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海洋真核微藻*Ostreococcus tauri*对砷的解毒机制研究

Arsenic detoxification mechanism in marine eukaryotic microalgae *Ostreococcus tauri*

关键词：海洋真核微藻 解毒 As(III)氧化 砷甲基化 砷挥发

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摘要：实验选取模式藻种——海洋真核微藻*Ostreococcus tauri*为材料,以毒性较强的三价砷(As(III))为代表,采用液态纯培养法研究海洋微藻对As(III)的解毒机制.结果表明,As(III)的氧化是*O.tauri*体内主要的砷解毒机制.暴露于含30 μmol·L^{-1}和1.67 μmol·L^{-1} As(III)的培养基时,该微藻分别在培养的60 h和72 h内将培养基中90%以上的As(III)氧化为毒性较低的五价砷(As(V)).随着培养时间的增加,培养6 d后在添加30 μmol·L^{-1} As(III)的培养基和藻体内均检测到二甲基砷(DMAs(V)),表明该海洋微藻同时具有砷甲基化功能.在*O.tauri*体内砷甲基化可作为另一种解毒机制,满足其对较高浓度砷的解毒需要.对*O. tauri*的气态砷挥发能力研究表明,该海洋微藻具有砷挥发功能,可通过将砷挥发出体外进行解毒.20、40、80 μmol·L^{-1} As(III)培养4周后,*O.tauri*可分别产生气态砷16.7、4.0和1.3 ng.*O. tauri*通过对砷的氧化来降低细胞周围环境的砷毒性,通过砷甲基化及挥发降低细胞体内的砷毒性.

Abstract: Marine phytoplankton is able to accumulate arsenic (As), but the resistant mechanisms are unclear. Microalga *Ostreococcus tauri (O.tauri),* a model organism of natural marine phytoplankton assemblage, was chosen to investigate its As detoxification mechanism. *O.tauri* was cultivated in pure culture with differen concentrations of arsenite (As(III)). The results showed that As(III) oxidation was the main As resistant mechanism. When the microalga was exposed to 30 μmol·L^{-1} and 1.67 μmol·L^{-1} As(III), more than 90% was oxidized to arsenate (As(V)) after incubation for 60 and 72 hours respectively. After exposed to 30 μmol·L^{-1} As(III) for 6 days, dimethylarsenate (DMAs(V)) was detected both in culture medium and algal cells. The study of As biovolatilization by *O. tauri* showed that this marine microalga was able to biovolatilize As into atmosphere for As detoxification. After exposed to 20, 40, 80 μmol·L^{-1} As(III) for 4 weeks, 16.7 ng, 4.0 ng and 1.3 ng volatile As was detected respectively. The results indicated that the As detoxification mechanisms of *O. tauri* were a combination of As oxidation, methylation and biovolatilization. This study expanded the understanding of As resistant mechanisms of marine phytoplankton and implied that marine organisms might play an important role in As biogeochemical cycle.

Key words: marine eukaryotic microalgae detoxification arsenite oxidation methylation volatilization