J. Org. Chem., 65 (2000), pp. 3363–3380

[12] M. Guan, Z.Q. Bian, Y.F. Zhou, F.Y. Li, Z.J. Li, C.H. Huang

Chem. Commun., 9 (2003), pp. 2708–2709

[13] C.R.W. Guimaraes, D.L. Boger, W.L. Jorgensen

J. Am. Chem. Soc., 127 (2005), pp. 17377–17384

[14] D.-M. Cheng, F.-Y. Ma, X. Liu

Opt. Laser Technol., 39 (2007), pp. 720–723

[15] H. Tang, N. Song, Z. Gao, X. Chen, X. Fan, Q. Xiang, Q. Zhou

Polymer, 48 (2007), pp. 129–138

[16] (a) B. Oussaid, L. Moeini, B. Martin, D. Villemin, B. Garrigues

Synth. Commun., 25 (1995), pp. 1451–1459

(b) X.C. Wang, Z. Li, Z.H. Zhang, Y.X. Da

Synth. Commun., 31 (2001), pp. 1907–1911

(c) X.C. Wang, Z. Li, B.G. Wei, J.Y. Yang

Synth. Commun., 32 (2002), pp. 1097–1103

(d) S.K. Srivastava, R.B. Pathak, S.C. Bahel

J. Indian Chem. Soc, 68 (1991), pp. 113–114

[16] A. Jemal, R. Siegel, E. Ward, Y. Hao, J. Xu, T. Murray, M.J. Thun

Cancer J. Clin., 58 (2008), pp. 71–96

[18] C.M. Haskell

Cancer Treatment

(fifth ed.)W.B. Saunders, Philadelphia, PA (2001) (Chapter 1)

[19] S. Eckhardt

Curr. Med. Chem. Anti Canc. Agents, 2 (2002), pp. 419–439

[20] K.H. Altmann

Curr. Opin. Chem. Biol., 5 (2001), pp. 424–431

[21] M. Wartmann, K.H. Altmann

Curr. Med. Chem. Anti Canc. Agents, 2 (2002), pp. 123–148

[22] M.E. O'Dwyer, B.J. Druker

Curr. Cancer Drug Targets, 1 (2001), pp. 49–57

[23] S. Bondock, W. Khalifa, A.A. Fadda

Eur. J. Med. Chem., 46 (2011), pp. 2555–2561

[24] S. Bondock, W. Fadaly, M.A. Metwally

Eur. J. Med. Chem., 45 (2010), pp. 3692–3701

[25] S. Bondock, W. Fadaly, M.A. Metwally

Eur. J. Med. Chem., 44 (2009), pp. 4813–4818

[26] S. Bondock, R. Rabie, H.A. Etman, A.A. Fadda

Eur. J. Med. Chem., 43 (2008), pp. 2122–2129

[27] S. Bondock, W. Khalifa, A.A. Fadda

Eur. J. Med. Chem., 42 (2007), pp. 948–954

[28] S. Bondock, A.E. Tarhoni, A.A. Fadda

Monatsh Chem., 139 (2008), pp. 153–159

[29] S. Bondock, A.E. Tarhoni, A.A. Fadda

Phosphorus Sulfur Silicon, 182 (2007), pp. 1915–1936

[29] S. Bondock, A.E. Tarhoni, A.A. Fadda

Curr. Org. Chem., 15 (2011), pp. 753–781

[31] R.B. Silverman (Ed.), The Organic Chemistry of Drug Design and Drug Action, Academic Press, London (1992), p. 263

[32] M.R.H. Elmoghayar, S.O. Abdalla, M.Y.A.S. Nasr

J. Heterocycl. Chem., 21 (1984), pp. 781–784

[33] S.A. Ryndina, A.V. Kadushkin, N.P. Soloveva, V.G. Granik

Russ. Chem. Bull., 51 (2002), pp. 854–859

[34] V. Padmavathi, A.V.N. Mohan, P. Thriveni, A. Shazia

Eur. J. Med. Chem., 44 (2009), pp. 2313–2321

[35] Y.M. Elkholy, K.A. Ali, A.M. Farag

J. Heterocycl. Chem., 43 (2006), pp. 1183–1188

[36] Y.M. Elkholy, K.A. Ali, A.M. Farag

Lett. Org. Chem., 3 (2006), pp. 195–200

[37] B. Gottineau, S. Renaux, J. Chenault, G. Guillaumet

Lett. Org. Chem., 2 (2005), pp. 599–601

[38] V. Padmavathi, G.S. Reddy, A.V.N. Mohan, K. Mahesh

ARKIVOC, xvii (2008), pp. 48–60

[39] T. Mosmann

J. Immunol. Methods, 65 (1983), pp. 55–63

[40] F. Denizot, R. Lang

J. Immunol. Methods, 22 (1986), pp. 271–277

[41] M.I. Thabrew, R.D. Hughes, I.G. McFarlane

J. Pharm. Pharmacol., 49 (1997), pp. 1132–1135

[42] J. Gutteridge, D. Rowley, B. Halliwell

Biochem. J., 199 (1981), pp. 263–265

[43] B.F. Abdel-Wahab, A.-A.S. El-Ahl, F.A. Badria

Chem. Pharm. Bull., 57 (2009), pp. 1348–1351

[44] F.A. Badria, M. Ameen, M. Akl

Z. Naturforsch., 62c (2007), pp. 656–660

Synthesis and chemical transformations of azonine derivatives

Fadda, AA (Fadda, Ahmed A.)[1]; Afsah, EM (Afsah, Elsayed M.)[1]; Bondock, S (Bondock, Samir)[1]; Ammouda, MMH (Ammouda, Mohamed M. H.)[1]

Abstract

This review describes synthetic procedures for the preparation of azonines and their benzo-condensed derivatives. Examples or the most important chemical transformations of some azonine groups, including their useful derivatives; are also provided.

Author Keywords: Azonines; benzoazonines; medium-ring nitrogen; heterocycles

KeyWords Plus: ANGIOTENSIN CONVERTING ENZYME; RING NITROGEN-HETEROCYCLES; MEDIUM-SIZED RINGS; STRUCTURAL ASSIGNMENT; ACID-DERIVATIVES; EXPANSION; AGENTS; REARRANGEMENT; CONDENSATION; ANALGESICS

Reprint Address: Fadda, AA (reprint author), Mansoura Univ, Fac Sci, Dept Chem, ET-35516 Mansoura, Egypt.

Addresses:
[1] Mansoura Univ, Fac Sci, Dept Chem, ET-35516 Mansoura, Egypt

E-mail Address: afadda2@yahoo.com

Publisher: SCIENTIFIC TECHNICAL RESEARCH COUNCIL TURKEY-TUBITAK, ATATURK BULVARI NO 221, KAVAKLIDERE, TR-06100 ANKARA, TURKEY

Refrencess:

1. Alvarez, M.; Joule, J. A. In *The Alkaloids: Chemistry and Biology, Volume 57*; Cordell, G. A., Ed.; Academic
Press, San Diego, CA, 2001.
2. Bertha, C. M.; Ellis, M.; Flippen-Anderson, J. L.; Porreca, F.; Rothman, R. B.; Davis, P.; Xu, H.; Becketts, K.;
Rice, K. C. *J. Med. Chem.* **1996**, *39*, 2081-2086.
3. Iliopoulou, D.; Vagias, C.; Harvala, C.; Roussis, V. *Phytochemistry* **2002**, *59*, 111-116.
4. Harrison, R. J.; Gowan, S. M.; Kelland, L. R.; Needle, S. *Bioorg. Med. Chem. Lett.* **1999**, *9*, 2463-2468.
5. Watthey, J. W. H.; Gavin, T.; Desai, M. *J. Med. Chem.* **1984**, *27*, 816-818.
6. Sicher, J. *Progr. Stereochem.* **1962**, *3*, 202-211.
7. Illuminati, G.; Mandolin, L. *Accounts Chem. Res.* **1981**, *14*, 95-98.
8. Bandarage, U. K.; Kuehne, M. E.; Glick, S. D. *Tetrahedron* **1999**, *55*, 9405-9424.
9. Shirahama, T.; Kohno, T.; Kaijima, T.; Nagoka, Y.; Morimoto, D.; Hirata, K.; Uesato, S. *Chem. Pharm. Bull.*
2006, *54*, 665-668.
10. Shaw, R.; Anderson, M.; Gallagher, T. *Synlett* **1990**, *10*, 584-587.
11. Leonard, N. J.; Oki, M. *J. Am. Chem. Soc.* **1955**, *77*, 6241-6244.
12. Leonard, N. J.; Sato, T. *J. Org. Chem.* **1969**, *34*, 1066-1070.
13. Bremner, J. B.; Perkins, D. F. *Tetrahedron* **2005**, *61*, 2659-2665.

14. Ikemoto, T.; Ito, T.; Nishiguchi, A.; Tomimatsu, K. *Tetrahedron Lett.* **2004**, *45*, 9335-9339.
15. Seto, M.; Aikawa, K.; Miyamoto, N.; Aramaki, Y.; Kanzaki, N.; Takashima, K.; Kuze, Y.; Iizawa, Y.; Baba, M.;
Shiraishi, M. *J. Med. Chem.* **2006**, *49*, 2037-2048.

16. Theuns, H. G.; Lenting, H. B. M.; Salemink, C. A.; Tanaka, H.; Shibata, M.; Ito, K.; Lousberg, R. J. J. Ch.
Heterocycles **1984**, *22*, 2007-2011.
17. Orzalesi, G.; Seller, R.; Vittory, R. L.; Innocent, F.; Grandolini, G. *J. Heterocycl. Chem.* **1977**, *14*, 733-738.
18. Casadio, S.; Pala, G.; Mantegani, A.; Marazzi-Uberti, E.; Coppi, G.; Turba, C. *J. Med. Chem.* **1970**, *13*, 1092-1095.
19. Pecherer, B.; Sunbury, R. C.; Brossi, A. *J. Med. Chem.* **1969**, *12*, 149-151.
20. Shiotani, S.; Kometani, T.; Mitsuhashi, K.; Nozawa, T.; Kurobe, A.; Futsukaichi, O. *J. Med. Chem.* **1976**, *19*,
803-806.
21. Horiguchi, Y.; Sakuma, S.; Suzuki, H.; Sano, T. *Heterocycles* **2000**, *53*, 1305-1316.
22. Tanemura, M.; Kaiho, S.; Mizuno, K.; Matsunaga, I.; Hata, S.; Shindo, M. *Yakugaku Zasshi* **1985**, *105*, 659-664.
23. Hayashi, K.; Inoue, S.; Shimizu, H.; Kobayashi, A.; Ishizaki, M.; Matsuoka, Y.; Nishitani, K.; Hara, H. *Heterocycles*
2005, *65*, 1-4.
24. Thompson, M. D. *J. Heterocycl. Chem.* **1986**, *23*, 1545-1549.
25. Gaozza, C. H.; Grinberg, H.; Lamdan, S. *J. Heterocycl. Chem.* **1972**, *9*, 883-886.
26. Peet, N. P.; Sunder, S.; Barbuch, R. J.; Whalon, M. R.; Huber, E. W. *J. Heterocycl. Chem.* **1989**, *26*, 1611-1617.
27. Leonard, N. J.; Oki, M.; Chiavarelli, S. *J. Am. Chem. Soc.* **1955**, *77*, 6241-6244.
28. Kaul, R.; Surprenant, S.; Lubell, W. D. *J. Org. Chem.* **2005**, *70*, 3838-3844.
29. Qadir, M.; Cobb, J.; Sheldrake, P. W.; Whittall, N.; White, A. J. P.; Hii, K. K.; Horton, P. N.; Hursthouse, M. B.
J. Org. Chem. **2005**, *70*, 1552-1557.
30. Beckmann, E. *Chem. Ber.* **1886**, *19*, 988-993.
31. Gawley, R. E. *Org. Reactions* **1987**, *35*, 1-420.
32. Jensen, B. L.;Woods, M. A. *J. Heterocycl. Chem.* **1979**, *16*, 1317-1319.
33. Wilson, S. R.; Sawicki, R. A. *J. Org. Chem.* **1979**, *44*, 330-336.
34. Olson, G. L.; Voss, M. E.; Hill, D. E.; Kahn, M.; Madison, V. S.; Cook, C. M. *J. Am. Chem. Soc.* **1990**, *112*,
323-333.
35. Schmidt, Z. *Angew. Chem.* **1923**, *36*, 511-524.
36. Moore, J. A.; Mitchell, E. In *Heterocyclic Compounds*; Elderfield, R. C., Ed.; Wiley, New York, 1967.
37. Elliott, I. W.; Sloan, M. J.; Tate, E. *Tetrahedron* **1996**, *52*, 8063-8072.
38. Black, D. St. C.; Johnstone, L. M. *Angew. Chem. Int. Edit.* **1981**, *20*, 670-671.
39. Benattar, A.; Barbry, D.; Hasiak, B.; Couturier, D. *J. Heterocycl. Chem.* **1981**, *18*, 63-65.
40. Pine, S. H. *Org. Reactions* **1970**, *18*, 403-464.
41. Shirai, N.; Sumiya, F.; Sato, Y.; Hori, M. *J. Org. Chem.* **1989**, *54*, 836-840.
42. Kim, G.; Chu-Moyer, M. Y.; Danishefsky, S. J. *J. Am. Chem. Soc.* **1990**, *112*, 2003-2005.
43. Bremner, J. B.; Dragar, C. *Heterocycles* **1985**, *23*, 1451-1457.
44. El-Subbagh, H.; Wittig, T.; Decker, M.; Elz, S.; Nieger, M.; Lehmann, J. *Arch. Pharm. Pharm. Med. Chem.* **2002**,
9, 443-448.
45. Wentland, M. P. *Tetrahedron Lett.* **1989**, *30*, 1477-1478.

46. Donohoe, T. J.; Raoof, A.; Linney, I. D.; Helliwell, M. *Org. Lett.* **2001**, *3*, 861-864.
47. Witkop, B. *J. Am. Chem. Soc.* **1950**, *72*, 1428-1429.
48. Gatta, F.; Misiti, D. *J. Heterocycl. Chem.* **1989**, *26*, 537-539.

49. Schenck, L. W.; Kuna, K.; Frank, W.; Albert, A.; Asche, C.; Kucklaender, U. *Bioorgan. Med. Chem.* **2006**, *14*, 3599-3614.
50. Voskressensky, L. G.; Akbulatov, S. V.; Borisova, T. N.; Varlamov, A. V. *Tetrahedron* **2006**, *62*, 12392-12397.
51. Soldatenkov, A. T.; Volkov, S. V.; Soldatova, S. A. *Chem. Heterocycl. Comp.* **2007**, *43*, 508-509.
52. Salama, T. A.; El-Ahl, A.-A. S.; Khalil, A.-G. M.; Girges, M. M.; Lackner, B.; Steindl, C.; Elmorsy, S. S. *Monatsh. Chem.* **2003**, *134*, 1241-1252.
53. Barcza, S.; Goppola, G. M.; Shapiro, M. J. *J. Heterocycl. Chem.* **1979**, *16*, 439-443.
54. Anastassiou, A. G. In *Comprehensive Heterocyclic Chemistry*; Katritzky, A. R.; Rees, C. W., Eds.; Pergamon, Oxford, 1984.
55. Sigaut, F.; Levy, J. *Tetrahedron Lett.* **1989**, *30*, 2937-2940.
56. Brickwood, D. J.; Hassan, A. M.; Ollis, W. D.; Stephanatou, J. S.; Stoddart, J. F. *J. Chem. Soc. Perkin Trans. 1* **1978**, 1393-1397.
57. Sainsbury, M.; Brown, D. W.; Dyke, S. F.; Hardy, G. *Tetrahedron* **1969**, *25*, 1881-1895.
58. Godfry, J. *J. Org. Chem.* **1959**, *24*, 581-581.
59. Boltukhina, E. V.; Zubkov, F. I.; Varlamov, A. V. *Chem. Heterocycl. Comp.* **2006**, *42*, 971-1001.
60. Askitoglu, E.; Guggisberg, A.; Hesse, M. *Helv. Chim. Acta* **1985**, *68*, 750-759.
61. Tawil, B. F.; Guggisberg, A.; Hesse, M. *Tetrahedron* **1992**, *48*, 3775-3780.
62. Wasserman, H. H.; Pearce, B. C. *Tetrahedron Lett.* **1985**, *26*, 2237-2240.
63. Wasserman, H. H.; Leadbetter, M. R. *Tetrahedron Lett.* **1985**, *26*, 2241-2244.
64. Roxburgh, C. J. *Tetrahedron* **1995**, *51*, 9767-9822.
65. Evans, P. A.; Holmes, B. *Tetrahedron* **1991**, *47*, 9131-9166.
66. Hall, H. K. Jr. *J. Am. Chem. Soc.* **1958**, *80*, 6404-6409.
67. Werner & Pfleiderer, *Neth. Appl.* 6,408,333/25 Jan. **1965**; *Chem. Abstr.* **1965**, *63*, 1953e.
68. Elison, C.; Lien, E. J.; Zinger, A. P.; Hussain, M.; Tong, G. L.; Golden, M. *J. Pharm. Sci.* **1971**, *60*, 1058-1062.
69. Thorsett, E. D.; Harris, E. E.; Aster, S. D.; Peterson, E. R.; Snyder, J. P.; Springer, J.; Hirshfield, P. J.; Tristram, E. W.; Patchett, A. A. *J. Med. Chem.* **1986**, *29*, 251-260.
70. Klayman, D. L.; Scovill, J. P.; Bartosevich, J. F.; Mason, C. J. *J. Med. Chem.* **1979**, *22*, 1367-1373.
71. Clark, C. R.; Halfpenny, P. R.; Hill, R. G.; Horwell, D. C.; Hughes, J.; Jarvis, T. C.; Rees, D. C.; Schofield, D. *J. Med. Chem.* **1988**, *31*, 831-836.

72. Fischer, A.; Kiefer, H.; Koenig, K. H. *Ger. Offen.* 1,917,534/8 Oct. **1970**; *Chem. Abstr.* **1970**, *73*, 130909w.