

研究论文

硝酸镧引起 *Escherichia coli* B 代谢过程热爆发及其机理研究

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摘要 采用微量热法研究了硝酸镧对 *Escherichia coli* B 生长代谢过程的影响, 发现高浓度硝酸镧引起 *E. coli* B 热谱图出现异常变化: 生长速率常数 k 值增大、产热峰显著升高和总发热量异常增加. 当硝酸镧浓度为 300 和 500 mg/L 时, 培养物在培养过程的总发热量分别是正常条件下的 3.89 和 2.54 倍.

用生物学方法对细胞存活率和生物量进行测定结果表明, 细胞在高浓度硝酸镧条件下增殖受到抑制、

细胞生物量减少. 表明高浓度的硝酸镧存在时, *E. coli*

B 细胞生长受到抑制反而释放出比正常生长细胞多得多的热量, 将抑制状态细胞释放大量热量的现象称为热爆发.

分析热爆发的原因, 认为是 La^{3+} 离子破坏细胞壁外膜而增加其透性,

导致细胞膜与外膜间的质子电化学势因质子外泄而降低或者不能形成,

氧化磷酸化过程中的能量不能有效地转化为 ATP, 而以热能的方式释放出来. 细胞由于缺乏生物通用能量 ATP, 因而其生长受到抑制.

关键词 [硝酸镧](#) [Escherichia coli B](#) [微量热](#) [热爆发](#) [氧化磷酸化](#)

分类号

Study on the Eruption of Heat for *Escherichia coli* B Aroused by Lanthanum Nitrate and Its Mechanism

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Abstract The biological effect of rare earth lanthanum nitrate on the growth of *Escherichia coli* B have been studied with calorimetric method. There were exceptional changes on the growth thermogenic curves for high concentration of lanthanum nitrate, for example the peak high, the total quantity of heat (Q) of cultures and the growth rate constants (k) increased evidently compared with normal *E. coli* B culture. When the concentration of lanthanum nitrate was 300 and 500 mg/L, Q of the cultures reached to 3.89 and 2.54 times of normal culture respectively. The livability of cells and biomass of cultures were measured with biological methods, and the results show that the growth and multiplication of cells were inhibited, and the biomass decreased at high concentration of lanthanum nitrate. These revealed that inhibiting cells discharged more quantity of heat than the normal growing cells, and this phenomenon was named as “eruption of heat”. The mechanism of eruption of heat were suggested that La^{3+} ion damages of the outer cell membrane and augment its permeability, proton electron-chemistry potential energy across cell membrane was reduced or could not even be engendered, energy could not be translated into ATP effectively in the course of oxidative phosphorylation and released with heat only, so the cells growth were inhibited finally due to scarceness of current energy ATP.

Key words [lanthanum nitrate](#) [Escherichia coli B](#) [calorimetry](#) [eruption of heat](#) [oxidative phosphorylation](#)

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