ELECTROBIOLUMINESCENCE OF THE BLOOD

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The electrobioluminescence of the blood studied within a temperature range of 35-50°C has maxima at 42 and 50°C. These are attributed to disturbance of native water and protein structures.

Numerous experimental and theoretical studies have shown that biopolymers may possess semiconductor properties and emphasize the important biological role of delocalized electrons [1, 4, 5].

The object of the present investigation was to study the temperature dynamics of the electrobioluminescence (EBL) of the blood, which depends intimately on the concentration of free charge carriers [2].

EXPERIMENTAL METHOD

To investigate the blood EBL and also the luminescence of physiological saline, a photoelectric apparatus combined with a high-frequency generator to excite luminescence [2] was used. A method was developed for recording the intensity of the EBL of liquid media. Blood in a transparent plastic well was placed on a conducting glass slide on the surface of which luminescence was generated. From the surface of the glass the luminescence was transmitted along a light conductor to a type FÉU-22 photoelectric multiplier. The conducting glass was grounded, and the active electrode of the high-frequency pulse generator inserted into the blood by means of a stand. The FÉU-22 was powered by a high-voltage rectifier, and the signal was amplified by a "Cactus" type dc amplifier and recorded on an ÉPP-09 instrument.

To measure the electrical resistance of the blood and physiological saline, a bridge system was used and measurements made at 50 Hz. Blood was obtained from animals by decapitation, and heparin was used as anticoagulant. All measurements were made in a special thermostat with temperature control from 26-54°C.

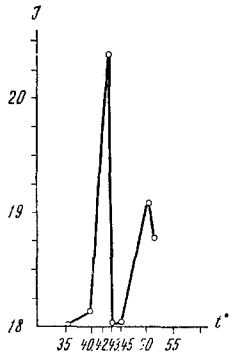

Fig. 1

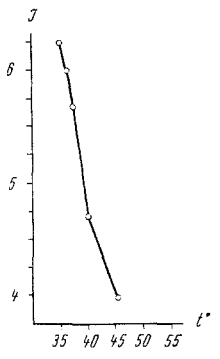

Fig. 2

Fig. 1. Intensity of blood EBL as a function of temperature.

Fig. 2. Intensity of fluorescence of physiological saline as a function of temperature.

EXPERIMENTAL RESULTS

The temperature dependence of the blood EBL is represented by a curve with two maxima at 42 and 50°C (Fig. 1). At the same time, the intensity of fluorescence of the physiological saline changed inversely proportionally to the rise of temperature (Fig. 2). The electrical conductivity of the blood and physiological saline increased with a rise of temperature.

The temperature dependence of the ionic conductivity of blood and physiological saline is identical, but the temperature dependence of the EBL does not coincide with the dynamics of fluorescence of physiological saline or with the

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temperature dependence of the electrical conductivity of blood and physiological saline. It must accordingly be concluded that the intensity of the EBL depends on the electronic conductivity of the test object to a far greater degree than on its ionic conductivity.

Migration of electrons requires structures with metallic or semiconductor properties. Nonmetallic properties require the presence of a rigid crystal lattice of long-range order, which is improbable in biological objects. The only possible assumption is therefore the presence of semiconductor properties.

Bearing in mind the existence of protein and lipid molecules which possess semiconductivity, the dynamics of the EBL can be explained as follows. An increase in intensity of EBL is evidently associated with an increase in the number of electrons in the zones of conductivity, and also with an increase in their mobility. The sharp drop in the intensity of the blood EBL after 42°C is probably due to the complete rupture of intermolecular hydrogen bonds and to a disturbance of zonal conductivity or a change to a new conformation of macromolecular and water structures.

The second maximum observed at 50°C is evidently due to a secondary change in the conformation of the protein molecules.

Blood can evidently be regarded as a liquid semiconductor with short-range order, possessing electronic conductivity. Investigations in this direction are proceeding.

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