

Effects of cationic surfactant on the bioaccumulation of polycyclic aromatic hydrocarbons in rice and the soil microbial community structure

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Content

Supplemental Results

3 tables, 7 figures

Table S1 Polycyclic aromatic hydrocarbon (PAH) concentrations in the soil used in this study.

Group	Compounds	Total concentrations ($\mu\text{g/kg}$ dry soil)	Environmental quality standards ($\mu\text{g/kg}$ dry soil)
2 rings	Naphthalene	118 \pm 5	100
	Acenaphthene	40 \pm 2	500
	Acenaphthylene	27 \pm 4	500
3 rings	Fluorene	43 \pm 2	500
	Phenanthrene	259 \pm 6	500
	Anthracene	49 \pm 4	500
Sum of 3-rings PAHs		417 \pm 12	
	Fluoranthene	909 \pm 25	500
4 rings	Pyrene	736 \pm 18	500
	Benzo[a]anthracene	691 \pm 21	100
	Chrysene	672 \pm 17	100
Sum of 4-rings PAHs		3008 \pm 53	
	Benzo(b)fluoranthene	885 \pm 25	100
5 rings	Benzo(k)fluoranthene	598 \pm 27	200
	Benzo(a)pyrene	792 \pm 35	100
		2274 \pm 65	
Sum of 5-rings PAHs	Indeno(1,2,3-c,d)pyrene	744 \pm 54	100
6 rings	Dibenzo(a,h)anthracene	181 \pm 15	100
	Benzo(g,h,i)perylene	739 \pm 38	500
Sum of 6-rings PAHs		1664 \pm 68	
Σ 16 PAHs		7481 \pm 105	

The environmental quality standards refer to the two orders of magnitude of the PAH concentrations in farmland soils in China (GB 15618-2008). Means \pm standard deviation ($N=3$).

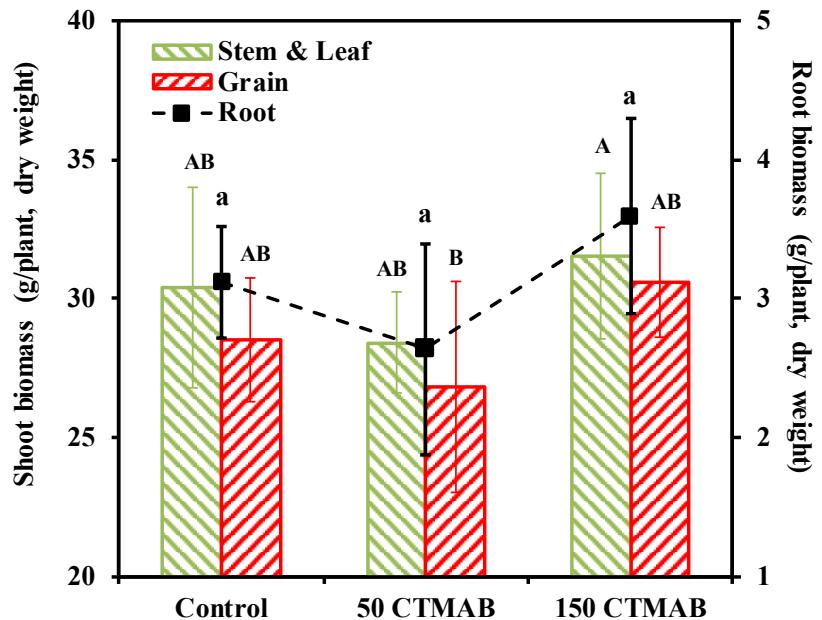


Fig. S1 Dry biomass of rice after 150 days of growth. Control: no cetyltrimethylammonium bromide (CTMAB) addition; 50 CTMAB: 50 mg/kg CTMAB addition; 150 CTMAB: 150 mg/kg CTMAB addition. Different lowercase (root) and capital (shoot) letters indicate significant differences among the treatments based on LSD post hoc comparison tests at $p < 0.05$. Error bars indicate the standard deviation ($N = 3$).

Table S2 Physicochemical characteristics of the soil after 150 days of rice growth.

	pH	Cation exchange capacity (cmol/kg)	Organic matter (g/kg)	Dissolved organic carbon (mg/kg)	Nitrate nitrogen (mg/kg)	Ammonium nitrogen (mg/kg)
Control	7.38 ± 0.02 ab	14.58 ± 0.30 c	20.02 ± 0.07 ab	302 ± 12 ab	51.26 ± 0.30 a	31.52 ± 0.50 b
50 CTMAB	7.40 ± 0.06 ab	14.72 ± 0.15 c	20.72 ± 0.24 ab	289 ± 7 ab	51.06 ± 1.46 a	35.12 ± 1.08 b
150 CTMAB	7.49 ± 0.05 a	14.84 ± 0.15 c	21.34 ± 0.82 a	312 ± 18 a	52.67 ± 0.05 a	66.91 ± 2.66 a

Control: no cetyltrimethylammonium bromide (CTMAB) addition; 50 CTMAB: 50 mg/kg CTMAB addition; 150 CTMAB: 150 mg/kg CTMAB addition. Mean values with the same letter in a column are not significantly different among treatments based on LSD post hoc comparison tests at the 5% level. Means ± standard deviation ($N = 3$).

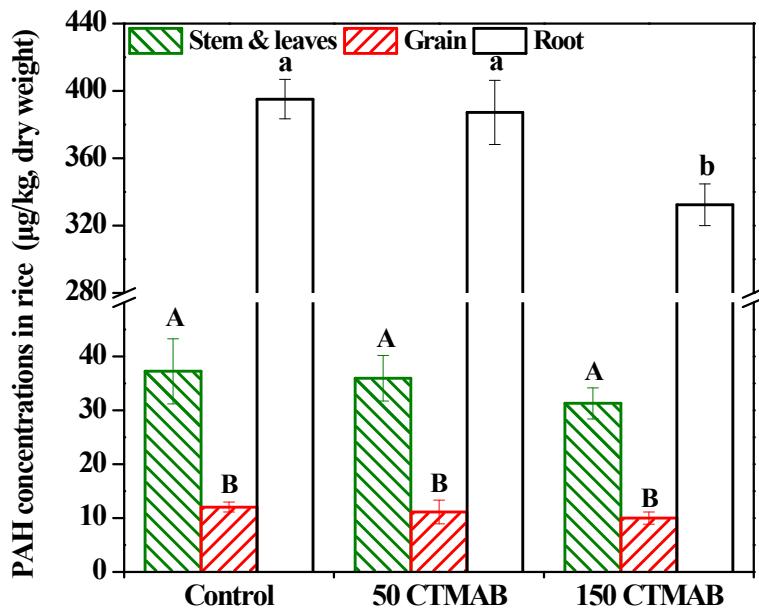


Fig. S2 Concentrations of PAHs in rice grown in soils amended with/without cetyltrimethylammonium bromide (CTMAB). Control: no CTMAB addition; 50 CTMAB: 50 mg/kg CTMAB addition; 150 CTMAB: 150 mg/kg CTMAB addition. Different lowercase (root) and capital (stem, leaf and grain) letters indicate significant differences among the treatments based on LSD post hoc comparison tests at $p < 0.05$. Error bars indicate the standard deviation ($N = 3$).

Table S3 Bioconcentration factors of carrot shoots and roots in the different treatments.

Root-shoot translocation factor		BCF _{Shoot}	BCF _{Root}	BCF _{Grain}
Control	0.125 ± 0.021 a	0.0065 ± 0.0006 a	0.0686 ± 0.0023 a	0.0021 ± 0.0003 a
50 CTMAB	0.122 ± 0.018 a	0.0065 ± 0.0009 a	0.0682 ± 0.0013 a	0.0020 ± 0.0001 a
150 CTMAB	0.124 ± 0.013 a	0.0059 ± 0.0005 a	0.0629 ± 0.0009 b	0.0019 ± 0.0001 a

Control: no cetyltrimethylammonium bromide (CTMAB) addition; 50 CTMAB: 50 mg/kg CTMAB addition; 150 CTMAB: 150 mg/kg CTMAB addition. Mean values with the same letter in a column are not significantly different among treatments based on LSD post hoc comparison tests at the 5% level. Means ± standard deviation ($N = 3$).

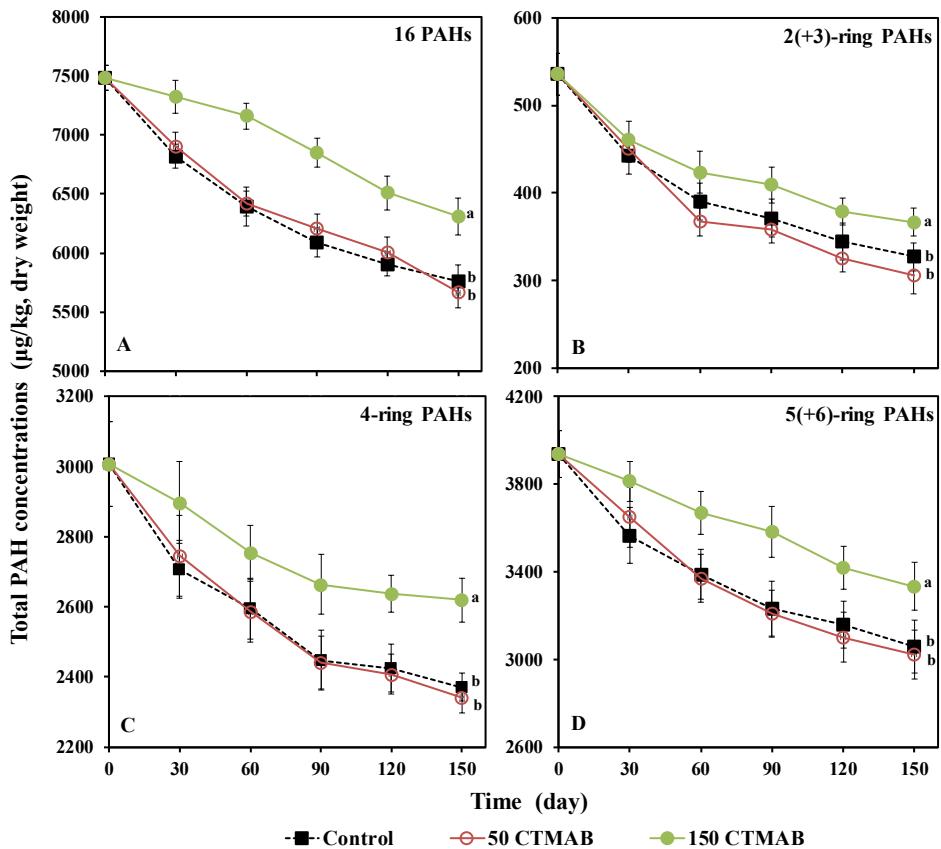


Fig. S3 Time course of the total concentrations of \sum 16 PAHs (A), 2(+3)-ring (B), 4-ring (C), and 5(+6)-ring (D) PAHs in the soils after 150 days of rice growth. Control: no cetyltrimethylammonium bromide (CTMAB) addition; 50 CTMAB: 50 mg/kg CTMAB addition; 150 CTMAB: 150 mg/kg CTMAB addition. Different letters indicate significant differences among the treatments based on LSD post hoc comparison tests at $p < 0.05$. Error bars indicate the standard deviation ($N=3$).

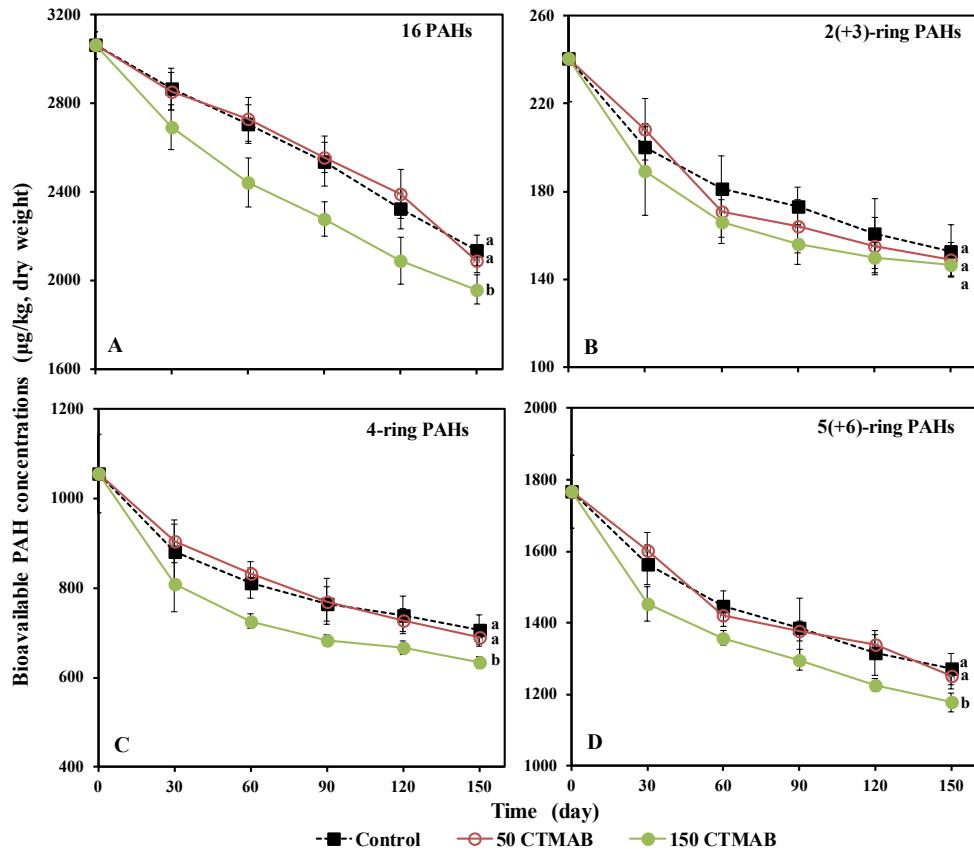


Fig. S4 Time course of the HPCD-extracted concentrations of Σ 16 (A), 2(+3)-ring (B), 4-ring (C), and 5(+6)-ring (D) PAHs in the soils after 150 days of rice growth. Control: no cetyltrimethylammonium bromide (CTMAB) addition; 50 CTMAB: 50 mg/kg CTMAB addition; 150 CTMAB: 150 mg/kg CTMAB addition. Different letters indicate significant differences among the treatments based on LSD post hoc comparison tests at $p < 0.05$. Error bars indicate the standard deviation ($N = 3$).

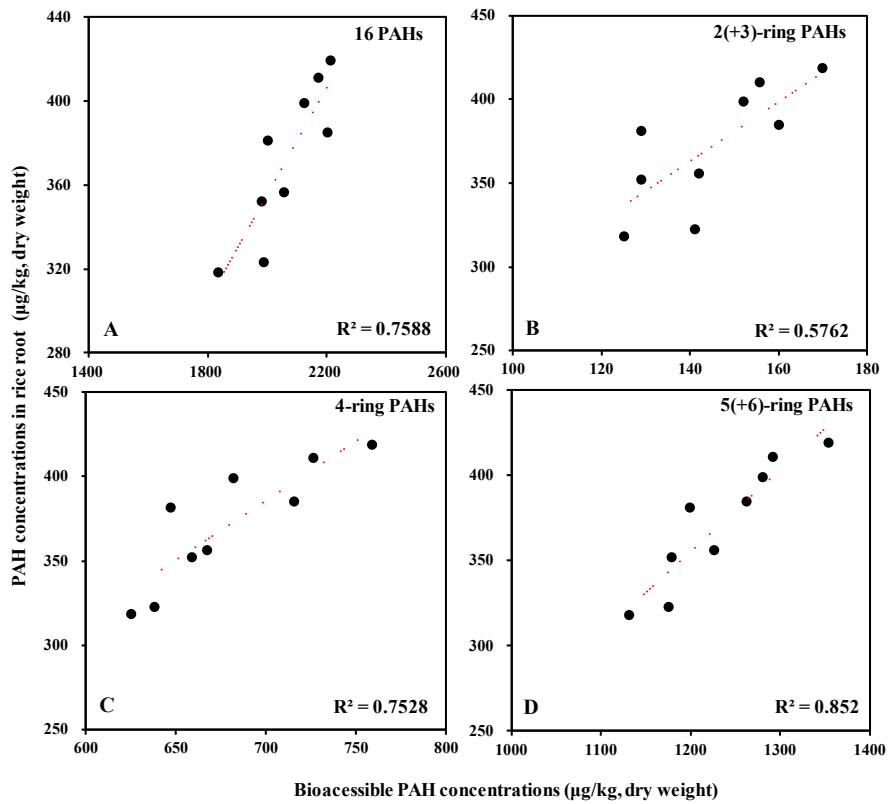


Fig. S5 Correlations between the bioaccumulated concentrations in rice roots and the bioavailable concentrations of $\sum 16$ PAHs (A), 2(+3)-ring (B), 4-ring (C), and 5(+6)-ring (D) PAHs in the soil amended with/without cetyltrimethylammonium bromide. Error bars indicate the standard deviation ($N = 3$).

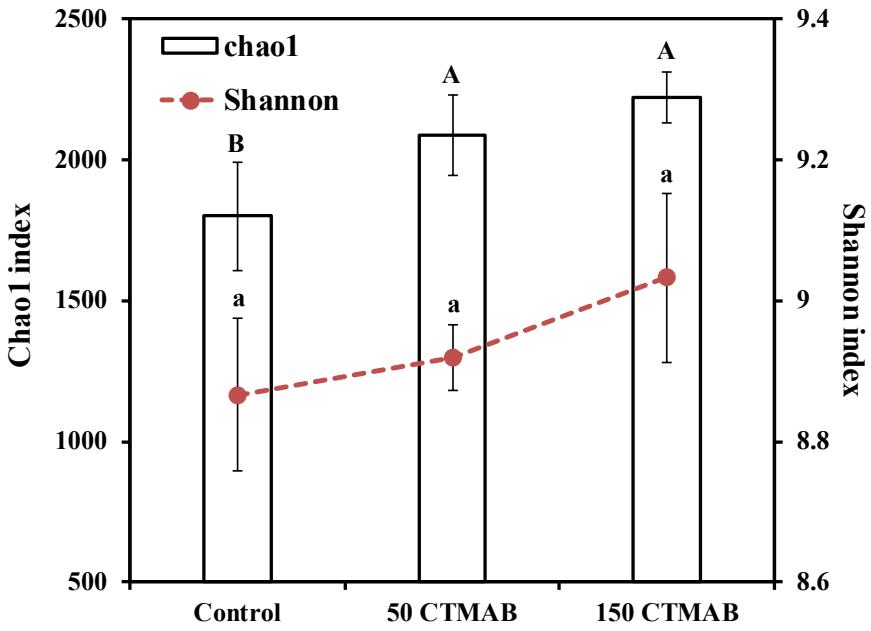


Fig. S6 Species richness and bacterial diversity respectively expressed as chao1 and Shannon indexes in the soils after 150 days of rice growth. Control: no cetyltrimethylammonium bromide (CTMAB) addition; 50 CTMAB: 50 mg/kg CTMAB addition; 150 CTMAB: 150 mg/kg CTMAB addition. Different lowercase (Shannon) and capital letters (chao1) indicate significant differences among the treatments by LSD post-hoc comparison tests at $p < 0.05$. Error bars indicate the standard deviation ($N = 3$).

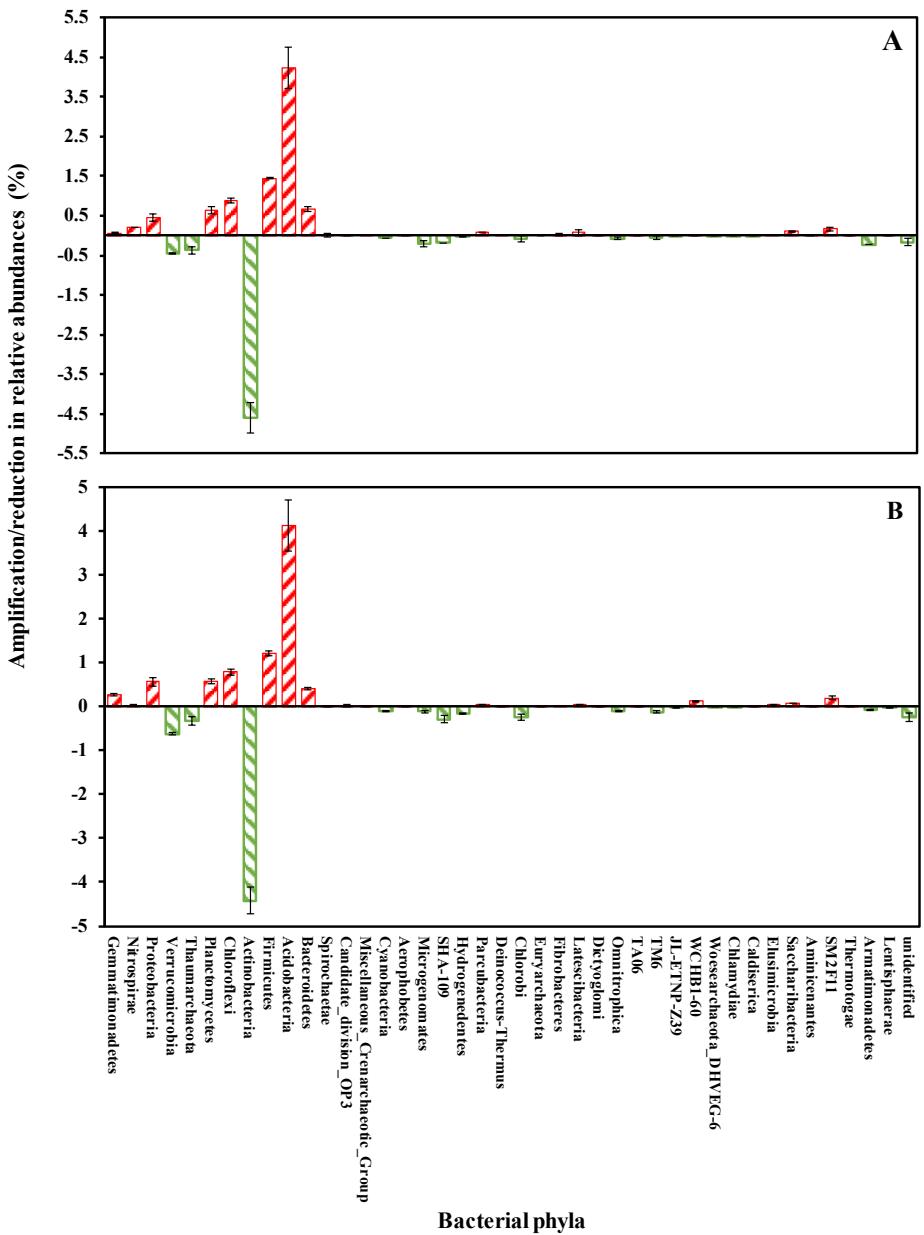


Fig. S7 Amplification/reduction in relative abundances of bacterial phyla in the 50 cetyltrimethylammonium bromide (CTMAB) treatment (A), and that in the 150 CTMAB treatment (B) compared to the control. Error bars indicate the standard deviation ($N = 3$).