DEVELOPMENT OF INSTRUMENTAL ANALYTICAL APPROACHES BASED ON THE PRINCIPLES OF BIOSENSORICS FOR CONTROL OF QUALITY OF MILK AND MILK PRODUCTS

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Quality of milk and milk products is strong depended on the number of factors and among them a big role here belongs to such ones as: the health of cows, especially, their mode of feeding and maintenance, environment state, and at last, cooking, storage as well as delivery of products to the consumer. There is necessary to pay a special attention of possibility of appearing a different chemical substances in milk products as results of their dispersion in environment in generally, for example: phosphor organic pesticides, heavy metals, a some mycotoxins and a different pathogenic bacteria, particularly, *Salmonella thyphimurium*. From other hand, now among cows it is very dispersed retroviral leucosis which may be dangerous for peoples too. More important to note that the propagateddisease cows as mastitis they are treated with antibiotics, which are appearing in the milk and can carry the non-favorable load for people. All these factors may pose a significant risk to the health of the population who use such products. In additional to that, unfortunately, modern technologies of milk industry used a lot of types of the nutritional supplements. A huge threat to human health and all living it is presented previously not controlled and not reasoned from position of biosafety the use of nano-structures in the food industry and the agricultural sector. To prevent possibility of all possible non-desirable effects for people health there is necessary to provide the express and constant control as milk and milk products. Unfortunately the existed traditional methods of analysis cannot provide these practice demands since they are sophisticated, time consumable, expensive and could not curried in on line regime and in field conditions. There is necessary to use a new generation of instrumental analytical devices, in particular, based on the principles of biosensorics. Nevertheless, a lot of variants of the developed biosensors are or that which do not response to practice demands due to complicate, high prices and others indexes, or do not adapted to analysis of needed indicators. To remove this gap between real step of biosensorics development and demands of the veterinary and medical sanitary controlling authorities we have started in working out a number of optical non-labeled biosensors which are able to fulfill analysis in real time and in field condition as well as to simultaneous control of number of samples or several parameters needed for control of milk and milk foods. The detailed analysis of the obtained experimental results are given in report.

It was proposed a new algorithm with the application of the immune biosensor based on the principle of biosensorics, in particular, the surface plasmon resonance (SPR), for the express diagnostic of the bovine retroviral leucosis at the analysis of the serum blood and milk. As result of detailed investigation it was stated that for early biochemical diagnostics of this disease there is needed some drop of blood and after its dilution in one hundred time or less it is possible to reveal the presence of the antibodies (Ab) appearing of which was induced by retroviral infection. Of course, the titer of such Ab in serum blood increases with the development of disease. There is necessary to underline that the appearing of the specific Ab in milk strong correlates with the step of retroviral leucosis. The minimal dilution of milk is no more as 1:20. That is why it was concluded that revealing of specific Ab may be as main factor for concluding the origin of the milk from healthy or sick cows. The overall time of analysis is about 10-15 min and it may be shortened, in particular, if the transducer surfaces were preliminary prepared. In this case the measuring time may be 5 min only.

The similar other approach for the biochemical diagnostics of retroviral leucosis was based on the application of immune biosensor with working transducer on the nano-porous silicon and registration of the formed immune complex through measuring photoluminescence (PhL). This approach is very simple, may be instrumental realized in portable form for the wide application including farms and other field conditions. It provides the same express analysis but the sensitivity of such immune biosensor a few less than above presented one. It is very effective for screening observation of animals and express control of milk and milk products.

The next similar type of the immune biosensor was developed on the basis of ZnO nano-rods with the registration of the specific signal with the help of the PhL. This immune biosensor has a very high sensitivity which allows revealing the presence of specific Ab at the dilution of serum blood of ill animals up to dissolution in 1:100000. This approach is very suitable for the verification of the preliminary fulfilled screening investigations.

All the developed immune biosensors were used for control a number of micotoxins (first of all such as T2, aflatoxins, patulin and others) in environmental objects. In this case the sensitivity of analysis was on the level that which is inherent to the traditional methods, such as ELISA-method, thin-layer chromatography and others. At the same time the time of analysis with the application of the developed immune biosensors is much less than others analytical approaches and it may be in frame of 10-15 min if both the transducer surface and the sample to be analyzed were preliminary prepared. In the additional to the they are very simple during their application and do not demand a big financial expenses.

There is necessary underline that all proposed types of biosensors were successfully examined at the control of some additional components (in particular of soy proteins and some others proteins included into milk or milk products). There is possible to determine these additional components in express regime of analysis and moreover giving quantitative results.

At last time we developed SOS-type of the cell biosensor for the determination of level genotoxicity of the number of chemical substances. It is very important today for the control of different foods, in particular, in case including to them so called of nutritional supplements.

This biosensor was tested at the determination of the genotoxicity of the number substances as: ethanol, dimethylsulfate and mitomycin C. The sensitivity of the proposed biosensor corresponds to the approaches based on the application based on the traditional, complicate and expensive devices. The developed biosensor may be used for the express analysis, namely during 20 min if the optrodes with the appropriate immobilised cells will be prepared in advance. It was informed that according to the preliminary results the functional activity of such optrodes may be served up to one day. It was concluded that the biosensor may have perspective in future for the using in field conditions.

In form of the general conclusion it is possible to underline that a number of proposed of new generation of the instrumental analytical devices based on the principles of biosensorics which was developed and successfully demonstrated at the control of quality of milk (in case of understanding the origin of its from the healthy or sick cows, the presence in its not a natural component, or some toxic compounds as a result of feeding animal by feed after fungal attack or the use of specific food additives) are very effective for practical application to prevent a lot of non desirable effects. And it should be emphasized that there is an opportunity for the express characterisation of milk and dairy product according to the standards, but also the presence of some components with overall toxicity and genotoxicity.