

植物诱变育种 · 农业生物技术

耐辐射球菌中 *priA* 类似基因突变对 DNA 修复和 DNA 转化的影响

王媛, 华跃进

浙江大学原子核农业科学研究所/农业部核农学重点开放实验室, 浙江 杭州 310029

摘要:

DNA 损伤很易阻断复制叉的前进。损伤 DNA 的修复以及接下来停止复制叉的重启动过程对细胞生存极为重要。依赖于 PriA 的复制重启动机制是细菌复制重启动的主要途径。为了解 *priA* 类似基因 *Dr2606* 在耐辐射球菌中的作用, 并检测 *Dr2606* 在 DNA 修复中的作用, 本研究用卡那霉素抗性基因代替 *Dr2606* 阅读框, 构建了 *Dr2606* 缺失突变株, 并对突变株进行 UV 和丝裂霉素处理, 测定了 *Dr2606* 突变株的转化效率。 *Dr2606* 的突变导致菌体生长缓慢, 细胞生存率急剧下降。意外的是, 耐辐射球菌的 DNA 修复能力没有削弱。但突变株的转化效率大大削弱。这说明在耐辐射球菌中 *priA* 类似基因 *Dr2606* 对停止复制叉的重启动过程并不是必需的; 耐辐射球菌不依赖于原点的复制重启动过程可能与其他细菌不同。

关键词: *priA* 耐辐射球菌 DNA 修复 DNA 转化效率

EFFECT OF *priA* like GENE MUTATION ON DNA REPAIR AND DNA TRANSFORMATION OF *Deinococcus radiodurans*

WANG Yuan, HUA Yue-jin

Key Laboratory for Nuclear-Agricultural Sciences of Chinese Ministry of Agriculture and Zhejiang Province/Institute of Nuclear-Agricultural Sciences, Zhejiang University, Zhejiang, Hangzhou 310029

Abstract:

Replication fork progression can be blocked easily by DNA damage. Damaged DNA repair and the subsequent restart of the stalled or collapsed replication forks are critical for cell survival. The PriA-dependent pathway is the major replication restart mechanism in bacteria. To understand the roles of a *priA-like* gene (*Dr2606*) in *Deinococcus radiodurans* and DNA repair, a *Dr2606* null mutant was constructed by replacing *Dr2606* open reading frame with a kanamycin-resistance gene and treated the *Dr2606* mutant with UV and mitomycin C (MMC), and the DNA transformation efficiency of the *Dr2606* mutant was also tested. Successively, the *Dr2606* mutant showed a delayed growth and a dramatic decrease of cell viability. Unexpectedly, the DNA repair capability of *D. radiodurans* was not impaired by the inactivation of *Dr2606*. However, the DNA transformation efficiency was largely compromised in the mutant. These results indicate that the *priA-like* gene (*Dr2606*) is dispensable for stalled DNA replication forks restart in *D. radiodurans* and origin-independent replication restart in *D. radiodurans* may be different from other bacteria.

Keywords: *priA* *Deinococcus radiodurans* DNA repair DNA transformation efficiency

收稿日期 2011-01-25 修回日期 2011-02-24 网络版发布日期

DOI:

基金项目:

国家“863”项目(2007AA021305), 国家自然科学基金重点资助项目(30830006), 重大新药创制科技重大专项(2009ZXJ09001-034), 转基因生物新品种培育重大专项项目(2009ZX08009-075B), 农业部行业专项(200803034)

通讯作者: 华跃进(1959-), 男, 浙江东阳人, 博士, 博士生导师, 研究方向为 DNA 损伤修复与分子调控。Tel: 0571-86971703;

作者简介: 王媛(1986-), 女, 浙江温州人, 硕士研究生, 研究方向为 DNA 损伤修复。Tel: 0571-86971251; E-mail: shmily\_wangyuan@163.com

作者 Email: yjhua@zju.edu.cn

参考文献:

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(1491KB)
- ▶ [HTML全文]
- ▶ 参考文献[PDF]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ *priA*
- ▶ 耐辐射球菌
- ▶ DNA 修复
- ▶ DNA 转化效率

本文作者相关文章

PubMed

- [1] Masai H, Tanaka T, Kohda D. Stalled replication forks: making ends meet for recognition and stabilization [J]. *Bioessays*, 2010, 32(8): 687-697
- [2] Gabbai CB, Marians K J. Recruitment to stalled replication forks of the PriA DNA helicase and replisome-loading activities is essential for survival [J]. *DNA Repair (Amst)*, 2010, 9(3): 202-209
- [3] Nurse P, Liu J, Marians K J. Two modes of PriA binding to DNA [J]. *J Biol Chem*, 1999, 274(35): 25026-25032
- [4] McGlynn P, Al-Deib A A, Liu J, et al. The DNA replication protein PriA and the recombination protein RecG bind D-loops [J]. *J Mol Biol*, 1997, 270(2): 212-221
- [5] Heller R C, Marians K J. Non-replicative helicases at the replication fork [J]. *DNA Repair (Amst)*, 2007, 6(7): 945-952
- [6] Lopper M, Boonsombat R, Sandler S J, et al. A hand-off mechanism for primosome assembly in replication restart [J]. *Mol Cell*, 2007, 26(6): 781-793
- [7] Xu L, Marians K J. PriA mediates DNA replication pathway choice at recombination intermediates [J]. *Mol Cell*, 2003, 11(3): 817-826
- [8] Kogoma T, Cadwell G W, Barnard K G, et al. The DNA replication priming protein, PriA, is required for homologous recombination and double-strand break repair [J]. *J Bacteriol*, 1996, 178(5): 1258-1264
- [9] Kline K A, Seifert H S. Mutation of the priA gene of *Neisseria gonorrhoeae* affects DNA transformation and DNA repair [J]. *J Bacteriol*, 2005, 187(15): 5347-5355
- [10] Polard P, Marsin S, McGovern S, et al. Restart of DNA replication in Gram-positive bacteria: functional characterisation of the *Bacillus subtilis* PriA initiator [J]. *Nucleic Acids Res*, 2002, 30(7): 1593-1605
- [11] Blasius M, Sommer S, Hubscher U. *Deinococcus radiodurans*: what belongs to the survival kit? [J]. *Crit Rev Biochem Mol Biol*, 2008, 43(3): 221-238
- [12] Cox M M, Battista J R. *Deinococcus radiodurans*-the consummate survivor [J]. *Nat Rev Microbiol*, 2005, 3(11): 882-892
- [13] Bentchikou E, Servant P, Coste G, et al. A major role of the RecFOR pathway in DNA double-strand-break repair through ESDSA in *Deinococcus radiodurans* [J]. *PLoS Genet*, 2010, 6(1): e1000774
- [14] Slade D, Lindner A B, Paul G, et al. Recombination and replication in DNA repair of heavily irradiated *Deinococcus radiodurans* [J]. *Cell*, 2009, 136(6): 1044-1055
- [15] Zahradka K, Slade D, Bailone A, et al. Reassembly of shattered chromosomes in *Deinococcus radiodurans* [J]. *Nature*, 2006, 443(7111): 569-573
- [16] Makarova K S, Aravind L, Wolf Y I, et al. Genome of the extremely radiation-resistant bacterium *Deinococcus radiodurans* viewed from the perspective of comparative genomics [J]. *Microbiol Mol Biol Rev*, 2001, 65(1): 44-79
- [17] Xu G, Wang L, Chen H, et al. RecO is essential for DNA damage repair in *Deinococcus radiodurans* [J]. *J Bacteriol*, 2008, 190(7): 2624-2628
- [18] 华孝挺, 王超, 黄丽分, 李铭峰, 玉媛, 陈琦, 翁石莉, 童艳铮, 田兵, 华跃进. 不同利福平浓度压力下耐辐射球菌的自发突变率与突变谱研究 [J]. *核农学报*, 2010, 24(6): 1166-1171.
- [19] Hua X, Huang L, Tian B, et al. Involvement of recQ in the ultraviolet damage repair pathway in *Deinococcus radiodurans* [J]. *Mutat Res*, 2008, 641(1-2): 48-53
- [20] Kim M, Wolff E, Huang T, et al. Developing a genetic system in *Deinococcus radiodurans* for analyzing mutations [J]. *Genetics*, 2004, 166(2): 661-668
- [21] Earl A M, Mohundro M M, Mian I S, et al. The IrrE protein of *Deinococcus radiodurans* R1 is a novel regulator of recA expression [J]. *J Bacteriol*, 2002, 184(22): 6216-6224

[22] Sasaki K, Ose T, Okamoto N, et al. Structural basis of the 3'-end recognition of a leading strand in stalled replication forks by PriA [J]. EMBO J, 2007, 26(10): 2584-2593

[23] Ouzounis C A, Blencowe B J. Bacterial DNA replication initiation factor priA is related to proteins belonging to the 'DEAD-box' family [J]. Nucleic Acids Res, 1991, 19(24): 6953

[24] Zavitz K H, Marians K J. ATPase-deficient mutants of the Escherichia coli DNA replication protein PriA are capable of catalyzing the assembly of active primosomes [J]. J Biol Chem, 1992, 267(10): 6933-6940

[25] Sandler S J, Samra H S, Clark A J. Differential suppression of priA2::kan phenotypes in Escherichia coli K-12 by mutations in priA, lexA, and dnaC [J]. Genetics, 1996, 143(1): 5-13

[26] 华孝挺, 田兵, 华跃进. 耐辐射奇球菌同源重组修复机制研究新进展 [J]. 核农学报, 2010, 24(6): 1192-1197

[27] Grompone G, Sanchez N, Dusko Ehrlich S, et al. Requirement for RecFOR-mediated recombination in priA mutant [J]. Molecular microbiology, 2004, 52(2): 551-562

本刊中的类似文章

1. 田兵, 高冠军, 徐步进, 华跃进. 辐射对耐辐射球菌 (*Deinococcus radiodurans*) 抗氧化酶活性提高的影响 [J]. 核农学报, 2004, 18(03): 221-224

2. 华孝挺, 田兵, 华跃进. 耐辐射奇球菌同源重组修复机制研究新进展 [J]. 核农学报, 2010, 24(6): 1192-1197

3. 华孝挺, 王超, 黄丽芬, 李铭峰, 王媛, 陈琦, 翁石莉, 童艳铮, 田兵, 华跃进. 不同利福平浓度压力下耐辐射球菌的自发突变率与突变谱研究 [J]. 核农学报, 2010, 24(6): 1166-1171

4. 杨明坤, 张颖, 侯晓光, 郝艳华, 张维, 陈明. 耐辐射球菌 Rsr 增强大肠杆菌抗逆性的研究 [J]. 核农学报, 2011, 25(1): 53-56

5. 常胜合, 秦广雍, 李宗伟, 王雁萍, 陈林海, 谈重芳, 李宗义. 低剂量超辐射敏感与诱导辐射抗性的研究进展 [J]. 核农学报, 2008, 22(02): 196-199+187

6. 田兵, 徐步进, 华跃进. 耐辐射球菌清除活性氧自由基及对 DNA 的保护作用 [J]. 核农学报, 2004, 18(05): 376-380

---

Copyright by 核农学报