Specific synthetic nucleic acids instead antibodies

For a long time immunological methods have been applied in biological research as well as for detection and evaluation of various substances in clinical analysis of body fluids. Serum proteins, antibodies, form integral parts in all variants of immunoassays. These large protein molecules are highly specific and react with strong affinity with a broad array of ligands. However, the production of antibodies is a costly, time-consuming process. Furthermore, antibodies easily lose their specific activity after denaturation, therefore necessitating mild conditions during experimentation.

About 25 years ago two groups of American scientists found that short, synthetic single chain DNA or RNA nucleic acids, designated as aptamers, react specifically, and with high affinity, with proteins and other macromolecules as well as with various low-molecular weight molecules. Since that time, aptamers have been widely used in various areas of biological research including immunological studies. The importance of aptamers in a wide range of applications is based on several factors, among them the following - the production of aptamers is relatively inexpensive and they are highly reproducible from batch to batch; aptamers are stable products and after denaturation can be rapidly regenerated, with no loss of specificity and reused. Aptamers intensively applied in the development of many effective analytical methods including immunoassays.

Detection of substances by a specific aptamer is much easier if it is immobilized on insoluble supports like gold, silica and carbon nanoparticles, glass, and graphene among others. Such apta-sorbents are widely used in various immunoassays as well as in many other techniques for detection and extraction of various substances. As aptamers are small molecules, their density on solid surfaces is high. On solid matrix it is possible to fix aptamers with different specificity simultaneously. Such dual aptamer-nanoparticles have been applied as effective diagnostic probes in instances of breast cancer. They were much more effective then single aptamer probes.

Over the past decade aptamers specific to immunoglobulin molecules were obtained. Interest in the problem is understandable as such aptamers could be applied to detect immunoglobulins and also to the industrial-scale isolation of antibodies used for treatment of various pathologies. Aptamers specific to immunoglobulin E (IgE) were successfully used for detection of IgE concentrations in the blood. This analysis is important as in allergic patients IgE levels sharply rise and a high IgE concentration is an important clinical marker pointing the presence of allergy. Several laboratories have developed aptamer assays for the measurements of IgE concentrations including immobilized anti-IgE aptamers. Using this method, IgE was detected in protein mixtures with high sensitivity.

The development of assays involving aptamers is progressing rapidly. For preparation of apta-sorbents, new solid phases have been suggested. Novel methodologies using aptamers for immunoglobulin detection, and the application of aptamers rather than antibodies in classical immunoassays have also been successfully developed. Clearly, progress in the use of aptamers

will continue, taking advantage of their unique properties.

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