Study of the influence of non-contact activated water on the electrokinetic properties of yeast cells

Kazankin Dmitry Sergeevich, Shironosov Valentin Georgievich

Department of Biomedphysics, UdSU, Izhevsk, ikar@udm.ru,

(Collection of abstracts III International Symposium Electrochemical activation in medicine, agriculture, industry. Moscow, 2002 - p.190-194)

In connection with the discovery of the phenomenon of non-contact activation of liquids (BAF) [1], and the possibility of non-contact activation (BA) of solutions in a diaphragmless electrolyzer [2], it is of interest to clarify the effect of non-contact activated water on living cells. Baker's yeast Saccharomyces cerevisiae GOST 171-81 served as a biological test object.

Differences in the physiological state of cells in the control and experiment were determined by their electrokinetic properties (ECS). ECS are manifested in the movement of the cell under the influence of an external electric field. We used the method of intravital alternating cell microelectrophoresis [3, 4]. The essence of the method is to measure the amplitude of cell oscillation in the field of view of the microscope. In the electrophoretic chamber, the cells perform forced reciprocating movements when the voltage sign on the electrodes changes (10 V, with a frequency of 0.1 Hz). The frequency of cell oscillations is equal to the frequency of changing signs on the electrodes, but the oscillation amplitude can be different depending on the charge of the cell surface. As you know, the surface is the place where numerous biologically important phenomena occur. The charge of the cell surface is an indicator of the physiological state and an inherent property of any cell. The ECS of the cell surface reflects the physiological state of the cell.

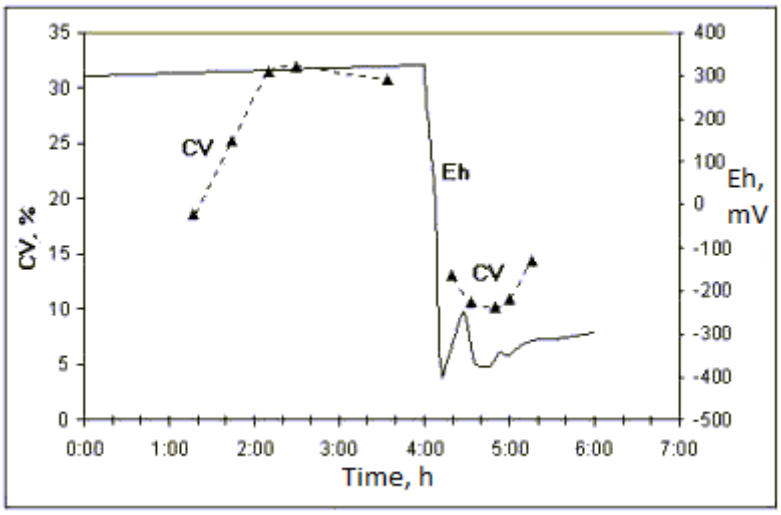
Determination of the influence of non-contact activated water was carried out on the basis of differences in the pacemaker of individual cells within the culture. In this method, the pacemaker of cells is their amplitude of oscillation in an alternating field. Based on the literature data [3], it can be concluded that unfavorable environmental factors or transient processes increase the heterogeneity of the pacemaker cells within the population. In stable conditions of existence, as a rule, cells homogeneous in ECS are observed.

In the first series of experiments, the effect of changes in the ORP in the process of non-contact activation of the medium on the coefficient of variation CV of the amplitude xi of cell oscillations during alternating electrophoresis was studied

$$CV = 100\frac{S}{\bar{x}}\ \%, \quad S = \sqrt{\frac{1}{n}\sum\left(x_i - \bar{x}\right)^2}, \quad \bar{x} = \frac{\sum x_i}{n}$$

where i=1, 2,…n, n - number of cells tested.

The coefficient of variation CV serves in this case as an indicator of population heterogeneity in terms of the electrokinetic properties of individual cells. To increase the heterogeneity of the ECS cells, a strong dilution with distilled water was used: 1 g of cell mass per liter. The action of limiting factors: a lack of a carbon source and a weak negative osmotic shock, increase the heterogeneity of cells according to ECS. The activated environment (in the experiment) compensates to some extent for the effect of unfavorable factors on cells. A typical graph of CV change versus redox potential (ORP) during contactless activation is shown in Pic. 1.

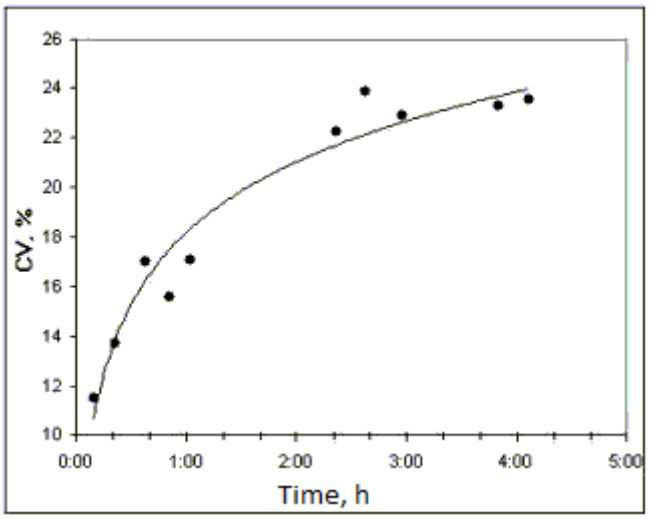


Pic.1. Dependence of the coefficient of variation of the pacemaker of yeast cells on the change in the ORP of the medium during non-contact activation. CV - coefficient of variation of the amplitude of cell oscillations during alternating electrophoresis; Eh - redox potential of the aquatic environment in which the cells are located. Abscissa - time of incubation of yeast cells, h; ordinates-CV-coefficient of variation in %; Eh- ORP environment in mV.

The suspension of yeast cells was diluted with ordinary distilled water with Eh " + 300 mV (HSE) to a concentration of 1 g of cell mass per 1 l and V = 40 ml suspensions were incubated in a polyethylene container with a wall thickness " 0,025 mm. After some time, the CV value leveled off and the container with the cell suspension was placed in an electrochemically activated solution NaCl (C=9 g/l V=1 l), immediately after the termination of electrolysis (tel=15 мин.). ECA was carried out in a diaphragmless electrolyser similar in design to that described in the work [2]. As a result of the contactless activation of an aqueous suspension of cells, Eh in a polyethylene container rapidly changed to " -270…-400 mV (HSE). In this case, the coefficient of variation of the amplitude of cell oscillations changed in the suspension of yeast cells. Based on the results of 3 repetitions, the change is from 5 to 17%. A decrease in the heterogeneity of the population by the pacemaker of individual cells indicates a greater homogeneity of the electrokinetic properties of cells in the experimental culture as compared to the control. This fact indicates an increase in the adaptability of cells.

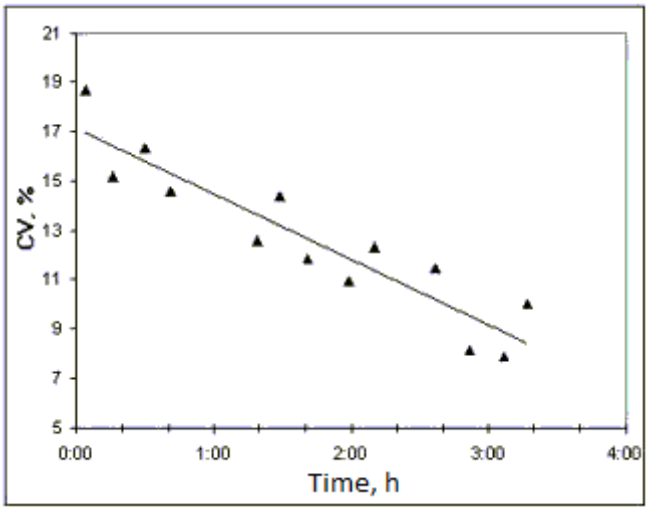
In the next series of experiments, the effect of non-contact activated water on the variation of the oscillation amplitude of cells in suspensions diluted with distilled water (Pic. 2, control) and non-contact activated distilled water (Pic. 3, experiment).

Pic. 2 shows the dependence of the coefficient of variation of the amplitude of the oscillation in the case of alternating electrophoresis on the time spent by the cells in distilled water.



Pic. 2. Dependence of the coefficient of variation of the amplitude of oscillation of cells on the time spent in a control medium with a standard value Eh (+290 … +350 mV).

Pic. 3 shows the dependence of the change in the coefficient of variation of the amplitude of cell oscillation on the time spent in non-contact activated distilled water. The initial cell suspension was diluted with activated water with altered ORP " -370 mV (HSE). In the experiment, water was used that passed contactless activation (15 min.) In the chamber of a non-dipharagmatic electrolyzer [2], after the termination of electrolysis of the solution NaCl (V=1l, C=9 g/l, tel=15 min.). After diluting the cell suspension with activated water, the amplitude of cell oscillations during electrophoresis was measured, and the coefficient of variation was determined. In the graph, the time t = 0 corresponds to the time of cell dilution in the activated medium.



Pic. 3. Dependence of the coefficient of variation of the amplitude of cell oscillations on the time spent in an activated medium with a non-contact changed value Eh " -370 mV (HSE).

The results of the second series of experiments showed that in a highly diluted medium based on ordinary distilled water with Eh " +300 mV (HSE) is a gradual increase in the heterogeneity of the cell culture, which is associated with unfavorable environmental conditions (lack of carbon source and weak negative osmotic shock). In a highly diluted medium, based on non-contact activated water with Eh " -370 mV (HSE) a gradual decrease in the heterogeneity of the cell culture is observed, despite the effect of the listed factors. A decrease in the heterogeneity of a cell culture in a BA environment, all other things being equal, indicates an increase in the adaptability of cells to limiting environmental factors due to the acquisition of additional energy by cells..

The possibility of a reagent-free effect on the biochemical reactions of cells will make it possible to obtain a population of cells, plants, animals with homogeneous, artificially specified improved properties.

List of publications:

1. Bakhir V.M. Electrochemical activation. - M .; VNIIIMT, 1992, p.1. p.197.
2. Shironosov V.G., Shironosov E.V. Experiments on contactless electrochemical activation of water, p. 66 - 68, 2nd International Symposium "Electrochemical activation in medicine, agriculture, industry", abstracts. report - M .; VNIIIMT JSC NPO "Ekran". 1999. - p. 67. sb15-12.htm
3. Miroshnikov A.I., Fomichenkov V.M., Ivanov A.Yu. Electrophysical analysis and cell separation. M.: Science, 1986.
4. Kazankin D.S. Electrokinetic methods of intravital cell research. "MIS-RT", collection 17-3, 2000. sb17-3.htm

Translated by Shironosova O. E.
Found a mistake?

Write me: shironosova.pr@gmail.com