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NOTE

Synthesis of Novel 2,4-Di(*o*-Hydroxyphenyl)-6-substituted Amino-1,3,5-triazine

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Seven novel 1,3,5-triazine derivatives were synthesized in good to high yields (69.19-91.15 %) by the reaction of substituted guanidine with 2-(2-hydroxyphenyl)-4*H*-benzo[*e*][1,3]oxazin-4-one in ethanol. The products were recrystallized from ethanol or ethanol-DMF mixture and their structures were confirmed by ^{1}H NMR and FT-IR.

Keywords: Guanidine, 2-(2-Hydroxyphenyl)-4*H*-benzo[*e*][1,3]oxazin-4-one, Triazine.

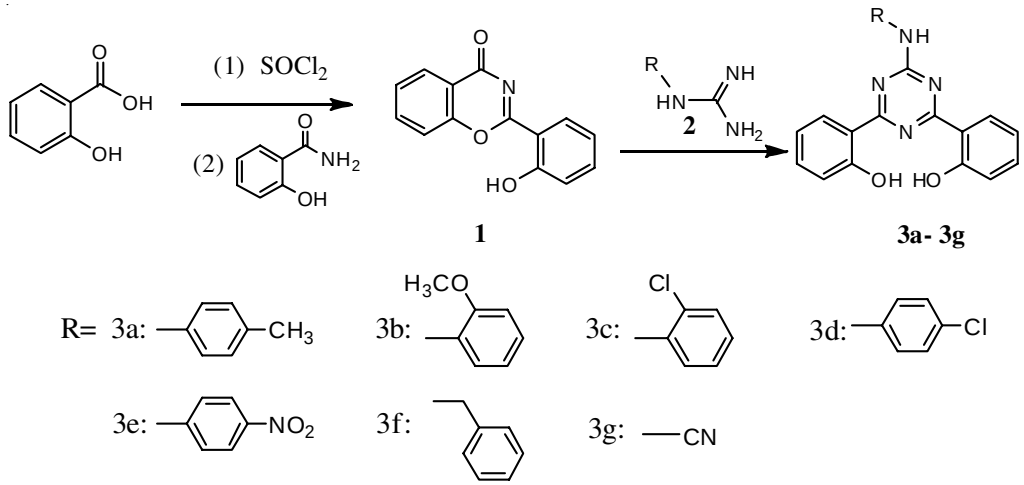
1,3,5-Triazine and its derivatives constitute an important class of molecules that are prevalent in nature. They possess various applications in the pharmaceutical[1,2], textile[3] and rubber industries[4] and are also used as pesticides[5], dyestuffs[6], explosives[7], optoelectronic[8,9] and surface active agents[10,11]. In the past few decades, numbers of derivatives containing *o*-hydroxyphenyl-substituted 1,3,5-triazine have been reported as UV absorbers[12-14]. According to the relevant literatures, triazine-based UV absorbers are prepared by a number of different methods. One method is to react benzamides with *o*-phenol derivatives and haloformate or with hydroxyaryl aldehydes in formation of the triazine ring[15,16]. Other methods start from cyanuric halides which are reacted with phenyl derivatives by Friedel-Craft[17,18] or Gignard[19,20] reaction. In this paper, we described a convenient synthetic approach to a novel series of *o*-hydroxyphenyl-substituted 1,3,5-triazine derivatives by the reaction of substituted guanidine with 2-(2-hydroxyphenyl)-4*H*-benzo[*e*][1,3]oxazin-4-one in ethanol.

The melting points were determined on a WRS-2A apparatus and is uncorrected. The IR spectra were recorded in KBr pellets on a Nicolex FI-IR-170 spectrophotometer. The ^{1}H NMR spectra was obtained in DMSO at 500 MHz on a Brucker AVANCE III 500 spectrometer using TMS as the internal standard.

Synthesis of 2-(2-hydroxyphenyl)-4*H*-benzo[*e*][1,3]-oxazin-4-one (1): Xylene (20 mL) and salicylic acid (13.8 g, 0.1 mol) were added to a 250 mL 4-neck round bottom flash equipped with a mechanical stirrer and thermocouple respectively and thionyl chloride(10 mL) was then added at 10-15 °C. After addition of thionyl chloride, the reaction solution was stirred at 10-15 °C for further 0.5 h and then heated at 70 °C for 3 h. Then, salicylamide (13.7 g, 0.1 mol) was added to the above mixture and stirred for 10 min. Xylene was removed from the reaction mixture by distillation under reduced pressure. The resulting residue was heated to 180 °C for 3 h, during which the process of reaction, water and low-boiling matters were removed from the reaction mixture by simultaneous distillation. Anhydrous ethanol (50 mL) was added to the mixture at 60-70 °C, gradually cooled the mixture at 25-30 °C. The solid obtained was filtered, washed with ethanol (20 mL) and dried to get the title compound (16.8 g, 70.3 %) under vacuum. m.p.: 210-213 °C. (lit.[21]:210-212 °C).^{1}H NMR (DMSO-d_6) δ: 12.9 (s, 1H, OH), 8.22-7.59 (m, 6H, ArH), 7.11-7.07 (m, 2H, ArH).

Synthesis of *o*-hydroxyphenyl-substituted 1,3,5-triazines (3a-3g): 2-(2-Hydroxyphenyl)-4*H*-benzo[*e*][1,3]oxazin-4-one (**1**) (2.39 g, 0.01 mol), substituted guanidine hydrochloride (**2**) (0.01 mol), sodium hydroxide (0.5 g, 0.0125 mol) and anhydrous ethanol (50 mL) were added to a 100 mL of three necked round bottom flask with a mechanical stirrer and refluxed for 3-6 h. Then the reaction solution was cooled by ice water. The crude *o*-hydroxyphenyl-substituted 1,3,5-triazine (**3a-3g**) products were filtered, washed, dried and crystallized from ethanol or ethanol/DMF (1/1) mixture.

2,2'-(6-(*p*-Tolylamino)-1,3,5-triazine-2,4-diyl)diphenol (3a): The title compound was synthesized from 1-(*p*-tolyl)-guanidine hydrochloride (1.85 g, 0.01 mol), refluxed for 4 h; yellow powder; yield 3.04 g (82.13 %); m.p. 257-258 °C; ^{1}H NMR (DMSO-d_6): δ: 12.88 (s, 2H, 2-OH), 10.87 (s, 1H, NH), 8.33 (q, J = 8.56 Hz, 2H, ArH), 7.50 (t, J = 7.25 Hz, 4H, ArH), 7.28 (d, J = 8.2 Hz, 2H, ArH), 7.04-6.93 (m, 4H, ArH), 2.43 (s, 3H, CH_3). IR: (KBr, ν_{max}, cm^{-1}): 3435, 3304.



Structure of compounds **3a-3g**

2,2'-(6-((2-Methoxyphenyl)amino)-1,3,5-triazine-2,4-diyl)diphenol (3b): The title compound was synthesized from 1-(2-methoxyphenyl)guanidine hydrochloride (2.01 g, 0.01 mol), refluxed for 3 h, yellow powder; yield 3.25 g (84.17 %); m.p.: 191-192 °C; ^{1}H NMR (DMSO-d_6) δ: 12.84 (s, 1H, OH), 12.60 (s, 1H, OH), 10.51 (s, 1H, NH), 8.44 (d, *J* = 7.0 Hz, 1H, ArH), 8,33 (d, *J* = 7.5 Hz, 1H, ArH), 7.53-6.87 (m, 10H, ArH), 3.82 (s, 3H, OCH_3). IR: (KBr, ν_{max}, cm^{-1}): 3428, 3322, 1253, 1029.

2,2'-(6-((2-Chlorophenyl)amino)-1,3,5-triazine-2,4-diyl)diphenol (3c): The title compound was synthesized from 1-(2-chlorophenyl)guanidine hydrochloride (2.05 g, 0.01 mol), refluxed for 5 h, yellow powder; yield 2.7 g (69.23 %); m.p.: 190-192 °C; ^{1}H NMR (DMSO-d_6) δ: 12.84 (s, 1H, OH), 12.45 (s, 1H, OH), 10.84 (s, 1H, NH), 8.46-8.43 (m, 2H, ArH), 7.71-7.42 (m, 6H, ArH), 7.10-6.89 (m, 4H, ArH). IR: (KBr, ν_{max}, cm^{-1}): 3447, 3390, 756.

2,2'-(6-((4-Chlorophenyl)amino)-1,3,5-triazine-2,4-diyl)diphenol (3d): The title compound was synthesized from 1-(4-chlorophenyl)guanidine hydrochloride (2.05 g, 0.01 mol), refluxed for 5 h, yellow powder; yield 3.15 g (80.77 %); m.p.: 215-217 °C; ^{1}H NMR (DMSO-d_6) δ: 12.55 (s, 2H, 2-OH), 10.88 (s, 1H, NH), 8.41 (d, *J* = 7.65 Hz, 2H), 7.58-7.06 (m, 10H, ArH). IR: (KBr, ν_{max}, cm^{-1}): 3296, 755.

2,2'-(6-((4-Nitrophenyl)amino)-1,3,5-triazine-2,4-diyl)diphenol (3e): The title compound was synthesized from 1-(4-nitrophenyl)guanidine hydrochloride (2.16 g, 0.01 mol), refluxed for 6 h, yellow powder; yield 3.22 g (80.3 %); m.p.: 279-281 °C; ^{1}H NMR (DMSO-d_6) δ: 12.95 (s, 2H, 2-OH), 11.37 (s, 1H, NH), 8.38 (d, *J* = 9.15 Hz, 2H, ArH), 8.07-7.05 (m, 10H, ArH). IR: (KBr, ν_{max}, cm^{-1}): 3446, 3329, 1534, 1333.

2,2'-(6-(Benzylamino)-1,3,5-triazine-2,4-diyl)diphenol (3f) The title compound was synthesized from 1-benzylguanidine hydrochloride (1.85 g, 0.01 mol), refluxed for 6 h, yellow powder; yield 2.56 g (69.19 %); m.p.: 194-196 °C; ^{1}H NMR (DMSO-d_6) δ: 13.16 (s, 1H, OH), 12.87 (s, 1H, OH), 9.48 (t, *J* = 5.95 Hz, 1H, NH), 8.31-7.01 (m, 13H, ArH), 4.66 (d, *J* = 5.95 Hz, 2H, CH_2). IR: (KBr, ν_{max}, cm^{-1}): 3392, 3335.

***N*-(4,6-*bis*(2-Hydroxyphenyl)-1,3,5-triazin-2-yl)cyanamide (3g):** The title compound was synthesized from dicyandiamide (0.84 g, 0.01 mol) and sodium hydroxide (0.05 g, 1.25 mmol), refluxed for 3 h, pale yellow powder; yield 2.78 g (91.15 %); m.p.: 250 °C; (decomposition). ^{1}H NMR (DMSO-d_6) δ: 14.12 (s, 1H, OH), 13.80 (s, 1H, OH), 12.65 (s, 1H, NH), 8,44-8.40 (m, 2H, ArH), 7.59-6.93 (m, 8H, ArH). IR: (KBr, ν_{max}, cm^{-1}): 3421, 2175.

Reaction of substituted guanidine and 2-(2-hydroxyphenyl)-4*H*-benzo[*e*][1,3]oxazin-4-one afforded novel *o*-hydroxyphenyl-substituted 1,3,5-triazine in good to high yields. The structures of the products were confirmed by IR, ESI-MS, ^{1}H NMR spectral methoda. For example, the ^{1}H NMR spectrum of compound **4** shows two singlets at δ 12.84 and 12.45 but the compound **5** shows one singlet at δ 12.55 for symmetrical structure.

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