Description for the general public

Iron is a trace element that plays a key role in the functioning of living organisms. Mostly, iron is associated with a component of a heme in hemoglobin responsible for oxygen transport. However, the function of this element has much wider biological potential: iron is a part of enzymes and cytochromes, it is involved in the processes of cell growth and the synthesis of neurotransmitters and hormones and also has a large contribution to the function of immune system. Despite such comprehensive nature, it has to be remembered that iron perfectly fulfills its function only if it is associated with specific proteins. In the situation of occurrence of greater amount of free iron in a body (overload), the free radicals appears. Examples include Fenton reaction and formation of reactive oxygen species, which are involved in DNA point mutations. Therefore, the amount of free iron has to be minimized in organism by mentioned proteins. Thus, after the absorption of iron in the intestine by enterocytes (cells of small intestine) it is bonded to the transport protein - transferrin and in such complex reaches cells by circulatory system. Afterwards, iron-transferrin complex combines with transferrin receptors located on the surface of cells. It results in a release of iron inside the cell and then it can be transferred into either ferritin (iron storage protein) or mitochondria of the cell (in the case of heme synthesis).

From medical diagnosis point of view, the knowledge of mentioned forms of proteins associated with transportation and distribution of iron carries an information about the condition of this element's metabolism in body. The proposed project concerns the determination of three forms of proteins (transferrin, transferrin receptor and ferritin) using relatively simple and cheap, mechanized analytical biosystems. To implement such systems dedicated detection systems consisting of light emitting diodes (LEDs as a function of the emitter and the radiation detector) and the solenoid and / or a piezoelectric devices for flow control (micropumps and microvalves) will be used. The measurements would be carried out by selective precipitation of proteins by a selective reaction with the antibodies. As a result, a turbidity appears due to antigen-antibodies complex, which is proportional to the concentration of proteins in blood serum. However, this problem is not trivial because of the very low concentrations of proteins in blood serum. Thus, in the course of the project ways to reduce the limit of quantification of proposed methods will be tested by e.g. .: different construction of detectors or use of the polymer particles to enhanced the analytical signal. The applicant believes that obtained flow biosystems will be characterized by full mechanization of the analytical procedure, robustness, low consumption of samples and reagents, as well as high precision and repeatability.

Two significant aspects connected with potential future utility of the results of this project should be stressed. Firstly, proposed systems could be used for diagnosis of diseases associated with iron's metabolism, such as anemia, inflammation, hypothyroidism and hyperthyroidism or impaired liver's function. The second aspect is the capability to study the role of the aforementioned proteins in the case of tumor processes. It is known that transferrin delivers iron to the actively dividing cancer cells. These cells are provided with large numbers of transferrin receptors (to trap particles of transferrin with iron). Therefore, it is believed that these proteins may be critical in the treatment process of cancer.