

## Accepted Manuscript

The effects of algal extracellular substances on algal growth, metabolism and long-term medium recycle, and inhibition alleviation through ultrasonication

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PII: S0960-8524(18)30916-7  
DOI: <https://doi.org/10.1016/j.biortech.2018.07.019>  
Reference: BITE 20149

To appear in: *Bioresource Technology*

Received Date: 31 May 2018  
Revised Date: 4 July 2018  
Accepted Date: 5 July 2018

Please cite this article as: Yu, Z., Pei, H., Hou, Q., Nie, C., Zhang, L., Yang, Z., Wang, X., The effects of algal extracellular substances on algal growth, metabolism and long-term medium recycle, and inhibition alleviation through ultrasonication, *Bioresource Technology* (2018), doi: <https://doi.org/10.1016/j.biortech.2018.07.019>

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1 **The effects of algal extracellular substances on algal growth, metabolism and**  
2 **long-term medium recycle, and inhibition alleviation through ultrasonication**

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13 **Abstract:** The algal extracellular substances (AESs), mainly excreted in the lag and  
14 stationary phases, inhibited the algal growth and culture recycle. The AESs consisted  
15 of protein-like substances and saccharides, which restrained the algal lipid and protein  
16 biosynthesis. Moreover, the increasing reactive oxygen species and anti-oxidative  
17 enzymes caused by AESs led to the oxidative damage and suppressed the cell activity.  
18 The AESs affected the cells through two possible ways: one is the AESs adhered to  
19 the cell surfaces; another is the cells yielded signal molecules in response to the AESs.  
20 Fortunately, the ultrasound degraded the AESs into small molecules, which clearly  
21 alleviated the limitation and recovered the algal biomass and metabolism to recover.  
22 This study demonstrated that ultrasonication is a promising way to alleviate the AESs,

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