Electrochemically activated water

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Electrochemically activated aqueous media are characterized by the existence of a metastable state with anomalous properties, which disappear during long course of relaxation. Electrolytes obtained after membrane electrolysis of aqueous solutions in the anode and cathode compartments (anolyte and catholyte respectively) have different physicochemical properties and biological activity. This phenomenon was discovered in 1981 by V.M. Bakhir and is used now in several countries in medicine, agriculture and industry. Electrochemical activation of aqueous solutions (mainly chloride solutions) with salt concentration of about 0.01-0.1 M is described in literature. Changes in the physicochemical properties of catholyte and anolyte are generally judged from changes in three parameters: pH, red-ox potential and electric conductivity. As a result of electrolysis electrolyte in the cathode compartment becomes more alkaline with reduced red-ox potential. On contrary, the anolyte is characterized as more acid with increased red-ox potential. The effect depends on the duration of the process and salinity of the initial electrolyte. However, in most cases the effect of catholyte and anolyte on biological objects failed to be modeled by non-electrochemically prepared solutions having the same values of mentioned parameters. There are numerous indications that the catholyte stimulates cell growth and the anolyte inhibits it. The inhibitory effects of anolyte are usually explained by formation of strong oxidizers, chlorine compounds in particular, in the anode compartment. The stimulatory effect of catholyte are explained mainly by reducing properties of the media.

We studied the membrane electrolysis of distilled water and highly diluted ($C < 10^{-4}$ M) sodium chloride solutions. This allowed us to exclude from consideration the products of oxidation and reduction of dissolved salts. The electrolysis was performed in a rectangular batch electrolyzer 197(length)×24(width)×50 (height) – mm, separated into two equal parts by a vertical nonselective membrane, with two 22×50-mm flat platinum electrodes. Initial parameters of solutions were the following: electrical conductivity $(3.2 \div 2.6) \cdot 10^{-6}$ S/cm; $pH_0 = 5.6 \div 6.0$; red-ox potential relative to an Ag/AgCl reference electrode $E_0 = 420 \div 360$ mV. Depending on the voltage applied the current in the circuit was 1 to 3 mA and the current density was about 0.1 to 0.3 mA/cm^2. Biological effects of catholyte and anolyte were performed on green spiderwort, duckweed and infusorians.

The direction of the shift in physicochemical parameters of catholyte and anolyte from the equilibrium values as well as the direction of their biological effects, depends on the salt concentration in the initial solutions in a threshold manner. It means that the role of water in electrochemical activation is decisive and various biological effects are related not to the products of electrolysis of dissolved salts but to the changes in solvent properties.

The efficiency of separation of the products depends both on the pore (mesh) size and the material of membrane. The considerable decrease in the red-ox potential of the catholyte prepared of distilled water cannot be explained by the molecular hydrogen formation only. Metastable state is relaxing to equilibrium state during one day. Increasing of ionic strength of catholyte causes a multiple decrease in the rate of relaxation of the red-ox potential. The red-ox potential of both catholyte and anolyte can be preserved for many days by freezing. The catholyte contains hydrogen peroxide at a concentration of 10^{-7} M.

The catholyte and anolyte prepared of distilled water can substantially affect the development of biological objects as demonstrated by the examples of the growth of roots on green spiderwort cuttings, the growth of duckweed and spontaneous motility of infusorians.