Transformation of Herbicides into Dual Function Quaternary Tropinium Salts

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The following abbreviations were used in the description of NMR spectra: s – singlet, d – doublet, dd – doublet of doublets, t – triplet, q – quintet, m – multiplet; br – broad; H_a – axial position of proton, H_e – equatorial position of proton.

N-octyltropinium 4-chloro-2-methylphenoxyacetate **[QTS-C$_8$][MCPA]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.85 (t, J=6.5 Hz, 3H, C$\underline{H_3}$-CH$_2$), 1.27 (m, 10H, CH$_3$-(C$\underline{H_2)_5}$-), 1.66 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-C$\underline{H_2}$-), 1.81 (d, J=15.9 Hz, 2H, HO-CH-(C$\underline{H_a}$H$_e$-CH-)$_2$), 2.12 (s, 3H, C$\underline{H_3}$-Ar), 2.14 (t, J=5.5 Hz, 2H, -C$\underline{H_e}$H$_a$-CH)$_2$-N$^+$), 2.32 (d, J=16.3 Hz, 2H, -CH$_e\underline{H_a}$-CH)$_2$-N$^+$), 2.39 (d, J=8.2 Hz, 2H, HO-CH-(CH$_a\underline{H_e}$-CH-)$_2$), 2.96 (s, 3H, N$^+$-C$\underline{H_3}$), 3.14 (t, J=8.3 Hz, 2H, alkyl-C$\underline{H_2}$N$^+$), 3.78 (s, 2H, -CH$_2$-C$\underline{H)_2}$-N$^+$), 3.89 (t, J=4.9 Hz, 1H, -CH$_2$)$_2$-C$\underline{H}$-OH), 4.08 (s, 2H, OC$\underline{H_2}$COO$^-$), 6.63 (d, J=8.8 Hz, 1H, ClC=HCC$\underline{H}$=CO), 7.05 (dd, $J^{1,2}$=2.4 Hz, $J^{1,3}$=8.7 Hz, 1H, ClC=$\underline{H}$CCH=CO), 7.10 (d, J=2.2 Hz, 1H, ClCC$\underline{H}$=CCH$_3$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.34 ($\underline{C}$H$_3$-(CH$_2$)$_7$-N$^+$), 16.43 ($\underline{C}$H$_3$-Ar), 22.04, (CH$_3$-$\underline{C}$H$_2$-(CH$_2$)$_6$-N$^+$), 22.46 (CH$_3$-(CH$_2$)$_4$-$\underline{C}$H$_2$-(CH$_2$)$_2$-N$^+$), 25.05 (-CH-$\underline{C}$H$_2$-$\underline{C}$H$_2$-CH-), 26.36, (CH$_3$-CH$_2$-$\underline{C}$H$_2$-(CH$_2$)$_5$-N$^+$), 28.91, (CH$_3$-(CH$_2$)$_3$-$\underline{C}$H$_2$-(CH$_2$)$_3$-N$^+$), 28.98, (CH$_3$-(CH$_2$)$_2$-$\underline{C}$H$_2$-(CH$_2$)$_4$-N$^+$), 31.59 (CH$_3$-(CH$_2$)$_5$-$\underline{C}$H$_2$-CH$_2$-N$^+$), 34.66 (-$\underline{C}$H$_2$-CH(OH)-$\underline{C}$H$_2$-), 59.24 ($\underline{C}$H$_3$-N$^+$($\underline{C}$H-)$_2$), 60.59 (CH$_3$-(CH$_2$)$_6$-$\underline{C}$H$_2$-N$^+$), 65.90 (-CH$_2$-$\underline{C}$H(OH)-CH$_2$-), 68.87 (O$\underline{C}$H$_2$COO$^-$), 113.24 (ClC=HC$\underline{C}$H=CO), 122.74 (ClCCH=$\underline{C}$CH$_3$), 126.21, (Cl$\underline{C}$CH=CCH$_3$), 128.12 (ClC=H$\underline{C}$CH=CO), 129.68 (ClC$\underline{C}$H=CCH$_3$), 156.69 (ClC=HCCH=$\underline{C}$O), 169.70 (OCH$_2\underline{C}$OO$^-$).

N-decyltropinium 4-chloro-2-methylphenoxyacetate **[QTS-C$_{10}$][MCPA]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, J=6.5 Hz, 3H, C$\underline{H_3}$-CH$_2$), 1.24 (m, 14H, CH$_3$-(C$\underline{H_2)_5}$-), 1.63 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-C$\underline{H_2}$-), 1.81 (d, J=15.9 Hz, 2H, HO-CH-(C$\underline{H_a}$H$_e$-CH-)$_2$), 2.12 (s, 3H, C$\underline{H_3}$-Ar), 2.14 (t, J=5.1 Hz, 2H, -C$\underline{H_e}$H$_a$-CH)$_2$-N$^+$), 2.33 (d, J=16.3 Hz, 2H, -CH$_e\underline{H_a}$-CH)$_2$-N$^+$), 2.39 (d, J=8.3 Hz, 2H, HO-CH-(CH$_a\underline{H_e}$-CH-)$_2$), 2.96 (s, 3H, N$^+$-C$\underline{H_3}$), 3.14 (t, J=8.3 Hz, 2H, alkyl-C$\underline{H_2}$N$^+$), 3.78 (s, 2H, -CH$_2$-C$\underline{H)_2}$-N$^+$), 3.89 (t, J=4.7 Hz, 1H, -CH$_2$)$_2$-C$\underline{H}$-OH), 4.07 (s, 2H, OC$\underline{H_2}$COO$^-$), 6.62 (d, J=8.7 Hz, 1H, ClC=HCC$\underline{H}$=CO), 7.05 (dd, $J^{1,2}$=2.3 Hz, $J^{1,3}$=8.7 Hz, 1H, ClC=$\underline{H}$CCH=CO), 7.10 (d, J=2.3 Hz, 1H, ClCC$\underline{H}$=CCH$_3$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.34 ($\underline{C}$H$_3$-(CH$_2$)$_9$-N$^+$), 16.44 ($\underline{C}$H$_3$-Ar), 22.04 (CH$_3$-$\underline{C}$H$_2$-(CH$_2$)$_8$-N$^+$), 22.49 (CH$_3$-(CH$_2$)$_6$-$\underline{C}$H$_2$-(CH$_2$)$_2$-N$^+$), 25.05 (-CH-$\underline{C}$H$_2$-$\underline{C}$H$_2$-CH-), 26.35 (CH$_3$-CH$_2$-$\underline{C}$H$_2$-(CH$_2$)$_7$-N$^+$), 29.02 (CH$_3$-(CH$_2$)$_5$-$\underline{C}$H$_2$-(CH$_2$)$_3$-N$^+$), 29.08 (CH$_3$-(CH$_2$)$_2$-$\underline{C}$H$_2$-(CH$_2$)$_6$-N$^+$), 29.25 (CH$_3$-(CH$_2$)$_4$-$\underline{C}$H$_2$-(CH$_2$)$_4$-N$^+$), 29.31 (CH$_3$-(CH$_2$)$_3$-$\underline{C}$H$_2$-(CH$_2$)$_5$-N$^+$), 31.67, (CH$_3$-(CH$_2$)$_7$-$\underline{C}$H$_2$-CH$_2$-N$^+$), 34.67 (-$\underline{C}$H$_2$-CH(OH)-$\underline{C}$H$_2$-), 59.24 ($\underline{C}$H$_3$-N$^+$($\underline{C}$H-)$_2$), 60.60 (CH$_3$-(CH$_2$)$_8$-$\underline{C}$H$_2$-N$^+$), 65.89 (-CH$_2$-$\underline{C}$H(OH)-CH$_2$-), 68.93 (O$\underline{C}$H$_2$COO$^-$), 113.25 (ClC=HC$\underline{C}$H=CO), 122.70 (ClCCH=$\underline{C}$CH$_3$), 126.20 (Cl$\underline{C}$CH=CCH$_3$), 128.09 (ClC=H$\underline{C}$CH=CO), 129.66 (ClC$\underline{C}$H=CCH$_3$), 156.72 (ClC=HCCH=$\underline{C}$O), 169.60 (OCH$_2\underline{C}$OO$^-$).

N-dodecyltropinium 4-chloro-2-methylphenoxyacetate **[QTS-C$_{12}$][MCPA]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, J=6.6 Hz, 3H, C$\underline{H_3}$-CH$_2$), 1.23 (m, 18H, CH$_3$-(C$\underline{H_2)_5}$-), 1.63 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-C$\underline{H_2}$-), 1.80 (d, J=15.8 Hz, 2H, HO-CH-(C$\underline{H_a}$H$_e$-CH-)$_2$), 2.12 (s, 3H, C$\underline{H_3}$-Ar), 2.16 (t, J=4.7 Hz, 2H, -C$\underline{H_e}$H$_a$-CH)$_2$-N$^+$), 2.32 (d, J=16.3 Hz, 2H, -CH$_e\underline{H_a}$-CH)$_2$-N$^+$), 2.38 (d, J=8.4 Hz, 2H, HO-CH-(CH$_a\underline{H_e}$-CH-)$_2$), 2.96 (s, 3H, N$^+$-C$\underline{H_3}$), 3.14 (t, J=8.5 Hz, 2H, alkyl-C$\underline{H_2}$N$^+$), 3.34 (br. s, 1H, CH-O$\underline{H}$ + H$_2$O), 3.79 (s, 2H, -CH$_2$-C$\underline{H)_2}$-N$^+$), 3.90 (t, J=4.7 Hz, 1H, -CH$_2$)$_2$-C$\underline{H}$-OH), 4.05 (s, 2H, OC$\underline{H_2}$COO$^-$), 6.62 (d, J=8.7 Hz, 1H, ClC=HCC$\underline{H}$=CO), 7.04 (dd, $J^{1,2}$=2.7 Hz, $J^{1,3}$=8.7 Hz, 1H, ClC=$\underline{H}$CCH=CO), 7.09 (d, J=2.1 Hz, 1H, ClCC$\underline{H}$=CCH$_3$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.33 ($\underline{C}$H$_3$-(CH$_2$)$_{11}$-N$^+$), 16.43 ($\underline{C}$H$_3$-Ar), 22.03 (CH$_3$-$\underline{C}$H$_2$-(CH$_2$)$_{10}$-N$^+$), 22.48 (CH$_3$-(CH$_2$)$_8$-$\underline{C}$H$_2$-(CH$_2$)$_2$-N$^+$), 25.07 (-CH-$\underline{C}$H$_2$-$\underline{C}$H$_2$-CH-), 26.54 (CH$_3$-CH$_2$-$\underline{C}$H$_2$-(CH$_2$)$_9$-N$^+$), 28.99 (CH$_3$-(CH$_2$)$_7$-$\underline{C}$H$_2$-(CH$_2$)$_3$-N$^+$), 29.09 (CH$_3$-(CH$_2$)$_2$-$\underline{C}$H$_2$-(CH$_2$)$_8$-N$^+$), 29.22 (CH$_3$-(CH$_2$)$_6$-$\underline{C}$H$_2$-(CH$_2$)$_4$-N$^+$), 29.33 (CH$_3$-(CH$_2$)$_3$-$\underline{C}$H$_2$-(CH$_2$)$_7$-N$^+$), 29.39 (CH$_3$-(CH$_2$)$_5$-$\underline{C}$H$_2$-(CH$_2$)$_5$-N$^+$), 29.41 (CH$_3$-(CH$_2$)$_4$-$\underline{C}$H$_2$-(CH$_2$)$_6$-N$^+$), 31.68 (CH$_3$-(CH$_2$)$_9$-$\underline{C}$H$_2$-CH$_2$-N$^+$), 34.71 (-$\underline{C}$H$_2$-CH(OH)-$\underline{C}$H$_2$-), 59.31 ($\underline{C}$H$_3$-N$^+$($\underline{C}$H-)$_2$), 60.67 (CH$_3$-(CH$_2$)$_{10}$-$\underline{C}$H$_2$-N$^+$), 65.90 (-CH$_2$-

CH(OH)-CH$_2$-), 69.00 (OCH$_2$COO$^-$), 113.31 (ClC=HCCH=CO), 122.66 (ClCCH=CCH$_3$), 126.19 (ClCCH=CCH$_3$), 128.09 (ClC=HCCH=CO), 129.64 (ClC=HCCH=CO), 156.76 (ClC=HCCH=CO), 169.47 (OCH$_2$COO$^-$).

N-tetradecyltropinium 4-chloro-2-methylphenoxyacetate **[QTS-C$_{14}$][MCPA]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, J=6.5 Hz, 3H, CH$_3$-CH$_2$), 1.23 (m, 22H, CH$_3$-(CH$_2$)$_5$-), 1.63 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-CH$_2$-), 1.79 (d, J=16.1 Hz, 2H, HO-CH-(CH$_a$H$_e$-CH-)$_2$), 2.12 (s, 3H, CH$_3$-Ar), 2.17 (t, J=4.4 Hz, 2H, -CH$_e$H$_a$-CH)$_2$-N$^+$), 2.33 (d, J=16.0 Hz, 2H, -CH$_e$H$_a$-CH)$_2$-N$^+$), 2.38 (d, J=7.5 Hz, 2H, HO-CH-(CH$_a$H$_e$-CH-)$_2$), 2.96 (s, 3H, N$^+$-CH$_3$), 3.14 (t, J=8.3 Hz, 2H, alkyl-CH$_2$N$^+$), 3.33 (br. s, 1H, CH-OH + H$_2$O), 3.79 (s, 2H, -CH$_2$-CH)$_2$-N$^+$), 3.90 (t, J=4.9 Hz, 1H, -CH$_2$)$_2$-CH-OH), 4.05 (s, 2H, OCH$_2$COO$^-$), 6.62 (d, J=8.7 Hz, 1H, ClC=HCCH=CO), 7.04 (dd, $J^{1,2}$=2.1 Hz, $J^{1,3}$=8.5 Hz, 1H, ClC=HCCH=CO), 7.09 (d, J=2.2 Hz, 1H, ClCCH=CCH$_3$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.34 (CH$_3$-(CH$_2$)$_{13}$-N$^+$), 16.43 (CH$_3$-Ar), 22.03 (CH$_3$-CH$_2$-(CH$_2$)$_{12}$-N$^+$), 22.47 (CH$_3$-(CH$_2$)$_{10}$-CH$_2$-(CH$_2$)$_2$-N$^+$), 25.07 (-CH-CH$_2$-CH$_2$-CH-), 26.53 (CH$_3$-CH$_2$-CH$_2$-(CH$_2$)$_{11}$-N$^+$), 28.99 (CH$_3$-(CH$_2$)$_9$-CH$_2$-(CH$_2$)$_3$-N$^+$), 29.09 (CH$_3$-(CH$_2$)$_2$-CH$_2$-(CH$_2$)$_{10}$-N$^+$), 29.22 (CH$_3$-(CH$_2$)$_8$-CH$_2$-(CH$_2$)$_4$-N$^+$), 29.33 (CH$_3$-(CH$_2$)$_3$-CH$_2$-(CH$_2$)$_9$-N$^+$), 29.40 (CH$_3$-(CH$_2$)$_7$-CH$_2$-(CH$_2$)$_5$-N$^+$), 29.43, (CH$_3$-(CH$_2$)$_4$-CH$_2$-(CH$_2$)$_9$-N$^+$), 29.44 (CH$_3$-(CH$_2$)$_5$-(CH$_2$)$_2$-(CH$_2$)$_6$-N$^+$), 31.68 (CH$_3$-(CH$_2$)$_9$-CH$_2$-CH$_2$-N$^+$), 34.71 (-CH$_2$-CH(OH)-CH$_2$), 59.32 (CH$_3$-N$^+$(CH-)$_2$), 60.67 (CH$_3$-(CH$_2$)$_{12}$-CH$_2$-N$^+$), 65.89 (-CH$_2$-CH(OH)-CH$_2$-), 69.02 (OCH$_2$COO$^-$), 113.31 (ClC=HCCH=CO), 122.63 (ClCCH=CCH$_3$), 126.19 (ClCCH=CCH$_3$), 128.07 (ClC=HCCH=CO), 129.63 (ClC=HCCH=CO), 156.77 (ClC=HCCH=CO), 169.39 (OCH$_2$COO$^-$).

N-hexadecyltropinium 4-chloro-2-methylphenoxyacetate **[QTS-C$_{16}$][MCPA]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.86 (t, J=6.2 Hz, 3H, CH$_3$-CH$_2$), 1.24 (m, 26H, CH$_3$-(CH$_2$)$_5$-), 1.65 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-CH$_2$-), 1.81 (d, J=15.9 Hz, 2H, HO-CH-(CH$_a$H$_e$-CH-)$_2$), 2.13 (s, 3H, CH$_3$-Ar), 2.18 (t, J=5.5 Hz, 2H, -CH$_e$H$_a$-CH)$_2$-N$^+$), 2.34 (d, J=16.0 Hz, 2H, -CH$_e$H$_a$-CH)$_2$-N$^+$), 2.38 (d, J=8.0 Hz, 2H, HO-CH-(CH$_a$H$_e$-CH-)$_2$), 2.98 (s, 3H, N$^+$-CH$_3$), 3.15 (t, J=7.0 Hz, 2H, alkyl-CH$_2$N$^+$), 3.36 (br. s, 1H, CH-OH + H$_2$O), 3.80 (s, 2H, -CH$_2$-CH)$_2$-N$^+$), 3.91 (t, J=4.9 Hz, 1H, -CH$_2$)$_2$-CH-OH), 4.06 (s, 2H, OCH$_2$COO$^-$), 6.63 (d, J=8.9 Hz, 1H, ClC=HCCH=CO), 7.05 (dd, $J^{1,2}$=2.2 Hz, $J^{1,3}$=8.7 Hz, 1H, ClC=HCCH=CO), 7.10 (d, J=2.2 Hz, 1H, ClCCH=CCH$_3$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 13.91(CH$_3$-(CH$_2$)$_{13}$-N$^+$), 16.01(CH$_3$-Ar), 21.61 (CH$_3$-CH$_2$-(CH$_2$)$_{14}$-N$^+$), 22.06 (CH$_3$-(CH$_2$)$_{12}$-CH$_2$-(CH$_2$)$_2$-N$^+$), 24.64 (-CH-CH$_2$-CH$_2$-CH-), 25.91 (CH$_3$-CH$_2$-CH$_2$-(CH$_2$)$_{11}$-N$^+$), 28.58 (CH$_3$-(CH$_2$)$_{11}$-CH$_2$-(CH$_2$)$_3$-N$^+$), 28.68 (CH$_3$-(CH$_2$)$_2$-CH$_2$-(CH$_2$)$_{12}$-N$^+$), 28.81 (CH$_3$-(CH$_2$)$_{10}$-CH$_2$-(CH$_2$)$_4$-N$^+$), 28.87 (CH$_3$-(CH$_2$)$_3$-CH$_2$-(CH$_2$)$_{11}$-N$^+$), 28.92 (CH$_3$-(CH$_2$)$_9$-CH$_2$-(CH$_2$)$_5$-N$^+$), 28.98 (CH$_3$-(CH$_2$)$_4$-CH$_2$-(CH$_2$)$_{10}$-N$^+$), 28.99 (CH$_3$-(CH$_2$)$_8$-CH$_2$-(CH$_2$)$_6$-N$^+$), 29.02 (CH$_3$-(CH$_2$)$_5$-CH$_2$-(CH$_2$)$_9$-N$^+$), 29.09 (CH$_3$-(CH$_2$)$_6$-(CH$_2$)$_2$-(CH$_2$)$_7$-N$^+$), 31.26 (CH$_3$-(CH$_2$)$_{13}$-CH$_2$-CH$_2$-N$^+$), 34.27 (-CH$_2$-CH(OH)-CH$_2$), 58.88 (CH$_3$-N$^+$(CH-)$_2$), 60.22 (CH$_3$-(CH$_2$)$_{14}$-CH$_2$-N$^+$), 65.45 (-CH$_2$-CH(OH)-CH$_2$-), 68.55 (OCH$_2$COO$^-$), 112.85 (ClC=HCCH=CO), 122.21 (ClCCH=CCH$_3$), 125.76 (ClCCH=CCH$_3$), 127.64 (ClC=HCCH=CO), 129.21 (ClC=HCCH=CO), 156.32 (ClC=HCCH=CO), 169.02 (OCH$_2$COO$^-$).

N-octadecyltropinium 4-chloro-2-methylphenoxyacetate **[QTS-C$_{18}$][MCPA]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, J=6.3 Hz, 3H, CH$_3$-CH$_2$), 1.22 (m, 30H, CH$_3$-(CH$_2$)$_5$-), 1.63 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-CH$_2$-), 1.81 (d, J=15.9 Hz, 2H, HO-CH-(CH$_a$H$_e$-CH-)$_2$), 2.12 (s, 3H, CH$_3$-Ar), 2.17 (t, J=5.0 Hz, 2H, -CH$_e$H$_a$-CH)$_2$-N$^+$), 2.32 (d, J=16.0 Hz, 2H, -CH$_e$H$_a$-CH)$_2$-N$^+$), 2.38 (d, J=8.0 Hz, 2H, HO-CH-(CH$_a$H$_e$-CH-)$_2$), 2.96 (s, 3H, N$^+$-CH$_3$), 3.14 (t, J=8.5 Hz, 2H, alkyl-CH$_2$N$^+$), 3.35 (br. s, 1H, CH-OH + H$_2$O), 3.79 (s, 2H, -CH$_2$-CH)$_2$-N$^+$), 3.90 (t, J=4.9 Hz, 1H, -CH$_2$)$_2$-CH-OH), 4.06 (s, 2H, OCH$_2$COO$^-$), 6.63 (d, J=8.7 Hz, 1H, ClC=HCCH=CO), 7.04 (dd, $J^{1,2}$=2.2 Hz, $J^{1,3}$=8.7 Hz, 1H, ClC=HCCH=CO), 7.08 (d, J=2.2 Hz, 1H, ClCCH=CCH$_3$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.31 (CH$_3$-(CH$_2$)$_{15}$-N$^+$), 16.42 (CH$_3$-Ar), 22.04 (CH$_3$-CH$_2$-(CH$_2$)$_{16}$-N$^+$), 22.49 (CH$_3$-(CH$_2$)$_{14}$-CH$_2$-(CH$_2$)$_2$-N$^+$), 24.84 (-CH-CH$_2$-CH$_2$-CH-), 25.06 (CH$_3$-CH$_2$-CH$_2$-(CH$_2$)$_{15}$-N$^+$), 26.36 (CH$_3$-(CH$_2$)$_{13}$-CH$_2$-(CH$_2$)$_3$-N$^+$), 28.92 (CH$_3$-(CH$_2$)$_2$-CH$_2$-(CH$_2$)$_{14}$-N$^+$), 28.98 (CH$_3$-(CH$_2$)$_{12}$-

$\underline{C}H_2$-$(CH_2)_4$-N^+), 28.99 (CH_3-$(CH_2)_3$-$\underline{C}H_2$-$(CH_2)_{13}$-N^+), 29.01 (CH_3-$(CH_2)_{11}$-$\underline{C}H_2$-$(CH_2)_5$-N^+), 29.02 (CH_3-$(CH_2)_4$-$\underline{C}H_2$-$(CH_2)_{12}$-N^+), 29.09 (CH_3-$(CH_2)_{10}$-$\underline{C}H_2$-$(CH_2)_6$-N^+), 29.10 (CH_3-$(CH_2)_5$-$\underline{C}H_2$-$(CH_2)_{11}$-N^+), 29.25 (CH_3-$(CH_2)_9$-$\underline{C}H_2$-$(CH_2)_7$-N^+), 29.44 (CH_3-$(CH_2)_6$-$(\underline{C}H_2)_3$-$(CH_2)_8$-N^+), 31.69 (CH_3-$(CH_2)_{15}$-$\underline{C}H_2$-CH_2-N^+), 34.70 (-$\underline{C}H_2$-CH(OH)-$\underline{C}H_2$), 59.29 ($\underline{C}H_3$-N^+($\underline{C}$H-$)_2$), 60.64 (CH_3-$(CH_2)_{16}$-$\underline{C}H_2$-N^+), 65.91 (-CH_2-$\underline{C}$H(OH)-CH_2-), 68.98 (O$\underline{C}H_2COO^-$), 113.28 (ClC=HC$\underline{C}$H=CO), 122.68 (ClCCH=$\underline{C}CH_3$), 126.18 (Cl$\underline{C}$CH=CCH_3), 128.09 (ClC=HCCH=CO), 129.63 (ClC=H$\underline{C}$CH=CO), 156.76 (ClC=HCCH=$\underline{C}$O), 169.15 ($OCH_2\underline{C}OO^-$).

N-octyltropinium 3,6-dichloro-2-methoxybenzoate **[QTS-C_8][dicamba]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.85 (t, *J*=6.7 Hz, 3H, $C\underline{H_3}$-CH_2), 1.26 (m, 10H, CH_3-$(C\underline{H_2})_5$-), 1.63 (q, *J*=4.2 Hz, 2H, -$(CH_2)_5$-$C\underline{H_2}$-), 1.79 (d, *J*=15.9 Hz, 2H, HO-CH-($C\underline{H_a}H_e$-CH-$)_2$), 2.16 (t, *J*=4.9 Hz, 2H, -$C\underline{H_e}H_a$-CH$)_2$-N^+), 2.34 (d, *J*=16.0 Hz, 2H, -$CH_e\underline{H_a}$-CH$)_2$-N^+), 2.36 (d, *J*=8.0 Hz, 2H, HO-CH-($CH_a\underline{H_e}$-CH-$)_2$), 2.97 (s, 3H, N^+-$C\underline{H_3}$), 3.14 (t, *J*=8.3 Hz, 2H, alkyl-$C\underline{H_2}N^+$), 3.36 (br. s, 1H, CH-O$\underline{H}$ + H_2O), 3.77 (s, 3H, $C\underline{H_3}$-O-Ar), 3.78 (s, 2H, -CH_2-$C\underline{H)_2}$-N^+), 3.90 (t, *J*=5.0 Hz, 1H, -$CH_2)_2$-C$\underline{H}$-OH), 7.00 (d, *J*=8.5 Hz, 1H, ClCCH=C$\underline{H}$C(Cl)=$CCOO^-$), 7.13 (d, *J*=8.5 Hz, 1H, ClCC$\underline{H}$=CHC(Cl)=$CCOO^-$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.34 ($\underline{C}H_3$-$(CH_2)_7$-N^+), 22.04 (CH_3-$\underline{C}H_2$-$(CH_2)_6$-N^+), 22.45 (CH_3-$(CH_2)_4$-$\underline{C}H_2$-$(CH_2)_2$-N^+), 25.06 (-CH-$\underline{C}H_2$-$\underline{C}H_2$-CH-), 26.33 (CH_3-CH_2-$\underline{C}H_2$-$(CH_2)_5$-N^+), 28.89 (CH_3-$(CH_2)_3$-$\underline{C}H_2$-$(CH_2)_3$-N^+), 28.95 (CH_3-$(CH_2)_2$-$\underline{C}H_2$-$(CH_2)_4$-N^+), 31.57 (CH_3-$(CH_2)_5$-$\underline{C}H_2$-CH_2-N^+), 34.69 (-$\underline{C}H_2$-CH(OH)-$\underline{C}H_2$-), 59.34 ($\underline{C}H_3$-N^+($\underline{C}$H-$)_2$), 60.64 (CH_3-$(CH_2)_6$-$\underline{C}H_2$-N^+), 61.22 ($\underline{C}H_3$-O-Ar), 65.85 (-CH_2-$\underline{C}$H(OH)-CH_2-), 125.35 (ClCCH=$\underline{C}$HC(Cl)=$CCOO^-$), 125.51 (Cl$\underline{C}$CH=CHC(Cl)=$CCOO^-$), 126.61 (ClCCH=CHC(Cl)=$\underline{C}COO^-$), 127.91, (ClCCH=CH$\underline{C}$(Cl)=$CCOO^-$), 141.69 (ClC$\underline{C}$H=CHC(Cl)=$CCOO^-$), 151.48 ($\underline{C}H_3$-O-$\underline{C}$=CCl), 165.23 (-$\underline{C}OO^-$).

N-decyltropinium 3,6-dichloro-2-methoxybenzoate **[QTS-C_{10}][dicamba]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, *J*=6.6 Hz, 3H, $C\underline{H_3}$-CH_2), 1.23 (m, 14H, CH_3-$(C\underline{H_2})_5$-), 1.62 (q, *J*=4.2 Hz, 2H, -$(CH_2)_5$-$C\underline{H_2}$-), 1.80 (d, *J*=15.9 Hz, 2H, HO-CH-($C\underline{H_a}H_e$-CH-$)_2$), 2.15 (t, *J*=4.8 Hz, 2H, -$C\underline{H_e}H_a$-CH$)_2$-N^+), 2.32 (d, *J*=16.0 Hz, 2H, -$CH_e\underline{H_a}$-CH$)_2$-N^+), 2.37 (d, *J*=8.5 Hz, 2H, HO-CH-($CH_a\underline{H_e}$-CH-$)_2$), 2.97 (s, 3H, N^+-$C\underline{H_3}$), 3.15 (t, *J*=8.3 Hz, 2H, alkyl-$C\underline{H_2}N^+$), 3.43 (br. s, 1H, CH-O$\underline{H}$ + H_2O), 3.78 (s, 3H, $C\underline{H_3}$-O-Ar), 3.78 (s, 2H, -CH_2-$C\underline{H)_2}$-N^+), 3.90 (t, *J*=4.8 Hz, 1H, -$CH_2)_2$-C$\underline{H}$-OH), 7.01 (d, *J*=8.5 Hz, 1H, ClCCH=C$\underline{H}$C(Cl)=$CCOO^-$), 7.13 (d, *J*=8.6 Hz, 1H, ClCC$\underline{H}$=CHC(Cl)=$CCOO^-$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.34 ($\underline{C}H_3$-$(CH_2)_9$-N^+), 22.05 (CH_3-$\underline{C}H_2$-$(CH_2)_8$-N^+), 22.49 (CH_3-$(CH_2)_6$-$\underline{C}H_2$-$(CH_2)_2$-N^+), 25.05 (-CH-$\underline{C}H_2$-$\underline{C}H_2$-CH-), 26.34 (CH_3-CH_2-$\underline{C}H_2$-$(CH_2)_7$-N^+), 29.01 (CH_3-$(CH_2)_5$-$\underline{C}H_2$-$(CH_2)_3$-N^+), 29.09 (CH_3-$(CH_2)_2$-$\underline{C}H_2$-$(CH_2)_6$-N^+), 29.26 (CH_3-$(CH_2)_4$-$\underline{C}H_2$-$(CH_2)_4$-N^+), 29.31 (CH_3-$(CH_2)_3$-$\underline{C}H_2$-$(CH_2)_5$-N^+), 31.68 (CH_3-$(CH_2)_7$-$\underline{C}H_2$-CH_2-N^+), 34.66 (-$\underline{C}H_2$-CH(OH)-$\underline{C}H_2$-), 59.32 ($\underline{C}H_3$-N^+($\underline{C}$H-$)_2$), 60.58 (CH_3-$(CH_2)_8$-$\underline{C}H_2$-N^+), 61.24 ($\underline{C}H_3$-O-Ar), 65.84 (-CH_2-$\underline{C}$H(OH)-CH_2-), 125.40 (ClCCH=$\underline{C}$HC(Cl)=$CCOO^-$), 125.54 (Cl$\underline{C}$CH=CHC(Cl)=$CCOO^-$), 126.74 (ClCCH=CHC(Cl)=$\underline{C}COO^-$), 127.89 (ClCCH=CH$\underline{C}$(Cl)=$CCOO^-$), 141.52 (ClC$\underline{C}$H=CHC(Cl)=$CCOO^-$), 151.50 ($\underline{C}H_3$-O-$\underline{C}$=CCl), 165.43 (-$\underline{C}OO^-$).

N-dodecyltropinium 3,6-dichloro-2-methoxybenzoate **[QTS-C_{12}][dicamba]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, *J*=6.7 Hz, 3H, $C\underline{H_3}$-CH_2), 1.23 (m, 18H, CH_3-$(C\underline{H_2})_5$-), 1.63 (q, *J*=4.2 Hz, 2H, -$(CH_2)_5$-$C\underline{H_2}$-), 1.80 (d, *J*=15.9 Hz, 2H, HO-CH-($C\underline{H_a}H_e$-CH-$)_2$), 2.16 (t, *J*=5.0 Hz, 2H, -$C\underline{H_e}H_a$-CH$)_2$-N^+), 2.34 (d, *J*=16.0 Hz, 2H, -$CH_e\underline{H_a}$-CH$)_2$-N^+), 2.37 (d, *J*=7.9 Hz, 2H, HO-CH-($CH_a\underline{H_e}$-CH-$)_2$), 2.97 (s, 3H, N^+-$C\underline{H_3}$), 3.15 (t, *J*=8.3 Hz, 2H, alkyl-$C\underline{H_2}N^+$), 3.37 (br. s, 1H, CH-O$\underline{H}$ + H_2O), 3.78 (s, 3H, $C\underline{H_3}$-O-Ar), 3.80 (s, 2H, -CH_2-$C\underline{H)_2}$-N^+), 3.90 (t, *J*=4.9 Hz, 1H, -$CH_2)_2$-C$\underline{H}$-OH), 7.00 (d, *J*=8.6 Hz, 1H, ClCCH=C$\underline{H}$C(Cl)=$CCOO^-$), 7.13 (d, *J*=8.5 Hz, 1H, ClCC$\underline{H}$=CHC(Cl)=$CCOO^-$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.32 ($\underline{C}H_3$-$(CH_2)_{11}$-N^+), 22.04 (CH_3-$\underline{C}H_2$-$(CH_2)_{10}$-N^+), 22.48 (CH_3-$(CH_2)_8$-$\underline{C}H_2$-$(CH_2)_2$-N^+), 25.06 (-CH-$\underline{C}H_2$-$\underline{C}H_2$-CH-), 26.33 (CH_3-CH_2-$\underline{C}H_2$-$(CH_2)_9$-N^+), 28.99 (CH_3-$(CH_2)_7$-$\underline{C}H_2$-$(CH_2)_3$-N^+), 29.09 (CH_3-$(CH_2)_2$-$\underline{C}H_2$-$(CH_2)_8$-N^+), 29.23 (CH_3-$(CH_2)_6$-$\underline{C}H_2$-$(CH_2)_4$-N^+), 29.33 (CH_3-$(CH_2)_3$-$\underline{C}H_2$-$(CH_2)_7$-N^+), 29.39 (CH_3-$(CH_2)_5$-$\underline{C}H_2$-$(CH_2)_5$-N^+), 29.41 (CH_3-$(CH_2)_4$-$\underline{C}H_2$-$(CH_2)_6$-N^+), 31.69 (CH_3-$(CH_2)_9$-$\underline{C}H_2$-CH_2-N^+), 34.71 (-$\underline{C}H_2$-CH(OH)-$\underline{C}H_2$-), 59.34 ($\underline{C}H_3$-N^+($\underline{C}$H-$)_2$), 60.64 (CH_3-

(CH$_2$)$_{10}$-$\underline{C}$H$_2$-N$^+$), 61.22 ($\underline{C}$H$_3$-O-Ar), 65.87 (-CH$_2$-$\underline{C}$H(OH)-CH$_2$-), 125.36 (ClCCH=$\underline{C}$HC(Cl)=CCOO$^-$), 125.49 (Cl$\underline{C}$CH=CHC(Cl)=CCOO$^-$), 126.66 (ClCCH=CHC(Cl)=$\underline{C}$COO$^-$), 127.92 (ClCCH=CH$\underline{C}$(Cl)=CCOO$^-$), 141.60 (ClC$\underline{C}$H=CHC(Cl)=CCOO$^-$), 151.51 ($\underline{C}$H$_3$-O-$\underline{C}$=CCl), 165.31 (-$\underline{C}$OO$^-$).

N-tetradecyltropinium 3,6-dichloro-2-methoxybenzoate **[QTS-C$_{14}$][dicamba]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, J=6.7 Hz, 3H, C$\underline{H_3}$-CH$_2$), 1.23 (m, 22H, CH$_3$-(C$\underline{H_2}$)$_5$-), 1.63 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-C$\underline{H_2}$-), 1.79 (d, J=15.9 Hz, 2H, HO-CH-(C$\underline{H_a}$H$_e$-CH-)$_2$), 2.17 (t, J=4.7 Hz, 2H, -C$\underline{H_e}$H$_a$-CH)$_2$-N$^+$), 2.34 (d, J=16.0 Hz, 2H, -CH$_e$$\underline{H_a}$-CH)$_2$-N$^+$), 2.37 (d, J=8.0 Hz, 2H, HO-CH-(CH$_a$$\underline{H_e}$-CH-)$_2$), 2.96 (s, 3H, N$^+$-C$\underline{H_3}$), 3.14 (t, J=8.5 Hz, 2H, alkyl-C$\underline{H_2}$N$^+$), 3.31 (br. s, 1H, CH-O$\underline{H}$ + H$_2$O), 3.77 (s, 3H, C$\underline{H_3}$-O-Ar), 3.80 (s, 2H, -CH$_2$-C$\underline{H}$)$_2$-N$^+$), 3.90 (t, J=4.7 Hz, 1H, -CH$_2$)$_2$-C$\underline{H}$-OH), 6.99 (d, J=8.5 Hz, 1H, ClCCH=C$\underline{H}$C(Cl)=CCOO$^-$), 7.11 (d, J=8.6 Hz, 1H, ClCC$\underline{H}$=CHC(Cl)=CCOO$^-$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.33 ($\underline{C}$H$_3$-(CH$_2$)$_{13}$-N$^+$), 22.04 (CH$_3$-$\underline{C}$H$_2$-(CH$_2$)$_{12}$-N$^+$), 22.47 CH$_3$-(CH$_2$)$_{10}$-$\underline{C}$H$_2$-(CH$_2$)$_2$-N$^+$), 25.07 (-CH-$\underline{C}$H$_2$-$\underline{C}$H$_2$-CH-), 26.32 (CH$_3$-CH$_2$-$\underline{C}$H$_2$-(CH$_2$)$_{11}$-N$^+$), 28.98 (CH$_3$-(CH$_2$)$_9$-$\underline{C}$H$_2$-(CH$_2$)$_3$-N$^+$), 29.09 (CH$_3$-(CH$_2$)$_2$-$\underline{C}$H$_2$-(CH$_2$)$_{10}$-N$^+$), 29.22 (CH$_3$-(CH$_2$)$_8$-$\underline{C}$H$_2$-(CH$_2$)$_4$-N$^+$), 29.27 (CH$_3$-(CH$_2$)$_3$-$\underline{C}$H$_2$-(CH$_2$)$_9$-N$^+$), 29.33 (CH$_3$-(CH$_2$)$_7$-$\underline{C}$H$_2$-(CH$_2$)$_5$-N$^+$), 29.40 (CH$_3$-(CH$_2$)$_4$-$\underline{C}$H$_2$-(CH$_2$)$_9$-N$^+$), 29.42 (CH$_3$-(CH$_2$)$_6$-$\underline{C}$H$_2$-(CH$_2$)$_6$-N$^+$), 29.44 (CH$_3$-(CH$_2$)$_5$-$\underline{C}$H$_2$-(CH$_2$)$_7$-N$^+$), 31.68 (CH$_3$-(CH$_2$)$_9$-$\underline{C}$H$_2$-CH$_2$-N$^+$), 34.73 (-$\underline{C}$H$_2$-CH(OH)-$\underline{C}$H$_2$-), 59.37 ($\underline{C}$H$_3$-N$^+$($\underline{C}$H-)$_2$), 60.68 (CH$_3$-(CH$_2$)$_{12}$-$\underline{C}$H$_2$-N$^+$), 61.18 ($\underline{C}$H$_3$-O-Ar), 65.87 (-CH$_2$-$\underline{C}$H(OH)-CH$_2$-), 125.31 (ClCCH=$\underline{C}$HC(Cl)=CCOO$^-$), 125.45 (Cl$\underline{C}$CH=CHC(Cl)=CCOO$^-$), 126.46 (ClCCH=CHC(Cl)=$\underline{C}$COO$^-$), 127.93 (ClCCH=CH$\underline{C}$(Cl)=CCOO$^-$), 141.90 (ClC$\underline{C}$H=CHC(Cl)=CCOO$^-$), 151.48 ($\underline{C}$H$_3$-O-$\underline{C}$=CCl), 165.09 (-$\underline{C}$OO$^-$).

N-hexadecyltropinium 3,6-dichloro-2-methoxybenzoate **[QTS-C$_{16}$][dicamba]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.85 (t, J=6.7 Hz, 3H, C$\underline{H_3}$-CH$_2$), 1.24 (m, 26H, CH$_3$-(C$\underline{H_2}$)$_5$-), 1.64 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-C$\underline{H_2}$-), 1.80 (d, J=16.3 Hz, 2H, HO-CH-(C$\underline{H_a}$H$_e$-CH-)$_2$), 2.19 (t, J=4.9 Hz, 2H, -C$\underline{H_e}$H$_a$-CH)$_2$-N$^+$), 2.34 (d, J=16.3 Hz, 2H, -CH$_e$$\underline{H_a}$-CH)$_2$-N$^+$), 2.38 (d, J=8.0 Hz, 2H, HO-CH-(CH$_a$$\underline{H_e}$-CH-)$_2$), 2.98 (s, 3H, N$^+$-C$\underline{H_3}$), 3.16 (t, J=8.1 Hz, 2H, alkyl-C$\underline{H_2}$N$^+$), 3.34 (s, 1H, CH-O$\underline{H}$ + H$_2$O), 3.79 (s, 3H, C$\underline{H_3}$-O-Ar), 3.81 (s, 2H, -CH$_2$-C$\underline{H}$)$_2$-N$^+$), 3.91 (t, J=5.0 Hz, 1H, -CH$_2$)$_2$-C$\underline{H}$-OH), 7.01 (d, J=8.7 Hz, 1H, ClCCH=C$\underline{H}$C(Cl)=CCOO$^-$), 7.13 (d, J=8.4 Hz, 1H, ClCC$\underline{H}$=CHC(Cl)=CCOO$^-$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 13.95 ($\underline{C}$H$_3$-(CH$_2$)$_{13}$-N$^+$), 21.66 (CH$_3$-$\underline{C}$H$_2$-(CH$_2$)$_{14}$-N$^+$), 22.10 (CH$_3$-(CH$_2$)$_{12}$-$\underline{C}$H$_2$-(CH$_2$)$_2$-N$^+$), 24.67 (-CH-$\underline{C}$H$_2$-$\underline{C}$H$_2$-CH-), 26.15 (CH$_3$-CH$_2$-$\underline{C}$H$_2$-(CH$_2$)$_{11}$-N$^+$), 28.63 (CH$_3$-(CH$_2$)$_{11}$-$\underline{C}$H$_2$-(CH$_2$)$_3$-N$^+$), 28.65 (CH$_3$-(CH$_2$)$_2$-$\underline{C}$H$_2$-(CH$_2$)$_{12}$-N$^+$), 28.72 (CH$_3$-(CH$_2$)$_{10}$-$\underline{C}$H$_2$-(CH$_2$)$_4$-N$^+$), 28.87 (CH$_3$-(CH$_2$)$_3$-$\underline{C}$H$_2$-(CH$_2$)$_{11}$-N$^+$), 29.92 (CH$_3$-(CH$_2$)$_9$-$\underline{C}$H$_2$-(CH$_2$)$_5$-N$^+$), 28.97 (CH$_3$-(CH$_2$)$_4$-$\underline{C}$H$_2$-(CH$_2$)$_{10}$-N$^+$), 29.04 (CH$_3$-(CH$_2$)$_8$-$\underline{C}$H$_2$-(CH$_2$)$_6$-N$^+$), 29.07 (CH$_3$-(CH$_2$)$_5$-($\underline{C}$H$_2$)$_3$-(CH$_2$)$_7$-N$^+$), 31.31, (CH$_3$-(CH$_2$)$_{13}$-$\underline{C}$H$_2$-CH$_2$-N$^+$), 34.30 (-$\underline{C}$H$_2$-CH(OH)-$\underline{C}$H$_2$-), 58.96 ($\underline{C}$H$_3$-N$^+$($\underline{C}$H-)$_2$), 60.23 (CH$_3$-(CH$_2$)$_{14}$-$\underline{C}$H$_2$-N$^+$), 60.81 ($\underline{C}$H$_3$-O-Ar), 65.45 (-CH$_2$-$\underline{C}$H(OH)-CH$_2$-), 124.96 (ClCCH=$\underline{C}$HC(Cl)=CCOO$^-$), 125.10 (Cl$\underline{C}$CH=CHC(Cl)=CCOO$^-$), 126.17 (ClCCH=CHC(Cl)=$\underline{C}$COO$^-$), 127.51 (ClCCH=CH$\underline{C}$(Cl)=CCOO$^-$), 141.39 (ClC$\underline{C}$H=CHC(Cl)=CCOO$^-$), 151.07 ($\underline{C}$H$_3$-O-$\underline{C}$=CCl), 164.86 (-$\underline{C}$OO$^-$).

N-octadecyltropinium 3,6-dichloro-2-methoxybenzoate **[QTS-C$_{18}$][dicamba]** ^{1}H NMR (400 MHz, DMSO–d_6): δ ppm = 0.84 (t, J=6.7 Hz, 3H, C$\underline{H_3}$-CH$_2$), 1.22 (m, 30H, CH$_3$-(C$\underline{H_2}$)$_5$-), 1.63 (q, J=4.2 Hz, 2H, -(CH$_2$)$_5$-C$\underline{H_2}$-), 1.79 (d, J=16.1 Hz, 2H, HO-CH-(C$\underline{H_a}$H$_e$-CH-)$_2$), 2.18 (t, J=4.9 Hz, 2H, -C$\underline{H_e}$H$_a$-CH)$_2$-N$^+$), 2.36 (d, J=16.7 Hz, 2H, -CH$_e$$\underline{H_a}$-CH)$_2$-N$^+$), 2.37 (d, J=7.6 Hz, 2H, HO-CH-(CH$_a$$\underline{H_e}$-CH-)$_2$), 2.97 (s, 3H, N$^+$-C$\underline{H_3}$), 3.14 (t, J=8.3 Hz, 2H, alkyl-C$\underline{H_2}$N$^+$), 3.32 (s, 1H, CH-O$\underline{H}$ + H$_2$O), 3.77 (s, 3H, C$\underline{H_3}$-O-Ar), 3.78 (s, 2H, -CH$_2$-C$\underline{H}$)$_2$-N$^+$), 3.90 (t, J=5.0 Hz, 1H, -CH$_2$)$_2$-C$\underline{H}$-OH), 6.99 (d, J=8.6 Hz, 1H, ClCCH=C$\underline{H}$C(Cl)=CCOO$^-$), 7.11 (d, J=8.5 Hz, 1H, ClCC$\underline{H}$=CHC(Cl)=CCOO$^-$); ^{13}C NMR (DMSO–d_6, 100 MHz): δ ppm = 14.32 ($\underline{C}$H$_3$-(CH$_2$)$_{15}$-N$^+$), 22.04 (CH$_3$-$\underline{C}$H$_2$-(CH$_2$)$_{16}$-N$^+$), 22.48 (CH$_3$-(CH$_2$)$_{14}$-$\underline{C}$H$_2$-(CH$_2$)$_2$-N$^+$), 24.84 (-CH-$\underline{C}$H$_2$-$\underline{C}$H$_2$-CH-), 25.07 (CH$_3$-CH$_2$-$\underline{C}$H$_2$-(CH$_2$)$_{15}$-N$^+$), 26.33 (CH$_3$-(CH$_2$)$_{13}$-$\underline{C}$H$_2$-(CH$_2$)$_3$-N$^+$), 29.00 (CH$_3$-(CH$_2$)$_2$-$\underline{C}$H$_2$-(CH$_2$)$_{14}$-N$^+$), 29.09 (CH$_3$-(CH$_2$)$_{12}$-$\underline{C}$H$_2$-(CH$_2$)$_4$-N$^+$), 29.24 (CH$_3$-(CH$_2$)$_3$-$\underline{C}$H$_2$-(CH$_2$)$_{13}$-N$^+$), 29.29 (CH$_3$-(CH$_2$)$_{11}$-$\underline{C}$H$_2$-(CH$_2$)$_5$-N$^+$), 29.34 (CH$_3$-(CH$_2$)$_4$-

$\underline{C}H_2\text{-}(CH_2)_{12}\text{-}N^+$), 29.39 ($CH_3\text{-}(CH_2)_5\text{-}\underline{C}H_2\text{-}(CH_2)_3\text{-}(\underline{C}H_2)_2\text{-}(CH_2)_6\text{-}N^+$), 29.44 ($CH_3\text{-}(CH_2)_6\text{-}(\underline{C}H_2)_3\text{-}(CH_2)_8\text{-}N^+$), 31.68 ($CH_3\text{-}(CH_2)_{15}\text{-}\underline{C}H_2\text{-}CH_2\text{-}N^+$), 34.72 ($\text{-}\underline{C}H_2\text{-}CH(OH)\text{-}\underline{C}H_2\text{-}$), 59.37 ($\underline{C}H_3\text{-}N^+(\underline{C}H\text{-})_2$), 60.66 ($CH_3\text{-}(CH_2)_{16}\text{-}\underline{C}H_2\text{-}N^+$), 61.18 ($\underline{C}H_3\text{-}O\text{-}Ar$), 65.86 ($\text{-}CH_2\text{-}\underline{C}H(OH)\text{-}CH_2\text{-}$), 125.31 ($ClCCH{=}\underline{C}HC(Cl){=}CCOO^-$), 125.45 ($Cl\underline{C}CH{=}CHC(Cl){=}CCOO^-$), 126.45 ($ClCCH{=}CHC(Cl){=}\underline{C}COO^-$), 127.93 ($ClCCH{=}CH\underline{C}(Cl){=}CCOO^-$), 141.91 ($ClC\underline{C}H{=}CHC(Cl){=}CCOO^-$), 151.46 ($\underline{C}H_3\text{-}O\text{-}\underline{C}{=}CCl$), 165.01 ($\text{-}\underline{C}OO^-$).

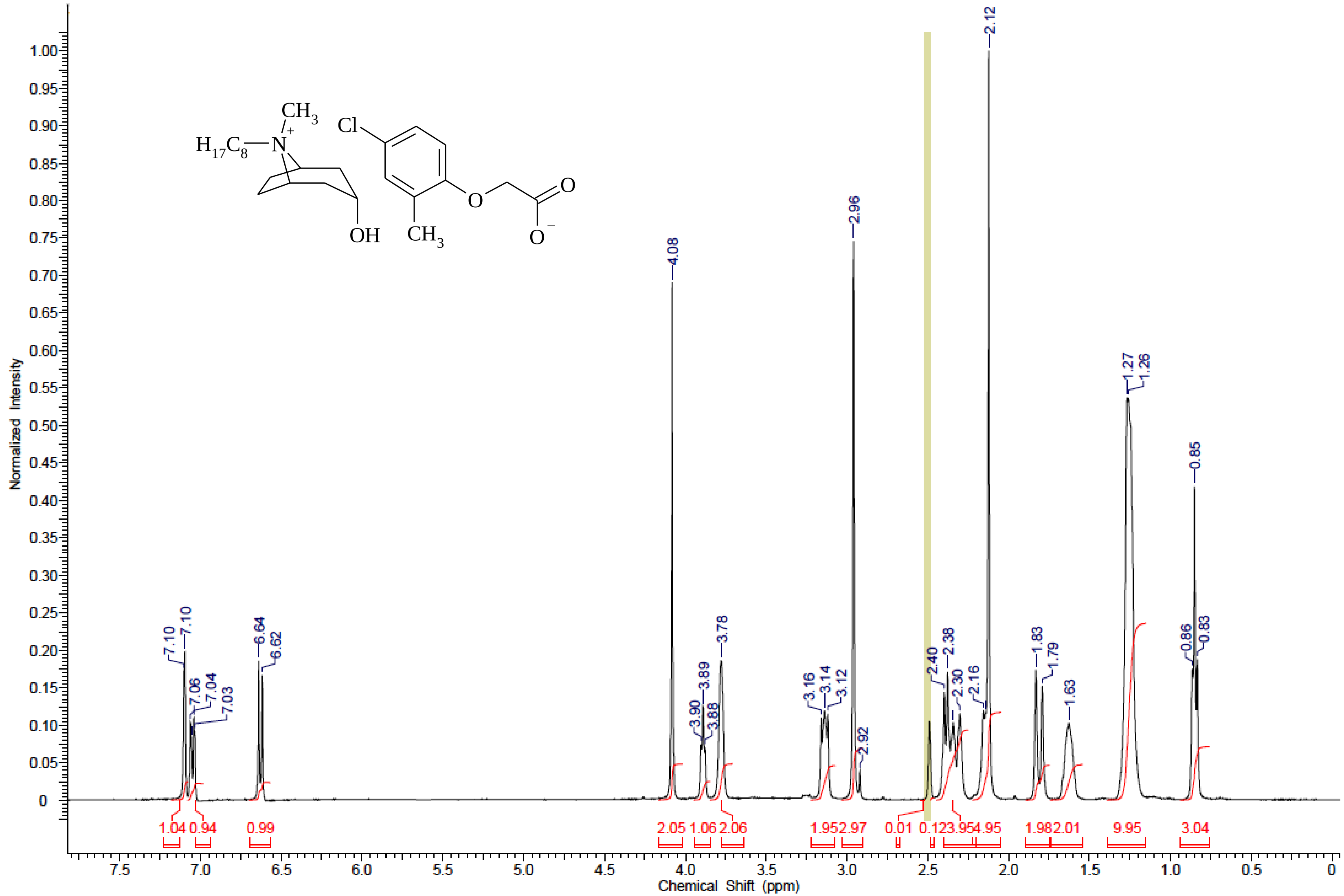

Fig. S1 [1]H NMR spectrum of **[QTS-C8][MCPA]**.

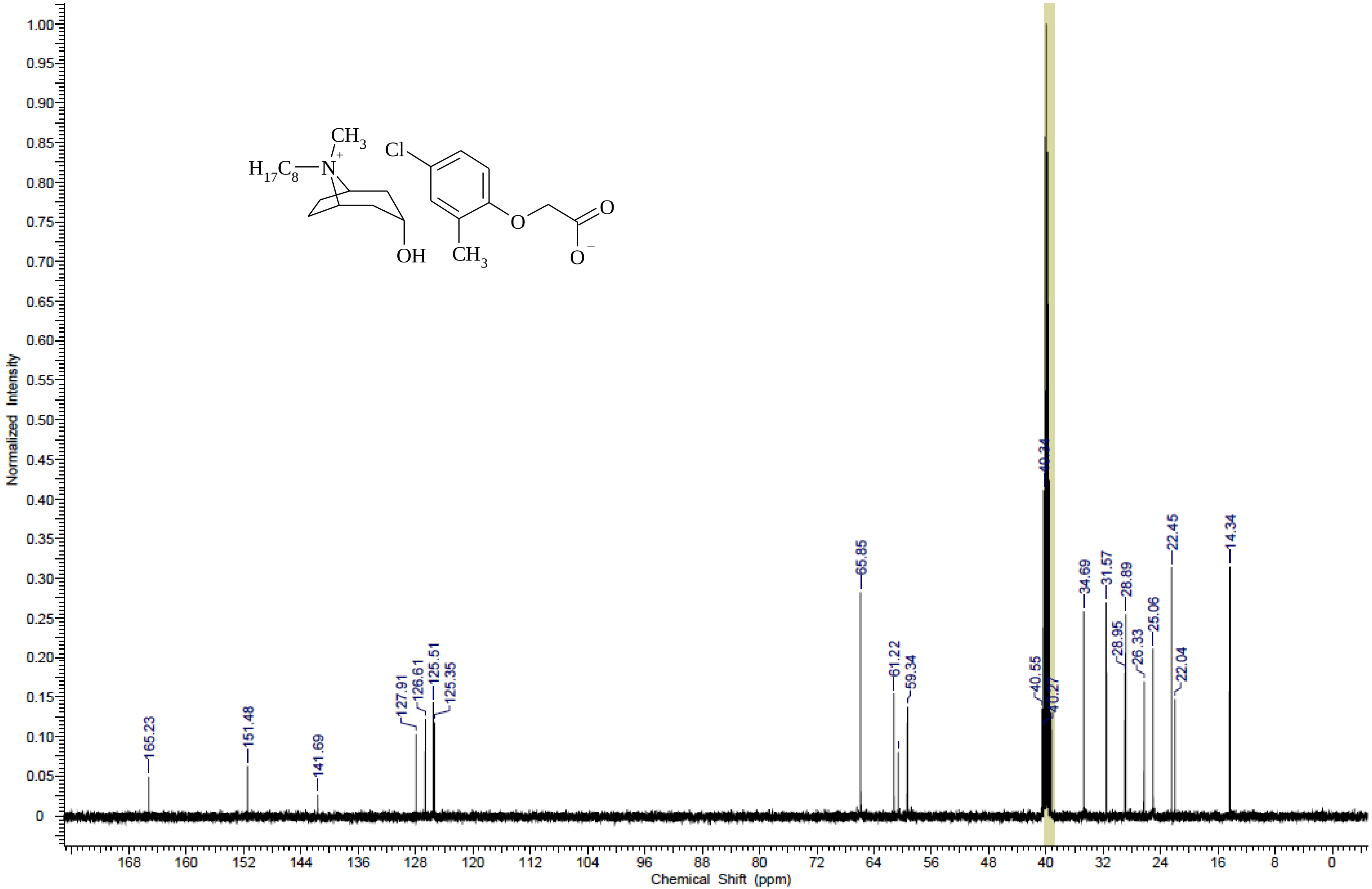

Fig. S2 ^{13}C NMR spectrum of **[QTS-C8][MCPA]**.

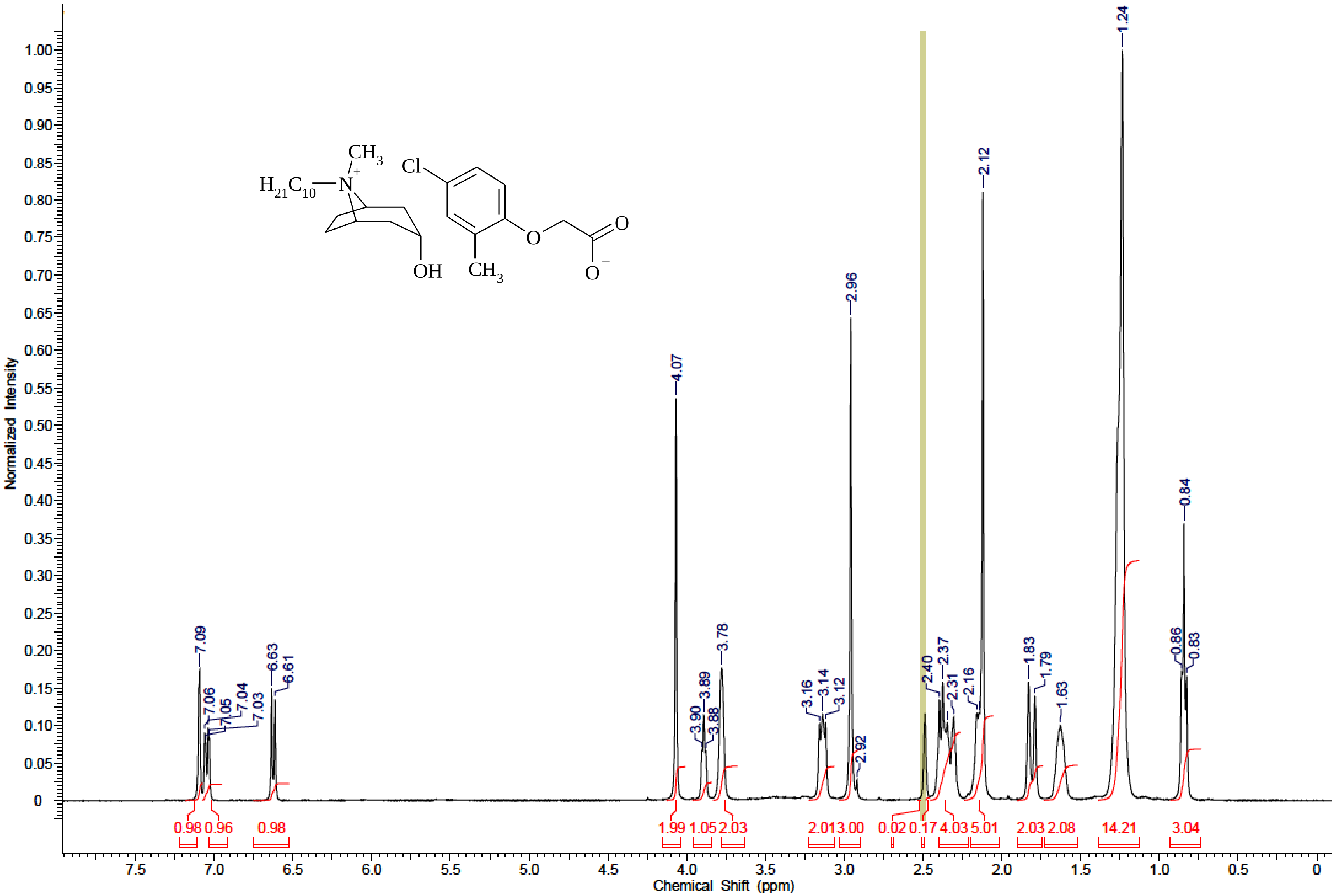

Fig. S3 ^{1}H NMR spectrum of **[QTS-C$_{10}$][MCPA]**.

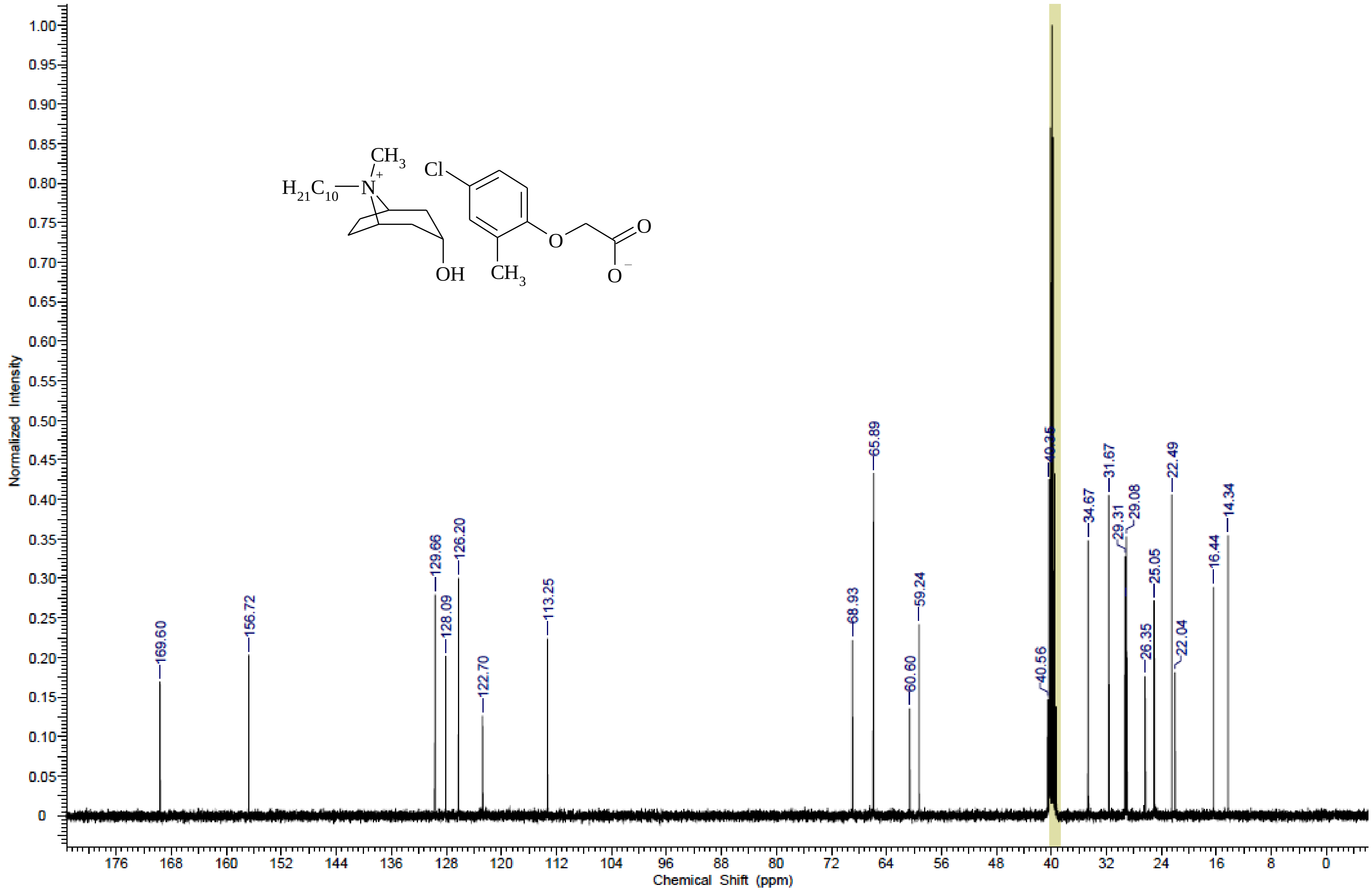

Fig. S4 ^{13}C NMR spectrum of **[QTS-C$_{10}$][MCPA]**.

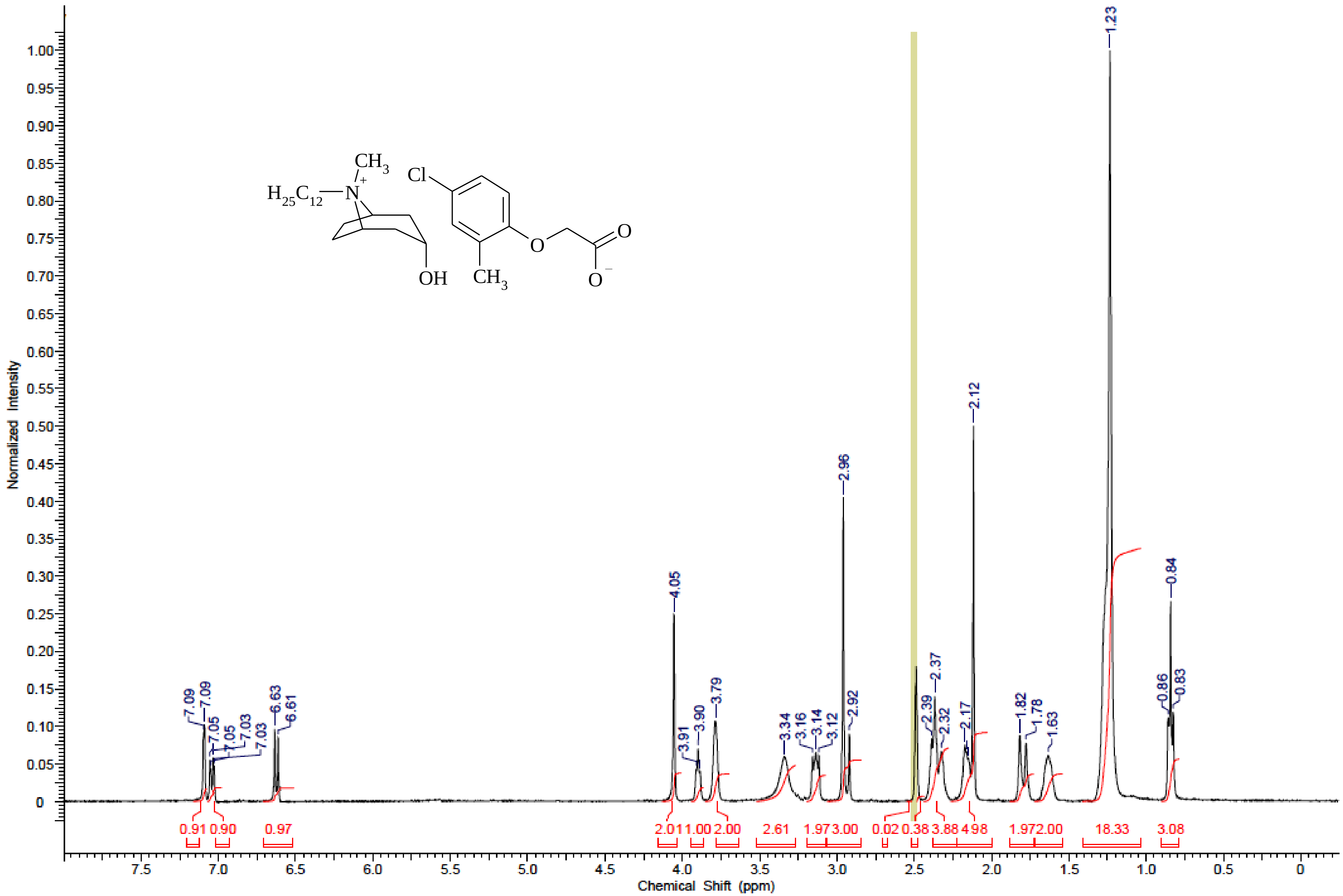

Fig. S5 ^{1}H NMR spectrum of **[QTS-C12][MCPA]**.

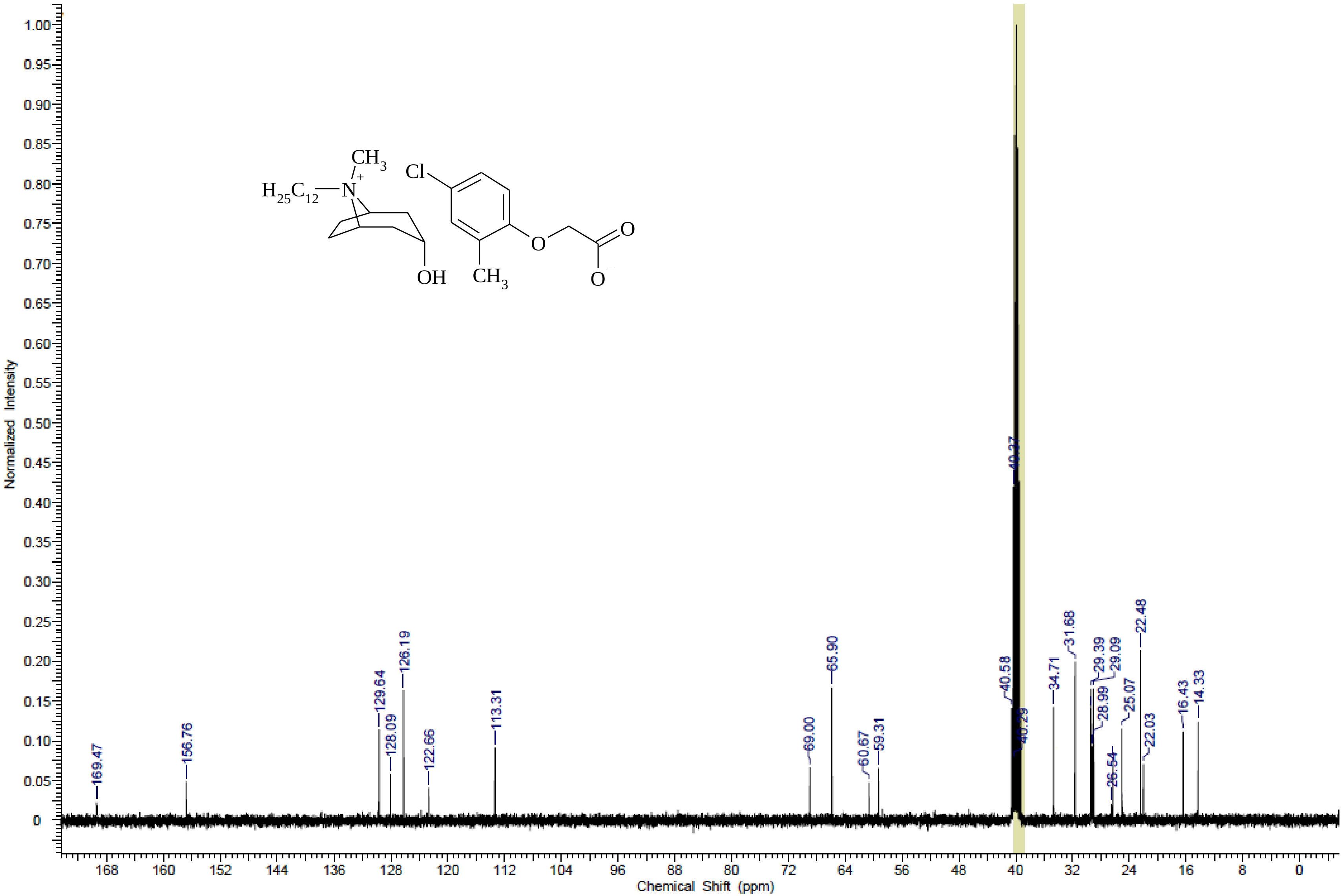

Fig. S6 ^{13}C NMR spectrum of **[QTS-C$_{12}$][MCPA]**.

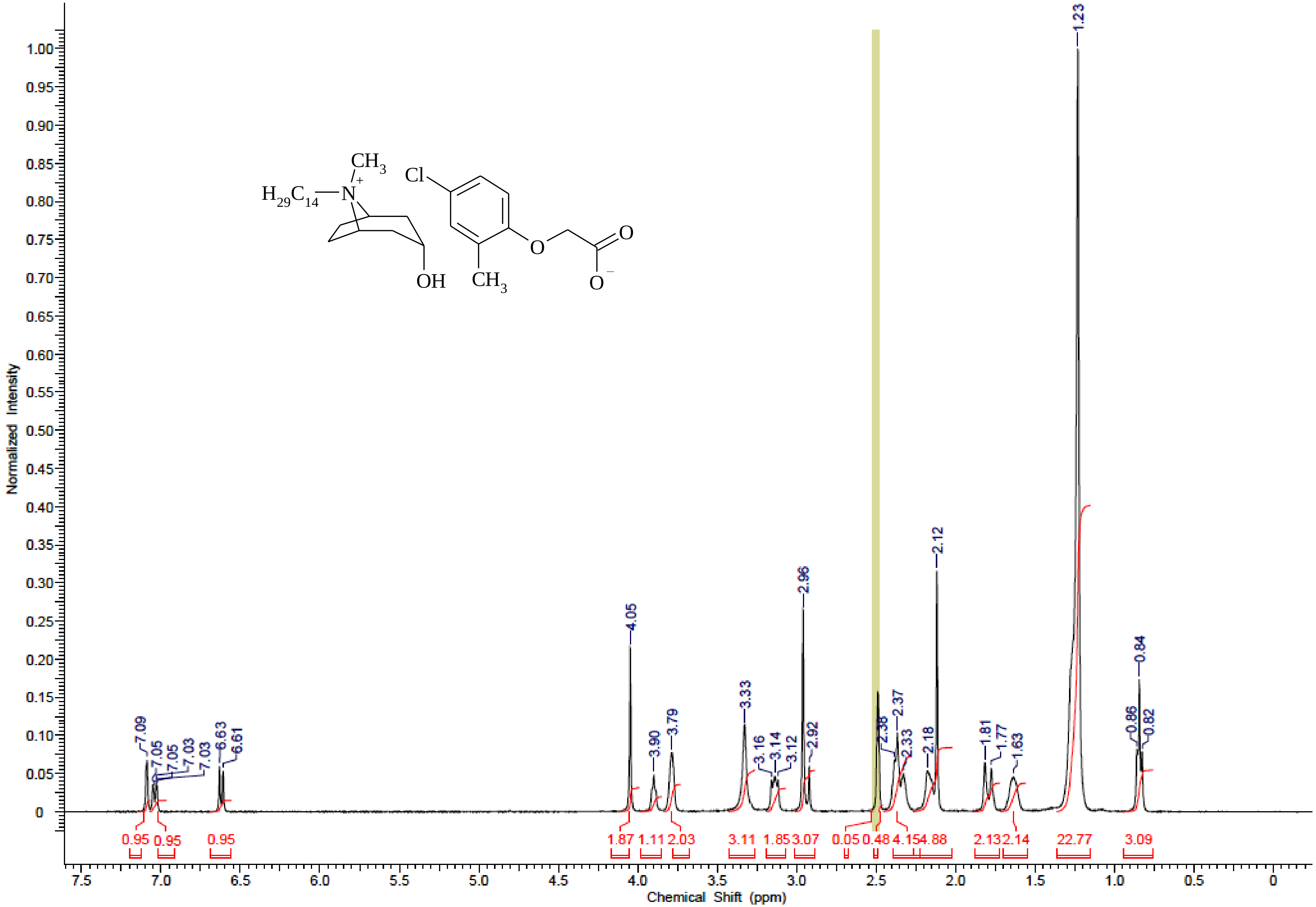

Fig. S7 [1]H NMR spectrum of **[QTS-C14][MCPA]**.

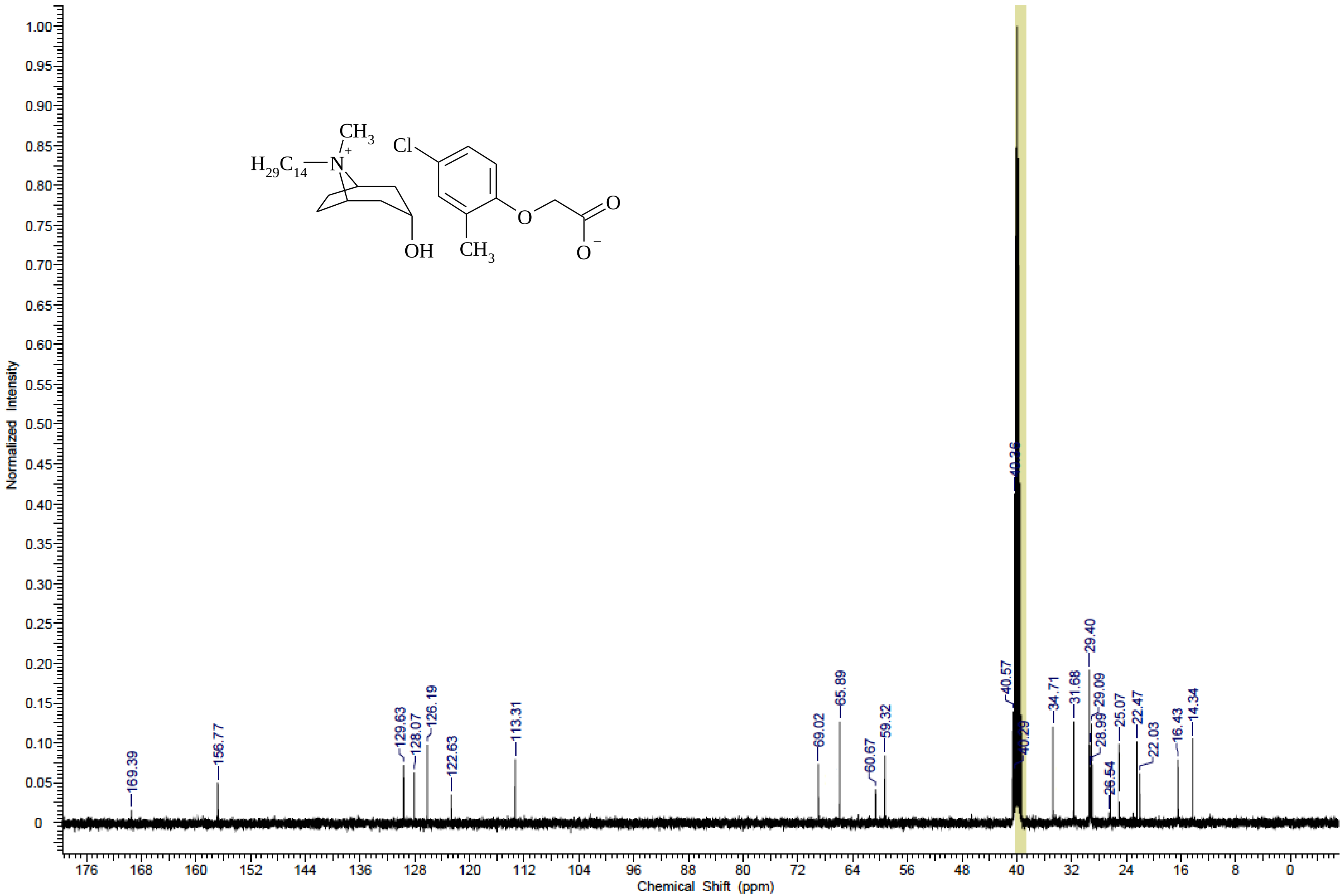

Fig. S8 ^{13}C NMR spectrum of **[QTS-C$_{14}$][MCPA]**.

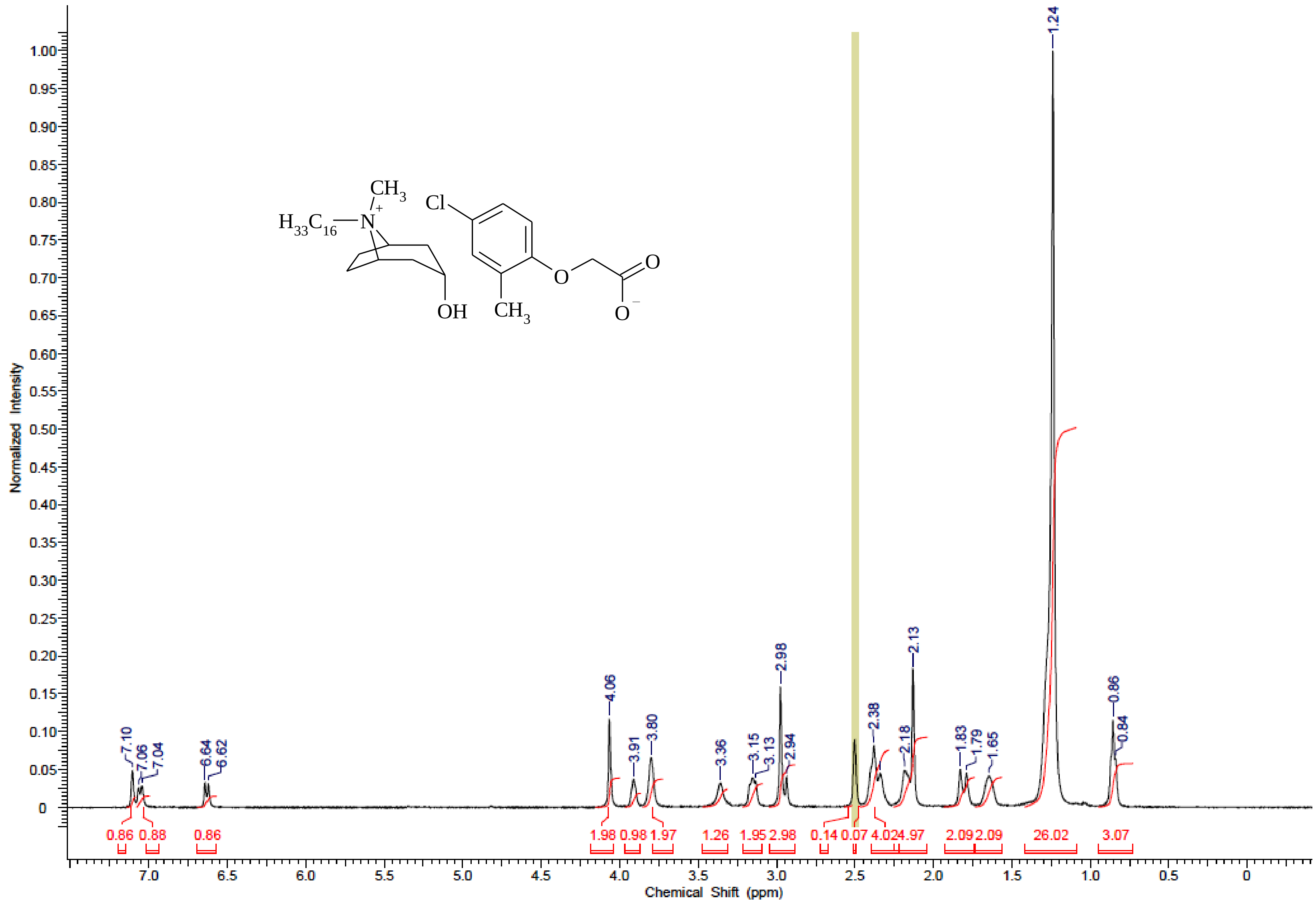

Fig. S9 ^{1}H NMR spectrum of **[QTS-C$_{16}$][MCPA]**.

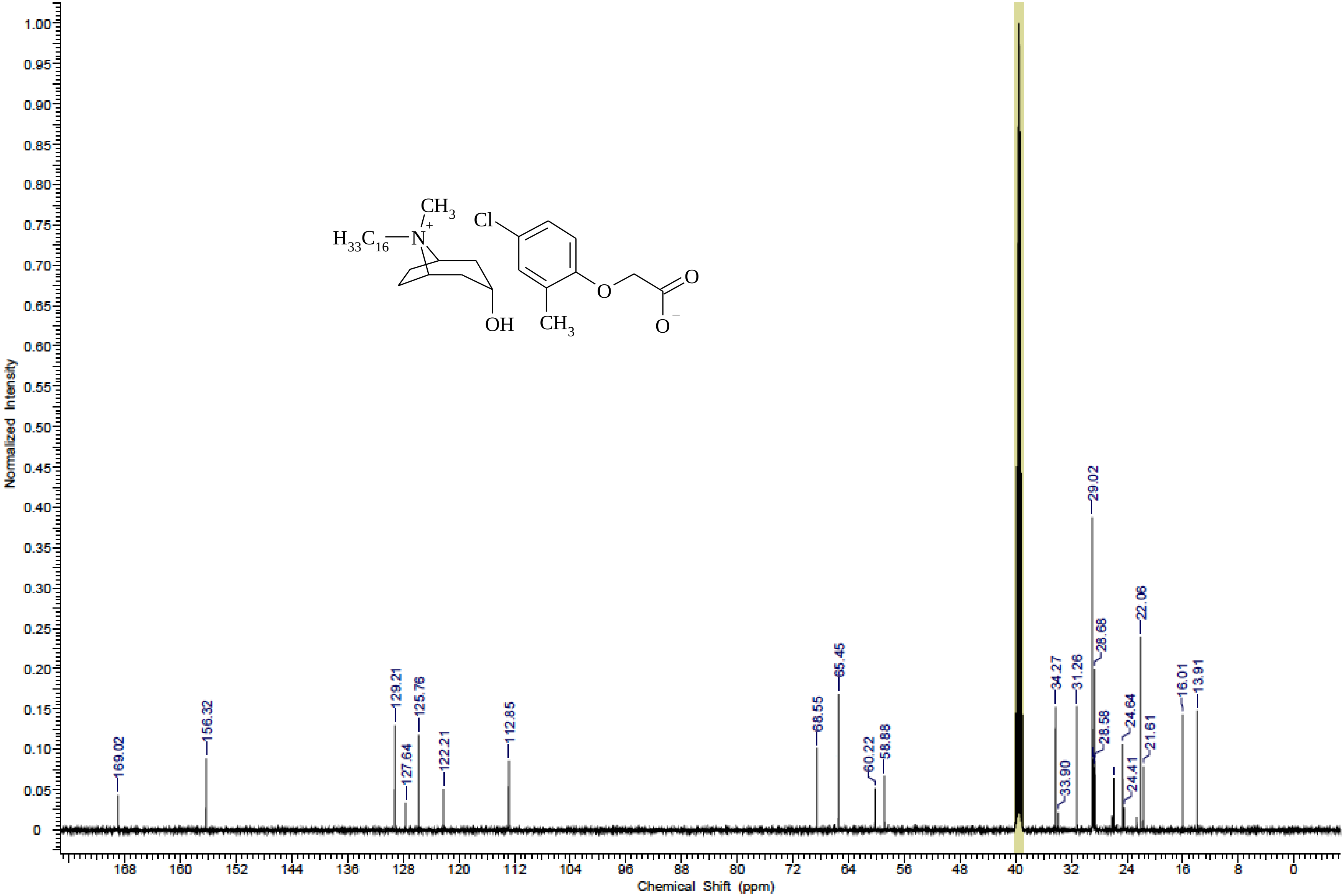

Fig. S10 ^{13}C NMR spectrum of **[QTS-C16][MCPA]**.

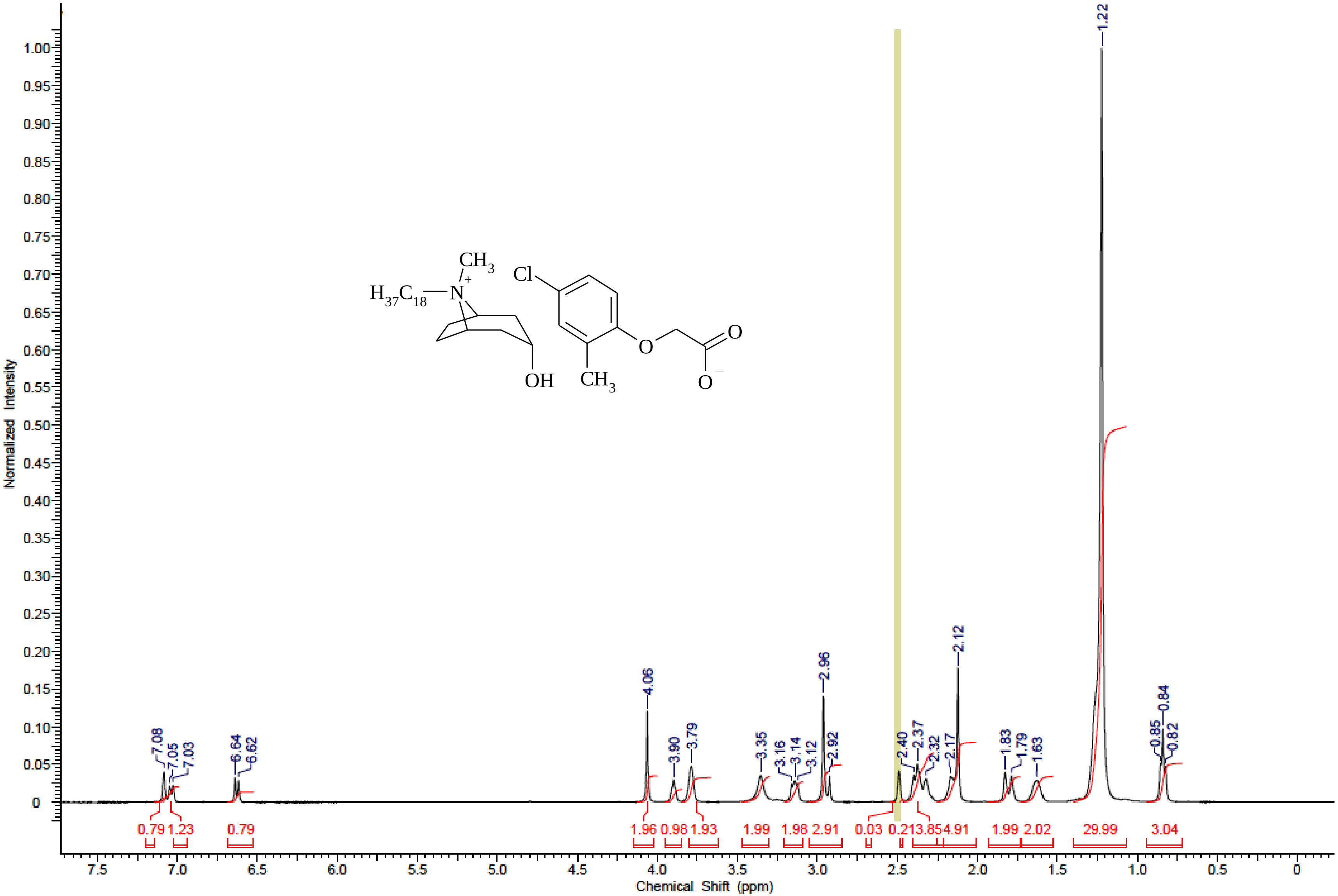

Fig. S11 ^{1}H NMR spectrum of **[QTS-C$_{18}$][MCPA]**.

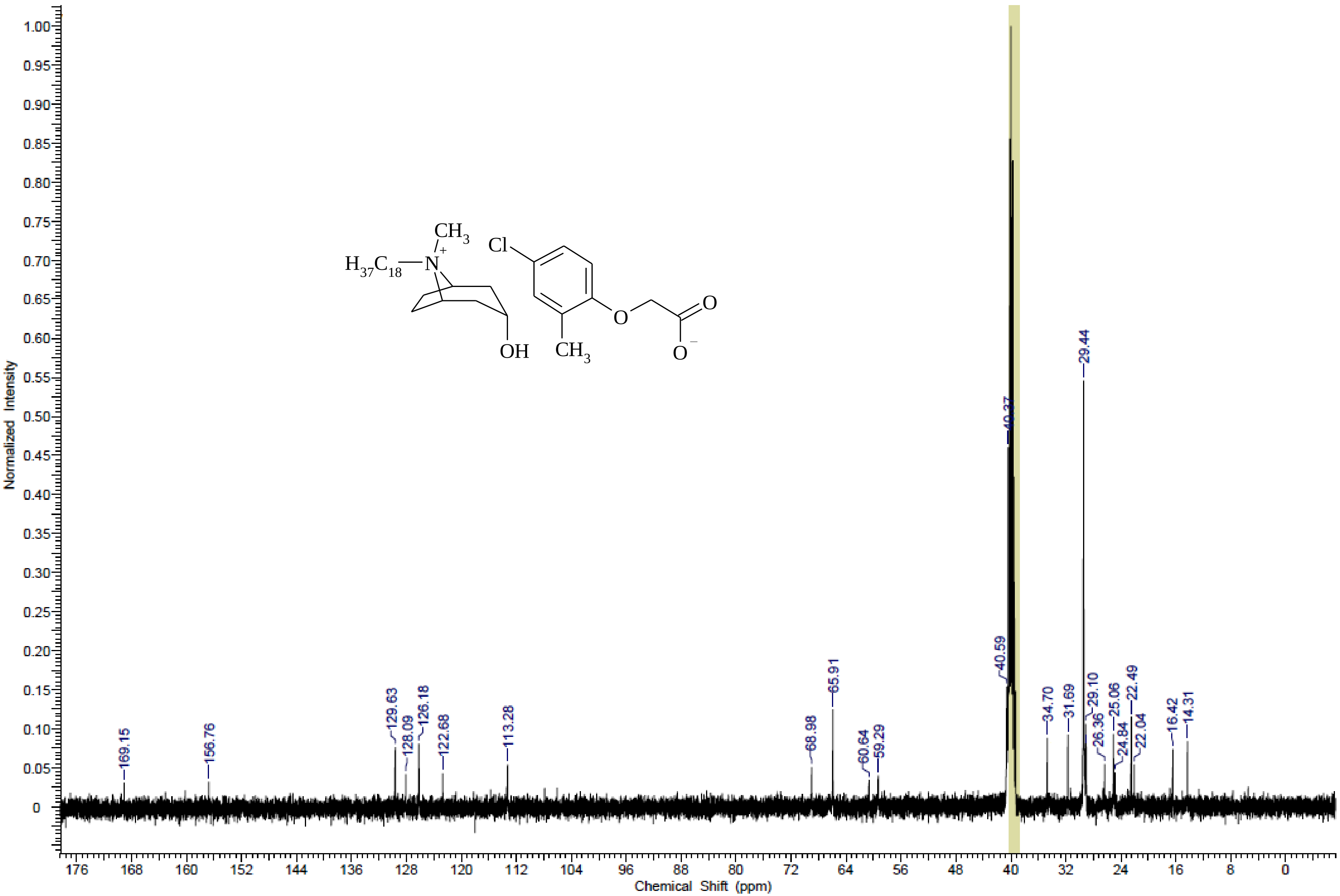

Fig. S12 ^{13}C NMR spectrum of **[QTS-C18][MCPA]**.

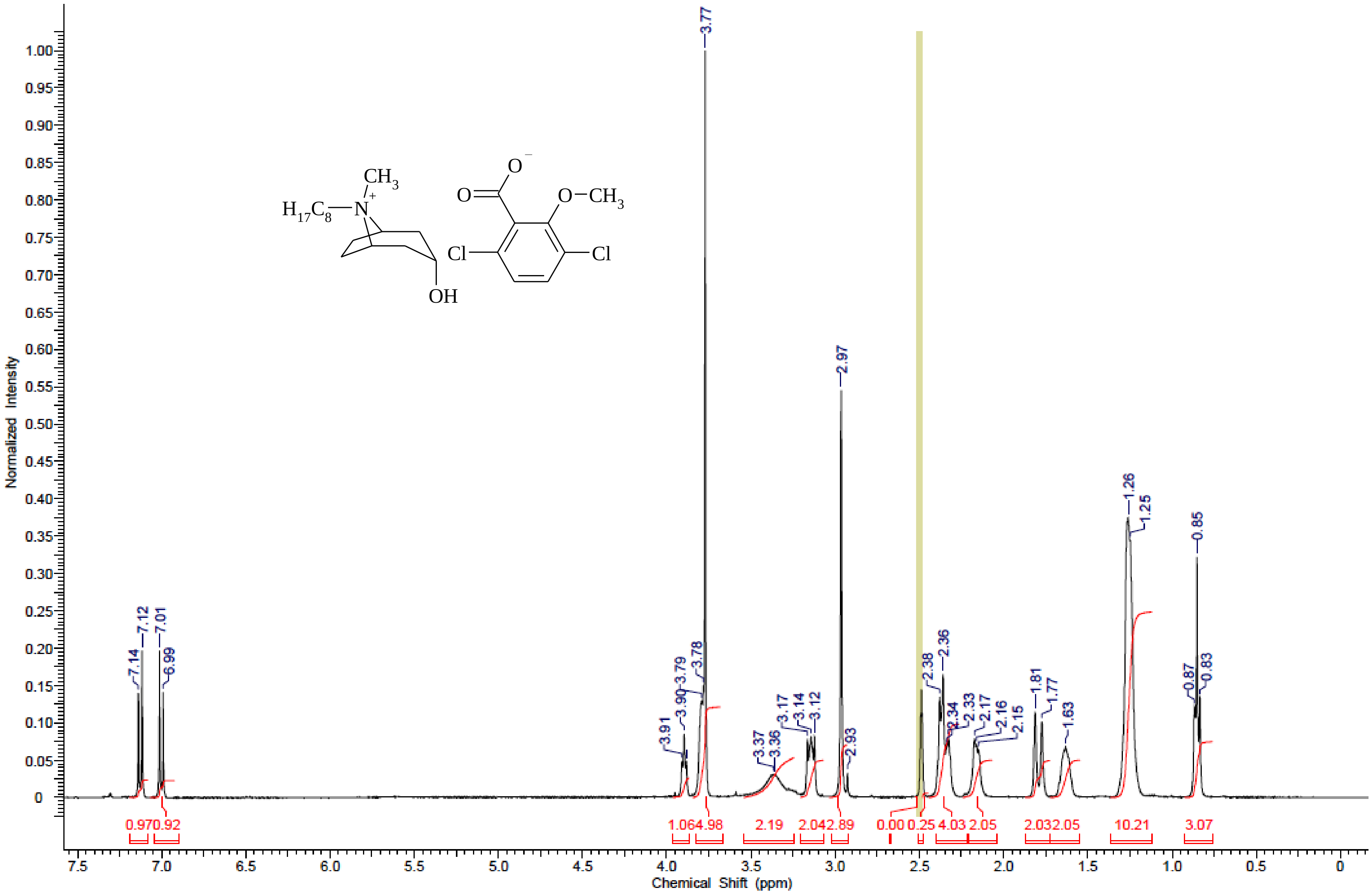

Fig. S13 ^{1}H NMR spectrum of **[QTS-C8][dicamba]**.

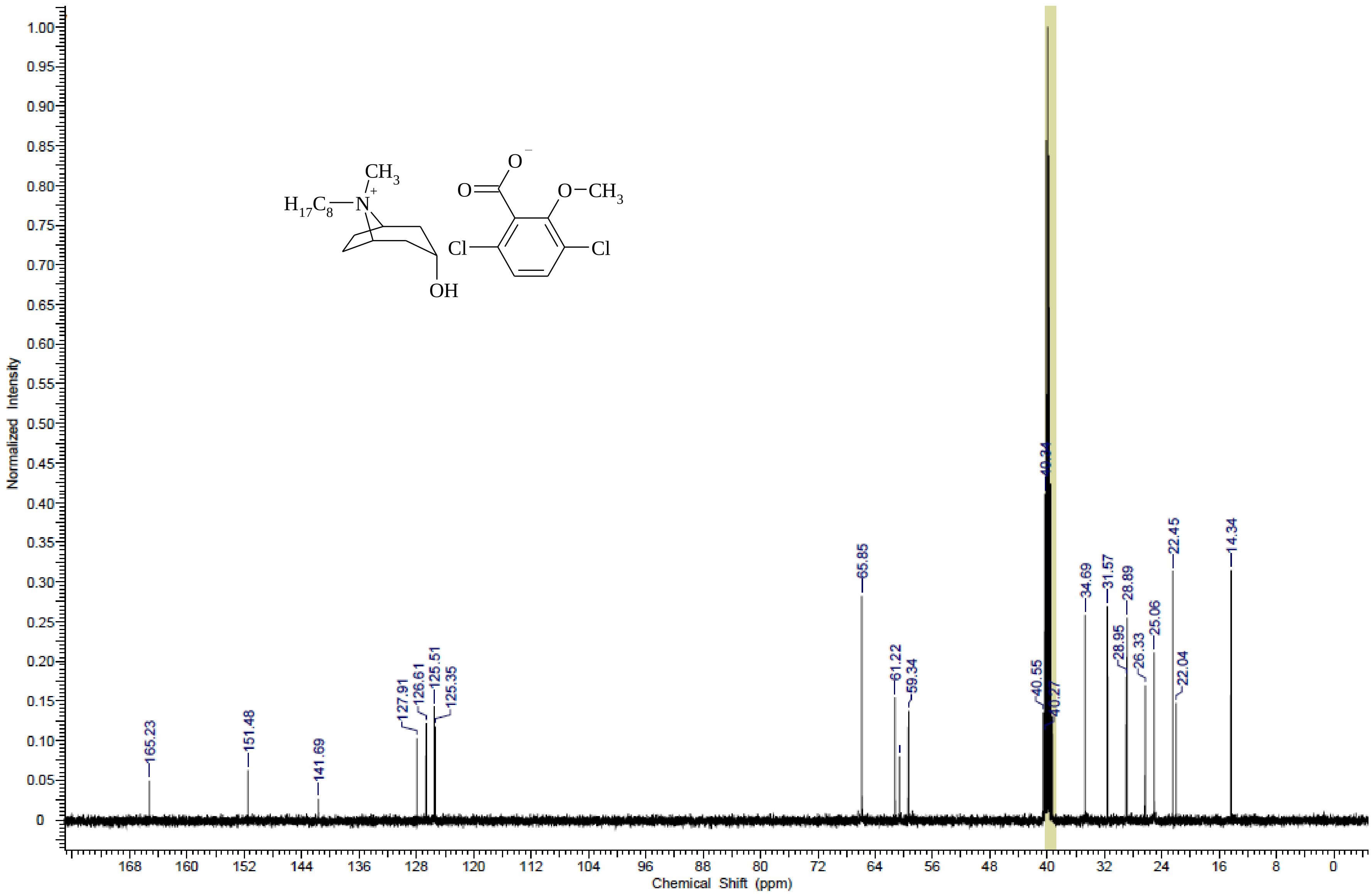

Fig. S14 ^{13}C NMR spectrum of **[QTS-C8][dicamba]**.

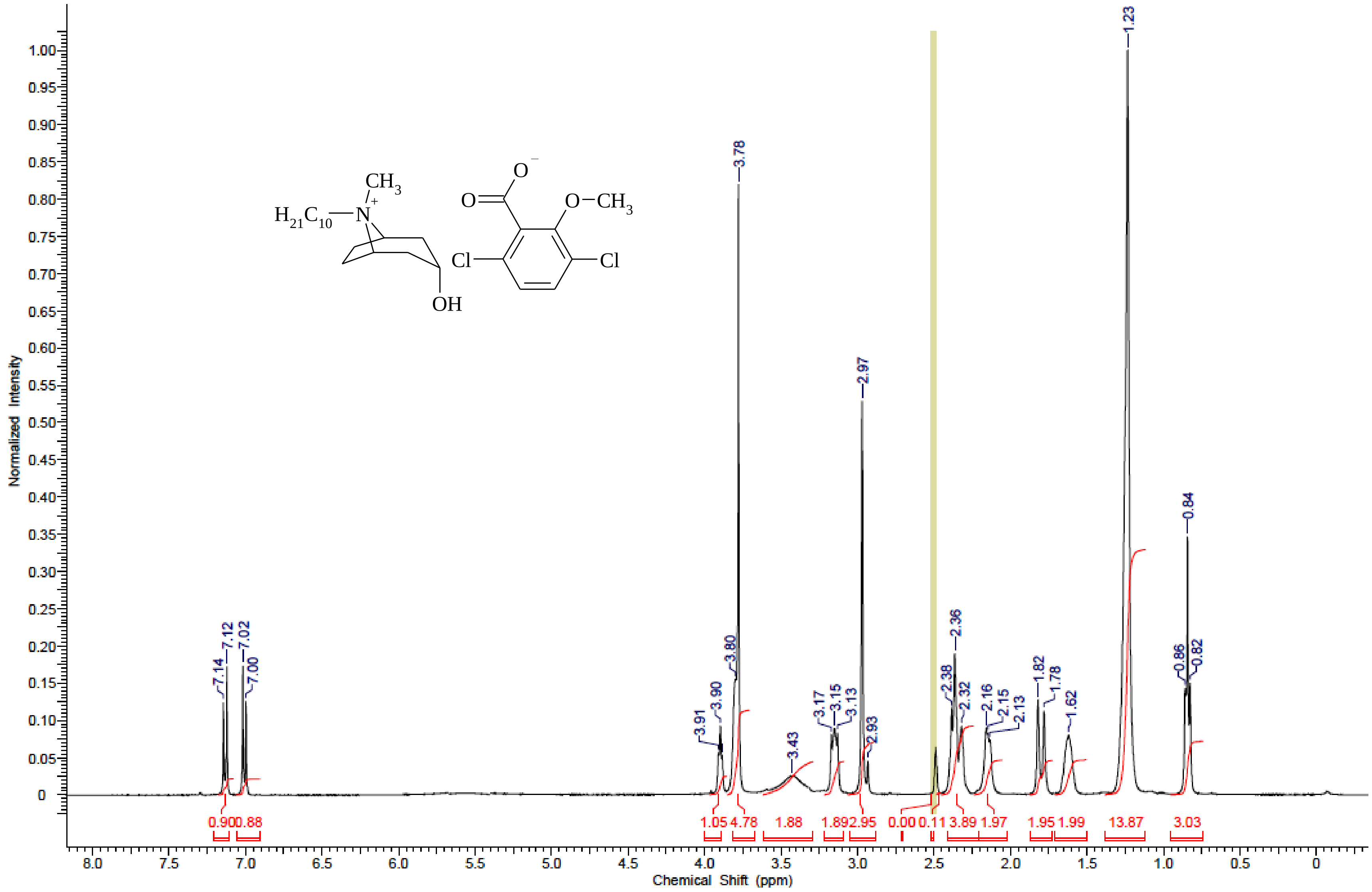

Fig. S15 ^{1}H NMR spectrum of **[QTS-C$_{10}$][dicamba]**.

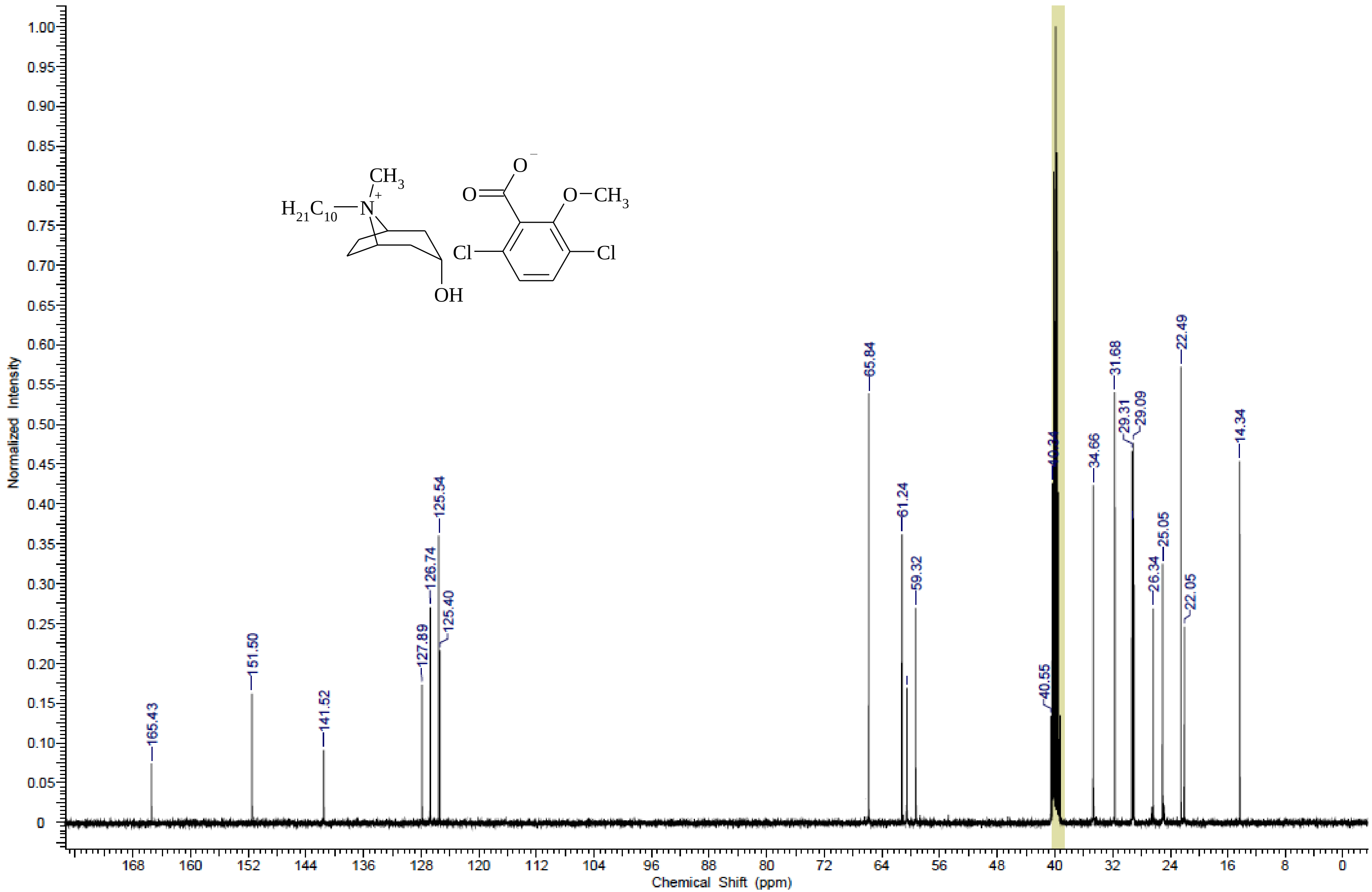

Fig. S16 ^{13}C NMR spectrum of **[QTS-C$_{10}$][dicamba]**.

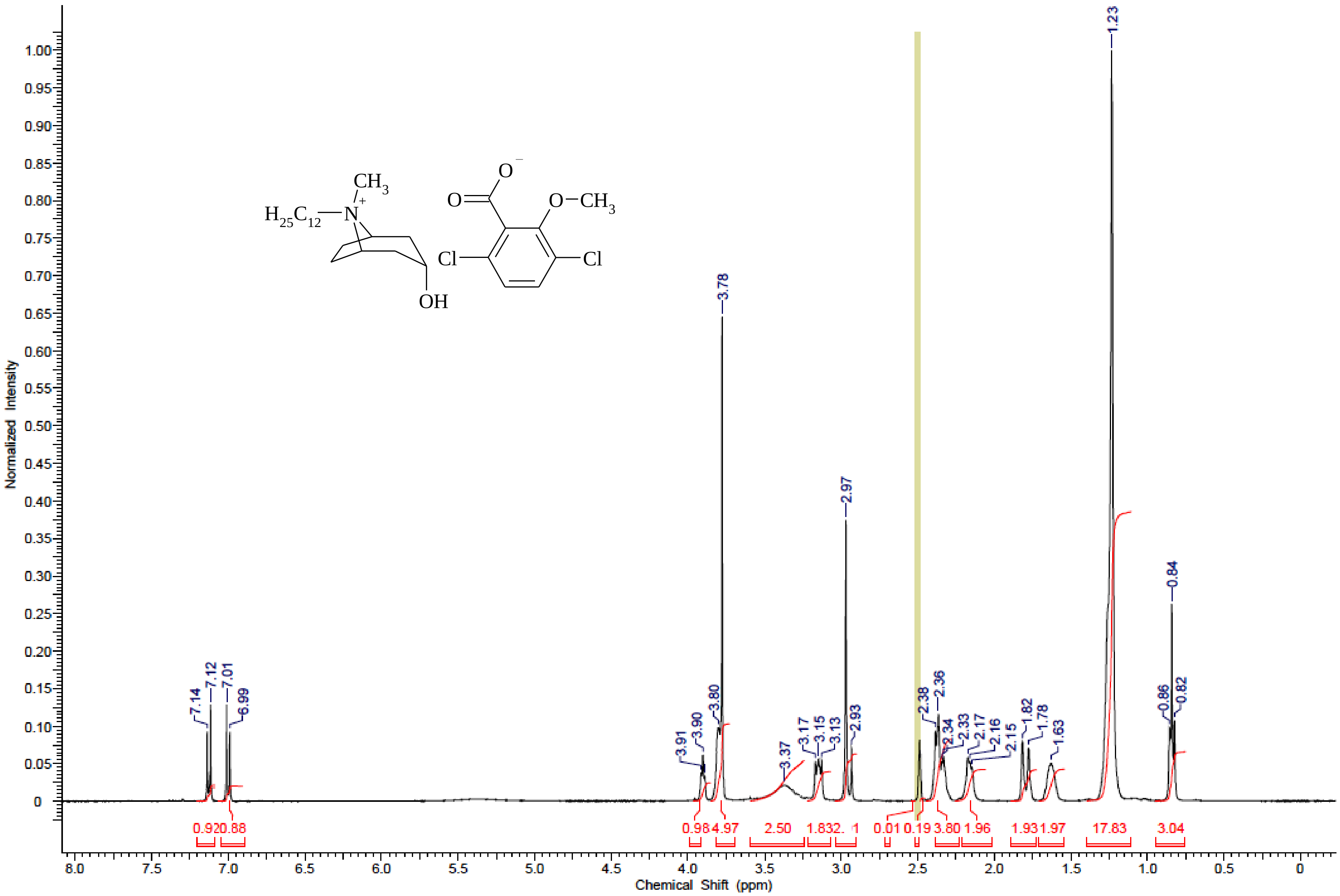

Fig. S17 [1]H NMR spectrum of **[QTS-C12][dicamba]**.

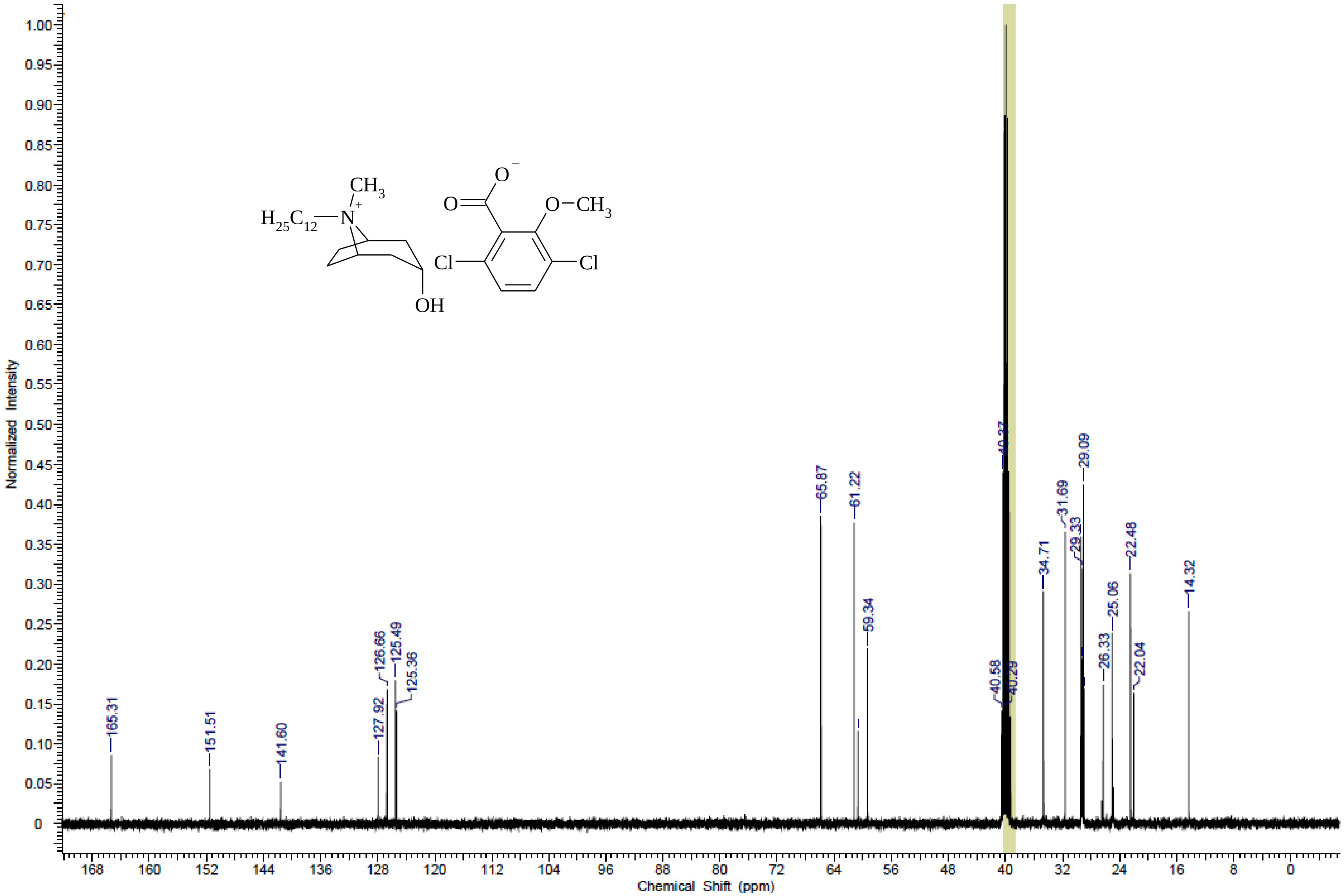

Fig. S18 ^{13}C NMR spectrum of **[QTS-C$_{12}$][dicamba]**.

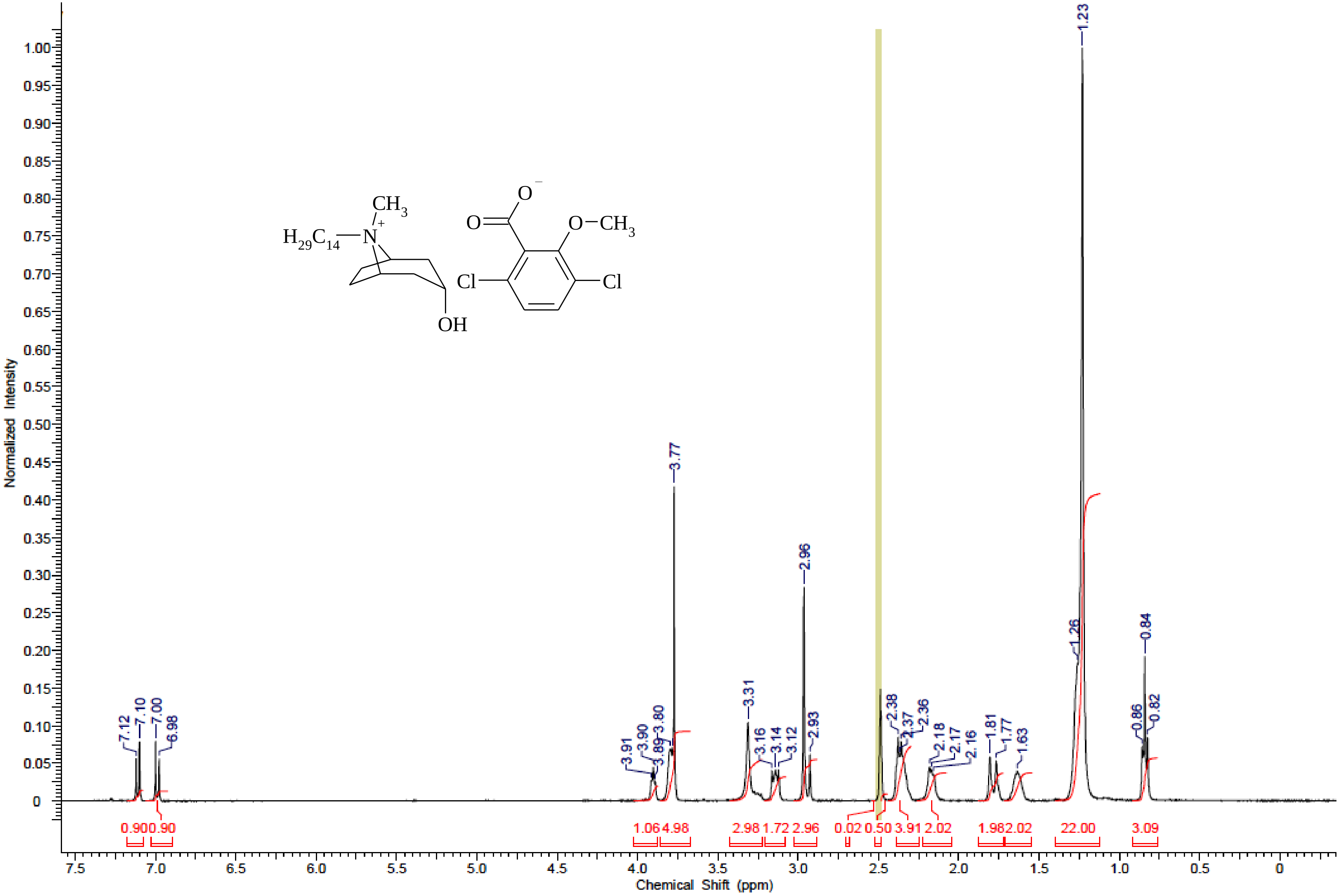

Fig. S19 ^{1}H NMR spectrum of **[QTS-C$_{14}$][dicamba]**.

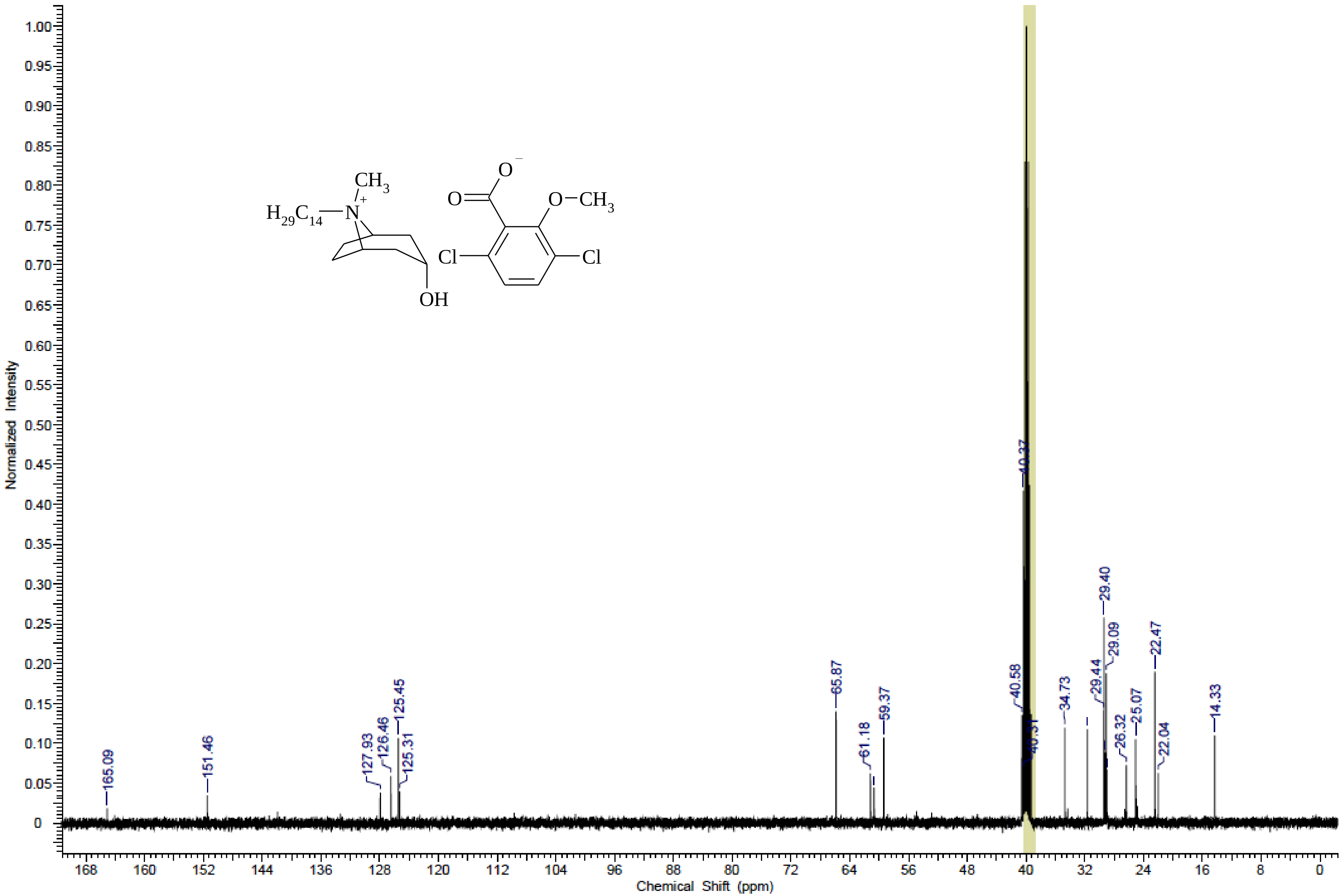

Fig. S20 ^{13}C NMR spectrum of **[QTS-C14][dicamba]**.

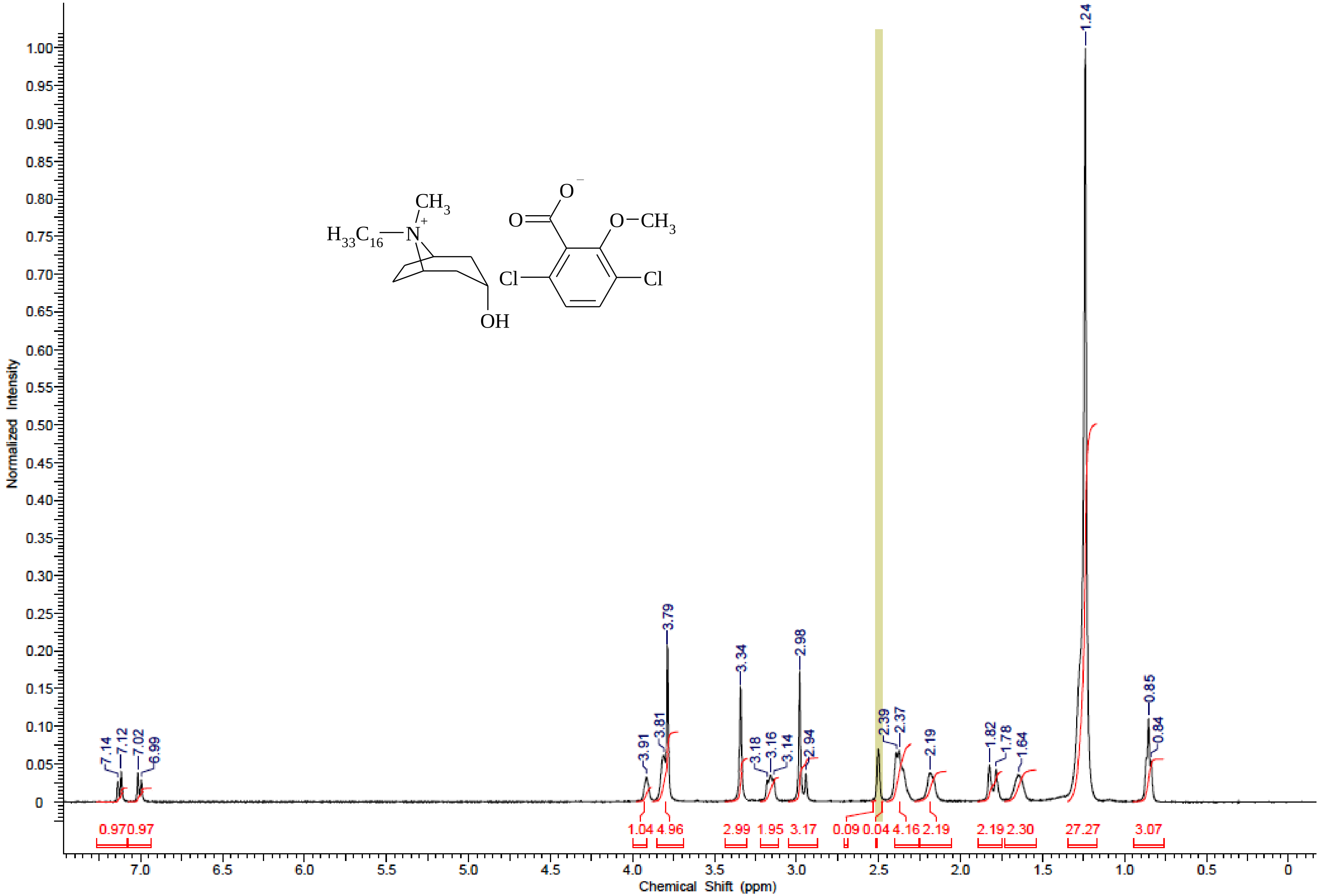

Fig. S21 [1]H NMR spectrum of **[QTS-C16][dicamba]**.

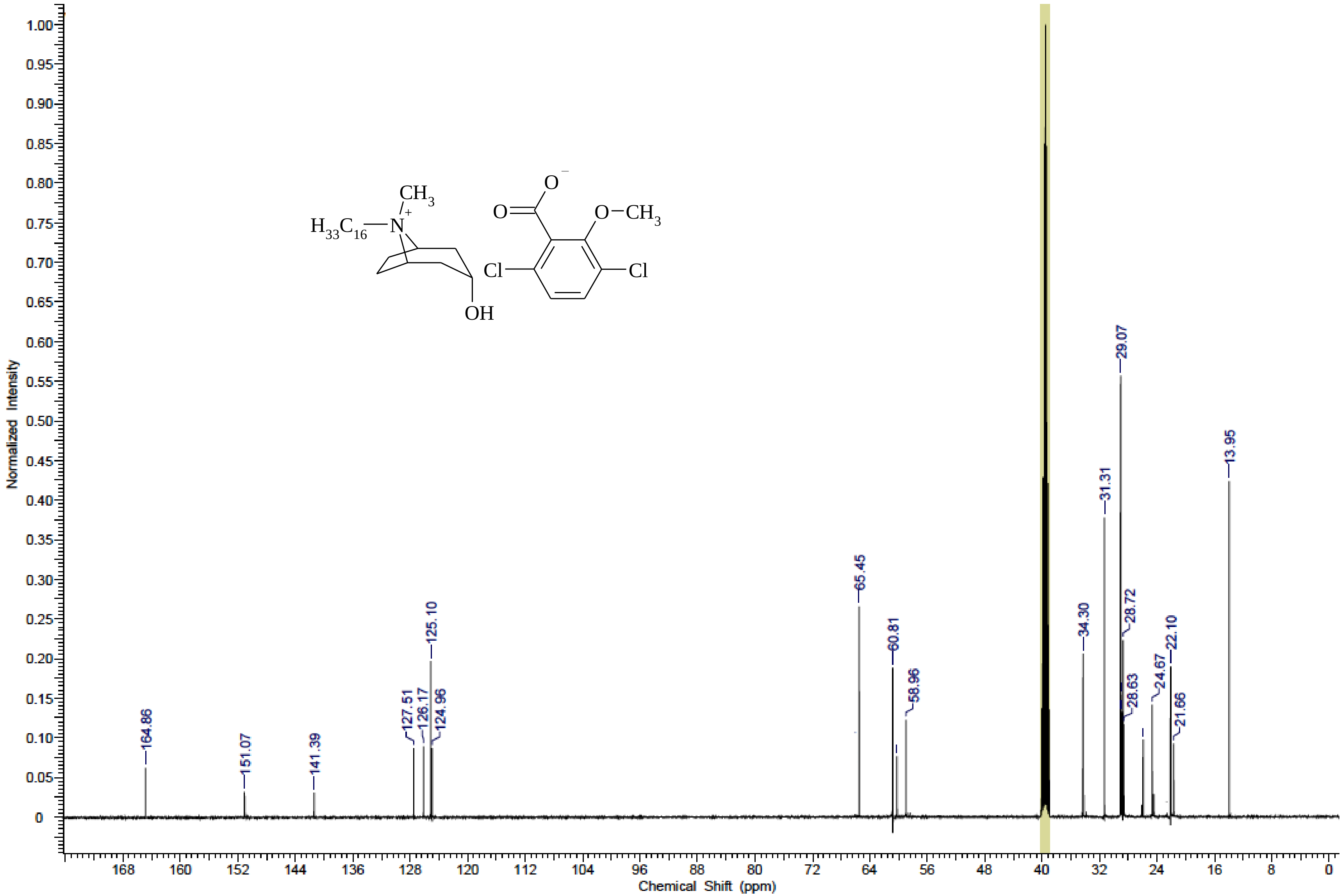

Fig. S22 ^{13}C NMR spectrum of **[QTS-C16][dicamba]**.

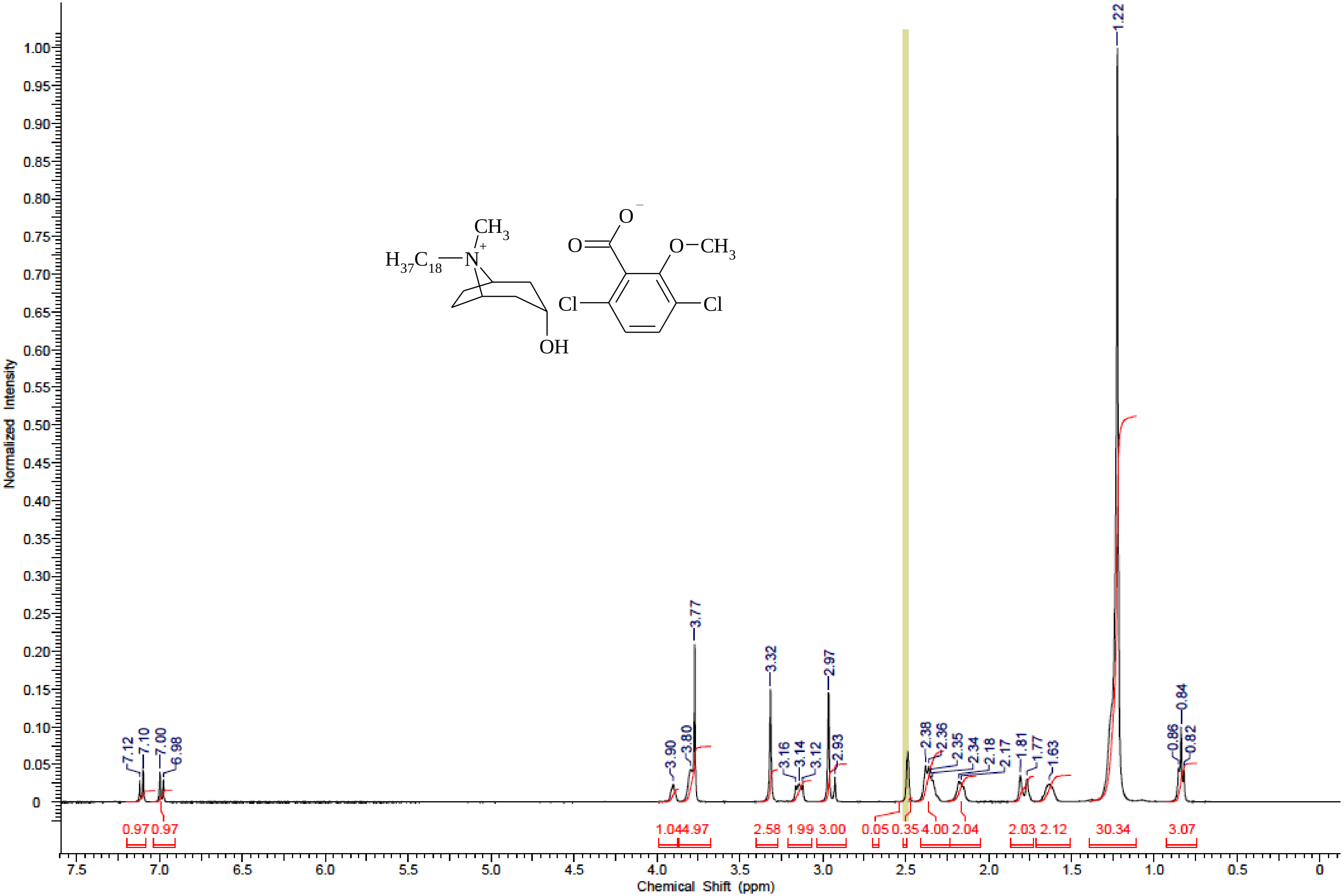

Fig. S23 [1]H NMR spectrum of **[QTS-C₁₈][dicamba]**.

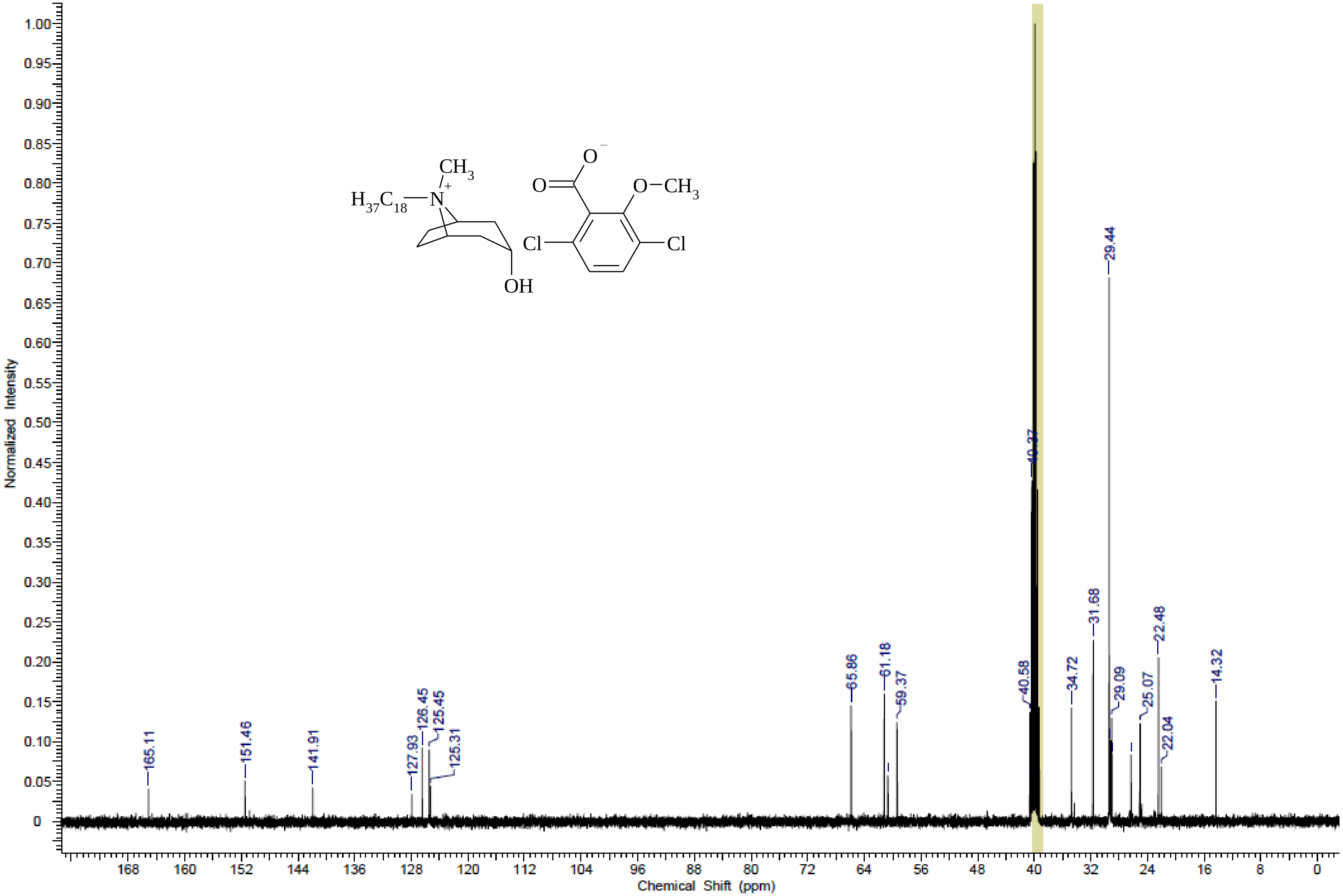

Fig. S24 ^{13}C NMR spectrum of **[QTS-C18][dicamba]**.

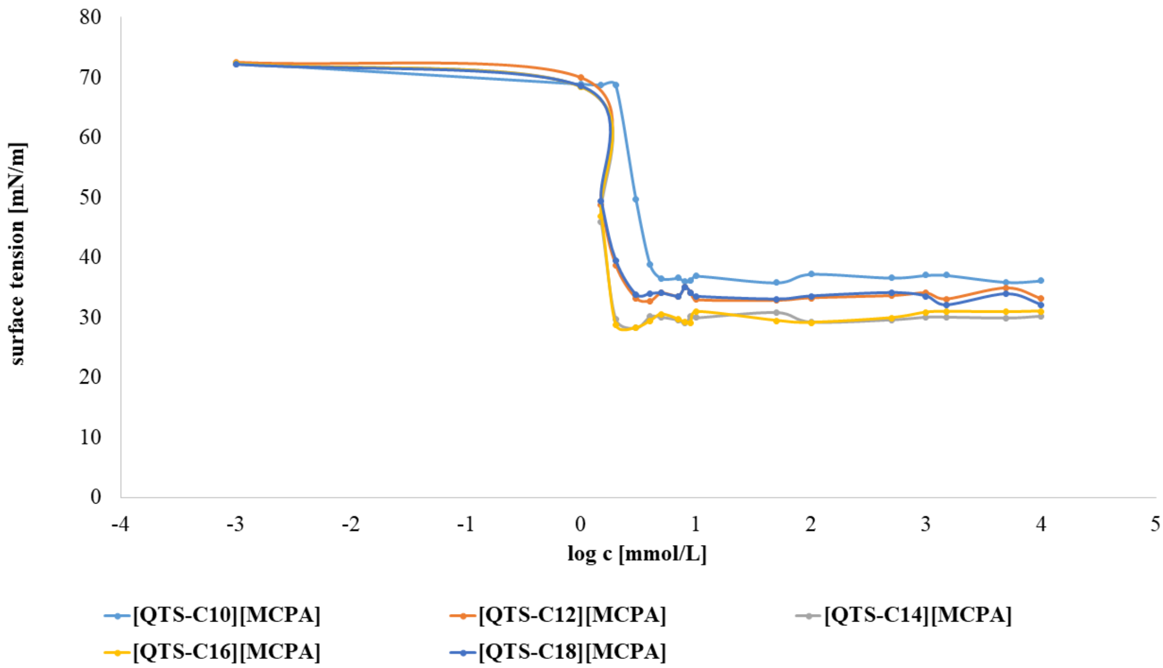

Fig. S25 Surface tension of *N*-alkyltropinium MCPA salts.

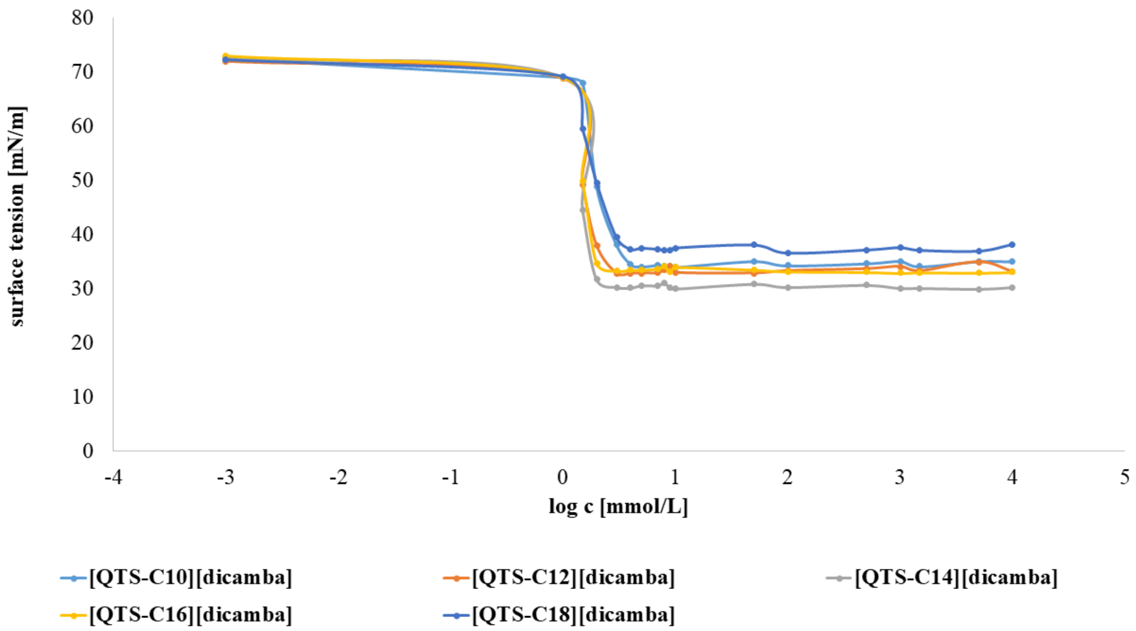

Fig. S26 Surface tension of *N*-alkyltropinium dicamba salts.

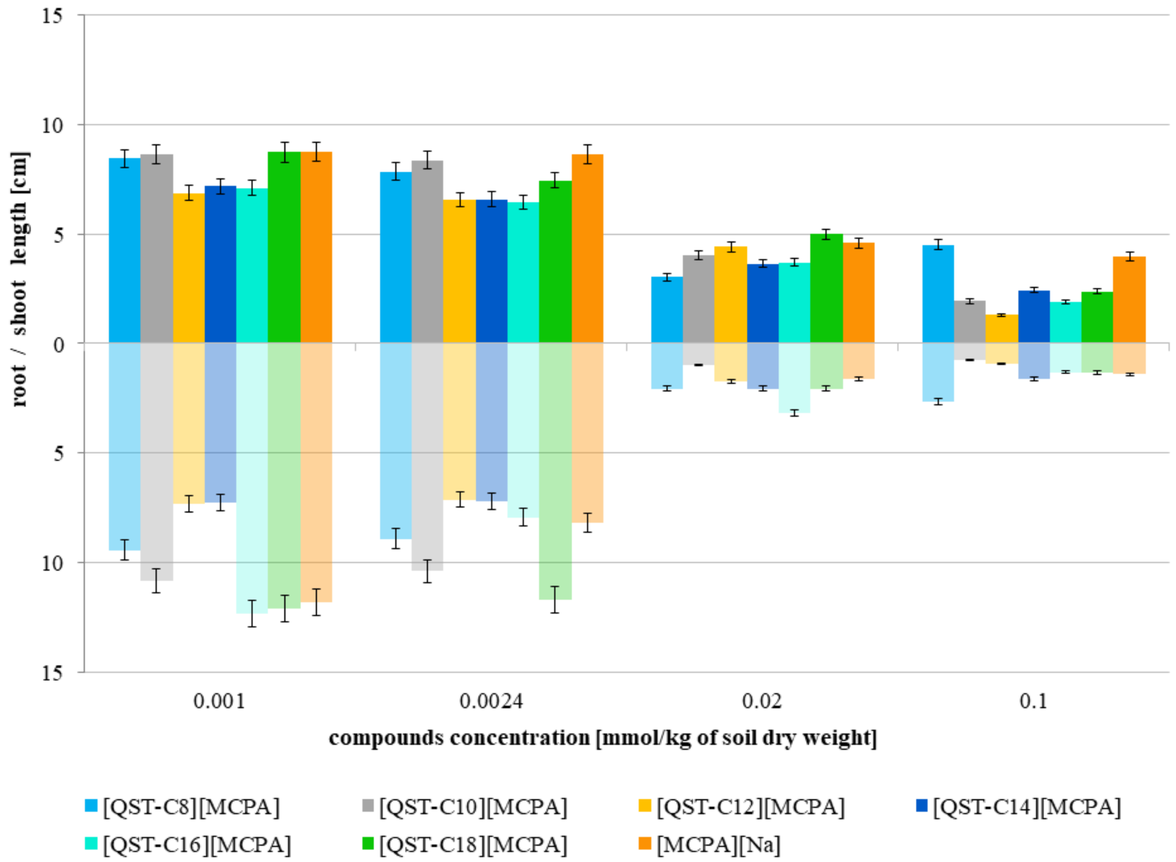

Fig. S27 The effect of *N*-alkyltropinium MCPA salts concentration on the shoots and roots length of maize.

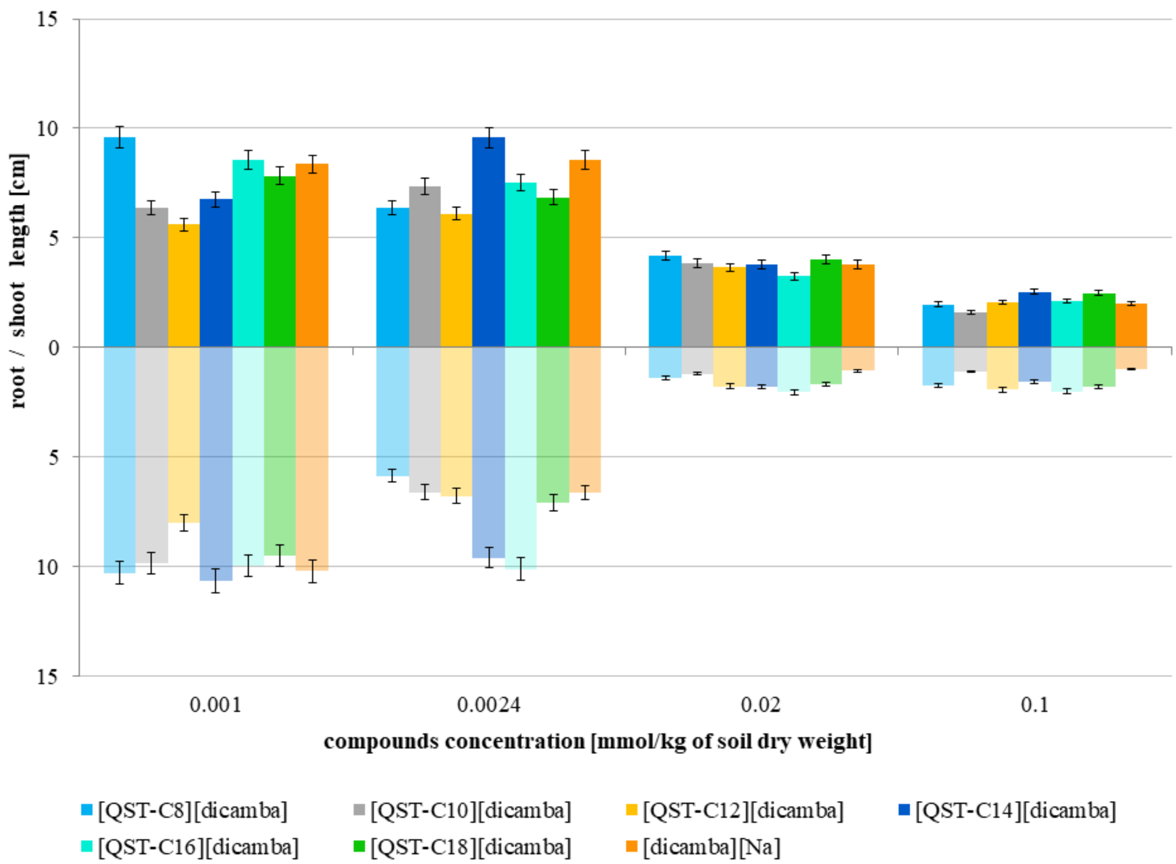

Fig. S28 The effect of *N*-alkyltropinium dicamba salts concentration on the shoots and roots length of maize

Table S1 The effect of *N*-alkyltropinium dicamba and MCPA salts concentration on the germination index of cornflower

Quaternary tropinium salt \ Concentration [mmol/kg of soil d.w.]	Germination index [%] 0.001	0.0024	0.02	0.1
[QTS-C_8][MCPA]	38.61 ± 2.77	34.71 ± 1.23	8.10 ± 1.87	0.00
[QTS-C_{10}][MCPA]	38.83 ± 2.89	19.31 ± 2.36	3.04 ± 2.36	0.00
[QTS-C_{12}][MCPA]	112.58 ± 4.56	64.49 ± 1.47	0.00 ± 0.00	0.00
[QTS-C_{14}][MCPA]	41.65 ± 1.87	20.39 ± 2.34	0.00 ± 0.00	0.00
[QTS-C_{16}][MCPA]	52.28 ± 2.13	20.61 ± 2.14	0.00 ± 0.00	0.00
[QTS-C_{18}][MCPA]	68.02 ± 3.12	42.30 ± 1.12	8.13 ± 1.86	0.00
[MCPA][Na]	39.91 ± 2.54	41.00 ± 1.57	0.00 ± 0.00	0.00
[QTS-C_8][dicamba]	95.41 ± 3.42	106.35 ± 3.45	20.11 ± 3.15	0.00
[QTS-C_{10}][dicamba]	68.61 ± 2.74	55.73 ± 2.42	12.09 ± 2.56	0.00
[QTS-C_{12}][dicamba]	67.27 ± 1.23	75.59 ± 1.89	18.37 ± 1.32	0.00
[QTS-C_{14}][dicamba]	89.42 ± 2.42	72.56 ± 3.48	27.46 ± 2.47	0.00
[QTS-C_{16}][dicamba]	57.60 ± 1.56	61.73 ± 1.56	42.63 ± 1.85	0.00
[QTS-C_{18}][dicamba]	114.08 ± 5.28	132.53 ± 4.02	26.98 ± 1.26	0.00
[dicamba][Na]	113.08 ± 4.63	43.08 ± 2.45	13.10 ± 2.86	0.00

± represents standard error of the mean from three independent samples