Effect of oxygen supplementation strategies on microbial community succession and carbon and nitrogen metabolism in photosynthetic bacteria wastewater resource system

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In view of the problem that continuous oxygen supplementation would weaken the photosynthetic bacteria (PSB) domination in the microbial community of PSB wastewater resource utilization system [1, 2], a 12 h-anaerobic/12 h-oxygen supplementation intermittent oxygen supplementation strategy (A/M-O) was proposed based on the special metabolic interaction mechanism of photophosphorylation and oxidative phosphorylation in PSB. Among A/M-O, continuous anaerobic (A-O), and continuous oxygen supplementation (M-O) strategies, the differences of PSB resource recovery and microbial community characteristics and functions were compared, and the mechanism of oxygen affecting carbon and nitrogen metabolism was analyzed.

The results showed that A/M-O significantly improved PSB biomass concentration (2419.3 mg/L) and protein concentration (1411.5 mg/L). Compared with A-O and M-O, the biomass concentration of A/M-O increased 76.4% and 26.4%, while the protein concentration increased 67.4% and 40.5%. In addition, A/M-O and M-O significantly enhanced chemical oxygen demand (COD), ammonia (NH_4^+-N) removal, and protein content. Under the above three oxygen supplementation strategies, the bacterial community structure was significantly different: the relative abundance of *Ectothiorhodospira* (the only PSB species in the system) under A/M-O condition increased to 78.0 %, which was 1.5 and 4.4 times higher than that under A-O and M-O conditions. The Ace and Chao indexes, the number of "nodes" and "connections", and the positive correlation ratio of the microbial network in the M-O and A/M-O strategies were all higher than those in the A-O strategy, indicating that the M-O and A/M-O were conducive to maintaining the stability of microbial community structure and function. Tax4Fun functional prediction showed that A/M-O increased biomass and protein concentration by promoting the relative abundance of key enzymes encoding genes in the EMP pathway and TCA cycle; M-O and A/M-O improved the COD and NH_4^+-N removal, and protein content by increasing the relative abundance of carbon metabolism and nitrogen metabolism key enzymes encoding genes and changing the oxidative redox potential (ORP).

The results of this study innovate the methods of maintaining the dominance of PSB, improving the stability of PSB consortium structure and function in PSB wastewater resource utilization system.

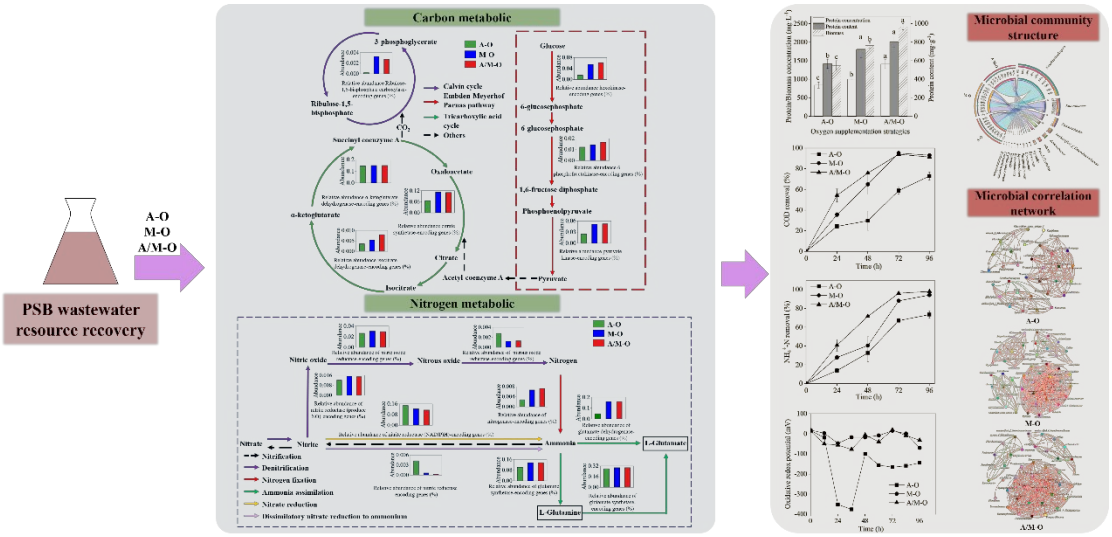

Figure 1. Effect of oxygen supplementation strategies on microbial community succession and carbon and nitrogen metabolism in photosynthetic bacteria wastewater resource system

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