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# Aerobic granular sludge in a sequencing batch reactor for tomato paste processing wastewater treatment: formation, characteristics, and microbial community structure

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**ABSTRACT**

In this study, a dense and stable aerobic granular sludge with excellent settling properties (with sludge volume index after 5 min of settling ($SVI_5$) decreased to 19.46 mL/g and $SVI_{30}/SVI_5$ = 1) and diameter size of approximately 10 mm was successfully cultivated in a sequencing batch reactor system fed with synthetic tomato paste to process wastewater. Concurrently, average removal rate of chemical oxygen demand of 95.53% was achieved at different organic loads in the system during the operation for 185 d. The combination of the bioanalytical techniques of confocal laser scanning microscopy, live/dead staining, and high-throughput sequencing were used to characterize the granulation process of activated sludge. The results showed that protein and α-D-glucopyranose polysaccharide were widely distributed throughout the granules and formed a framework of the granules. The pores in the granules provided the pathways for the nutrients and dissolved oxygen transport, and thus, live bacteria were located outside of the granule and around the internal pores. The community diversity and richness varied during the sludge granulation process. The dominant degradation bacteria at class level were shifted from the *Betaproteobacteria* and *Alphaproteobacteria* to *Gammaproteobacteria* and *Betaproteobacteria* after the granule sludge was formed. The succession of microbial communities showed cooperative effects of different bacterial communities, which may play a significant role in the degradation of tomato paste processing wastewater and stability of the system.

*Keywords:* Tomato paste processing wastewater; Aerobic granular sludge; Organic loads; Extracellular polymeric substances (EPS); High-throughput sequencing

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