The effects and mechanism of phycocyanin removal from water by high-frequency ultrasound treatment

Cheng Liu, Zhen Cao, Siyuan He, Zhehao Sun, Wei Chen

PII: S1350-4177(17)30457-1
DOI: https://doi.org/10.1016/j.ultsonch.2017.09.051
Reference: ULTSON 3899

To appear in: *Ultrasonics Sonochemistry*

Received Date: 10 June 2017
Revised Date: 27 September 2017
Accepted Date: 28 September 2017

Please cite this article as: C. Liu, Z. Cao, S. He, Z. Sun, W. Chen, The effects and mechanism of phycocyanin removal from water by high-frequency ultrasound treatment, *Ultrasonics Sonochemistry* (2017), doi: https://doi.org/10.1016/j.ultsonch.2017.09.051

The effects and mechanism of phycocyanin removal from water by high-frequency ultrasound treatment

Cheng Liu[a, b]

Zhen Cao[b]

Siyuan He[b]

Zhehao Sun[b]

Wei Chen[a, b]

107489860@qq.com

[a]Key Laboratory of Integrated Regulation and Resource Development on Shallow Lakes, Ministry of Education, Hohai University, Nanjing 210098, China

[b]College of Environment, Hohai University, Nanjing 210098, China

Abstract: The effects and mechanism of phycocyanin removal from water by high-frequency ultrasound treatment were studied. The efficiency of sonication treatment in removing proteins derived from algal cells was investigated, and the factors influencing the process, including the effects of coagulation, were also studied. In addition, sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE), the three-dimensional fluorescence spectrum, and mass spectrum were used to illustrate the removal mechanism. The results indicated that phycocyanin can be degraded to the point where it is barely detectable in water samples after 180 min of high-frequency sonication. While the total nitrogen (TN) concentration remained consistent during the entire sonication process (240 min), about 78.9% of the dissolved organic nitrogen (DON) was oxidized into inorganic nitrogen. The sonication effect was greatly influenced by the ultrasound frequency, with 200 kHz having the highest removal performance due to the large production of hydroxyl (HO·) radicals. Coagulation was adversely influenced by sonication in the first 60 min due to the cross-linking reaction between protein molecules caused by the sonication. The influence of sonication weakened with sonication time due to the further degradation of the proteins by ultrasound. The variation of the TN, DON, and inorganic nitrogen indicated that the main mechanism occurring during the high-frequency sonication of the phycocyanin was the direct oxidation of the radicals, which was totally different from of the mechanism occurring during ultrasound with low frequency.

Keywords: Ultrasound; phycocyanin; protein; drinking water; high-frequency