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Solar UV radiation as an important environmental factor for the evolution of life

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Abstract

Solar UV radiation has had a strong impact on the early evolution of life on Earth. The composition of the Earth's atmosphere of that time differed from that of today. From model calculations it can be assumed that in the Archaen era during which the diversification of early anaerobes took place and the first anaerobic photosynthetic bacteria appeared (about 3.5 Ga ago) the amount of free oxygen in the atmosphere was significantly lower than today. There was no or very little absorption of solar UV radiation by ozone. Therefore it is generally assumed that life originated in places that were sheltered from UV radiation, like hydrothermal vents deep down in the ocean.

UV radiation is absorbed by different cellular components, the most important one being the DNA molecule. UV radiation causes several types of damage that can interfere with transcription and replication. In all organisms a number of different partly complementary repair mechanisms have evolved to repair these UV-induced lesions, e.g. photoreactivation, base excision repair, nucleotide excision repair, recombinational repair.

We have investigated the UV resistance of different species of microorganisms, ranging from bacteria like Deinococcus radiodurans to bacterial spores from Bacillus subtilis to a various archaea. By analyzing the UV induced DNA photoproducts it could be shown that the UV DNA lesions are comparable in the different organisms, but that the efficiency and rate of repair is determing their UV resistance.

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