

生理浓度的活性氧对抗辐射菌的影响

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本研究探讨了生理状态下抗辐射菌 (*Deinococcus radiodurans*, DR) 内活性氧 (Reactive oxygen species, ROS) 的释放; 生理状态下释放的 ROS 在 DR 增殖中的作用; 以及受不同剂量照射下 ROS 的释放及其作用的改变。

受电离辐射后 DR 的 $O_2^{\cdot-}$ 释放随着剂量的升高而增加, 并在 700 Gy 时达到最高值, 当剂量超过 1 kGy 时 $O_2^{\cdot-}$ 释放即迅速下降, 加入二亚苯基碘 (Diphenyleneiodonium, DPI) 后, $O_2^{\cdot-}$ 释放显著降低, 且照射后 $O_2^{\cdot-}$ 的释放均未超过对照组。

受照后 DR 的增殖率随剂量的增大而上升, 剂量为 1 kGy 时增殖率达到最高点, 而剂量超过 1 kGy 时增殖率迅速下降; 达 3 kGy 时增殖率低于 0 Gy 对照组。经 DPI 处理后, 剂量在 0—1 kGy 范围内, 随剂量的增大, DR 增殖率无明显变化。

受照剂量小于 1 kGy 时 DR 内 H_2O_2 释放随剂量的增大而增多, 1 kGy 时达到高峰, 之后迅速下降, 剂量达 3 kGy 时, H_2O_2 释放水平与 500 Gy 照射时接近。

大多数真核细胞中存在 NADPH 氧化酶, 它可催化氧分子发生单电子还原反应而生成 $O_2^{\cdot-}$ ^[1], DPI 可专一抑制 NADPH 氧化酶的活性^[2]。本实验表明 DR 能自发释放 $O_2^{\cdot-}$ 并可被 DPI 抑制, 证实 DR 内有烟酰胺腺嘌呤二核苷酸磷酸 (Reduced form of Nicotinamide-Adenine Dinucleotide Phosphate, NADPH) 氧化酶的存在; 并且 $O_2^{\cdot-}$ 的存在对于与增殖有关基因的转录是必要的。

影响 DR 增殖的 ROS 不止 $O_2^{\cdot-}$ 一种, H_2O_2 也可能在其中起一定作用。本实验结果提示, DR 的增殖和照后修复的信号传递与 ROS 的释放有待进一步研究。

关键词 抗辐射菌, 辐射, 增殖, 活性氧

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参考文献

- 1 Finkel T. FEBS Letters, 2000, **476** (2): 52-54
- 2 Edgar P, Diane M. J Immunol Methods, 1981, **46** (4): 211-226

The effect on proliferation of deinococcus radiodurans of superoxide anion and hydrogen peroxide

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The work studies ROS (Reactive oxygen species) release in *Deinococcus radiodurans* (DR), the relationship between DR proliferation and ROS concentration, and ROS concentration change and its effect in irradiated DR.

The release of $O_2^{\cdot-}$ increased with the dose, reaching a peak at 700 Gy. At doses higher than 1 kGy, the $O_2^{\cdot-}$ re-

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lease decreased rapidly. Added with DPI, the $O_2^{\cdot-}$ release decreased markedly, and after radiation the concentration of $O_2^{\cdot-}$ was always lower than the control group (without DPI).

Irradiations of less than 1 kGy could stimulate the DR proliferation, which reached a peak at 1 kGy and decreased at higher doses. At 3 kGy, the DR proliferation was lower than the control. Added with DPI, the proliferation did not show obvious change below 1 kGy.

The release of H_2O_2 in DR increased with the dose, reaching a peak when at 1 kGy, and decreased rapidly at higher doses. At 3 kGy, the H_2O_2 concentration was about the same as the 500 Gy irradiated sample.

Most eukaryotic cells have NADPH oxidase, which converts oxygen molecule to $O_2^{\cdot-}$ through mono-electron reduction. DPI can inhibit the activity of NADPH oxidase specifically. We found that DR could release $O_2^{\cdot-}$ and that the $O_2^{\cdot-}$ release could be inhibited by DPI. The result manifested that the NADPH oxidase did exist in DR, and $O_2^{\cdot-}$ was necessary for the transcription of the proliferation-related genes. We also found that H_2O_2 may play a role in DR proliferation. These provide a new idea for further studies on signal transportation and mechanisms of coordination in DR proliferation and repair after irradiation.

KEYWORDS Deinococcus radiodurans, Radiation, Proliferation, Reactive oxygen species

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