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Report:

In the present work, the adaptation process is considered for the simplest example of the bacterial E. coli nucleoid. Experimental studies performed recently on prokaryotic bacterial cells, the simplest living organisms, have demonstrated that, under unfavorable environmental conditions (for example, starvation), bacterial cells can use biocrystallization, a special mechanism of protection of the genetic apparatus (nucleoid), generally untypical of living organisms. This mechanism helps to protect the nucleoid from damage and resume the activity of the bacterial cells later, upon improvement of the external conditions.

During this experimental period it was studied various types of bacterial E.coli cells. In particular, bacterial culture of Dps –overproducing E.coli cells in exponential phase; bacterial culture of Dps –overproducing E.coli cells under starvation stress; bacterial culture of Dps –overproducing E.coli cells under starvation stress with induction of Dps overexpression; bacterial culture of Dps –overproducing E.coli persister cells etc. of E. coli strains BL21-Gold(DE3) and Top10, as well as transformed strains BL21-Gold(DE3)/pET-DPS, Top10/pBAD-DPS with and without induction of overproduction of the stress-induced protein Dps. The dynamical changes in the structure of bacterial cells were studied using measurements of diffraction of synchrotron radiation.

In bacterial cells exposed to alkylhydroxybenzenes (AHBs), a very interesting phenomenon was discovered. Namely, these cells were placed in a culture medium with increased AHBs content and sustained there for one week. On Fig. 1a, you can see a characteristic for powder diffraction ring-shaped patterns as well as individual single-crystal diffraction maxima in the macromolecular resolution zone. These maxima, corresponding to the period of the crystal lattice 88 Å, 44 Å, 22 Å, 14.7 Å, are apparently associated with the formation of intramolecular in vivo crystals of the DNA-binding protein from starved cells (Dps) and the bacterial nucleoid (DNA). These maxima completely disappeared immediately after the bacterial cells were placed in the nutrient medium (Fig. 1b) and until the nutrients in the medium were completely sufficient for the growth of the bacterial colony (Fig. 1c). Then after 14 hour since inoculation the same cells were shooted. On the pictures (Fig. 1d), you can see again the appearance of diffraction maxima corresponding to the period of the crystal lattice 88 Å, 61.9 Å, 22 Å. We assume that these maxima are associated with the secondary appearance of intracellular crystals of DPS-DNA during biocrystallization process and they indicate that, in the absence of nutrients in the culture medium, the process of protecting the nucleoid of bacteria by biocrystallization has begun.

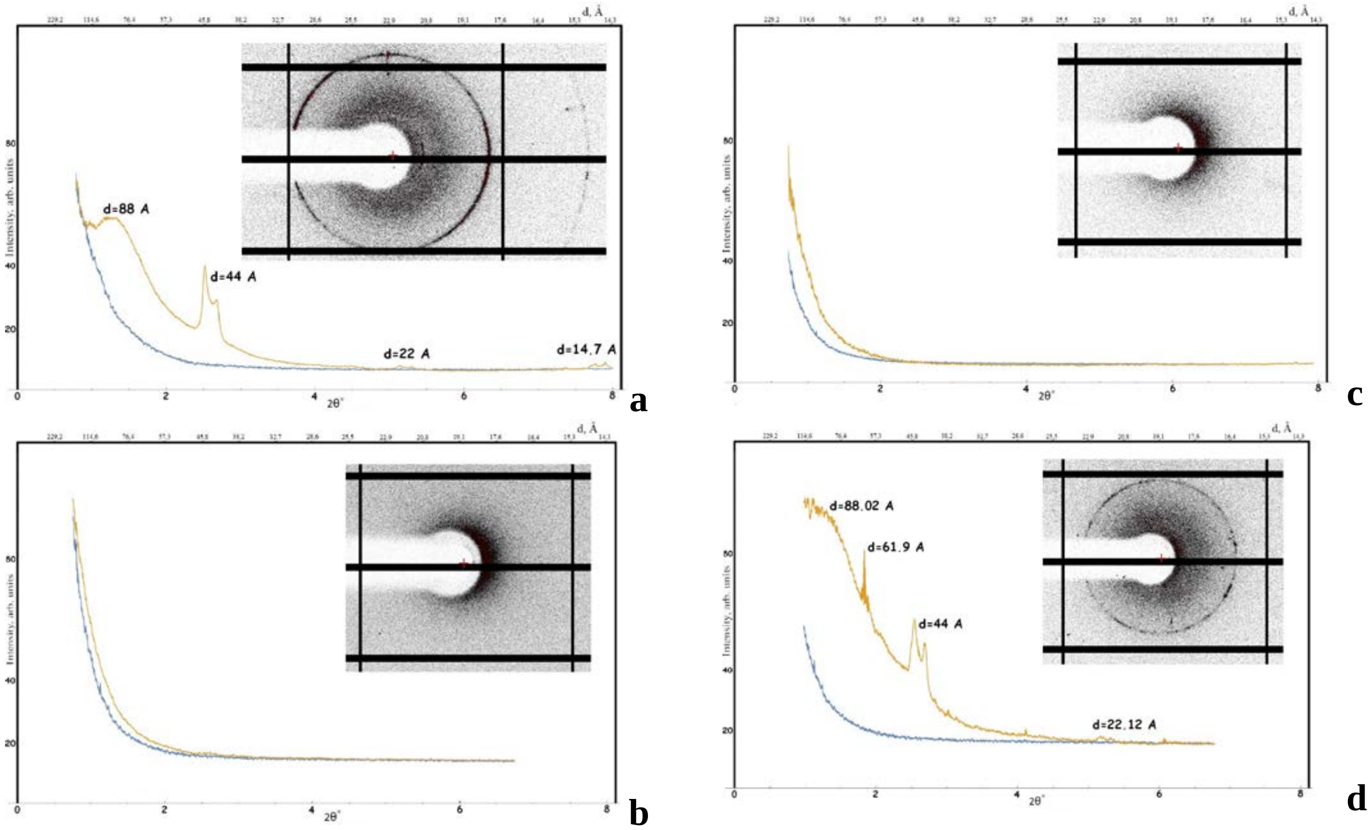

Fig. 1 (a) Anabiotic cells under the stress of alkylhydroxybenzenes (AHBs) in concentration of $2*10^{-4}$M, age – one week; (b) the same cells placed in growth medium and shooted immediately after inoculation; (c) the same cells placed in growth medium and shooted after 12 hour since inoculation; (d) the same cells placed in growth medium and shooted after 14 hour since inoculation. Blue line is the scattering from vegetative cells.

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