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Research on Innovative Application of Nucleic Acid Aptamers in the Detection Industry

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Abstract

Nucleic acid aptamer is a small piece of nucleotide sequence or polypeptide selected in vitro. Target substances that conform to the principle of antigen-antibody binding can bind to nucleic acid aptamers with high specificity and selectivity. Therefore, nucleic acid aptamers are It is widely used in the research and production of biosensors. The traditional general antibiotic detection method is the colloidal gold method, but the colloidal gold has large batch differences and low sensitivity, which reduces the detection accuracy of antibiotics. There is an urgent need for new detection technologies in the market. This article briefly discusses the innovative application of nucleic acid aptamers using virtual screening technology in the antibiotic detection industry for the first time.

Keywords

Nucleic Acid Aptamer; Biological Detection Industry; Antibiotics; Colloidal Gold.

1. Introduction

Nucleic acid aptamers are not only used in the field of biosensors, but also widely used in various detection fields, which are the basis for the development of various detection fields. Based on its high sensitivity and good specificity, the detection accuracy can be ensured at the time of detection. Food is related to human life, health and safety, and it is very important to do a good job in the detection of antibiotics in food.

2. Nucleic Acid Aptamers are Superior in Nature to Antibodies

Nucleic acid aptamer is an oligonucleotide DNA or RNA, generally 20-80 nucleotides in length, which has similar properties to antibodies and has advantages over antibodies. Compared with antibodies, it is more specific, and has a similar or even higher affinity to target molecules than antibodies, and has extremely strong affinity under a wide range of material conditions, including most of the Drugs, proteins, amino acids, carbohydrates, lipids, organic molecules, etc. Nucleic acid aptamers maximize the use of antibody-antigen responses, which greatly make up for the deficiencies of antibodies, and also open up a new path for the development of traditional biosensors and traditional immunosensors, making them better application prospects.

Nucleic acid aptamers are easier to obtain than antibodies, and the preparation method is simpler. To provide the raw materials required for the synthesis of nucleic acid aptamers, in vitro PCR amplification technology is used to make them exponentially enriched. Evolved into high-affinity and high-specificity oligonucleotide ligands. In this process, SELFX (Exponentially Enriched Ligand System Evolution) technology utilizes the interaction of a large-capacity random oligonucleotide library with target molecules, and selects oligonucleotides that specifically bind to the target molecule as its basis. The ability to find oligonucleotides that interact with target molecules is largely determined by the diversity of the oligonucleotide library.

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Nucleic acid aptamers can be screened against different kinds of targets, broadening their application scope. Nucleic acid aptamers can be modified according to different screening and utilization requirements, so that they can be widely used in different fields. The stability of nucleic acid aptamers is better than that of antibodies, which is convenient for storage. Compared with monoclonal antibodies, nucleic acid aptamers have lower molecular weight (15-50 bases), have no immunogenicity, do not cause immune responses in animals, and are not toxic themselves. Retrofit and markup. Unlike protein-based antibodies. Antibodies are protective proteins produced by plasma cells after the body is stimulated by antigens. Therefore, the antibody will not recover after encountering high temperature denaturation, and the stability is poor. However, nucleic acid aptamers are realized based on nucleotides, connected by phosphodiester bonds in the middle, which can be reversibly denatured and renatured, can withstand large temperature changes, and can be stored and transported at room temperature.

3. Nucleic Acid Aptamers Promote the Development of the Biological Detection Industry

Biological testing involves on-site testing, online monitoring, and even the separation and analysis of components in many fields such as clinical testing, disease prevention and control, and food safety assurance. As a specific recognition molecule, nucleic acid aptamers have attracted extensive attention due to their high stability and wide target range. Although in theory, as long as the random sequence library capacity of oligonucleotides is large enough, any nucleic acid aptamer corresponding to the target can be screened. The range of target substances is very wide: metal ions, organic molecules, nucleic acids, polypeptides, proteins, cells, cell aggregates, subcellular organelles, macromolecular aggregates, etc. In theory, the corresponding nucleic acid aptamers can be obtained through screening techniques body sensor to achieve detection. It can be seen that nucleic acid aptamers have broad application prospects.

From the perspective of market research, the antibiotic detection technology that can be seen on the market at this stage is almost all using the colloidal gold method in the rapid inspection. The colloidal gold method has obvious defects, a low throughput and the accuracy of the test paper is highly dependent on antibodies. The specificity of the antibody is not good and it is prone to cross-reaction, which affects the accuracy of the detection, and the low throughput will greatly prolong the time required for the reaction. There is no rapid detection product on the market that uses nucleic acid aptamer sensing technology, and the market share of nucleic acid aptamers is 0. In this huge market that is related to people's livelihood, no detection technology is fully mastered by China of. Once the control of autonomous nucleic acid aptamer technology is realized, the biological detection technology and the biological detection industry will be improved, and at the same time, the development of medicine can be greatly promoted. Under a lot of research and consideration, in the screening, we choose to use the current new technology 3D reconstruction and virtual simulation technology to establish a huge information library of nucleic acid aptamers, so as to reduce the experimental exploration time of the laboratory, and maximize the possible Reduce the appearance of wrong options.

4. Antibiotics are Extremely Harmful

Most antibiotics are metabolized by the liver and kidneys. Therefore, in the process of human metabolism, the kidneys and liver are the first to be affected, and the damage is also the greatest, followed by other organs. The various organs in infants and young children have not yet matured, their bodies are very fragile, and they are more vulnerable to the destruction or potential damage of antibiotics. The two organs that bear the brunt are the liver and kidneys.

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In particular, sulfonamides are essential, which are particularly harmful to infants and young children, and can cause deformities. Quinolones, aminoglycosides, chloramphenicol antibiotics are common clinical antibiotics. Major dysbacteriosis can cause a series of clinical symptoms in the body, which usually occurs in patients who are often treated with broad-spectrum antibiotics. Antibiotic-sensitive bacteria in the body are killed in large quantities, while insensitive bacteria such as Staphylococcus aureus are killed in large quantities. , Candida albicans, etc. are waiting for the opportunity to multiply, leading to pseudomembranous colitis, Candida albicans pneumonia, etc., which is the so-called superinfection in clinical practice, which brings great obstacles to the treatment of the disease and produces serious adverse results.

Excessive use of antibiotics will lead to the death of a large number of normal bacteria in the body, and the body's immunity will decline, allowing the bacteria to treat diseases to take advantage of it. ; Excessive use of antibiotics will cause bacteria to form drug resistance, which will make the human body produce drug dependence, make the use of antibiotic drugs worse, and even make drug treatment useless; large-scale use of antibiotics will bring strong toxicity, and the side effects of antibiotics will directly harm In the body, misuse of antibiotics during colds is especially common, and the most common side effect is hearing in children, which can lead to severe deafness. Antibiotics were originally used to destroy bacteria, but in the process of killing or restraining bacteria, bacteria have been fighting against antibiotics. The abuse of antibiotics will cause bacteria to become resistant and eventually lead to no drugs available. While taking antibiotics, the intestinal flora will inevitably be destroyed. Every time antibiotics are used, it can cause great damage to the intestinal flora, leading to the failure of the intestinal flora homeostasis, endangering human health, and even taking years to recover.

Most of the immune function of the human body is constructed on the homeostasis of probiotics in the intestine. From the birth of the baby, the intestinal flora gradually exerts its function, and the immune function is also activated. The abuse of antibiotics seriously affects the balance of intestinal flora, destroys a large number of probiotics, affects the human immune system, causes the human immune system to be turbulent, affects the stability of the human immune system, and makes us more susceptible to illness. Many antibiotics such as penicillin, streptomycin and other drugs can cause abnormal reactions, such as anaphylactic shock, from subtle rashes, fever to hematopoietic system abnormalities, etc., and even damage the nervous system, such as the central nervous system, hearing, vision, nerve Systemic lesions and neuromuscular blockade. The abuse of antibiotics may also lead to the imbalance of flora and delay the treatment of diseases. Due to the influence of antibiotics, the types and quantities of various bacteria in the normal flora will change.

There are tens of thousands of natural antibiotics and synthetic antibiotics, mainly divided into sulfonamide antibiotics, quinolone antibiotics, tetracycline antibiotics, macrolide antibiotics, β-lactam antibiotics, aminoglycosides antibiotics, lincosamides species and glycopeptides. There are 5 types of antibiotics widely existing in soil: sulfonamide antibiotics, quinolone antibiotics, tetracycline antibiotics, macrolide antibiotics, and β-lactam antibiotics. Among them, sulfonamide antibiotics have the advantages of high potency, low toxicity, broad antibacterial spectrum, and easy use, etc., and are one of the commonly used veterinary drugs in the breeding industry; species, excreted with urine and feces, and then applied to the soil in the form of manure. Therefore, sulfonamides and tetracyclines became the antibiotics with higher detection rate in soil. However, once the sulfonamide and tetracycline antibiotics exceed the standard, it will cause unpredictable consequences, especially for the health of infants and young children.

At present, China's regulations and standards related to water environment quality and pollutant discharge do not include indicators of antibiotic residues. Among the grassroots groups, the public has little or no understanding of antibiotics. The above factors have caused

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the current problems of antibiotic regulation. Antibiotics and their derivatives may enter the human body through drinking water, animal food, fruits, etc., posing a long-term potential threat to the safe water consumption of residents, normal life and the entire ecological environment system. Relevant regulations and testing standards need to be established for rapid and highly sensitive monitoring, screening and quantitative analysis of antibiotics and their metabolites. To this end, it is imperative to popularize rapid antibiotic testing products at the grassroots level.

Regarding the retention of antibiotics in China's water bodies, in 2015, Ying Guangguo's research group from the Guangzhou Institute of Geochemistry of the Chinese Academy of Sciences made a special research report and released a national antibiotic pollution map. According to the research conclusions, various aquaculture industries are intensive in the Pearl River Delta, Beijing-Tianjin-Hebei and Yangtze River Delta regions, and the problem of antibiotic pollution in the water environment is relatively concentrated. In the Yangtze River Delta region, antibiotic residues are detected in the urine of most pregnant women and infants, which shows that antibiotics are closely related to people's life and health.

5. Colloidal Gold Method Occupies a Large Area of the Market, Which is not Conducive to the Development of Emerging Technologies

Colloidal gold is a commonly used labeling technology. It is a new type of immunolabeling technology that uses colloidal gold as a tracer marker and is applied to antigen and antibody. It has its unique advantages. In recent years, it has been widely used in various biological research, and its technology has gradually improved and matured in use. Western blotting technology used in clinical (Western Blot) is a hybridization technology that combines high-resolution gel electrophoresis and immunochemical analysis technology. Western blotting has the advantages of large analytical capacity, high sensitivity and specificity. It is one of the most commonly used methods to detect protein characteristics, expression and distribution, such as qualitative and quantitative detection of tissue antigens, mass determination of polypeptide molecules, and virus antibody or antigen detection.) Almost all use its markers. At the same time, it may be used in flow, electron microscopy, immunology, molecular biology and even biochips. At this stage, the products we can buy in the antibiotic testing market rely on the colloidal gold method, and most of them use immunochromatography. The maturity of colloidal gold technology has stopped the current detection technology. Colloidal gold is a commonly used labeling technology. It uses colloidal gold as a tracer marker, which is wrapped with antibodies. It is a new type of immunoglobulin technology applied to antigen-antibody and has its unique advantages. It has been widely used in various biological researches in recent years. Almost all immunoglobulin techniques used in clinical use its markers. At the same time, it may be used in flow, electron microscopy, immunology, molecular biology and even biochips.

In 1971, Faulk and Taytor introduced colloidal gold into immunochemistry. Since then, immunocolloidal gold technology has been widely used in various fields of biomedicine as a new immunological method. At present, the main applications in medical testing are immunochromatography (immunochromatogra-phy) and rapid immunogold filtration assay (DIGFA), which are used to detect HBsAg, HCG and anti-double-stranded DNA antibodies, etc. , fast, accurate and pollution-free. According to the investigation, almost 90% of the rapid test products that can be seen on the market are applied immunochromatography.

It has been widely used in various biological researches in recent years. Almost all immunoblotting techniques used in clinical use its markers. At the same time, it may be used in flow, electron microscopy, immunology, molecular biology and even biochips. However, the disadvantages of colloidal gold are also very obvious. Because it relies on the principle of antigen-antibody binding, the essence of antibody is protein, so it has defects that cannot be

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ignored in terms of sensitivity and stability. Because the colloidal gold method is very mature, the room for improvement is limited.

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