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

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Saccharomyces cells were grown in a 58 000 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, 2]), were often very small and contradictory. Concerning the influence on irradiated yeast, a ninefold increase of the survival rate after ^{60}Co-γ-irradiation and subsequent reactivation in a 40 000 Oe field was described [3].

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 [4] 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 KH_2PO_4) 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 (≙73000 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%.

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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

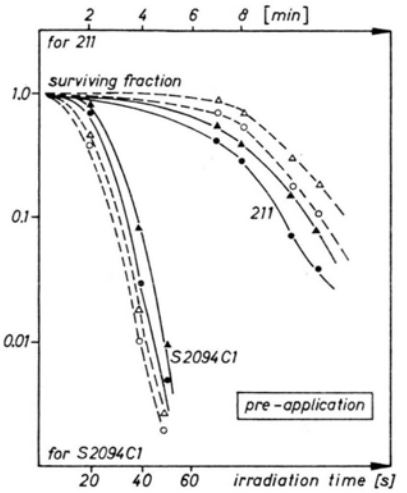

Fig. 1. Survival of yeast cells (strain 211 and mutant S 2094 C 1) after UV-irradiation (● = immediate plating, ○ = 48 hours liquid-holding) and with 11 hours of growth in a 58 000 A/cm field prior to irradiation (▲ = immediate plating, △ = 48 hours liquid-holding).

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 strain 211 and 0.86 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 effcet 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-

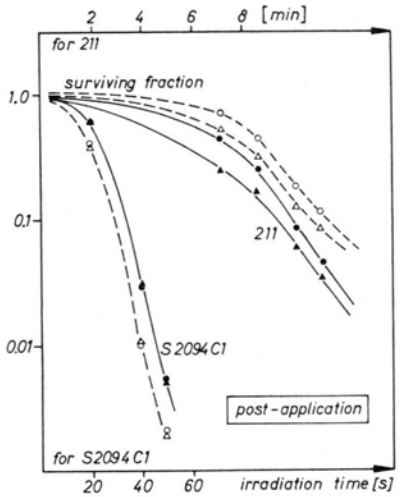

Fig. 2. Survival after UV-irradiation with subsequent application of a 58 000 A/cm field for 16 hours. For symbols see Fig. 1.

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. S 2094 C1 cells, carrying the rad-2 gene, were shown to be defective in an excision-repair system [5]. 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 [3, 6, 7]. On the other hand, cells with elevated energy supply are known to be more resistant against UV [8, 9]. This may explain the enhancement effect shown in Fig. 1.

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