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Research Article

Kinetics of photoconductivity of viper venom (Macrovipera lebetina obtusa Linnaeus, 1758) depending on storage period

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Abstract:

In order to study both the electrophysical parameters and photoconductivity of zootoxin, the temperature dependence of the resistivity (ρ) of the crystalline viper venom was studied. At the same time, a "sandwich" structure was created for further study of the electrophysical parameters of the viper's venom.

Presents data on the detection of kinetics and photoconductivity of the venom of the viper (Macrovipera lebetina obtusa Linnaeus, 1758) depending on the storage period. For this purpose, whole venom of the Transcaucasian viper (Macrovipera lebetina obtusa) and dried in a desiccator over calcium chloride vapor, collected in 1993 were subjected to photoconductivity studies in 2008. Were a study of the temperature dependence of the resistivity ρ for the crystalline snake venom of Macrovipera lebetina obtusa was carried out. The snake venom sample was heated in a measuring cell at a constant rate of 9.1°C/sec. The resistance was measured with an E6-13A teraohmmeter. It has been experimentally established that viper venom crystals are not photosensitive in the wavelength range 0.2 µm–2 µm. We assume that under the influence of external factors (in our case, under the influence of temperature), a change in the electrophysical parameters of snake venom is noted. The photoconductivity of snake venom crystals was studied depending on the heating temperature of the crystals in the wavelength range 2 µm - 4 µm. It was revealed that viper venom has photoconductivity in the wavelength range 2 µm – 4 µm. We assume that after each subsequent heating, structural changes may occur in the poison sample under study and, in turn, changes in both toxicity and pharmacological activity of enzymes are noted.

Keywords: venom of viper (Macrovipera lebetina obtusa Linnaeus, 1758); photoconductivity; electrophysical parameters; resistivity

Introduction

The problem of variability in the biological characteristics of snake venom is widely studied throughout the world. The variability of the properties of poisonous secretions is considered by researchers at different levels, including interspecific, intraspecific and interpopulation. An important component of the poison, responsible for its toxic properties, are bioactive protein components and enzymes. Small doses of venom do not cause any clinical manifestations of poisoning and have long been used in the treatment of many serious diseases [1-6].

Using circular dichroism and high-performance liquid chromatography, 12 cardiotoxins were isolated from the venom (Naja) of various cobra species. Significant differences in the stability of the studied cardiotoxins were revealed [10].

Despite the achievements and successes in the field of studying animal poisons many aspects and questions regarding the study of the chemical composition of snake venom remain poorly studied, although to date the primary structure of more than 50 individual peptides of snake venoms, the amino acid sequence of which shows a high degree of homology, has been studied and established [11-16, 17-21]. It has been noted that neurotoxins differ in antigenic properties, in a number of physicochemical characteristics and in many quantitative parameters of blocking cholinergic receptors [22, 23].

In literary sources the effect of snake venoms has been studied in detail and the picture of intoxication has been traced, the effect of snake venom on the functional systems of the body has been revealed, the enzymatic activity and toxicity of snake venom have been studied, and comparative pharmacological and biochemical characteristics of the venoms of various species of snakes have been given.

Have been studied Influence of small dozes γ--radiations on molecular mobility and pharmacological properties of venom of Vipera lebetina obtusa and studied Influence to small dozes radiation on spectral characteristics and pharmacological properties of venom transcaucasian viper Vipera lebetina obtusa.

Progress in the field of studying the venom of poisonous animals is the development of new drugs based on known toxins. However, even well-known toxins can have unexpected or unwanted effects. This issue requires careful study on a case-by-case basis before a compound is considered as a drug source. Despite great progress in the research of animal venoms, some problems remain unexplored [24, 25].

Based on the above, the purpose of these studies was to identify the photoconductivity of the venom of the viper (Macrovipera lebetina obtusa Linnaeus, 1758) depending on the storage period. The literature provides data on the study of snake venoms, but many issues still remain unaddressed and require in-depth analysis and study. The influence of temperature on the electrophysical parameters of the poison and the photoconductivity of zootoxins has not been studied. Based on the above, the study of the electrophysical parameters of zootoxin in order to study the photo- and thermal stability of snake venom crystals seems very relevant.

Material and research methods

Transcaucasian viper (Macrovipera lebetina obtusa), dried in a desiccator over calcium chloride vapor and venom samples collected in 1993, analyzed in 2024. For experiments, the poisonous secretion of the Transcaucasian viper was dried under standard conditions in a desiccator over calcium chloride at room. Next, the crystalline venom was analyzed. Samples of viper venom were stored in glass containers in the refrigerator at a temperature of +5-6^0 C. With this method of drying and storage, the venom retained its biological activity for at least 3 years.

The photoconductivity of snake venom crystals was studied depending on the heating temperature of the crystals in the wavelength range 2 µm – 4 µm. The corresponding dependence curves were constructed. To do this, we re-examined the temperature dependence of the resistivity ρ for the crystalline snake venom of Macrovipera lebetina obtusa. The crystal under study was glued to a metal substrate with silver paste, and a second electrode was applied to another surface with the same paste.

Thus, a structure was created for further study of the electrophysical parameters of the viper's venom.

Heating a sample of snake venom at a constant rate of 2K/min. produced in the measuring cell. The resistance was also measured with an E6-13A teraohmmeter.

Research results and discussion

In order to study both the electrophysical parameters and photoconductivity of zootoxin, the temperature dependence of the resistivity (ρ) of the crystalline viper venom was studied. At the same time, a "sandwich" structure was created for further study of the electrophysical parameters of the viper's venom.

To study the electrophysical parameters and photoconductivity of snake venom, we took viper venom, dried in a desiccator over calcium chloride vapor. We conducted studies of the temperature dependence of resistivity ρ for the crystalline snake venom of Macrovipera lebetina obtusa. In this case, the snake venom crystal under study was glued to a metal substrate with silver paste. A second electrode was glued to the other surface of the metal substrate with silver paste. Thus, a ("sangwich") structure was created for further study of the electrophysical parameters of the venom of the viper Macrovipera lebetina obtusa. The snake venom sample was heated in a measuring cell at a constant rate of 9.1°C/sec. The resistance was measured with an E6-13A teraohmmeter.

The sample was heated to 170^{0}C and the change in resistivity was observed, then it was cooled and the process was repeated again. The sample was heated again (the heating process was repeated three times). The photosensitivity of snake venom was studied based on photoconductivity measurements in the wavelength range 0.2 µm – 2 µm. Figure 1 shows the dependence curves of the resistivity ρ on the heating temperature of the sample: ρ= f (T).

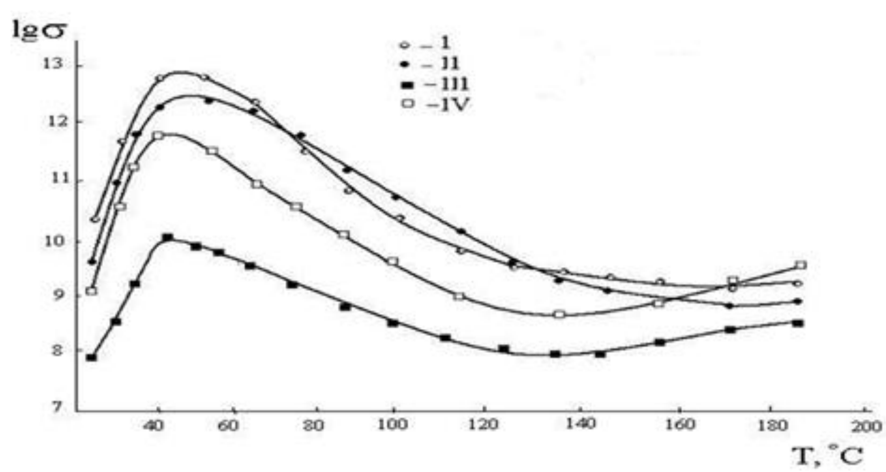

Figure 1: Graph of resistivity ρ versus heating temperature of the sample: ρ= f (T).

As can be seen from the figure, the resistivity increased each time. The experiments were repeated every other day. At the same time, as the experimental data obtained show, the resistivity decreased. In addition, there was a shift in the peaks on the resistivity curve. When heated to a temperature of 170^{0}C with subsequent reheating of the poison samples, a slight change in the resistivity of the zootoxin was noted. We assume that after each heating, structural changes occur in the sample, which, in turn, causes a change in both the pharmacological activity and the toxicity of the venom enzymes.

However, with subsequent heating of the snake venom with a 24-hour interval, which corresponds to curve 4, which resembles curve 1, in all likelihood, the reverse process is observed, that is, the destroyed structures are restored, which indicates the thermal stability of the snake venom. Based on the obtained resistivity values, we can say that snake venom crystals behave like semiconductors at temperatures up to 50°C. For semiconductors, the nature of the temperature dependence of resistivity and conductivity for a certain temperature range is determined by dependencies of the form:

$\rho = \rho_o e^{\beta/T}$ (5.1);

$\sigma = \sigma_o e^{-\beta/T}$ (5.2);

where, ρo, so, b are some constants for a given temperature range, characteristic of a given crystal. Based on the results of the studies, it can be seen that under the influence of heat there is a change in the resistivity of snake venom crystals.

Based on the results obtained, the conductivity of snake venom crystals was determined depending on the heating temperature. Curves were plotted for the dependence of conductivity s on the heating temperature of the sample s = f (T) over time. Based on the results of the studies, it can be seen that under the influence of heat there is a change in the resistivity of snake venom crystals.

Based on the results obtained, the conductivity of snake venom crystals was determined depending on the heating temperature. Curves were plotted for the dependence of conductivity s on the heating temperature of the sample s = f (T) over time. Photoconductivity measurements of viper venom crystals were also carried out in the wavelength range 0.2 µm – 2 µm at room temperature. When illuminating the poison crystals, at various values of forward and reverse voltage, photosensitivity was not observed.

It should be noted that when heating of the venom is stopped, enzymatic activity is restored, as well as the physicochemical properties of the snake venom. Based on the results of the research, we assume that under the influence of external factors (in our case, temperature) there is a change in the electrophysical parameters of snake venom.

The identified changes in the resistivity (conductivity) of viper venom, in our opinion, are the result of changes in the electrical properties of the zootoxin.

Curves were plotted for the dependence of conductivity □ on the heating temperature of the sample: σ = f (T). The research results are presented in Figure 2.

As can be seen from the graph, the conductivity of the poison increases with increasing heating temperature of the studied toxin samples to 43°C. However, with further heating, the conductivity decreases. Above 140^{0}C - conductivity increases again. Similar experiments were repeated every other day. At the same time, an increase in conductivity was noted, as well as a movement of the maxima on the resistivity curve. When the sample is heated to a temperature of 170°C, followed by reheating of the venom samples, a slight change in the conductivity of the snake venom is observed.

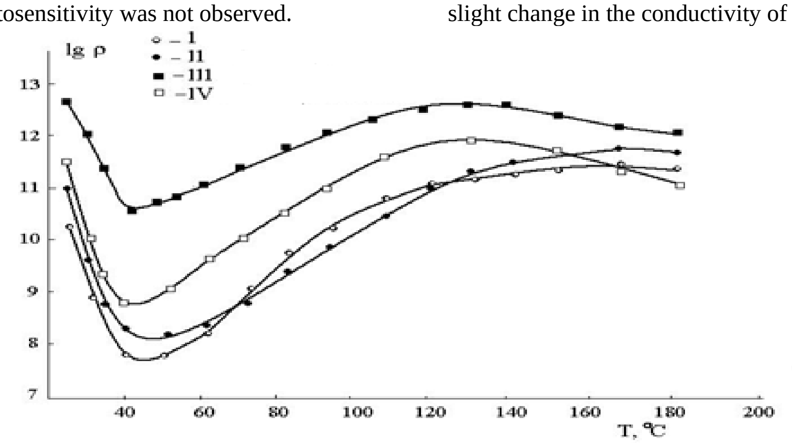

Figure 2: Graph of photoconductivity σ versus sample heating temperature σ = f(T).

We assume that after each subsequent heating, structural changes may occur in the poison sample under study. However, with subsequent heating of the snake venom at 24-hour intervals, a restoration of the physico-chemical properties of the snake venom is observed, which indicates the thermal stability of the zootoxin. Thus, when heating of the venom stops, there is a restoration of enzymatic activity, as well as the physicochemical properties of snake venom. Based on the results of the studies, we assume that under the influence of external factors (temperature) there is a change in the electrophysical parameters of the poison.

Based on experimental data, changes in the electrophysical properties of snake venom were identified. It has been established that the venom of the viper does not have photoconductivity. A change in the conductivity of snake venom under the influence of temperature was revealed.

From the above it follows that the conductivity of the poison increases with increasing temperature of heating the poison samples to 43°C. However, with a subsequent increase in the heating temperature of the snake venom, the opposite effect is observed, that is, a decrease in conductivity is noted. Subsequently, with an increase in the heating temperature of snake venom samples above 140°C, the conductivity increases again.

As a result, we measured the photoconductivity of viper venom. At the same time, the photoconductivity of crystalline snake venom was measured at various temperatures and wavelengths. The photoconductivity values of the venom were determined depending on the wavelength.

Thus, it can be stated that the venom of the viper has photoconductivity in the wavelength range 2 µm - 4 µm. The obtained data can be used when storing preparations based on snake venom, as well as the identified electrophysical characteristics of snake venom, and can be used as a criterion for establishing the authenticity of both whole venoms, its toxins, and preparations based on zootoxins.

It has been established that viper venom crystals are not photosensitive in the wavelength range 0.2 µm – 2 µm, but viper venom has photoconductivity in the wavelength range 2 µm – 4 µm. The results of experimental studies can be used in medical practice in forensic medical examination, in the analysis of cadaveric material to establish the authenticity and identification of both snake venom toxins and the products of its metabolism.

Conclusions

The photoconductivity of the venom was experimentally studied, and it was found that crystals of viper venom are not photosensitive in the wavelength range 0.2 µm - 2 µm.

It was revealed that viper venom has photoconductivity in the wavelength range 2 µm - 4 µm.

Thus, as a result of the research, the electrophysical properties of viper venom were revealed. The data we obtained can be used when storing preparations based on snake venom.

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