Application of Dna Molecular Genetic Markertechnology in the Identification of Biological Drugs

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Keywords: DNA; Molecular Genetic Marker Technology; Biopharmaceutical Identification

Abstract: An overview of DNA molecular genetic marker techniques (also known as DNA molecular genetic diagnostic techniques) applied in the identification of traditional Chinese medicines is presented, and recent advances in the identification of Chinese herbal medicines using DNA molecular genetic marker techniques are reviewed. The prospect of DNA molecular genetic marker identification in the identification of raw drugs is foreseen.

1 Preface

China is home to various medicinal resources. According to statistics, there are more than 10 to 20,000 species, including about 10,000 kinds of medicinal plants, 600 of which are important resources for our people to prevent and cure diseases. All of which is a treasure trove for finding and developing new medicines. Medicinal plants are an important source of traditional Chinese medicine, and their research must be modernized to meet the needs of new drug development. To ensure the safe and effective use of Chinese medicine, it is important to accurately identify various medicinal herbs. Traditional identification methods include basal origin identification, trait identification, microscopic identification, and physicochemical identification. However, these identification methods are the identification of genetic phenotype of organisms, which are not only influenced by genetic factors, but also closely related to growth and development stages, environmental conditions, and human activities (such as seed introduction and domestication, processing and preparation, etc.).[1] It has great variability and plasticity. With the rapid development of modern molecular biology technology, molecular biology and genetic engineering technology have become mature, and the identification of Chinese herbal medicines by DNA molecular genetic marker technology has shown good prospects for application because of its strong polymorphism and high accuracy, independent of environmental factors, individual developmental stages and tissue parts. DNA Molecular Genetic Marker (DMGM) technology has made great progress in gene localization, species identification, resource evaluation, species kinship and phylogeny. This paper discusses their application in the research of medicinal plants from several aspects [2].

2 DNA Molecular Genetic Marker Technology

DNA molecular genetic marker technology (also known as DNA molecular genetic diagnostic technology) is a technology to diagnose the inherent gene arrangement pattern and the external trait expression pattern of organisms by directly analyzing the polymorphism of genetic material. Due to any biological species or individual has specific DNA polymorphism, we can avoid the interference of environmental factors , quantitative trait inheritance or partial and complete dominance in the process of genetic trait expression, and quickly and accurately identify the authenticity of herbs, by directly analyzing the DNA polymorphism,[3].

2.1 Southern Hybridization-Based DNA Molecular Marker Technology

Restriction Fragment Length Polymorphism (RFLP), Single Strand Conformation

Polymorphism-RFLP (SSCP- RFLP), and so forth. The common feature of these techniques is that one or more restriction enzymes are used to digest DNA molecules from different individuals, and then molecular hybridization is carried out by specific clones or synthetic probes to reveal DNA polymorphisms.

2.2 PCR-Based Molecular Marker Technology

Techniques like Random Amplifed Polymorphic DNA (RAPD), Sequence Tagged Site (STS), Random Primer-Polymerase Chain Reaction (RP-PCR), Arbitrary Primer-PCR (AP-PCR), Oligo Primer-PCR (OP-PCR) and so on, have one common feature, they are all to use synthetic random primers (often 5-10 or more oligonucleotides) to amplify DNA molecules of different organisms by PCR and then directly analyze them by electrophoresis to reveal their DNA polymorphisms.[4]

2.3 Repeat Sequence-Based DNA Molecular Marker Technology

Satellite DNA (Satellite repeat sequence of several hundred to several thousand base pairs), Microsatellite DNA (repeat sequence unit of 2-5 base pairs), Minisatellite DNA (repeat unit of more than 5 base pairs), etc.

2.4 MRNA-based Molecular Marker Technology

Differential Display (DD), Differential Display Revert Transcription PCR(RT-PCR), Differential Display Revert Transcription PCR(DDRT-PCR), etc.

3 The Basis of DNA Molecular Genetic Marker Identification

Biomedical identification studies begin with finding species-specific genetic markers (genetic markers), which are characterized by morphology, tissue cells, chemical composition, proteins, karyotype, serology, isoenzymes, etc [5]. However, some characteristics are the result of a combination of hereditary and environmental factors of the organism, and they are influenced by genetic factors. Meanwhile, they are closely related to the developmental stage of the organism and the role of environmental conditions on the organism. DNA molecules, as direct carriers of genetic information, are not affected by external factors and differences in the developmental stage, organ and tissue. Each somatic cell of each individual contains the same genetic information. Therefore, it is more accurate and reliable to use DNA molecular characteristics as genetic markers - i.e., DNA molecular genetic markers. Finally, species identification is more accurate and reliable [5].

As carriers of genetic information, DNA molecules have high genetic stability and high chemical stability compared to proteins and isoenzymes. DNA preserved in old specimens can still be used for the study of DNA molecular genetic markers since the establishment and development of the Polymerase Chain Reaction (PCR) technique. Even trace amounts of DNA can be extracted from ancient skeletal specimens left over thousands of years ago and amplified by PCR to study specific DNA fragments for molecular genetic markers. Since DNA molecules contain huge amount of information and are relatively stable, PCR technology has the advantages of high speed, high efficiency and high specificity, so the identification of herbal species by DNA molecular genetic markers and the detection of components in herbal compound preparations have the advantages of rapidity, accuracy, specificity and good reproducibility [6].

4 Application of DNA Molecular Genetic Markers in the Identification of Biological Drugs

The first problem to be solved in the use of DNA molecular genetic marker methods for raw drug identification is whether the DNA of the herb itself can be extracted from aged herbal specimens and can be used for PCR amplification, which has been successfully reported, followed by the search for a method to detect DNA polymorphisms in herbs.

4.1 Biomedical Identification is an Important Part of Biopharmacology

It is important to identify herbs of different species of the same genus and authenticate herbs to

ensure the accuracy of Chinese medicine and maintain people's health. Traditional Chinese medicine identification mainly relies on perceptual characteristics such as color, shape, odor, taste, and texture, and the shortcomings of this identification method are that it is inaccurate and the grasp of these characteristics varies from person to person. The application of histological, morphological and chemical methods to the identification of herbal medicines is an advancement in the identification of herbal medicines, but these methods still have significant limitations. Using DNA molecular genetic marker technology to directly analyze the DNA polymorphism of herbs, find out the DNA fragment unique to the authentic product, sequence this, and then prepare DNA probes to detect the corresponding herbs. It is a convenient and accurate method for raw drug identification. Zhang Rong et al used RAPD analysis for the identification of eight herbal medicines of the genus Artemisia (indigoferae Linn) and seven herbal medicines of the genus Clematis L. The results were very good and proved that RAPD analysis is an effective method for the identification of herbal medicines [7].

4.2 Application to the Affinities of Medicinal Plants

Academician Xiao Peigen established the affinities of medicinal plants, using some small molecule compounds as the basis for identifying affinities. Since DNA essentially reflects the affinities of medicinal plants, many scholars now suggest that the two should be considered together. Only then can the affinities of medicinal plants be studied more effectively. Wang Xiaoquan et al. used five primers to perform RAPD analysis on five species of the genus Asclepias (cimicifugaL) and one species of the genera Actaea asiatica Hara and Actinium. Combining the results of the analysis, they concluded that the genus Actaea asiatica is more closely related to the genus Asclepias, while the genus Actinium is more distant from the genus, which is consistent with the classical The results of the taxonomic study are consistent with the classical results.

5 Problems of DNA Molecular Genetic Marker Technology

5.1 Not Building a Real Database in the Real Sense

The stability of DNA molecular genetic marker methods is influenced by many factors of template and amplification conditions. In addition, no real database has been constructed. The DNA molecular diagnostic technique is difficult to distinguish herbs from different parts of the drug, and each ministry has the same DNA marker pattern. The DNA markers of the finished drug, compound, and extracts have not been reported [8].

5.2 Herbal Treatment

Due to the high sensitivity of molecular markers, any contamination of biological sources in herbs, such as mold, insects, or even human touch, can leave exogenous DNA molecules, which can be amplified together in the PCR amplification process, thus distorting the obtained DNA fingerprint. The DNA molecular labeling study requires very little experimental material, usually in the sampling process must choose the part of the herb without mold and insects, scrape the surface, scrape a very small amount of tissue from the inside, or wash the surface of the herb, and then irradiate the surface of the herb with strong ultraviolet light to completely destroy the surface of the exogenous DNA.

5.3 Improve Stability

Chinese medicinal materials are usually dried bodies of plants and animals, which are old specimens compared with fresh materials commonly used in molecular biology studies, which are often very difficult for DNA amplification of large fragments and have little effect on DNA amplification of small fragments. In addition, the stability problems of certain molecular biology methods themselves need to be further improved, for example, although RAPD was the first DNA molecular marker identification method used for the identification of Chinese medicine, any small changes in experimental conditions during the experiment can change the consistency of the experimental results [9].

5.4 Reduce Economic Costs

At present, molecular biology experiments still require high costs. However, with the development of molecular biology and the formation of large-scale production of products, the price of general consumables for molecular biology experiments will have a greater degree of decline, such as random primers used in experiments have been commercialized in large quantities, and now the cost of primers used in each reaction has been greatly reduced, with the deepening of molecular marker identification research, it is entirely possible to find a more economical, practical, accurate and reliable method [10]

6 Outlook

Today, molecular biology techniques are rapidly developing and are widely used in life sciences and related disciplines. Molecular Pharmacog-nosy has been proposed as a new concept, and DNA molecular genetic marker technology has shown a wide range of prospects in its application, but the research of this technology in medicinal plants is not yet very deep. It is believed that with the continuous development of molecular biology technology and the deepening research of molecular genetic characteristics of medicinal plants, the research field of DNA molecular genetic marker technology in the molecular biology of medicinal plants will be greatly broadened and become an important element in the modernization of medicinal plants.

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