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Dedicated to the memory of
Professor Ioan Silaghi-Dumitrescu (1950 – 2009)

1-NAPHTHOYL-PYRROLO[1,2-*a*]QUINOLINES FROM QUINOLINIUM *N*-YLIDS

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New pyrrolo[1,2-*a*]quinoline derivatives **4** were obtained by 1,3-dipolar cycloaddition of the corresponding quinolinium *N*-ylides generated *in situ* by a simple one-pot, three component reaction starting from substituted quinolines, 2-bromo-1-(naphthyl)ethanones **2** and non-symmetrical dipolarophiles in 1,2-epoxybutane. The structure of the compounds was assigned by IR and NMR spectroscopy.

INTRODUCTION

Aromatic *N*-bridgehead heterocycles such as indolizines, azaindolizines and benzoindolizines are of great interest due to their potential biological activity and physical properties.[1-13] Among these condensed aromatic *N*-heterocycles, pyrrolo[1,2-*a*]quinolines were intensively studied regarding their syntheses and their potential application in pharmaceuticals and the field of material science.[14] Although a number of methods are available for the synthesis of pyrrolo[1,2-*a*]quinolines one of the most accessible synthetic procedure is the 1,3-dipolar cycloaddition of the quinolinium *N*-ylides with acetylenic and olefinic dipolarophiles.[15-19]

Recently we reported a versatile synthesis of the pyrrolo[1,2-*a*]quinolines *via* quinolinium *N*-ylide consisting by one-pot three component synthesis.[18, 19]

This paper presents the synthesis and characterization of new pyrrolo[1,2-*a*]quinolines bearing a naphthoyl in the pyrrole moiety by one-pot, three component synthesis from substituted quinolines, 2-bromo-1-(naphthyl)ethanones and non-symmetrical dipolarophiles in 1,2-epoxybutane.

RESULTS AND DISCUSSION

As the multicomponent reactions are of much interest in present due to their attractive synthetic applications, our previous results[18,19] encouraged us to go further with the synthesis of new pyrrolo[1,2-*a*]quinolines. Usually, the synthesis of pyrrolo[1,2-*a*]quinolines by 1,3-dipolar cycloaddition of the quinolinium *N*-ylides consists in the preparation and separation of quinolinium salts which in the second step by reaction with a suitable base afford *in situ* the corresponding quinolinium *N*-ylides. In presence of dipolarophiles the corresponding substituted pyrrolo[1,2-*a*]quinolines are obtained by 1,3-dipolar cycloaddition reaction.

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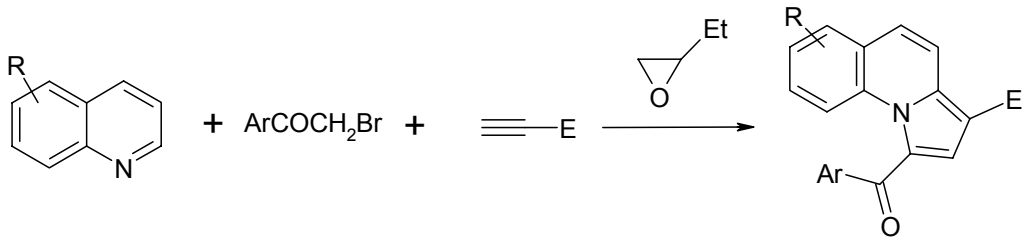
The starting materials for synthesis of the pyrrolo[1,2-*a*]quinolines **4** were the corresponding substituted quinolines **1**, 2-bromo-1-(naphthyl)ethanones **2** and ethyl propiolate or 1-butine-3-one as non-symmetric dipolarophiles **3**. The synthesis of pyrrolo[1,2-*a*]quinolines **4** was performed in 1,2-epoxybutane under stirring at room temperature for 50 hours. The pyrrolo[1,2-*a*]quinolines **4** were obtained in yields of 43-61% (Scheme 1).

The reaction mechanism implies a sequence of steps starting with the quaternization of the corresponding substituted quinolines with the 2-bromo-1-(naphthyl)ethanones **2** followed by the *in situ* generation of the *N*-ylides by the action of the solvent and subsequent cycloaddition in the presence of *unsymmetric* dipolarophiles ethyl propiolate or 1-butyn-3-one. The completely aromatic pyrroloquinolines are obtained after the rearrangement and dehydrogenation of the primary cycloadducts (Scheme 2).

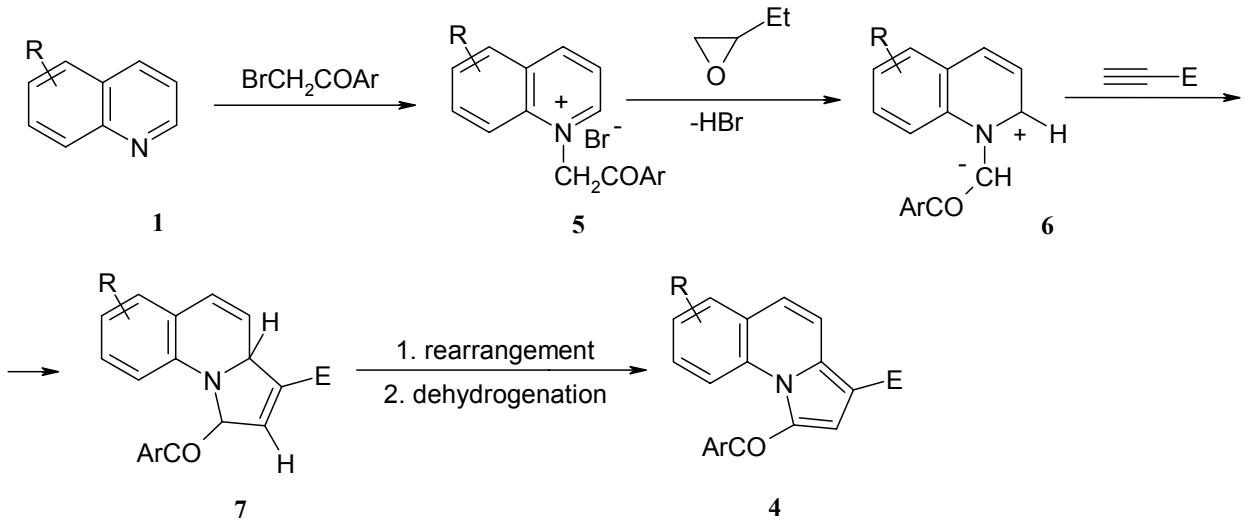


R=H,Me,MeO; E=COMe, CO_2Et, Ar=1-naphthyl, 2-naphthyl

1a-d **2a,b** **3a,b** **4a-j**

4a: R=5-Me, E=COMe, Ar=2-naphthyl; **4b**: R=7-Me, E=COMe, Ar=2-naphthyl; **4c**: R=7-OMe, E=COMe, Ar=1-naphthyl; **4d**: R=7-OMe, E=COMe, Ar=2-naphthyl; **4e**: R=H, E=CO_2Et, Ar=1-naphthyl; **4f**: R=5-Me, E=CO_2Et, Ar=1-naphthyl; **4g**: R=7-Me, E=CO_2Et, Ar=1-naphthyl; **4h**: R=7-Me, E=CO_2Et, Ar=2-naphthyl; **4i**: R=7-OMe, E=CO_2Et, Ar=1-naphthyl; **4j**: R=7-OMe, E=CO_2Et, Ar=2-naphthyl

Scheme 1



Scheme 2

The structures of the new compounds were confirmed by IR and NMR spectroscopy.

The IR spectra of the compounds present the characteristic bands of the main functional groups. The IR spectra of the compounds **4** present the carbonyl bands in the range 1630-1640 cm^{-1} for the carbonyl groups in the COAr. The carbonyl group in the carboethoxy groups are observed as strong bands at around 1700 cm^{-1} in compounds **4e-j** while the carbonyl group in the acetyl moiety is observed at around 1620 cm^{-1} for **4a-d**. Another characteristic band is the C-O stretch band in the methoxy or carboethoxy groups which was found at about 1230 cm^{-1}.

The ^{1}H-NMR spectra correspond to the proposed structures, the multiplicity of the signals being in agreement with the position and nature of the substituents on the quinoline ring. The

regioselectivity of the reaction is also determined. The hydrogen H-2 appears as a singlet at around 7.60 ppm this value being a characteristic of the series of compounds. The hydrogen H-4 appears as a doublet with J = 9.3 Hz at 8.50-8.53 ppm in the compounds **4b-d** and 8.21-8.37 ppm in the compounds **4e** and **4g-j** most probably due to spatial interaction with the carboethoxy moiety. In the case of compounds **4a** and **4f** due to the methyl group attached at C-5 the H-4 appears as a quartet at around 8.21 ppm. The multiplicity of the signal is due to the coupling between H-4 and the protons in the methyl group. The most evident influence on the protons in the quinoline system is due to the presence of the methoxy group in the position 7. The protons H-6 and H-8 in *ortho* position in respect with the methoxy group appear as a multiplet at 7.16-7.28 ppm. In contrast, when methyl group is the substituent at the C-7 carbon instead of methoxy group, the H-6 appears as doublet with $J_{6,8}$ = 2.1 Hz and H-8 appears as a doublet of doublets with $J_{8,9}$ = 8.8 Hz and $J_{8,6}$ = 2.1 Hz. Regarding the naphthyl moiety the most characteristic feature of spectra is the deshielded multiplet of H-8' for 1-naphthoyl moiety which appears in the range 8.50-8.60 ppm due to the spatial vicinity of the carbonyl group. Regarding the 2-naphtoyl moiety in the compounds **4a,b,d,h,j** the most characteristic signals are the H-3' signal which appears as doublet of doublets and the H-1' which appears as a singlet in the range 8.50-8.60 ppm. These protons are deshielded due to the influence of the carbonyl group attached to the C-2' carbon.

The signals in the ^{13}C-NMR spectra were assigned in respect with chemical shifts and by HETCOR experiments. The most characteristic feature is the chemical shift of carbon C-3 which appears at 107.4-108.4 ppm in compounds **4e-j** and at around 115 ppm for the compounds **4a-d,** slightly deshielded by the influence of the substituent attached to it**.** Due to the influence of MeO group attached at the carbon C-7 in the compounds **4c,d** and **4i,j**, the carbons C-6 and C-8 are shielded (ca.109 and respectively 118 ppm). The carbon C-7 in the compounds **4e,f** appears at around 157 ppm strongly deshielded by the OMe group directly attached to it. The ^{13}C-NMR characteristic signals of the naphthoyl moieties are the signals of the carbon atoms C-1' for compounds **4c,e,f,g,i** and respectively C-2' for compounds **4a,b,d,h,j** which appear deshielded due to direct bond to the carbonyl group. The carbon atoms in the carbonyl groups of the acetyl and carboethoxy moieties appear in normal ranges.

EXPERIMENTAL

Melting points were determined on a Boëtius hot plate microscope and are uncorrected. The elemental analysis was carried out on a COSTECH Instruments EAS32 apparatus. The IR spectra were recorded on a Nicolet Impact 410 spectrometer, in KBr pellets. The NMR spectra were recorded on a Varian Gemini 300 BB instrument, operating at 300 MHz for ^{1}H-NMR and 75 MHz for ^{13}C-NMR. Supplementary evidence was given by HETCOR and COSY experiments.

General procedure for synthesis of pyrrolo[1,2-*a*]quinolines 4

5 mmol of the corresponding substituted quinoline **1a-d**, 5 mmol of 2-bromo-1-(naphthyl)ethanones **2a,b** and 7 mmol of acetylenic dipolarophile (1-butyn-3-one, ethyl propiolate) in 40 mL 1,2-epoxybutane were stirred at room temperature for 50 hours. After removing the solvent by partial evaporation, 10 mL of methanol were added and the mixture was left over night at room temperature. The solid was filtered, washed with a MeOH-Et2O 1:1 mixture and recrystallized from $CHCl_3$/MeOH.

3-Acetyl-5-methyl-1-(2-naphthoyl)-pyrrolo[1,2-*a*]quinoline (**4a**). Yellow crystals with mp 196-7ºC; Yield 48 %. Anal. Calcd. $C_{26}H_{19}NO_2$: C 82.74; H 5.07; N 3.71. Found: C 83.96; H 5.40; N 3.87. FT-IR (cm^{-1}): 1621, 1641, 2915, 3047.
^{1}H-NMR (300 MHz, $CDCl_3$) δ: 2.47 (d, 1H, J = 1.1 Hz, 5-Me); 2.49 (s, 6H, MeO); 7.51-7.68 (m, 5H, H-2, H-7, H-8, H-6', H-7'); 7.96-8.03 (m, 4H, H-6, H-4', H-5', H-8'); 8.12-8.17 (m, 2H, H-9, H-3'); 8.45 (q, 1H, J = 1.1 Hz, H-4); 8.64 (s, 1H, H-1').
^{13}C-NMR (75 MHz, $CDCl_3$) δ: 19.6 (5-Me); 28.3 (Me); 115.1 (C-3); 118.2 (C-4); 120.8 (C-9); 125.2, 127.9, 132.5, 132.7, 135.7, 138.0 (C-1, C-3a, C-5a, C-9a, C-4a', C-8a'); 125.3 125.7, 125.9, 127.0, 128.0, 128.6, 128.7, 129.6, 129.9 (C-6, C-7, C-8, C-1', C-3', C-4', C-5', C-6', C-7', C-8'); 131.7 (C-2); 136.0 (C-5); 140.0 (C-2'); 185.0 (COAr); 193.7 (CO).

3-Acetyl-7-methyl-1-(2-naphthoyl)-pyrrolo[1,2-*a*]quinoline (**4b**). Yellow crystals with mp 190-1ºC; Yield 52%. Anal. Calcd. $C_{26}H_{19}NO_2$: C 82.74; H 5.07; N 3.71. Found: C 83.01; H 5.29; N 3.49. FT-IR (cm^{-1}): 1621, 1641, 2915, 3047.
^{1}H-NMR (300 MHz, $CDCl_3$) δ: 2.48, 2.49 (2s, 6H, 7-Me, MeCO); 7.38 (dd, 1H, J = 8.8 Hz, 2.1 Hz , H-8); 7.56 (s, 1H, H-2); 7.56-7.69 (m, 4H, H-6, H-7, H-6', H-7'); 7.96-8.02 (m, 4H, H-9, H-4', H-5', H-8'); 8.15 (dd, 1H, J = 8.6, 1.8 Hz, H-3'); 8.53 (d, 1H, J = 9.3 Hz, H-4); 8.64 (s, 1H, H-1').
^{13}C-NMR (75 MHz, $CDCl_3$) δ: 21.0 (7-Me); 28.3 (Me); 115.8 (C-3); 118.4 (C-4); 120.1 (C-9); 125.6, 127.9, 131.1, 132.5, 135.6, 135.7 (C-1, C-3a, C-5a, C-9a, C-4a', C-8a'); 125.7, 127.0, 128.0, 128.5, 128.6, 128.7, 129.2, 129.6, 130.0, 130.4 (C-5, C-6, C-8, C-1', C-3', C-4', C-5', C-6', C-7', C-8'); 135.9 (C-7); 131.8 (C-2); 139.6 (C-2'); 185.1 (COAr); 193.6 (CO).

3-Acetyl-7-methoxy-1-(1-naphthoyl)-pyrrolo[1,2-*a*]quinoline (**4c**). Yellow crystals with mp 118-120 ºC. Yield 48%. Anal. Calcd. $C_{26}H_{19}NO_3$: C 79.37; H 4.87; N 3.56.

Found: C 79.66; H 4.39; N 3.87. FT-IR (cm^{-1}): 1620, 1649, 3053.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 2.36 (s, 3H, Me); 3.88 (s, 3H, 7-MeO); 7.18-7.26 (m, 2H, H-6, H-8); 7.57 (s, 1H, H-2); 7.51-7.59 (m, H-3', H-6', H-7'); 7.67 (d, 1H, *J* = 9.3 Hz, H-5); 7.91-7.95 (m, 1H, H-2'); 8.03-8.08 (m, 2H, H-4', H-5'); 8.28 (d, 1H, *J* = 8.6 Hz, H-9); 8.45-8.49 (m, 1H, H-8'); 8.51 (d, 1H, *J* = 9.3 Hz, H-4).

^{13}C-NMR (75 MHz, $CDCl_3$) δ: 28.2 (MeCO); 55.7 (7-OMe); 109.1 (C-6); 115.0 (C-3); 118.4, 118.8 (C-4, C-8); 122.3 (C-9); 126.9, 128.1, 129.8, 131.5, 134.1, 136.5, (C-1, C-3a, C-5a, C-9a, C-4a', C-8a'); 125.8 (C-8'); 124.4, 126.8, 127.7 (C-3', C-6', C-7'); 130.3, 130.4, 132.5 (C-2', C-4', C-5'); 128.5 (C-5); 130.4 (C-2); 139.5 (C-1'); 157.1 (C-7); 185.6 (COAr); 193.6 (CO).

3-Acetyl-7-methoxy-1-(2-naphthoyl)-pyrrolo[1,2-*a*]quinoline (**4d**). Yellow crystals with mp 187-9 ºC. Yield 47%. Anal. Calcd. $C_{26}H_{19}NO_3$: C 79.37; H 4.87; N 3.56. Found: C 79.66; H 4.39; N 3.87. FT-IR (cm^{-1}): 1616, 1644, 2938, 3050.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 2.48 (d, 3H, *J* = 1.1 Hz, 5-Me); 7.38 (dd, 1H, *J* = 8.8 Hz, 2.1 Hz , H-8); 7.56 (s, 1H, H-2); 7.56-7.69 (m, 5H, H-7, H-8, H-3', H-6', H-7'); 7.96-8.02 (m, 4H, H-9, H-4', H-5', H-8'); 8.15 (dd, 1H, *J* = 8.6, 1.8 Hz, H-3'); 8.53 (d, 1H, *J* = 9.3 Hz, H-4); 8.64 (s, 1H, H-1').

^{13}C-NMR (75 MHz, $CDCl_3$) δ: 21.0 (7-MeO); 28.3 (MeCO); 115.8 (C-3); 118.4, 188.9 (C-4, C-8); 120.1 (C-9); 126.9, 127.7, 128.0 132.5, 135.7, 136.0 (C-1, C-3a, C-5a, C-9a, C-4a', C-8a'); 125.8, 127.1, 128.0, 128.6, 128.7, 128.7, 129.2, 129.6, 129.9 (C-5, C-6, C-1', C-3', C-4', C-5', C-6', C-7', C-8'); 130.1 (C-2); 139.6 (C-2'); 157.1 (C-7); 185.2 (COAr); 193.7 (CO).

Ethyl 1-(1-naphthoyl)-pyrrolo[1,2-*a*]quinoline-3-carboxylate (**4e**). Yellow crystals with mp 179-181 ºC. Yield 53%. Anal. Calcd. $C_{26}H_{19}NO_3$: C 79.37; H 4.87; N 3.56. Found: C 79.76; H 4.67; N 3.79. FT-IR (cm^{-1}): 1628, 1687, 2984, 3048.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 1.33 (t, 3H, *J* = 7.1 Hz, $MeCH_2$); 4.32 (q, 2H, *J* = 7.1 Hz, CH_2); 7.49-7.64(m, H, H-7, H-8, H-3', H-6', H-7'); 7.51 (s, 1H, H-2); 7.74 (d, 1H, *J* = 9.3 Hz, H-5); 7.84 (dd, 1H, *J* = 7.8, 1.6 Hz, H-6); 7.95-7.98 (m, 1H, H-2'); 8.05-8.09 (m, 2H, H-4', H-5'); 8.37 (d, 1H, *J* = 8.6 Hz, H-9); 8.37 (d, 1H, *J* = 9.3 Hz, H-4); 8.45-8.48 (m, 1H, H-8')

^{13}C-NMR (75 MHz, $CDCl_3$) δ: 14.4 ($MeCH_2$); 60.1 (CH_2O); 108.0 (C-3); 117.7 (C-4); 120.6 (C-9); 125.8 (C-8'); 124.7, 126.6, 127.6 (C-3', C-6', C-7'); 125.3, 130.4 131.5, 133.4, 134.0, 136.4, (C-1, C-3a, C-5a, C-9a, C-4a', C-8a'); 125.9 (C-7); 128.7, 128.8 (C-6, C-8); 128.4 (C-2'); 129.3(C-5); 129.4 (H-5'); 130.5 (C-2); 132.4 (C-5'); 140.7 (C-1'); 163.9 (COO); 185.7 (COAr).

Ethyl 5-methyl-1-(1-naphthoyl)-pyrrolo[1,2-*a*]quinoline-3-carboxylate (4f) Yellow crystals with mp 161-3 ºC. Yield 43 %. Anal. Calc. $C_{27}H_{21}NO_3$: C 79.59; H 5.19; N 3.44. Found: C 79.35; H 5.04; N 3.29. FT-IR (cm^{-1}): 1633, 1702, 2976, 3059.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 1.31 (t, 3H, *J* = 7.1 Hz, Me); 2.71 (d, 3H, *J* = 1.1 Hz, 5-Me); 4.38 (q, 2H, *J* = 7.1 Hz, CH_2); 7.46 (s, 1H, H-2); 7.50-7.63 (m, 5H, H-7, H-8, H-3', H-6', H-7'); 7.93-7.98 (m, 2H, H-6, H-2'); 8.03-8.07 (m, 2H, H-4', H-5'); 8.21 (q, 1H , *J* = 1.1 Hz, H-4); 8.37 (dd, 1H, *J* = 8.8, 1.6 Hz, H-9); 8.43-8.47 (m, 1H, H-8').

^{13}C-NMR (75 MHz, $CDCl_3$) δ: 14.5 ($MeCH_2$); 19.7 (5-Me); 60.2 (OCH_2); 107.0 (C-3); 117.4 (C-4); 121.0 (C-9); 125.5, 130.1, 131.5, 133.3, 134.1, 136.6, 137.0 (C-1, C-3a, C-5a, C-9a, C-5, C-4a', C-8a');125.2 (C-6); 125.6 (C-7); 125.8 (C-8'); 124.3, 126.7, 127.6 (C-3', C-6', C-7'); 128.8, 128.6 132.3 (C-2', C-4', C-5'); 129.3 (C-8); 131.1 (C-2); 141.1 (C-1'); 164.2 (COOEt). 185.5 (COAr).

Ethyl 7-methyl-1-(1-naphthoyl)-pyrrolo[1,2-*a*]quinoline-3-carboxylate (**4g**). Yellow crystals with mp 174-5 ºC. Yield 46 %. Anal. Calc. $C_{27}H_{21}NO_3$: C 79.59; H 5.19; N 3.44. Found: C 77.32; H 5.40; N 3.14.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 1.33 (t, 3H, *J* = 7.1 Hz, $MeCH_2$); 2.51 (s, 3H, 7-Me); 4.31 (q, 2H, *J* = 7.1 Hz, CH_2); 7.38 (dd, 1H, *J* = 8.8 Hz, 2.1 Hz , H-8); 7.52-7.60 (m, H-3', H-6', H-7'); 7.48 (s, 1H, H-2); 7.62 (d, 1H, *J* = 2.1 Hz , H-6); 7.74 (d, 1H, *J* = 9.3 Hz, H-5); 7.94-7.98 (m, 1H, H-2'); 8.04-8.09 (m, 2H. H-4', H-5'); 9.24(d, 1H, *J* = 8.8 Hz, H-9); 8.29 (d, 1H, *J* = 9.3 Hz, H-4) 8.43-8.47 (m, 1H, H-8').

^{13}C-NMR (75 MHz, $CDCl_3$) δ: 14.5 ($MeCH_2$); 21.0 (7-Me); 60.2 (OCH_2); 107.6 (C-3); 117.6 (C-4); 120.4 (C-9); 125.3, 130.0, 131.4, 131.6, 134.0, 135.5, 136.5 (C-1, C-3a, C-5a, C-9a, C-7, C-4a', C-8a'); 125.8 (C-8'); 124.3, 128.3, 128.4 (C-3', C-6', C-7'); 128.7 (C-6); 129.2, 129.3 132.3 (C-2', C-4', C-5'); 130.1 (C-5, C-8); 130.5 (C-2); 140.6 (C-1'); 164.0 (COO); 185.6 (COAr).

Ethyl 7-methyl-1-(2-naphthoyl)-pyrrolo[1,2-*a*]quinoline-3-carboxylate (**4h**). Yellow crystals with mp 159-160 ºC. Yield 52 %. Anal. Calc. $C_{27}H_{21}NO_3$: C 79.59; H 5.19; N 3.44. C 77.67; H 5.34; N 3.71. FT-IR (cm^{-1}): 1640, 1697, 2981, 3051.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 1.36 (t, 3H, *J* = 7.1 Hz, $MeCH_2$); 2.49 (s, 3H, 7-Me); 4.35 (q, 2H, *J* = 7.1 Hz, CH_2); 7.38 (dd, 1H, *J* = 8.8 Hz, 2.1 Hz , H-8); 7.55-7.69 (m, H-6', H-7' H-6, H-5); 7.67 (s, 1H, H-2); 7.93-8.01 (m, 4H, H-9, H-4', H-5', H-8'); 8.15 (dd, 1H, *J* = 8.6, 1.8 Hz, H-3'); 8.31 (d, 1H, *J* = 9.3 Hz, H-4) 8.64 (s, 1H, H-1').

^{13}C-NMR (75 MHz, $CDCl_3$) δ: 14.5 ($MeCH_2$); 21.0 (7-Me); 60.1 (OCH_2); 107.6 (C-3); 117.6 (C-4); 120.0 (C-9); 125.1, 127.8, 129.4, 131.3, 135.2, 135.6, 135.9 (C-1, C-7, C-3a, C-5a, C-9a, C-4a', C-8a'); 125.7, 126.8, 128.0, 128.4, 128.5, 128.8, 129.3, 129.5, 130.1 (C-5, C-6, C-8, C-1', C-3', C-4', C-5', C-6', C-7', C-8'); 131.8 (C-2); 140.6 (C-2'); 164.1 (COO); 185.0 (COAr).

Ethyl 7-methoxy-1-(1-naphthoyl)-pyrrolo[1,2-*a*]quinoline-3-carboxylate (**4i**). Yellow crystals with mp 209-210 ºC. Yield 46 %. Anal. Calc. $C_{27}H_{21}NO_4$: C 76.58; H 5.00; N 3.31. Found: C 76.68; H 5.29; N 3.47. FT-IR (cm^{-1}): 1625, 1698, 2976, 3070.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 1.30 (t, 3H, *J* = 7.1 Hz, $MeCH_2$); 3.89 (s, 3H, 7-MeO); 4.32 (q, 2H, *J* = 7.1 Hz, CH_2); 7.20-7.28 (m, 2H, H-6, H-8); 7.47 (s, 1H, H-2); 7.51-7.56 (m, H-3', H-6', H-7'); 7.61 (d, 1H, *J* = 9.3 Hz, H-5); 7.90-7.93 (m, 1H, H-2'); 8.01-8.05 (m, 2H, H-4', H-5'); 8.29 (d, 1H, *J* = 8.6 Hz, H-9); 8.30 (d, 1H, *J* = 9.3 Hz, H-4); 8.43-8.45 (m, 1H, H-8')

^{13}C-NMR (75 MHz, $CDCl_3$) δ: 14.5 ($MeCH_2$); 55.6 (OCH_2); 60.1 (MeO); 107.8 (C-3); 109.3 (C-6); 117.9, 118.0 (C-4, C-8); 122.0 (C-9); 126.5, 128.1, 129.9, 131.4, 134.0, 136.5 (C-1, C-3a, C-5a, C-9a, C-4a', C-8a'); 125.8 (C-8'); 124.3, 126.6, 127.6 (C-3', C-6', C-7'); 129.1, 129.3 132.3 (C-2', C-4', C-5'); 128.5 (C-5); 130.5 (C-2); 140.1 (C-1'); 157.0 (C-7); 164.0 (COO); 185.6 (COAr).

Ethyl 7-methoxy-1-(2-naphthoyl)-pyrrolo[1,2-*a*]quinoline-3-carboxylate (**4j**). Yellow crystals with mp 166-7 ºC. Yield 61 %. Anal. Calc. $C_{27}H_{21}NO_4$: C 76.58; H 5.00; N 3.31. Found: C 77.29; H 5.21; N 3.03. FT-IR (cm^{-1}): 1620, 1696, 2976, 3083.

^{1}H-NMR (300 MHz, $CDCl_3$) δ: 1.36 (t, 3H, *J* = 7.1 Hz, $MeCH_2$); 3.91 (s, 3H, 7-MeO); 4.38 (q, 2H, *J* = 7.1 Hz, CH_2); 7.16-7.20 (m, 2H, H-6, H-8); 7.56-7.65 (m, 3H, H-6', H-7', H-5); 7.67 (s, 1H, H-2); 7.94-8.08 (m, 4H, H-9, H-4', H-5', H-8'); 8.15 (dd, 1H, *J* = 8.6, 1.8 Hz, H-3'); 8.32 (d, 1H, *J* = 9.3 Hz, H-4); 8.63 (s, 1H, H-1').

^{13}C-NMR (75 MHz, CDCl3) δ: 14.5 (MeCH2); 55.6 (7-OMe); 60.2 (CH2O); 107.6 (C-3); 109.4 (C-6); 118.0, 118.1 (C-4, C-8); 121.7 (C-9); 125.7 (C-3'); 126.5, 127.9, 129.4, 131.4, 135.6, 135.9 (C-1, C-3a, C-5a, C-9a, C-4a', C-8a'); 127.9, 128.0, 128.5, 128.7, 129.3, 129.6 (C-2, C-5, C-4', C-5', C-6', C-7', C-8'); 131.8 (C-1'); 132.4 (C-2'); 156.8 (C-7); 164.2 (COO); 185.0 (COAr).

CONCLUSIONS

In summary, new substituted pyrrolo[1,2-*a*]quinolines **4** were obtained by a facile one-pot, three component reaction. The structures of the compounds were assigned by IR and NMR spectroscopy and the regioselectivity of the reaction was also deduced.

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