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# Supplementary materials

## The title: Freshwater organic micropollutants alter submerged macrophyte litter decomposition dynamics and microbial community in the surface sediments

Author's/Co-authors: Fan Wu[1, 2], Ziyi Yang [1], Tao Lyu[2]*, Xiaohong Zhou [1]*, Qingjie Xie[1]

**Affiliation (s)**

1 School of the Environment and Safety Engineering, Jiangsu University, Zhenjiang 212013, China.

2 Faculty of Engineering and Applied Sciences, Cranfield University, Bedfordshire MK43 0AL, UK.

* Corresponding author: Xiaohong Zhou, Tao Lyu

E-mail: xhzhou0214@ujs.edu.cn, T.Lyu@cranfield.ac.uk

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**Table S1** Summarized results of physicochemical parameters in freshwater sediment

| | $NH_4^+$-N mg·kg$^{-1}$ | $NO_3^-$-N mg·kg$^{-1}$ | O.M. % | TP g·kg$^{-1}$ | TC g·kg$^{-1}$ | TN g·kg$^{-1}$ | pH |
|---|---|---|---|---|---|---|---|
| **Initial sediment** | 0.08±0.00 | 1.58±0.11 | 0.13±0.03 | 0.25±0.00 | 7.95±0.11 | 1.07±0.00 | 7.22±0.27 |

**Table S2** P-value of analysis of similarities (ANOSIM) and permutational multivariate analysis of variance (PERMANOVA) test results at the OTU level

| Group | ANOSIM | PERMANOVA |
|---|---|---|
| CK and LD group | 0.001** | 0.001** |
| CK and ALD group | 0.001** | 0.001** |
| LD and ALD group | 0.861 | 0.462 |
| N, D and ND-ALD group | 0.978 | 0.938 |
| CK Time group | 0.267 | 0.155 |
| LD Time group | 0.001** | 0.004** |
| N-ALD time group | 0.001** | 0.007** |
| D-ALD time group | 0.001** | 0.006** |
| ND-ALD time group | 0.001** | 0.004** |

(Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). * and ** indicate significant differences ($P$<0.05 and $P$<0.01))

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**Table S3** Mantel test results in both the microbial community matrix (at the OTU level) and influence factor matrix based on Bray-curtis distance

| Matrix1 (Species) | Matrix2 | Mantel *r* statistic | *P* value |
|---|---|---|---|
| CK group | Physicochemical parameters of the sediment | -0.20618 | 0.339 |
| LD group | Litter-related factors | 0.74982 | 0.001** |
| | Physicochemical parameters of the sediment | 0.73302 | 0.001** |
| ALD group | Litter-related factors | 0.77288 | 0.001** |
| | Physicochemical parameters of the sediment | 0.58788 | 0.001** |
| | Antibiotic concentration | 0.61103 | 0.001** |
| N_ALD group | Litter-related factors | 0.77367 | 0.001** |
| | Physicochemical parameters of the sediment | 0.55843 | 0.002** |
| | Antibiotic concentration | 0.76642 | 0.001** |
| D_ALD group | Litter-related factors | 0.91055 | 0.001** |
| | Physicochemical parameters of the sediment | 0.70549 | 0.001** |
| | Antibiotic concentration | 0.88108 | 0.001** |
| ND_ALD group | Litter-related factors | 0.66212 | 0.001** |
| | Physicochemical parameters of the sediment | 0.6567 | 0.001** |
| | Antibiotic concentration | 0.64786 | 0.001** |

(Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). * and ** indicate significant differences ($P$<0.05 and $P$<0.01))

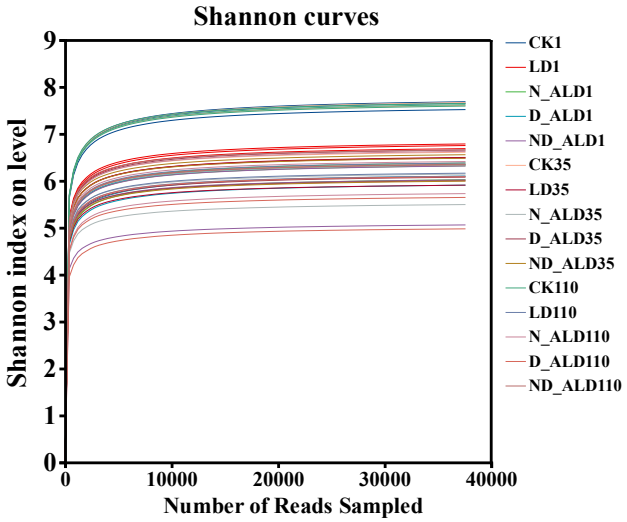



**Fig. S1** Shannon curves of bacterial microorganisms in freshwater sediment. (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). * and ** indicate significant differences ($P$<0.05 and $P$<0.01))

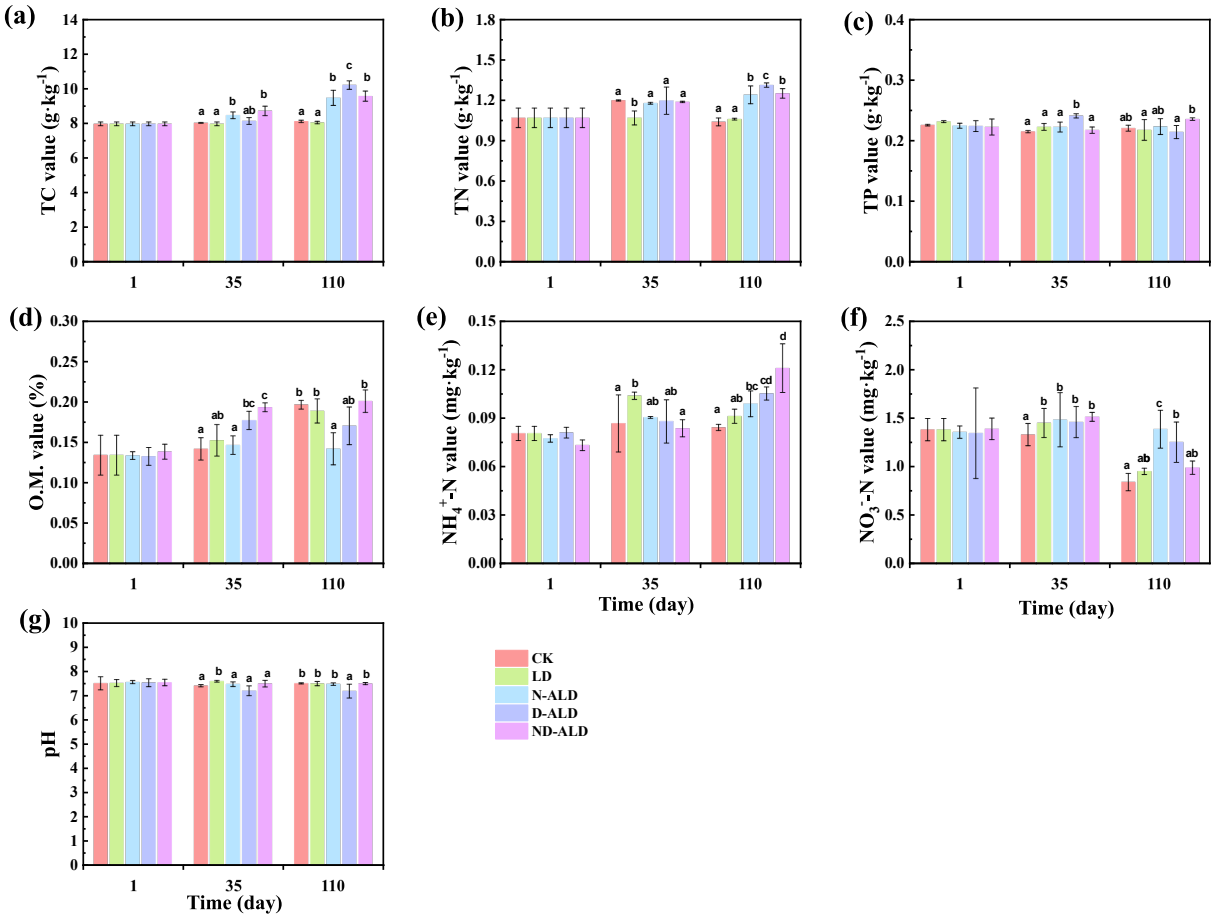



**Fig. S2** Physicochemical parameters (TC (a), TN (b), TP (c), O.M. (d), $NH_4^+$-N (e), $NO_3^-$-N (f) and pH (g)) of sediment during the litter decomposition processing. (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). Means with a common letter are significantly different ($P < 0.05$))

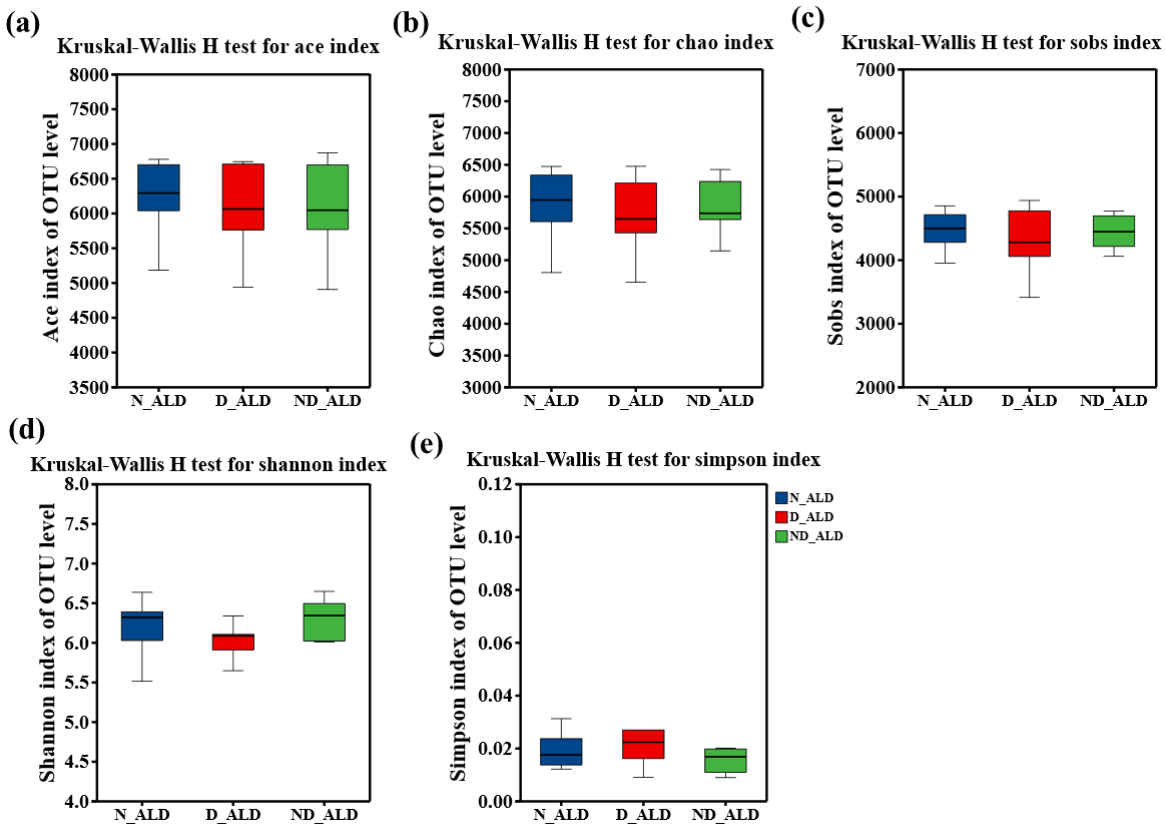



**Fig. S3** Kruskal-Wallis H test bar plot of alpha diversity indices of N-ALD, D-ALD and ND-ALD group in sediment. (Norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). * and ** indicate significant differences ($P$<0.05 and $P$<0.01))

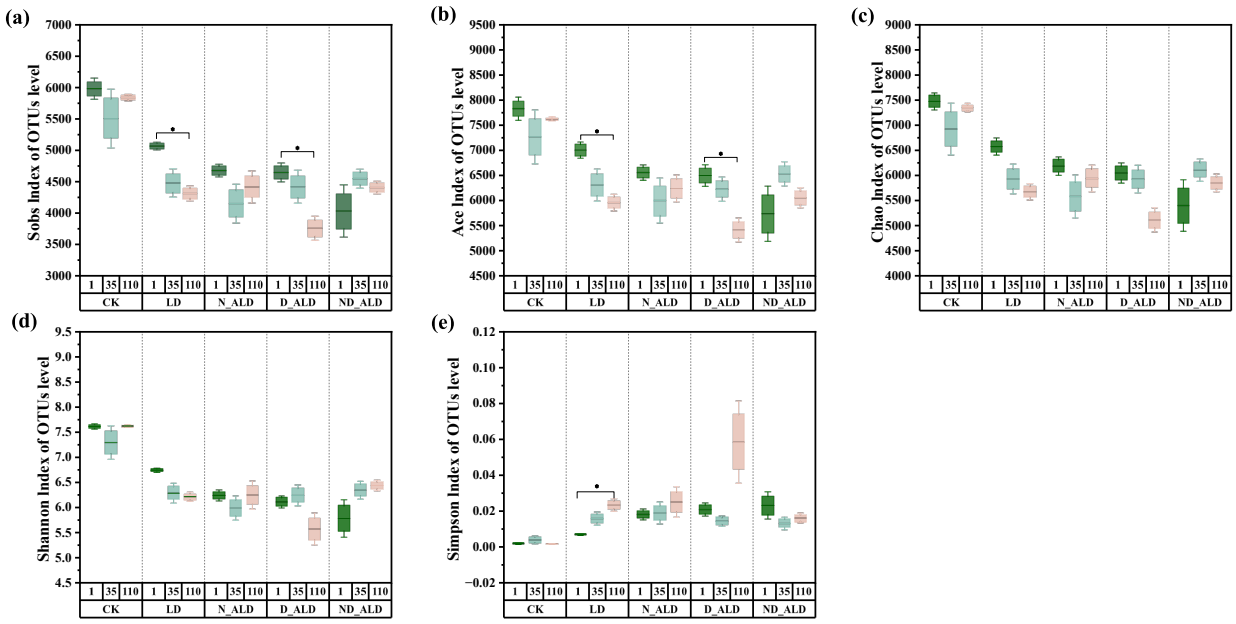



**Fig. S4** Kruskal-Wallis H test bar plot of alpha diversity indices of CK, LD, N-ALD, D-ALD and ND-ALD group 1, 35 and 110 of litter decomposition. (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD).

* and ** indicate significant differences ($P$<0.05 and $P$<0.01))

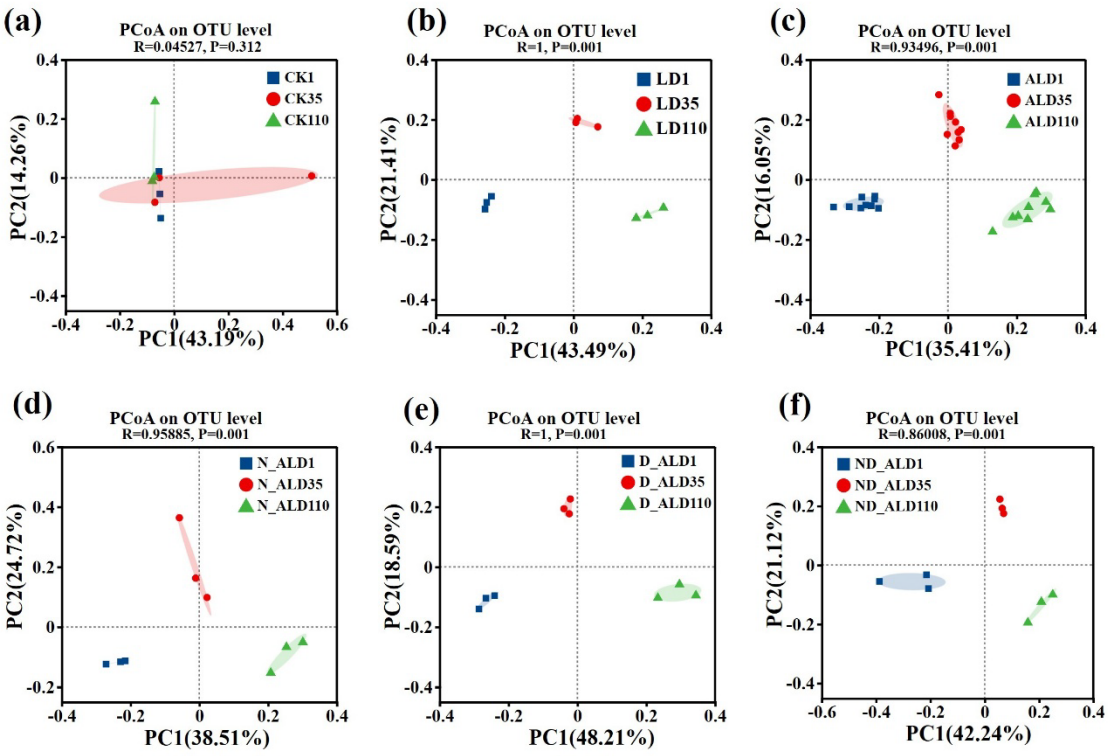



**Fig. S5** Principal co-ordinate analysis (PCoA) of the bacterial community structure of CK (a), LD (b), ALD (c), N-ALD (d), D-ALD (e) and ND-ALD (f) group on day 1, 35 and 110 of litter decomposition. (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD))

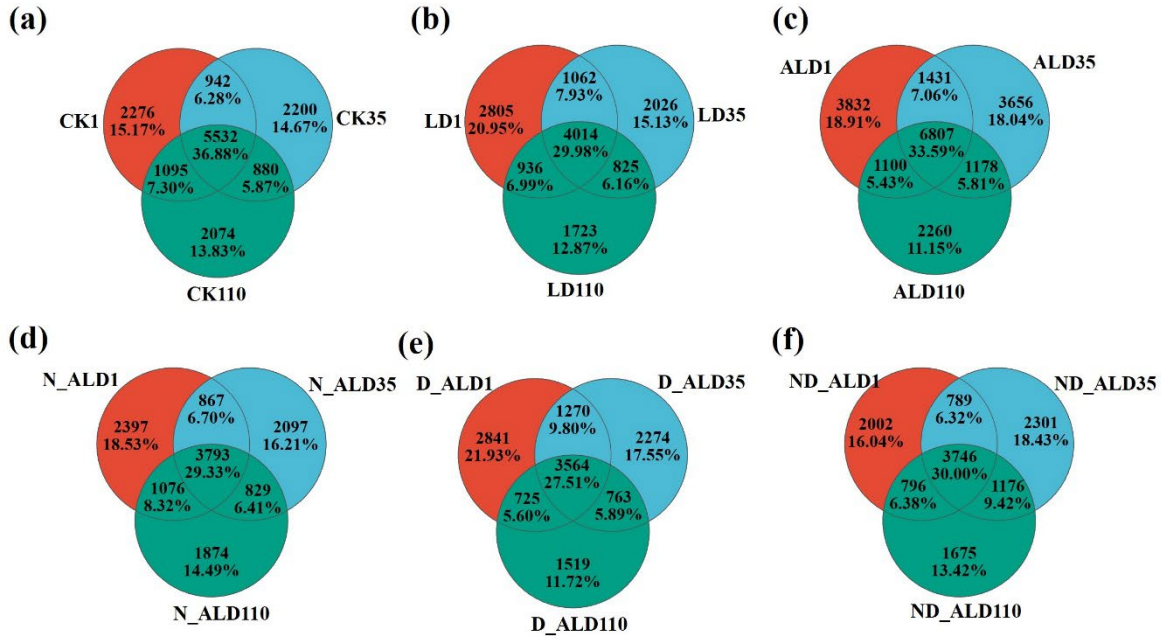



**Fig. S6** Venn diagram of CK (a), LD (b), ALD (c), N-ALD (d), D-ALD (e) and ND-ALD (f) and group on day 1, 35 and 110 of litter decomposition. (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD).)

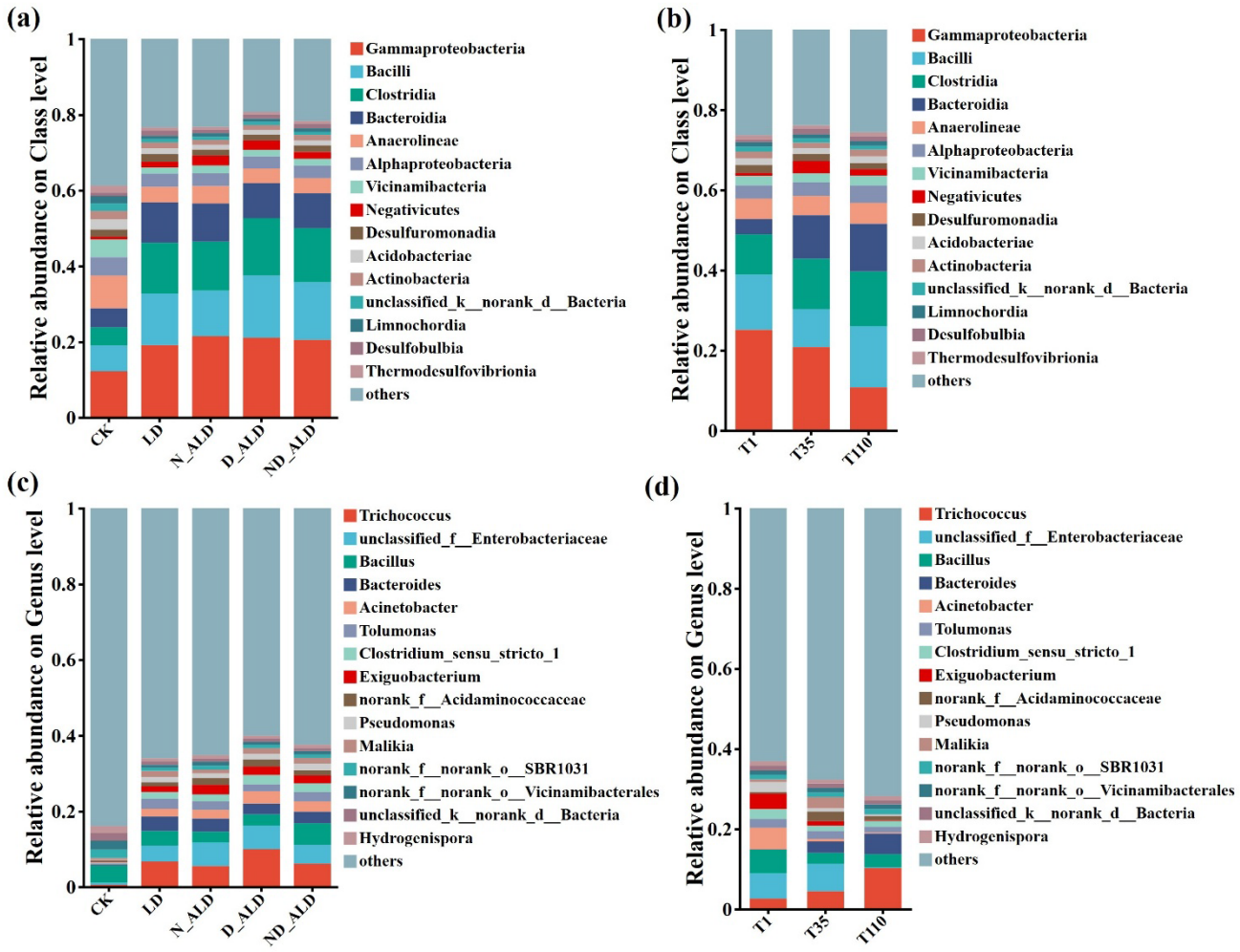



**Fig.S7** The relative abundance of bacterial communities at Class (a-b) and genus (c-d) level. (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD))

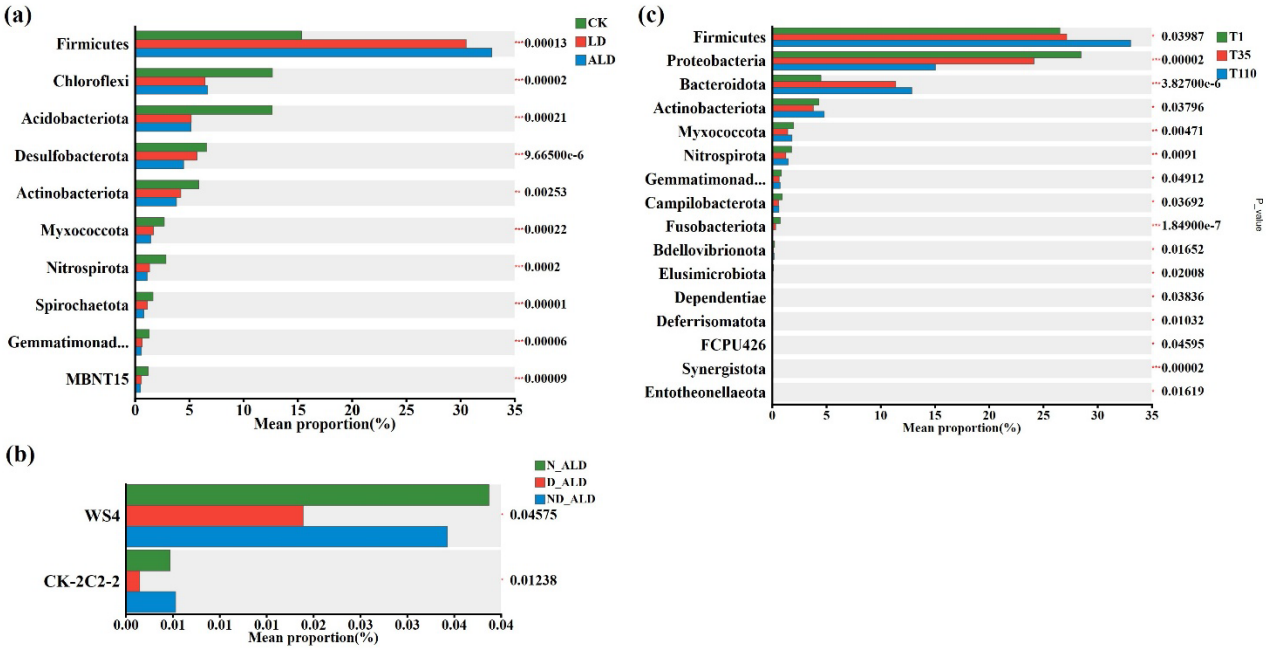



**Fig.S8** Kruskal-wallis H test bar plot of community composition between CK, LD and ALD group (a), and N-ALD, D-ALD and ND-ALD group (b) and day 1, 35 and 110 (c) at phylum level (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). *$P < 0.05$; **$P < 0.01$; **$P < 0.001$)

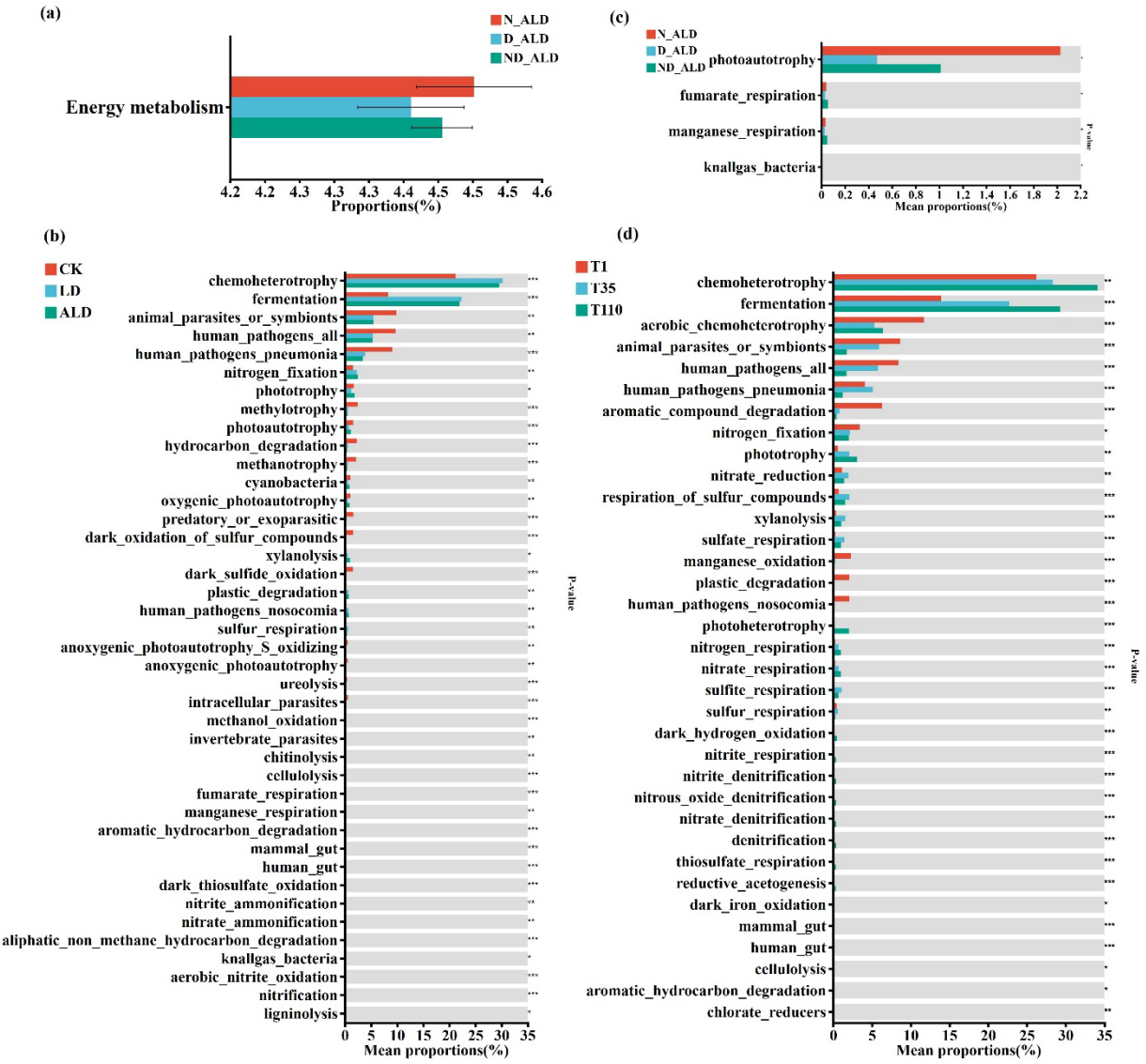



**Fig.S9** Bacterial functional pathways showing significant differences at Level 2 (a) by PICRUSt2 analysis based on the KEGG database in the N-ALD, D-ALD and ND-ALD group and ecologically relevant functional groups of bacteria showing significant differences via FAPROTAX analysis (b-d) (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$)

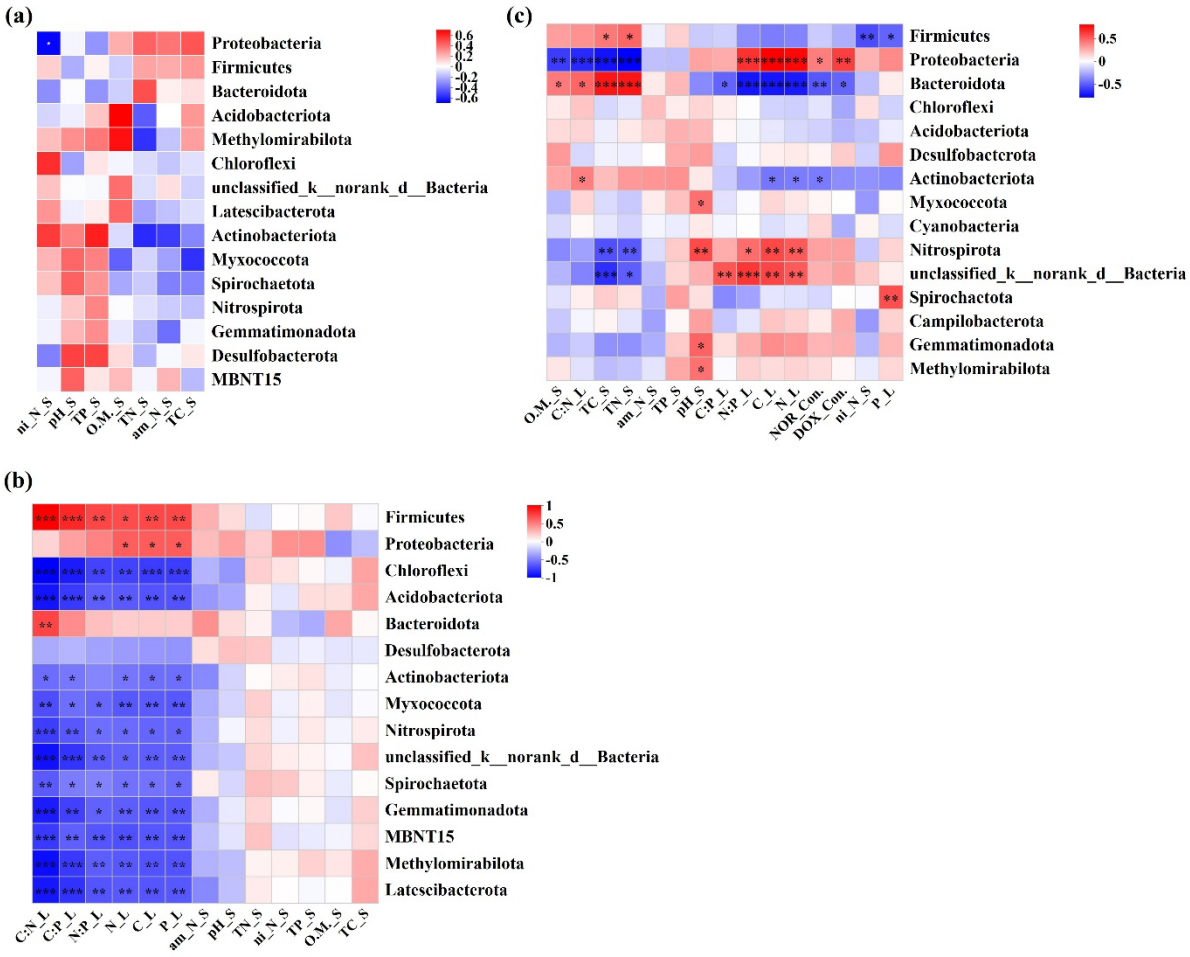



**Fig S10** Spearman correlation heatmap of Phylum species with litters nutrients and the physicochemical parameters of sediment in the CK (a), LD (b) and ALD (c) groups. (Control group (CK), litter decomposition group (LD), and antibiotic-litter decomposition group (ALD). **P*<0.05; ***P*<0.01; ***P*<0.001)

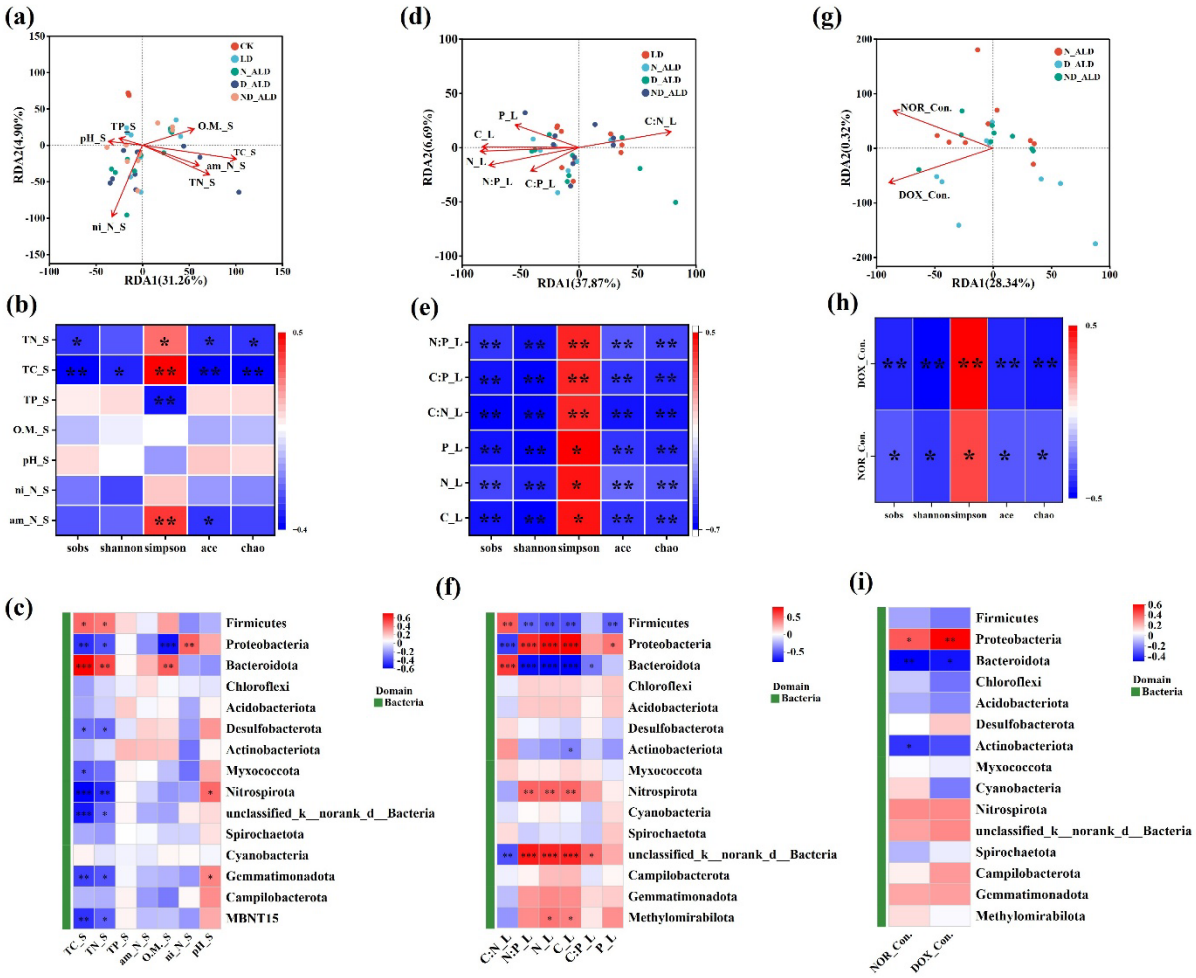



**Fig S11** Correlation between sediment physicochemical properties (a-c), litter nutrient (d-f) and antibiotics concentration (g-i) on sediment community structure, microbial alpha diversity indices and phylum species. ((Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD). *$P$<0.05; **$P$<0.01; **$P$<0.001)

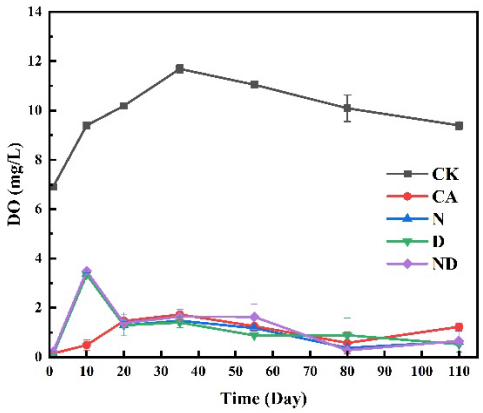



**Fig S12** Physicochemical indicators DO of overlying water. (Control group (CK), litter decomposition group (LD), antibiotic-litter decomposition group (ALD), norfloxacin-litter decomposition group (N-ALD), doxycycline-litter decomposition group (D-ALD), a combination of both antibiotics-litter decomposition group (ND-ALD))



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**Wu, Fan; Yang, Ziyi; Lyu, Tao; Zhou, Xiaohong; Xie, Qingjie**

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