Est. 1984

ORIENTAL JOURNAL OF CHEMISTRY
An International Open Free Access, Peer Reviewed Research Journal

www.orientjchem.org

ISSN: 0970-020 X
CODEN: OJCHEG
2012, Vol. 28, No. (3):
Pg. 1085-1090

Design and Synthesis of Three Naphtol Derivatives using the Three Component System

L. FIGUEROA-VALVERDE[1]*, F. DIAZ-CEDILLO[2], E. GARCIA-CERVERA[1] and E. POOL GOMEZ[1]

[1]Laboratory of Pharmaco-Chemistry at the Faculty of Chemical Biological Sciences of University Autonomicof Campeche, Av. Agustín Melgar s/n, Col, Buenavista C.P.24039 Campeche Cam, Mexico.
[2]Escuela Nacional de Ciencias Biológicas del Instituto Politécnico Nacional. Prol. Carpio y Plan de Ayala s/n Col. Santo Tomas, D.F. C.P. 11340, México.
*Corresponding author E-mail: lauro_1999@yahoo.com

(Received: May 30, 2012; Accepted: July 03, 2012)

ABSTRACT

Three naphtol derivativesweresynthesized using several strategies; in first stage, was synthetized the compound 4(1-[(2-Amino-ethylamino)-phenyl-methyl]-naphthalen-2-ol) using the three-component system (β-naphtol, benzaldehyde and ethylenediamine).The secondstage involves the synthesis of1-{[2-Hex-1-ynyl-phenyl-amino)-ethylamino]-phenyl-methyl}-naphtalen-2-ol (6) by the reaction of 4 with 1-hexyne andbenzaldheydeusing cupric chloride as catalyst. The third stage, was achieved by synthesis of 3,8-di(naphtyl-2-ol)-1,10-diphenyl-4,7-diaza-deca-1,9-diene (8) using the three-component system (cinamaldehyde, β-naphtol and ethylenediamine). The structure of all compounds obtainedwas confirmed by spectroscopy and spectrometry data. In conclusion, in this study we report some efficient methods for synthesis of naphtol derivatives.It is important to mention that the methods used are highly versatile and the yield is good.

Key words: Naphtol Derivatives, Different methods, Component System.

INTRODUCTION

Several methods have been reported for synthesis of aromatic-condensed derivatives; for example, the synthesis of naphtyl ketone by the reaction of *o*-alkynylbenzaldehydes with alkynes using $AuCl_3$ as catalyst[1]. Other reports indicate the tandem pummerer Diels-Alder sequence for the preparation of α-thiosubstituted naphthalene derivatives[2]. Additionally, other studies[3] showed the synthesis of 1,8-diphenylnaphtalene and 1-Iodo-8-phenylnaphtalene by the reaction of lithium diphenylcuprate and aryl halides. Other studies reported by Ganapathy & Viswanathan[4] shown the synthesis of polysubstituted naphthalene derivatives through gallium trichloride catalyzed by alkyne-aldehyde coupling. In addition, some carbamato-alkyl-naphtol derivatives[5-6] have been synthetized by condensation of β-naphtol, aromatic aldehyde and methyl carbamate in ionic liquid media. Other studies indicate that the compound N-(2,4-Dibromonaphthyl)benzamide was prepared by benzoylation of 2,4-Dibromonaphthylamine in pyridine[7]. Additionally, other naphtalen benzamide

derivative (N-(3-mercapto-5-(naphthalen-1-yl)-4H-1,2,4-triazol-4-yl)benzamide) was synthetized by the reaction of potassium 2-(2-naphthoyl) hydrazinecarbodithioate with N-amino-arylcarboxamides in ethanol to reflux[8]. Recently, was synthetized a naphthalene-benzamide derivative (N-(3-(1-Methoxy-naphthalen-2-yl)-2,2-dimethylpropyl)-2-benzamide) by the reaction of benzoic acid with 3-(1-1 Methoxy-naphtalen-2-yl)-2,2-dimethyl-propylamine in methanol at room temperature[9]. All these experimental results show several procedures which are available for synthesis of naphthalene derivatives; nevertheless, expensive reagents and special conditions are required. Therefore, in this study three naphthol derivatives were synthetized using the three componentsystem.

MATERIAL AND METHODS

General methods

The compounds evaluated in this study were purchased from Sigma-Aldrich Co., Ltd. The melting points for the different compounds were determined on an Electrothermal (900 model). Infrared spectra (IR) were recorded using KBr pellets on a Perkin Elmer Lambda 40 spectrometer. ^{1}H and ^{13}C NMR spectra were recorded on a Varian VXR-300/5 FT NMR spectrometer at 300 and 75.4 MHz in $CDCl_3$ using TMS as internal standard. EIMS spectra were obtained with a Finnigan Trace GCPolaris Q. spectrometer. Elementary analysis data were acquired from a Perkin Elmer Ser. II CHNS/0 2400 elemental analyzer.

Synthesis of 1-[(2-Amino-ethylamino)-phenyl-methyl]-naphthalen-2-ol.(4)

A solution of β-naphtol (100 mg, 0.69 mmol), benzaldehyde (105 µl, 1.03mmol), ethylenediamine (92 µl, 1.38 mmol) in 10 ml of ethanol wasstirring for 72 h to room temperature. The reaction mixture was evaporatedto a smaller volume. After the mixture was diluted with water and extractedwith chloroform. The organic phase was evaporated to dryness underreduced pressure, the residue was purified by crystallization frommethanol:water (4:1) yielding 75 % of product, m.p. 52-54 ^{o}C; IR } =3530, 3330, 3310 cm^{-1}; ^{1}H NMR (300 MHz, CDCl3) δ_H: 2.88 (t, 2H, *J* =11 6.0 Hz), 3.08 (t, 2H, *J* = 6.0 Hz), 3.72 (broad, 3H), 5.75(s, 1H), 6.88 (m,12 2H), 7.05 (m, 1H), 7.11 (m, 2H), 7.20 (m, 1H), 7.41-7.54 (m, 3H), 7.68-7.75 (m, 2H) ppm. ^{13}C NMR (75.4 Hz, CDCl3) δ_C: 42.20 (C-15), 52.98(C-14), 55.53 (C-12), 114.39 (C-9), 121.17 (C-8), 123.57 (C-6), 125.65(C-2), 126.21 (C-7), 127.39 (C-20), 128.01 (C-4), 128.22 (C-10), 130.02(C-18, C-22), 130.06 (C-5), 130.88 (C-19, C-21), 137.07 (C-17), 138.35(C-3), 152.11 (C-1) ppm. EI-MS *m/z:* 292.07 (M+, 11). Anal. Calcd for: $C_{19}H_{20}N_2O$: C, 78.05; H, 6.89; N, 9.58; O, 5.47. Found: C, 78.02; H, 6.85.

1-{[2-Hex-1-ynyl-phenyl-amino)-ethylamino]-phenyl-methyl}-naphtalen-2-ol (6)

A solution of 4(100 mg, 0.34 mmol), 1-hexyne (42 µl, 0.36 mmol), benzaldheyde (50µl, 0.51 mmol) and cupric chloride anhydrous (90 mg, 0.67 mmol) in 10 ml of ethanol was stirring for 48 h to room temperature. The reaction mixture was evaporatedto a smaller volume. After the mixture was diluted with water and extracted with chloroform. The organic phase was evaporated to dryness under reduced pressure, the residue was purified by crystallization from methanol:water (4:1) yielding 70 % of product, m.p. 72-74 ^{o}C; IR (V_{max}, cm^{-1}): 3530, 3320, 2190 and 1170;^{1}H NMR (300 Hz, $CDCl_3$) δ_H: 0.91 (t, 3H, *J* = 6.3 Hz), 1.42 (m, 2H), 1.47 (m, 2H), 2.32 (t, 2H, *J* = 6.83 Hz), 2.88 (t, 2H, *J* = 6.9 Hz), 3.14(t, 3H, *J* = 6.3 Hz), 4.70 (broad, 2H), 5.02 (s, 1H), 6.61 (d, 3H, *J* = 8.0 Hz), 6.87 (d, 2H, *J* = 7.8 Hz), 7.10-7.12 (m, 4H), 7.20 (m, 1H), 7.42-7.54 (m, 3H), 7.69-7.75 (m, 2H) ppm.^{13}CNMR (75.4 Hz, $CDCl_3$) δ_C: 13.54 (C-34), 16.78 (C-31), 21.98 (C-33), 31.88 (C-32), 47.34 (C-14), 55.22 (C-12), 59.10 (C-15), 59.38 (C-30), 82.28 (C-29), 113.82(C-18, C-22), 114.02 (C-9), 120.18 (C-20), 121.10 (C-8), 123.57 (C-6), 125.16 (C-2), 126.60 (C-7), 127.38 (C-26), 128.01 (C-4), 128.14 (C-10), 128.90 (C-24, C-28), 129.28(C-5), 129.60 (C-19, C-21), 130.08 (C-25,C-27), 135.78 (C-25), 138.14 (C-3), 144.60 (C-17), 152.08 (C-1) ppm.EI-MS (70 eV): *m/z* =448.18 (M + 17), 262.19, 155.17, 105.14. Anal. Calcd. for $C_{31}H_{32}N_2O$: C, 83.00; H, 7.19; N, 6.24, O, 3.57. Found. C, 82.97; H, 7.16.

3,8-di(naphtyl-2-ol)-1,10-diphenyl-4,7-diaza-deca-1,9-diene (8)

A solution of cinamaldehyde(87 µl, 0.69 mmol), β-naphtol (100 mg, 0.69 mmol), and ethylenediamine(67µl1.00 mmol) in 10 ml of ethanol was stirring for 72 h to room temperature. The reaction mixture was evaporatedto a smaller

volume. After the mixture was diluted with water and extracted with chloroform. The organic phase was evaporated to dryness under reduced pressure, the residue was purified by crystallization from methanol:water (4:1) yielding 70 % of product, m.p. 54-56°C; IR (V_{max}, cm^{-1}): 3526, 3314, 1586 and 1164; ^{1}H NMR (300 Hz, $CDCl_3$) δ_H: 2.51 (m, 2H) 2.8 (m, 2H), 5.22 (d, 2H, J = 7.5 Hz), 6.07 (d, 2H, J = 7.5 Hz), 6.57 (d, 2H, J = 15.70 Hz), 6.92 (broad), 7.14-7.28 (m, 6H), 7.40-7.52 (m, 12H), 7.59-7.73 (m, 4H) ppm.^{13}C NMR (75.4 Hz, $CDCl_3$) δ_C:49.27 (C-14, C-15), 57.34 (C-12,C-17), 115.52 (C-9, C-20), 120.62 (C-8, C-24), 123.82 (C-6,C-26), 125.11 (C-2, C-18), 126.43 (C-7, C-25), 126.62 (C-31, C-35, C-39, C-43), 127.28 (C-33, C-41), 127.41 (C-4, C-22), 127.91 (C-10, C-21), 128.76 (C-32, C-34, C-40, C-42), 129.53 (C-5, C-27), 131.26 (C-29, C-37), 135.71 (C-28,C-36), 139.95 (C-3, C-23, C-30, C-38), 151.02 (C-1, C-19) ppm. EI-MS (70 eV): *m/z* = 576.17 (M^+, 3), 331.00 (100), 302.00 (63), 159.17 (38), 90.05 (57), Anal. Calcd. for $C_{40}H_{36}N_2O_2$: C, 83.30; H, 6.29; N, 4.86, O, 5.55. Found. C,83.28; H, 6.24.

RESULTS AND DISCUSSION

In this study were synthetized some naphtol derivativesusing the three components system; it is important to mention, that many procedures have usedthis method in order to synthesize several compounds. The most widely practiced methodemploys boric acid[10], silica sulfuric acid[11], poly(4-vinylpyridine-codivynylbenzene)-Cu(II) complex[11],H_2SO_4[12], silica triflate[13]and phosphorus pentoxide[14]. Nevertheless,despite its wide scope, the former protocols suffer from several drawbacks *e.g.*,some reagents have a limited stability and its preparation can be dangerous.Analyzing these data, in this study several straightforward routesare reported for the synthesis of three naphtol-derivatives. The first step involves preparation of 4 using the three-component system (β-naphtol, benzaldehyde and ethylenediamine) in ethanol. The ^{1}H NMR spectrum of 4 shows signals at 2.88 and 3.08 ppm for protons involved in the arm present in the compound 4; at 5.75 ppm for hydrogen of methylene which is bound to both phenyl and naphtol groups. Other signal at 3.72 ppm for both amino and hydroxyl groups were found. Finally, the spectrum contains several signals at 6.88, 7.11 and 7.20 ppm for phenyl group; at 7.05, 7.41-7.75 ppm for naphtol group. The ^{13}C NMR spectrum contains peaks at chemical shifts of 42.20 and 52.98 ppm for the carbons of the methylenes involved in the arm of 4. A signal at 55.53 ppm for methylene bound to phenyl group and naphtol group was found. In addition, several signals at 114.39-126.21, 128.01-128.22, 130.06 and 138.35-152.11 ppm for carbons involved in the naphtol group; at 127.39, 130.02, 130.88-137.07 ppm for carbons of phenyl group were found. In addition, the presence of 4 was further confirmed from mass spectrum which showed a molecular ion at m/z 292. 07.

In the second stage, the compound 6 was developed using the three-component system (compound 4, benzaldehyde and 1-hexyne) in presence of cupric chloride. It is important to mention that cupric chloride was used as catalyst because there are several reports which indicate that copper(I) reagent has been found tobe an efficient catalyst for an enantioselective one-pot three-component synthesisbetween aldehydes, amines and alkynes[15-16].The results indicate that ^{1}H NMR spectrum of 6showed several signals at 0.91 ppm corresponding to methyl presents in the alkyne fragment; at 1.42-2.32 ppm for methylenes bound to alkyne group; at 2.88-3.14 ppm for methylenes bound to amino groups; at 4.70 ppm for both amino and hydroxyl groups; at 5.02 ppm for the methylene bound to both amino and phenyl groups. Finally, other signals at6.61-7.75 ppm for protons involved in phenyl groups were found. The ^{13}C NMR spectra display chemical shifts at 13.54 ppm for the carbonof methyl present in the alkyne fragment; at 16.78-31.88 ppm for methylenes involved in the alkyne fragment; at 47.34 and 59.10 ppm for methylenes bound to both amine groups; at 55.22 ppm for carbon bound to both amine and phenyls groups; at 59.38-82.28 ppm for alkyne group. Finally, other signals at 113.82-152.08 ppm for phenyl groups were found.Additionally, the presence of the compound6was further confirmed from mass spectrum which showed a molecular ion at m/z 448.18.

In the third stage, the compound **8** was synthetized by the reaction of using the three components system (cinamaldehyde,β-naphtoland ethylenediamine) in ethanol.The ^{1}H NMR spectrum

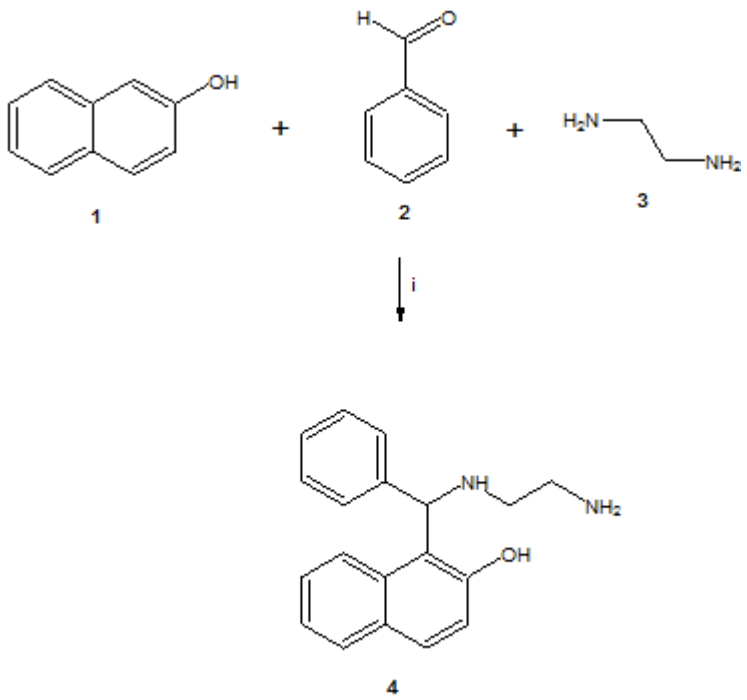

Fig. 1: Synthesis of 1-[(2-Amino-ethylamino)-phenyl-methyl]-naphthalen-2-ol.(4)
Reaction of β-naphtol (1) with benzaldehyde (2) and ethylenediamine (3) to form 4. i = ethanol/rt.

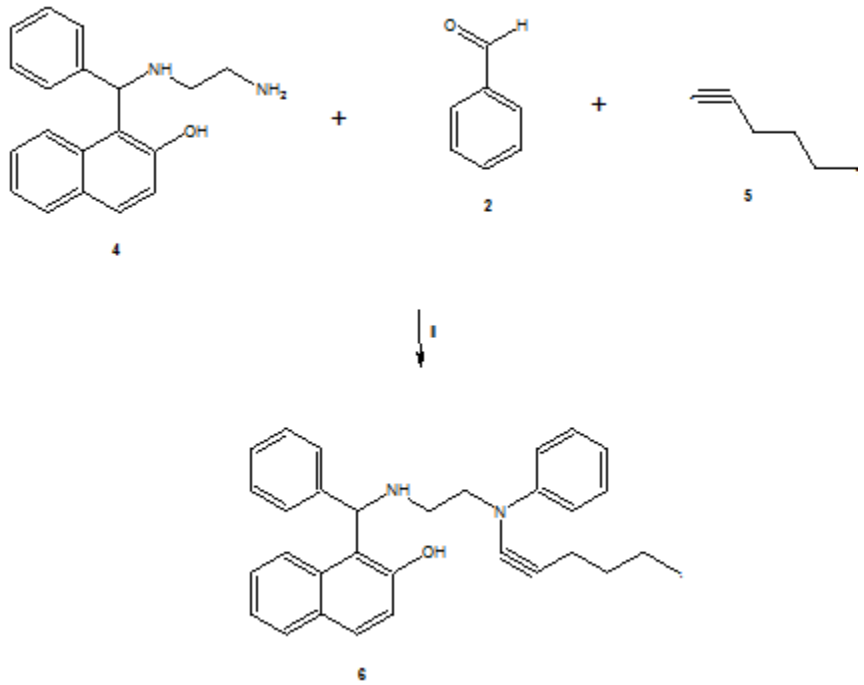

Fig. 2. Synthesis of 1-{[2-Hex-1-ynyl-phenyl-amino)-ethylamino]-phenyl-methyl}-naphtalen-2-ol (6)
Reaction of1-[(2-Amino-ethylamino)-phenyl-methyl]-naphthalen-2-ol (4) with 1-hexyne(5) and benzaldehyde (2) to form 6. ii = cupric chloride/ethanol/rt

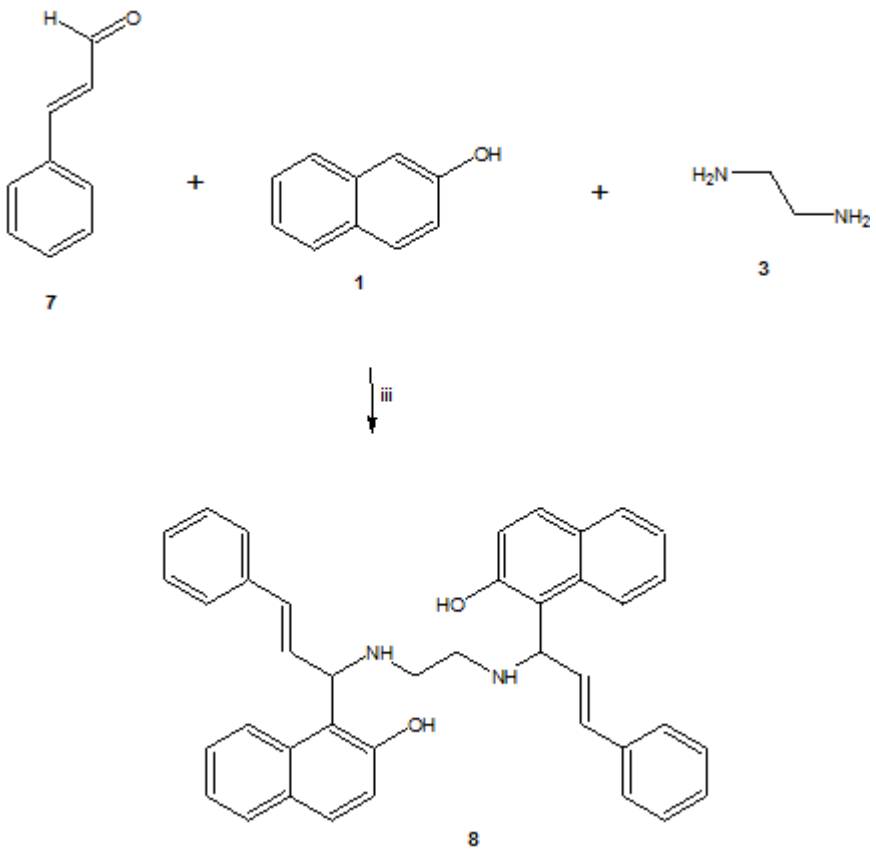

Fig. 3: Synthesis of3,8-di(naphtyl-2-ol)-1,10-diphenyl-4,7-diaza-deca-1,9-diene (8)
Reaction of cinamaldehyde (7), β-naphtol (1) and ethylenediamine (3) to form 8.iii = ethanol/rt

of **8**shows signals at 2.51 and 2.80 ppm for methylenesbound to amine groups; at 5.22 ppm for methylene bound to phenyl, amine and alkene groups; at 6.07-6.57 ppm for protons of alkene group; at 6.92 ppm for both amine and hydroxyl groups. Finally, other signals at 7.14-7.73 ppm for phenyls groups were found. The ^{13}C NMR spectrum contains peaks at chemical shifts of 49.27 ppm for the carbons of the methylenes involved in the arm bound to amine groups. Other signals at 131.26-135.71 ppm for alkene groups; at 115.52-129.53 and 139.95-151.02 ppm for phenyls groups were found. Finally, the presence of**8**was further confirmed from mass spectrum which showed a molecular ion at m/z 576.17. In conclusion, in this study are reported several strategies for the synthesis of some naphthol derivatives.It is important to mention that the methods used are highly versatile and the yield is good.

REFERENCES

1. Asao N., Takahashi K., Lee S., Kasahara T. and Yamamoto Y.,*J. Am. Chem., Soc.**124**,*12650-1261 (2002).
2. Cochran J. and Padwa A.,*Tetrahedron Lett.,* **30**: 3495-3498 (1995).
3. House H., Koepsell D. and Campbell W.,*J Org Chem*.,37: 1003-1011 (1972).
4. Ganapathy S. and Viswanathan A., *Angew Chem*.,**114**: 2242-2245 (2002).
5. Dabiri M., Delbari A. and Bazgir A.,

Heterocycles.,7: 543-547 (2007).
6. Shivaji Jadhav, Megha Rai, Ayesha Durrani and S.R. Bembaekar, *Orient. J. Chem*. **26**(2): 725-728 (2010).
7. In-Soo B., Yoo-Shin K., Yong-Tae P., *Bull. Korean Chem. Soc.,* **24**: 916-920 (2003).
8. Desai N., Shihora P., Rajpara K., Joshi V., Vaghani H., Satodiya H. and Dodiya, A. Med. Chem. Res., DOI 10.1007/s00044-011-9833-8 (2011).
9. Pradidphol N., Kongkathip N., Sittikul P., Boonyalai N. and Kongkathip B., *Eur. J. Med. Chem.,***49**: 253-270 (2012).
10. Tu S., FangF., MiaoC., JiangH., Feng Y.and ShiD., *Tetrahedron Lett*.,**44**: 6153-6155 (2003).
11. Salehi P., Dabiri M., Zolfigol M. and Bodaghui M., *Tetrahedron Lett*., **44**: 2889-2891 (2003).
12. YarapathiR., Kurva S. and TammishettiS., *Catal. Commun.,* **5**: 511-513 (2004).
13. Bussolari J. and McDonnellP., *J. Org. Chem*., **65**: 6777-6779 (2000).
14. ShiriniF., Marjani K.and NahzomiH., *Arkivoc*., **1:** 51-57 (2007).
15. Crossland R.and ServisK., *J. Org. Chem.,* **3**5: 3195-3196 (1970).
16. GommermannN., KoradinC., Polborn K.and KnochelP., *Angew. Chem*., **42**: 5763-5766 (2003).
17. Anary M. and Anaraki H., *Monatsh. Chem*., **14**0: 3497-400 (2009).