

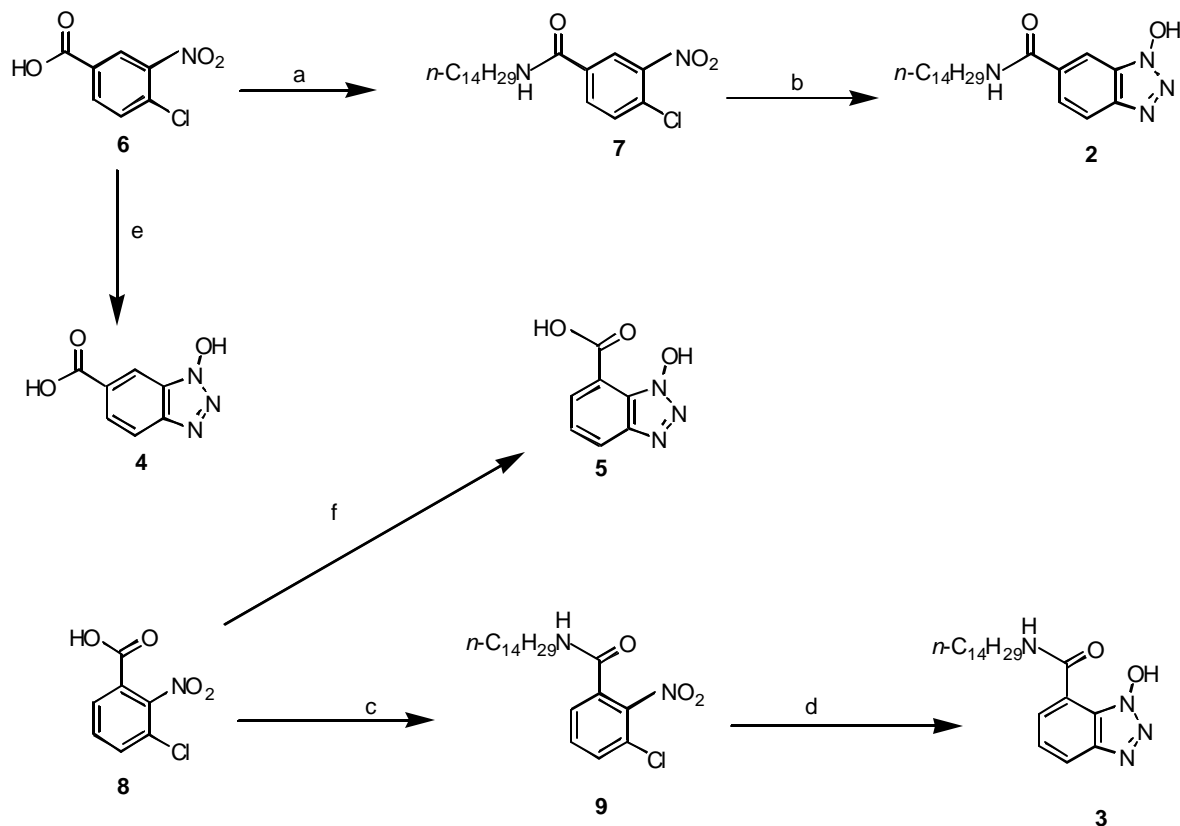
Ester Cleavage Properties of Synthetic Hydroxybenzotriazoles in Cationic Monovalent and Gemini Surfactant Micelles

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Scheme S1^a



^a*Reagents and conditions:* (a) (i) SOCl₂, reflux, 3 h; (ii) *n*-tetradecylamine (1.2 equiv.), Et₃N, dry THF, -10 °C (30 min), rt, 8 h, 82% (b) N₂H₄.H₂O, dry EtOH, reflux, 20 h, 60%; (c) (i) SOCl₂, reflux, 3 h; (ii) *n*-tetradecylamine (1.2 equiv.), Et₃N, dry THF, -10 °C (30 min), rt, 8 h, 80% (d) N₂H₄.H₂O, dry EtOH, reflux, 48 h, 60%; (e) N₂H₄.H₂O, dry EtOH, reflux, 15 h, 76%. (f) N₂H₄.H₂O, dry EtOH, reflux, 18 h, 62%.

General methods

Melting points were determined using open capillary tubes and are uncorrected. ¹H-NMR spectra were obtained on Jeol LAMBDA FT (300 MHz) instrument. Chemical shifts (δ) are reported in ppm downfield from the internal standard tetramethylsilane (TMS). IR spectra were recorded on JASCO FT IR-410 spectrometer.

Synthesis

***N*-Tetradecyl-4-chloro-3-nitrobenzamide (7).** 4-Chloro-3-nitrobenzoic acid, 6 (1 g, 5 mmol) was dissolved in 15 mL of distilled SOCl_2 and the mixture was heated to reflux for 3 h. Then the reaction mixture was allowed to cool, and the excess SOCl_2 was removed in vacuum. This afforded light yellow crystals, and which showed characteristic peak at ν_{max} 1782 cm^{-1} in IR. The yellowish solid was dissolved in freshly dried THF (10 mL) in the presence of Et_3N (0.83 mL, 6 mmol). To this *n*-tetradecylamine (1.27 mL, 6 mmol) was added at -10°C , and the reaction mixture was stirred for 30 min at -10°C , and then gradually warmed to room temperature and stirring was continued for another 8 h. THF was evaporated from the reaction mixture and then 25 mL of dilute HCl (pH 5) was added. The mixture was extracted thoroughly with ethyl acetate (3 x 25 mL). Organic layer was dried over anhyd. Na_2SO_4 . Evaporation of the organic solvent gave a crude solid, which was purified by column chromatography over silica gel using EtOAc/hexane (15:85) to furnish 7 as a solid (1.61 g, 82 %); mp $74\text{--}75^\circ\text{C}$; IR (nujol), ν_{max} 3320, 1642, 1537, 1338 cm^{-1} ; $^1\text{H-NMR}$ (CDCl_3 , 300 MHz) δ 8.18 (d, 1H), 7.96 (dd, 1H), 7.64 (d, 1H), 6.1 (br s, 1H), 3.47 (q, 2H), 1.61 (m, 2H), 1.25 (s, 22H), 0.88 (t, 3H); EI-MS; m/z 396 (M^+).

***N*-Tetradecyl-1-hydroxy-1*H*-benzo[d][1,2,3]triazole-6-carboxamide (2).** A mixture of 7 (1.58 g, 4 mmol) and hydrazine hydrate (1.94 mL, 40 mmol) in dry EtOH was heated under reflux for 20 h and then cooled to room temperature. From the reaction mixture, EtOH was evaporated under reduced pressure. This left a residue to which MeOH (20 mL) was added and the mixture was acidified with conc. HCl. This induced precipitation of a yellowish white solid. This was filtered and solvent from the filtrate upon evaporation afforded additional amount of yellowish solid. The residues were combined and were taken up in CHCl_3 . The chloroform solution was washed repeatedly with water and phase separated. Then the organic layer was dried over anhyd. Na_2SO_4 , the solvent was evaporated to afford a yellowish solid which was further purified by column chromatography over silica gel with using MeOH/EtOAc (2/98) to give 2 as a yellowish solid (0.89 g, 60 %); mp $141\text{--}142^\circ\text{C}$; IR (KBr), ν_{max} 3422, 3336, 2919, 1634, 1544, 856 cm^{-1} ; $^1\text{H-NMR}$ (CDCl_3 / DMSO-d_6 , 300 MHz) δ 8.16 (d, 1H), 7.89 (dd, 2H), 4.7 (br s, 1H), 3.45 (q, 2H), 1.64 (m, 2H), 1.25 (s, 22H), 0.87 (t, 3H); EI-MS; m/z 357 ($\text{M}^+ - 17$); Anal. Calcd for $\text{C}_{21}\text{H}_{34}\text{N}_4\text{O}_2$: C, 67.34; H, 9.15; N, 14.95. Found: C, 67.24; H, 9.46; N, 14.54.

***N*-Tetradecyl-3-chloro-2-nitrobenzamide (9).** Compound 9 was synthesized using a similar procedure adopted for the synthesis of 7. From 0.2 g (1 mmol) of 3-chloro-2-nitrobenzoic acid, 8, compound 9 was obtained as a light yellowish solid (0.32 g) in 82 % yield. mp $62\text{--}64^\circ\text{C}$; IR (KBr), ν_{max} 3287, 1651, 1539, 1351 cm^{-1} ; $^1\text{H-NMR}$ (CDCl_3 , 300 MHz) δ 7.58 (m, 3H), 5.96 (br, 1H), 3.40 (q, 2H), 1.25 (s, 24H), 0.88 (t, 3H); EI-MS; m/z 397 (M^+).

***N*-Tetradecyl-1-hydroxy-1*H*-benzo[d][1,2,3]triazole-7-carboxamide (3).** Compound 3 was synthesized using a similar procedure as described in the synthesis of 2. Starting with 0.29 g (0.75 mmol) of 9, we obtained 3 as a solid (0.16 g, 60 %); mp $128\text{--}130^\circ\text{C}$; IR (KBr), ν_{max} 3437, 3068, 2919, 1643, 1573, 864 cm^{-1} ; $^1\text{H-NMR}$ (CDCl_3 / DMSO-d_6 , 300 MHz) δ 8.07 (d, 1H), 7.95 (d, 1H), 7.31 (t, 1H), 5.95 (br, 1H), 3.46 (q, 2H), 1.61 (m, 2H),

1.25 (s, 22H), 0.86 (t, 3H); EI-MS m/z 374 (M^+). Anal. Calcd for $C_{21}H_{34}N_4O_2$: C, 67.34; H, 9.15; N, 14.95. Found: C, 67.53; H, 9.51; N, 14.67.

1-Hydroxy-1*H*-benzo[d][1,2,3]triazole-6-carboxylic acid (4). To a solution of 4-chloro-3-nitrobenzoic acid (2.51 g, 12.5 mmol) in dry EtOH (20 mL) hydrazine hydrate (6.2 mL, 125 mmol) was added. The mixture was heated to reflux for 15 h. After that reaction was allowed to cool to room temperature, then acidified with conc. HCl. During acidification, a white solid started precipitating out. After acidification and cooling, the solid was filtered and washed with hot EtOH. Then the residue was recrystallized using dry EtOH to afford **4** as a white solid (1.7 g, 76%). mp above 70 °C decomposes; IR (KBr), ν_{max} 3320, 1700, 840 cm^{-1} ; 1H -NMR (D_2O , 300 MHz) δ 8.15 (s, 1H), 7.87 (dd, 1H), 7.65 (d, 1H); EI-MS; m/z 179 (M^+). Anal. Calcd for $C_7H_5N_3O_3$: C, 46.93; H, 2.81; N, 23.45. Found: C, 46.9; H, 2.78; N, 23.43.

1-Hydroxy-1*H*-benzo[d][1,2,3]triazole-7-carboxylic acid (5). To a solution of 3-chloro-2-nitrobenzoic acid (0.31 g, 1.5 mmol) in dry EtOH (5 mL), hydrazine hydrate (0.73 mL, 15 mmol) was added. The mixture was heated to reflux for 18 h. After that reaction was allowed to cool to room temperature, then acidified with conc. HCl. During acidification, a white solid started precipitating out. The solid was filtered and washed with hot EtOH. The residue was recrystallized from dry EtOH to afford **5** as a white solid (0.17 g, 62%). mp above 70 °C decomposes; IR (KBr), ν_{max} 3315, 1704, 830 cm^{-1} ; 1H -NMR (D_2O , 300 MHz) δ 8.14 (d, 2H), 7.35 (t, 1H); EI-MS; m/z 179 (M^+). Anal. Calcd for $C_7H_5N_3O_3$: C, 46.93; H, 2.81; N, 23.45. Found: C, 46.92; H, 2.79; N, 23.42.