



**USE OF NEW CARBON CLUSTER FULLERENES AS ANTIOXIDANTS IN
PROTEIN STORAGE COMPOUNDS USED IN STROKE PREVENTION**

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ANNOTATION

As you know, ischemic brain damage is increasing all over the world. According to the WHO, cardiovascular disease (CVD) is the leading cause of death worldwide. 17.5 million people die from CVD every year.

This scientific research is aimed at biomedical study of conjugates of carbon nanostructures (light fullerenes) with antioxidant amino acids and peptides, as well as the use of these adducts to reduce the focus of ischemic/reperfusion brain damage. This area of research is relevant due to the increasing prevalence of cardiovascular diseases that reduce the quality of life and lead to disability of patients. The scientific research of the study lies in the fact that the synthesis, identification, and study of the biological activity of the studied conjugates with antioxidant amino acids and peptides will be carried out for the first time. The studies planned within the framework of the project will be the basis for the creation of medicinal nanodrugs for the treatment of ischemic brain damage.

Carbon atoms are able to form various crystalline, polymeric and molecular structures. An example of a stable molecular structure is fullerenes, which are closed spherical carbon frameworks. The most studied are C₆₀ and C₇₀ fullerenes, the molecules of which contain 60 and 70 carbon atoms, respectively. The C₆₀ molecule has the shape of a truncated icosahedron and resembles a soccer ball (pentagons alternate with hexagons) with a radius of about 0.33 nm. It is assumed that toxicity in some cases could be due to high doses of fullerenes, ligands or impurities. Other forms of pure carbon are known to be non-toxic. A feature of some nanoparticles, including fullerenes, may be their ability to penetrate the body through the lungs, overcome the blood-brain barrier and cytoplasmic membranes. Unlike carbon nanotubes, the available data on the carcinogenicity of fullerenes are considered insufficient for an objective assessment. Carcinogenicity tests conducted on rodents have yielded negative results. In vitro, C₆₀ fullerene, when simultaneously irradiated with visible light, caused DNA damage. Note that the



toxicity of fullerenes themselves is mainly discussed in the literature. In this case, impurities formed from the feedstock or by-products of reactions, for example, aimed at obtaining water-soluble fullerene derivatives, are sometimes overlooked. Among the supposed useful properties of fullerenes, antioxidant activity is primarily discussed, which is associated with the presence of double bonds in their molecules. However, double bonds exist in many organic compounds. Information about the effect of fullerenes on the redox balance is somewhat contradictory. It is assumed that the biological effects of fullerenes are mediated by both the absorption of free radicals and their generation. The redox balance of the body is maintained in dynamic equilibrium under the influence of many factors; it is doubtful that its temporary shift with the help of pharmacological drugs is useful a priori. The action of antioxidants can be both beneficial and harmful. The term "antioxidants" refers to various substances, such as vitamins, sometimes with a complex mechanism of action. It is far from always clear whether the intake of antioxidants is indicated, which drugs and in what quantity should be used.

Keywords: nanomedicine, biomedical materials science, ischemia, reperfusion, nanomaterials, carbon nanostructures, antioxidant activity.

Material and method The following equipment will be needed to carry out research work: rats, analytical balances, chromatographic columns, liquid chromatograph, spectrophotometer, thermostatic cabinets, oil baths and flask heaters, spectrophotometers, optical microscope.

Equipment for working with human and mammalian cell culture: laminar box, cytological protection, CO₂ incubator, inverted microscope Biolam-P1, centrifuge for working with cells, a set of equipment and accessories for separation of biomolecules. gel electrophoresis, water purification system, thermostat for thermostating slides and tablets, solid thermostat with cooling and mixing.

Purpose of the study: The development of original scalable methods for the synthesis of light fullerene adducts with antioxidant amino acids and peptides, followed by a comprehensive study of the biological and physicochemical properties of these molecules, is the basis for the creation of potential drugs. A comprehensive geological study will include an assessment of antioxidant properties, the effect on haematological and biochemical characteristics of blood, cyto- and genotoxicity, biodistribution, and the effect on reducing the focus of reperfusion damage to the brain in model experiments with animals. As a result, unique nanostructures will be synthesised and studied, which can be used as a basis for the creation of drugs aimed at reducing the focus of ischemic/reperfusion brain damage.



Results. *In vivo* experiments conducted so far in our research group have shown that light fullerenes functionalised with L-arginine contribute to neuroprotective processes after impaired cerebral vascularisation. In studies of motor activity of rats with cerebral ischemia in the period from 7 to 10 days, an advantage was noted in dynamic adaptation to a daily increase in load in the group of rats receiving nanoparticles at a dose of 5-10 mg/kg, compared with the control group. On the tenth day, the rats receiving nanoparticles could remain on the retard at a significantly increased speed (46.1 rpm) compared to the animals of the control group (ischemia) (25.5 rpm, $P < 0.05$). Thus, the continuation of this topic is promising.

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