

The Application Research of Bio-chip Technology in The Safety Detection of Agriculture Products

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Abstract: Bio-chip is a new micro-analysis technique. It has been rapidly developed because of its characteristics such as accurate, rapid and large amount of information. It first introduced the basic concepts of bio-chip, its classification, and the processing technology, illustrated the application status in the entire agricultural production, storage and terminal links based on bio-chip technology, then it discussed the focused application of bio-chip technology in the safety testing of agriculture products, and at last come to the conclusion that bio-chip technology will become more and more important in the safety detection of agriculture products.

Key word: bio-chip technology; agriculture products; safety; detection

1 Introduction

Bio-chip is a high-tech which has been developed rapidly in the field of life science in the 20th century 90's. The main features of bio-chip is the high-throughput, miniaturization and automation. At present, the most widely used bio-chip is the microarray chip, it integrated a large number of biological molecules in the form of micro-array. It can get the analysis results of biological samples in a short period of time, and fast and accurately access to a large number of biological information of the samples^[1]. Its detection efficiency is hundreds of times as the traditional means. Therefore, the bio-chip has a wide range of application areas, including disease diagnosis and treatment, drug screening, crop optimization, judicial appraisal, supervision of food hygiene, environmental testing, defense, aerospace and other fields. Nowadays, microarray chips has been widely used in the field of life science research and medical fields, such as human disease diagnosis, and new medicine development, etc^[2]. Its applications in the field of bio-safety and food safety testing has just begun, but has shown its great application advantages.

2 The concept of bio-chip

Bio-chip mainly refers to the micro-biochemical analysis system built on the surface of solid chip using micro-machining and micro-chip technology. It is mainly used in the accurate, rapid and large amount of

information testing such as the organization of living organisms, cells, proteins, nucleic acids, sugars and other biological components^[3].

2.1 The Classification of Bio-chip

At present, the common bio-chip is divided into three categories: Genechip (DNAchip, DNA microarray), Proteinchip, Lab-on-a-chip(microfluid).

2.2 Characteristics of Bio-chip

The main characteristics of bio-chip are high-throughput, miniaturization and automation. The highly integrated tens of thousands of intensive molecular microarray in the bio-chip can analyze a large number of biological molecules in a very short time, so as to allow people to quickly and accurately obtain the biological information of the samples. Its detection efficiency is hundreds of times as the traditional means.

3 The theoretical foundation of bio-chip

Genechip is the most sophisticated and the first commercialized product in the development of bio-chip technology, which is based on the theory of the hybridization and complementary technology of nucleic acid probe. Nucleic acid probe is a synthetic base sequence. Connected to some of the detected material in the probe, according to the principle of complementary base, use the gene probe to identify a specific gene in the gene mixtures. At present, the mature products are gene

chip for the detection of gene mutations and gene expression profile for the detection of the expression level of cell gene^[4].

Genechip technology mainly includes four basic techniques: microarray chip preparation, sample preparation, bio-molecular reaction and signal detection and analysis. At present, the preparation chip mainly adopted the methods of surface chemistry or combinatorial chemistry to deal with the solid-phase matrix such as glass or silicon, and then arranged the DNA fragments or protein molecules on the film base in a specific order. The preparation and processing of biological sample is the second important aspect of the gene chip technology. Biological samples are often very complex mixture of biological molecules, except for a small number of special samples, the general should not react directly with the chip. The samples required a specific biological treatment, so as to access to their protein or DNA, RNA and other information molecular, then labeled them to improve the detection sensitivity. The third step is the reaction between biological molecules and the chip. The reactions between biological molecules on the chip is a key step in chip testing. By selecting suitable reaction conditions to realize the best situation for the reaction between biological molecules, the mismatch ratio between biological molecules ought to be reduced as far as possible, so as to achieve the final signal which can best reflects the biological nature^[5,6]. The last step of genechip technology is the detection and analysis of chip signal. At present, the most commonly used chip signal detection method is to put chip into the chip scanner, by the method of the acquisition of the strong or weak of the fluorescence and the fluorescence position in the response point, and by the analysis of image-related software, to get the relevant biological information^[11].

Protein chip technology emerged relatively late,

which is still in the development stage, but recently has made significant progress. The principle of protein chip is similar to that of genechip. The differences, first, the fixed molecules on the chip are proteins such as antigen or antibody. Second, the detection principle is based on the interactions among protein molecules, protein and nucleic acid, protein and other molecules^[7].

Lab-on-chip is another important development direction of bio-chip technology. It intensified the whole processing of sample preparation, biochemical reaction and analysis and detection to form a micro-analysis system. Now, there has been the lab-on-chip composed of the heater, micro pumps, micro valves, micro-flow controller, micro-electrodes, electronic chemicals and electronic detectors, and light-emitting, etc^[8,9,10]. And there will be a type of bio-chip partly integrated biological and chemical reaction, sample preparation and detection and analysis, etc. Currently, the most used technology in the application is genechip.

4 The Application of bio-chip technology in the safety of agriculture products

The safety issue of agriculture products is a global problem. According to the estimate of the World Health Organization, there are more than 70 million people died of food poisoning in the Asia Pacific region alone each year. It has become an important issue to reduce or curb the occurrence of such incidents by the means of scientific and technological methods. With the continuously expand of the application region of bio-chip, there have been a lot of biological chips associated with the safety testing of agriculture products, such chips have been gradually moving toward industrialization.

The application of bio-chip technology in the safety testing of agriculture products involved in the whole process from the production, logistics, to the consumption, shown in Figure 1.

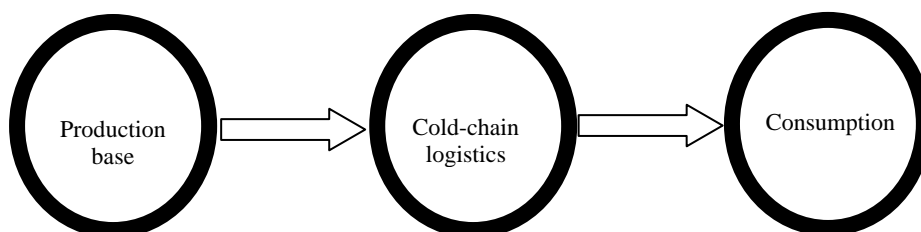


Figure 1. The sketch map of the whole process of the bio-chip application in agriculture products

During the whole life cycle of the agriculture products, in the production links, we should mainly concentrate in the environmental testing of production base, safety testing of agricultural products, producing hazard monitoring, pollutant source and so on. In the cold-chain logistics links, we should mainly concentrate in contaminants detection technology, agricultural products logistics safety standards and the management system HACCP of agriculture products, etc. In the consumer end-links, we should mainly concentrate in the agriculture safety support system in the process of

purchase, packaging, storage and transportation, and the sales process, and the establishment of traceability and information platform for the inquiries. As to the safety detection object, the application of bio-chip technology in the safety testing of agriculture products included the application of the detection of pesticide residues, detection of veterinary drug residues, detection of genetically modified food, food-borne pathogen detection, bio-toxin detection and food-borne virus detection etc^[11,12]. Shown in Figure 2.

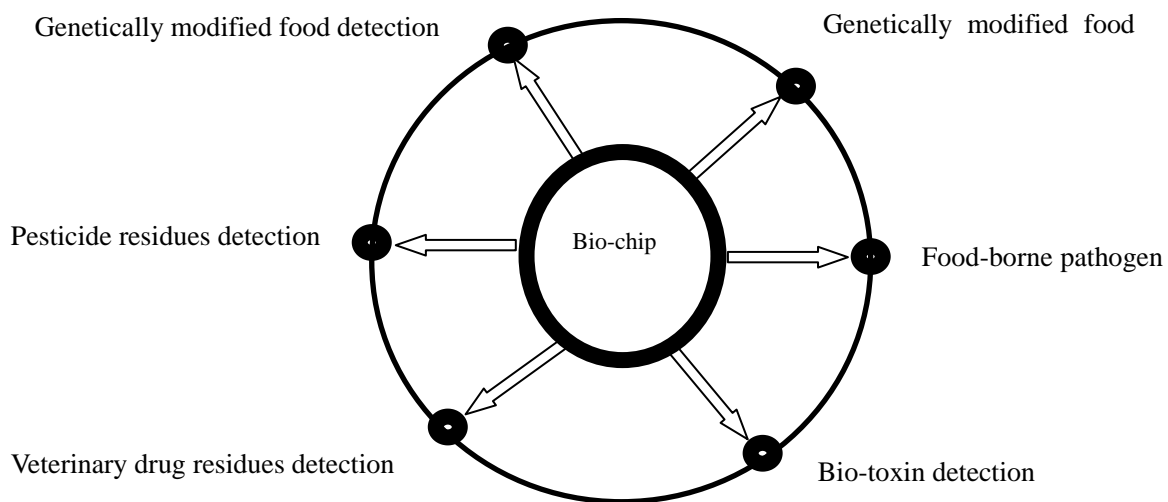


Figure 2. The application of bio-chip technology in the testing of agriculture products

5 Research on the integrated safety testing in the agriculture logistics

The integrated safety testing in the agriculture logistics includes the development of the food safety evaluation in the logistics process of fruits and vegetables, livestock, aquatic products and other species, the quality control of food hygiene, the inspection technology of food hazards, sourcing technology, hazard analysis and evaluation technology, etc. It required to establish the analysis technology system of pathogenic microorganisms, pesticides and veterinary drug residues, chemical contaminants (including biotoxins), food additives and packaging materials in the agriculture logistics process, and implemented the HACCP agricultural logistics management, then combined with the sourcing technology to build the safety monitoring system for each

logistics link, and upgrade the food safety level, gradually realize the transformation for food safeguard from the "passive response type" to the "voluntary protect type", and at last realize the safety management for the whole process quality of agriculture products form the "plow-to-table".

5.1 The construction of modern agriculture logistics safety system of the combination of the sourcing technology and retail detection technology

The research on the detection technology system is developed for the major pollutants such as micro-organisms, additives, harmful elements, pesticide residues, veterinary drug residues, toxins and so on. The research target is the important food (such as meat, poultry and eggs, tea, fruits and vegetables, cereals, oil, etc.)

based on the isotope fingerprint identification technology, in order to build the whole process sourcing technology system for the main hazard, establish the relevant databases, and develop the safety standards for agriculture products.

5.2 Improve the safety detection system of agriculture products by the use of bio-chip high-tech

The bio-chip technology is used in the agriculture products detection of pathogenic microorganisms, biological toxin detection, pesticide residues detection and antibiotics detection, thus to analyze the safety status of agriculture products in large quantities quickly, scientifically and quantitatively, to identify the threshold of food-borne disease, and establish the early warning of agriculture products logistics supervision monitoring and rapid response system, to improve the safety detection system of agriculture products.

5.3 Research on the food quality of shelf life and the safety protection system

Take the two terminals of consumption such as retail (including exports) and catering as the service object, establish and perfect the food safety protection system and its sourcing information platform for the whole process of purchase, packaging, storage and transportation.

5.4 Research on the detection system of the main harmful substances in packaging materials

Research on the establishment of migration testing system and the high-throughput detecting technology of plastic additives and residues such as phthalates, alkylphenols, fluorinated organic compounds (such as fluoride telomers, perfluoroalkyl acids and perfluoroalkyl sulfonamide, etc.), fatty acid amide and organic tin, etc.

5.5 Establish and implement the HACCP management system of agriculture products logistics

Analyze the segments which may occur hazards during the process of the agriculture products logistics, monitor the flow of each process, and take appropriate control measures to prevent the occurrence of hazards. Establish

and promote the implementation of the HACCP management system with Chinese characteristics for agriculture products logistics, so as to ensure the quality and safety of agriculture products.

6 Conclusion

As an emerging bio-technology, bio-chip has many characteristics such as high efficiency, large amount of information and high-specific. It can analyze a large number of biological molecules in a very short time, so that people can quickly and accurately obtain a wide range of information from the samples. Its detection efficiency has greatly improved compared with the traditional detection methods. The combination of bio-chip technology and food safety detection would certainly bring about new opportunities to the application of bio-chip detection and the detection level of food safety. Bio-chip technology has broad spaces and applying prospects in the scientific research of food area, and will make inestimable contributions for human's nutrition and health.

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