Assessment of the influence of different concentrations of zinc on the brain biochemical processes in rat model

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Being necessary for protein synthesis, zinc acts like a regulator, steering many important processes in enzyme systems in the right direction. Zinc compounds play important role in the controlling of muscle contractility, the insulin formation as well as in maintaining blood homeostasis and acid-base balance in the body. However, the zinc surplus has many pathological effects for organism.

Modern optical technologies show considerable advantages in application for drug discovery in small laboratory animals during efficiency and toxicity trials. In this study, using the fibre-optic probe, the fluorescence of the anterior brain regions was evaluated and analysed in a Wistar rat model. The probe made it possible to simultaneously record both fluorescence intensity and blood content parameters of the studied tissue site. To modulate the metabolic activity of brain tissues, Zn compound solution (in the form of zinc sulphate) of four different concentrations were administrated to the animals from treatment groups for 1 month in drinking water. After that, the fluorescence signals were measured on the brain cortex surface. Excitation at wavelengths of 365 nm, 450 nm, 532 nm and 637 nm was used to record the fluorescence signals. The processing of the obtained experimental spectra made it possible to reveal a direct relationship between the fluorescence intensity in the spectral region of NADH emission and the concentration of the orally administrated zinc. Optical measurements in vivo were supplemented by histochemical measurements of zinc ions in brain sections both in the treatment and control groups. The obtained results are in agreement with the statement that high concentrations of zinc ions are capable of inhibiting the mitochondrial complexes I, II and IV. The effect leads to inhibited cellular respiration in the cells of the nervous tissue.

It is well known that the activity of cortical neurons depends on the oxygen consumption in this cells. The dose dependent effect evaluation showed that the highest Zn concentration in drinked water caused intensity of the cell respiration. As a result in according with open field test the motor activity of the laboratory rats increased when low dose of Zn solution was added to water. Thus the concentration of Zn in water solution increased from 0.25 to 0.5 and then to 0.75 mg per animal it was notieced also the paradox effect that behavior of rats changed from aggressive (in low dose) to calm (in high dose). This may be explained as an effect of strong mitochondrial disfunction and pathological changes in the brain regions.