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沉积再悬浮颗粒物对马氏珠母贝摄食生理影响的室内模拟

Effect of suspended sediment on the feeding physiology of *Pinctada martensii* in laboratory

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中文摘要:

采用实验生态学方法室内模拟研究了不同浓度沉积再悬浮颗粒物对马氏珠母贝清滤率、摄食率、吸收率的影响。结果表明:(1)水体中总悬浮颗粒物对马氏珠母贝清滤率的影响极显著($P<0.01$)。总悬浮颗粒物由低浓度(12.6 mg/L)趋高浓度(500 mg/L)时,马氏珠母贝的清滤率呈现峰值变化规律。与总悬浮颗粒物浓度50 mg/L时的最大清滤率(1.12 L·个体$^{-1}$·h^{-1})比较,悬浮颗粒物浓度为500 mg/L时,清滤率达最小值(0.17 L·个体$^{-1}$·h^{-1})),其清滤率降幅达85%。这表明在高浓度悬浮颗粒物的水环境下,贝类受到环境胁迫,其生理和自身摄食机制受到限制,引起摄食减少和机体损伤。马氏珠母贝类的清滤率(*CR*)与总悬浮颗粒物浓度(TPM)之间的关系可表达为:$CR=-0.701+1.627\times TPM-0.463\times TPM^2+0.036\times TPM^3$ ($R^2=0.928$)。(2)水体中总悬浮颗粒物对马氏珠母贝摄食率的影响极显著($P<0.01$)。马氏珠母贝的摄食率随着总悬浮颗粒物浓度的升高而增加,在50 mg/L时达最大值(38.28 mg/h),当总悬浮颗粒物浓度超过50 mg/L时,摄食率反而下降,在总悬浮颗粒物浓度为500 mg/L时,降为最小值(16.22 mg/h),摄食率降幅为58%。随着悬浮颗粒物浓度的增加,马氏珠母贝摄食率受到的影响小于清滤率受到的影响。马氏珠母贝类的摄食率(*IR*)与总悬浮颗粒物浓度(TPM)之间的关系可表达为:$IR=-46.631+70.957\times TPM-18.385\times TPM^2+1.367\times TPM^3$ ($R^2=0.907$)。(3)水体中总悬浮颗粒物对马氏珠母贝吸收率影响极显著($P<0.01$)。总悬浮颗粒物由低浓度(12.6 mg/L)趋高浓度(500 mg/L)时,马氏珠母贝的吸收率呈逐渐下降趋势,在总悬浮颗粒物12.6 mg/L时,马氏珠母贝的吸收率最大(48.57%),而总悬浮颗粒物500 mg/L时,马氏珠母贝的吸收率最小(8.56%)。马氏珠母贝的吸收率(*AE*)与总悬浮颗粒物浓度(TPM)之间的关系可表达为:$AE=52.189+0.132\times TPM-3.111\times TPM^2+0.316\times TPM^3$ ($R^2=0.976$)。

English Summary:

Pinctada martensii, one of the important species for marine pearl culture, has brought about high economic and social benefits for the coastal communities. In this study, the effect of suspended sediment particles on the feeding physiology (clearance rate *CR*, ingestion rate *IR* and absorption efficiency *AE*) was investigated by adopting the measures of experimental ecology in laboratory to provide both insight into tolerance of *P. martensii* to environmental changes and guidelines for healthy culturing of *P. martensii*. The results were as followed: (1) The total suspended particle had significant effect on clearance rate of *P. martensii* ($P<0.01$), with peak value of clearance rate of *P. martensii* occured as the total suspended particle varying from 12.6 to 500 mg/L. Compared with the maximum value of 1.12 L·ind^{-1}·h^{-1} at a concentration of 50 mg/L, the clearance rate of *P. martensii* reached the minimum value of 0.17 L·ind^{-1}·h^{-1} at a concentration of 500 mg/L, decreased by 85%. The relationship of the clearance rate and the total suspended particle could be expressed by a function as: $CR=-0.701+1.627\times TPM-0.463\times TPM^2+0.036\times TPM^3$ ($R^2=0.928$). (2) The total suspended particle had significant effect on ingestion rate of *P. martensii* ($P<0.01$), the ingestion rate of *P. martensii* increased with increasing suspended particle concentration from 12.6 to 50 mg/L and decreased with suspended particle concentration above 50 mg/L, with the maximum value of 38.28 mg/h at a concentration of 50 mg/L. However, the ingestion rate of *P. martensii* reached the minimum value of 16.22 mg/h at a concentration of 500 mg/L, which reduced to 58% compared with a concentration of 50 mg/L. This showed that the ingestion rate of *P. martensii* was less affected in contrast to the clearance rate, implying *P. martensii* was able to reduce clearance rate for maintaining relatively stable ingestion rate with increasing suspended particle concentration to maintain normal energy balance and to adapt to change of environment. The relationship between the ingestion rate and the total suspended particle could be described by a function as: $IR=-46.631+70.957\times TPM-18.385\times TPM^2+1.367\times TPM^3$ ($R^2=0.907$). (3) The absorption efficiency of *P. martensii* decreased from 48.57% to 8.56% with increasing suspended particle concentration from 12.6 to 50 mg/L. This suggested that the organic content decrease with increasing suspended particle concentration, causing reduction of the absorption efficiency of *P. martensii*. The relationship of the absorption efficiency and the total suspended particle could be described by a function as: $AE=52.189+0.132\times TPM-3.111\times TPM^2+0.316\times TPM^3$ ($R^2=0.976$).

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