Influence of a Magnetic Field on the UV-sensitivity in Yeast

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Saccharomyces cells were grown in a 58000 A/cm magnetic field and then exposed to UV-irradiation. An increase of the survival rate is observed. The application of magnetic field just after UV-exposure shows a decreased survival.

The effects of homogeneous magnetic fields on biological material, reported during the last two decades (for review see 1-3), were often very small and contradictory. Concerning the influence on irradiated yeast, a ninefold increase of the survival rate after 40Co-γ-irradiation and subsequent reactivation in a 40000 Oe field was described.

We report here on the effect of the survival of yeast cells, placed in a strong magnetic field prior to (pre-application) or after an UV-irradiation (post-application). We used the diploid wild-type strain 211 of Saccharomyces and the related mutant S 2094 C1 carrying the rad-2 gene, which causes high UV-sensitivity and a negative liquid-holding effect. With the pre-method, cells were grown at 30°C in YEP-medium (1% yeast extract medium, 0.5% peptone, 2% glucose) for 2.5, 8.5, 11 or 16 hours in the field, washed and suspended in non-nutrient buffer (0.05 M KH2PO4) and irradiated with a low pressure mercury-vapour lamp (radiation intensity 5 erg/mm²-s). With the post-method, cells grown up for 48 h without field, were prepared, irradiated and then placed in the field for the given times, suspended in buffer, so that no growth took place.

The magnetic field was generated by a super conducting magnet (Cryos 30—350 S, Siemens) with super conducting wires of NbTi. The operating space is a cylindrical hole 3 cm in diameter. A magnetic field strength of 58000 A/cm (573000 Oe) was applied. At a distance of 1 cm from the centre the decrease of the field in axial direction was less than 0.7% and the increase in radial direction less than 0.4%.

Fig. 1. Survival of yeast cells (strain 211 and mutant S 2094 C1) after UV-irradiation (● = immediate plating, ○ = 48 hours liquid-holding) and with 10 hours of growth in a 58000 A/cm field prior to irradiation (▲ = immediate plating, ◯ = 48 hours liquid-holding).

Magnetic Field, UV-Inactivation, Dark Repair

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Four samples (3 ml) in glass vessels, stacked in a double-walled brass case connected to a 30°C water thermostat, were placed into the borehole of the magnet; controls in a similar arrangement in the thermostat. For liquid-holding procedure the cells were incubated in buffer for two days in the dark. The surviving fractions were determined by plating the treated suspensions of YEP-agar, incubating for four days, and scoring the macroscopic visible colonies.

Fig. 1 shows the results of inactivation and liquid-holding recovery after a pre-application of magnetic field. For both strains, the cells grown in the magnetic field behave more resistant against UV, and the dose modification factor (DMF) for the inactivation with field compared to inactivation without field ist 1.10 for strain 211 and 1.09 for mutant S 2094 C1. The ability of liquid holding recovery remains unaffected, since the DMF values for recovery without field (1.17 for 211 and 0.85 for S 2094 C1) do not differ significantly from those obtained with field (1.16 for 211 and 0.85 for S 2094 C1).

The results for the 8.5, 11 and 16 hours application of field vary no more than 3%, whereas the 2.5 hours show no effect, as this time is too short to give rise to more than one cell division (generation time for yeast ~ 1.5 h).

The effect of a post-irradiation application of field is shown in Fig. 2. A decreased survival after inactivation is observed with 211 cells (DMF 0.93), whereas the extent of liquid-holding recovery re-
mains unaltered as in the case of a pre-application experiment.

An incubation time of 8.75 to 16 hours in the field after UV-inactivation includes the possibility for liquid-holding recovery. This is confirmed by a slightly increased inactivation curve for strain 211 in Fig. 2. S2094C1 cells, carrying the rad-2 gene, were shown to be defective in an excision-repair system. As no influence is observed in a magnetic field (Fig. 2), an effect on the enzymatic system should be supposed.

In our experiments, cells exposed to a magnetic field show a diminished rate of buddings combined with an increased gas-production, indicating a stimulated energy metabolism in accordance with findings of other authors. On the other hand, cells with elevated energy supply are known to be more resistant against UV. This may explain the enhancement effect shown in Fig. 1.

5 J. C. Game and B. S. Cox, Mutation Res. 12, 328 (1971).
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