Supporting Information

**Hydroquinone monoester of thioctic acid** Synthetic procedure is shown in Scheme 1s. Hydroquinone 1 was converted to mono-tetrabutyldimethylsilyl (TBS) ether 2 using TBSCl in the presence of imidazole in dimethylformamide (DMF) in 82% yield. Thioctic acid 3 was coupled with mono-TBS ether 2 to afford ester 4 using dicyclohexylcarbodiimide (DCC) in the presence of catalytic 4-dimethylaminopyridine (DMAP) in THF in 56% yield. The TBS protective group of ester 4 was removed using potassium fluoride (KF) in the presence of catalytic 18-Crown-6 in tetrahydrofuran (THF) in 43% yield and ester 5 was obtained. The reaction was not progressed completely and ester 4 was recovered and recycled. $^1$H-NMR (300 MHz, CDCl$_3$): 6.9 (d, 2H), 6.8 (d, 2H), 3.6 (m, 1H), 3.1 (m, 2H), 2.5 (t, 2H), 2.4 (m, 1H), 1.9 (m, 1H), 1.7 (m, 4H), 1.6 (m, 2H).

![Scheme 1s](image)

**Scheme 1s.** Synthetic scheme of hydroquinone monoester 5 of thioctic acid.
12,12′-dithiobis(dodecanoic acid hydroquinone monoester) Synthetic procedure is shown in Scheme 2s. To a solution of 6 in methanol was added 0.1 eq. of conc-H$_2$SO$_4$ and the resulting solution was heated. The organic product was recrystallized and 7 was obtained in 94% yield. After a solution of PPh$_3$ in THF was cooled to 0°C, DIAD was added dropwise. After the solution was stirred for 30 min, to a resulting solution was added a mixture solution of 7 and thioacetic acid in THF. The solution was stirred at 0°C for 30 min. The mixture was extracted with ether and concentrated in vacuo. The organic crude was purified three times with column and 8 was obtained. To a solution of 8 was added 2N-NaOH and the solution was heated for 4 h. The resulting solution with white precipitation produced by heating is acidified with 6N-HCl to pH 3 and filtered. After white crude obtained by filtering was dissolved in ethyl acetate, the solution was dried and concentrated in vacuo. Purification of the reaction product with column (hexane-ethyl acetate 10:1) gave 9 (74 % yield). After a little amount of I$_2$ was added to a solution of 9 in THF, the solution was stirred at room temperature for 24 h. The reaction mixture was purified with column (hexane-ethyl acetate 2:1). This procedure gives 10 in 90% yield. 10 was coupled with mono-TBS ether 2 using dicyclohexylcarbodiimide (DCC) in the presence of catalytic 4-dimethylaminopyridine (DMAP) and Et$_3$N in THF. The mixture was filtered through Celite and concentrated. Purification with column (hexane-ethyl acetate 3:1) gives 11 in 70% yield. The TBS protective group of ester 11 was removed by reaction using potassium fluoride (KF) in the presence of catalytic 18-Crown-6 in THF at 0 °C for 24 h. The product was purified with column (hexane-ethyl acetate 2:1) and ester 12 was obtained in 50% yield. $^1$H-NMR (300 MHz, CDCl$_3$): 7.3 (s, 1H), 6.95 (d, 4H), 6.8 (d, 4H), 2.7 (t, 4H), 2.5 (t, 4H), 1.7 (m, 8H), 1.3 (m, 28H).
Scheme 2s. Synthetic scheme of 12,12′-dithiobis(dodecanoic acid hydro-quinone monoester) (12).