

Proteomics and Genomics in Veterinary Parasitology – A Diagnostic Tool

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Abstract

A different number of modern molecular technologies, genomics and proteomics in applied areas of veterinary parasitology are increasing rapidly. To assess the molecular and genetic host parasitic interaction different advanced molecular tools are required and it is useful in the diagnosis of parasitic diseases. The important molecular tool for identification and diagnosis of parasites is polymerase chain reaction as well as there are other so many applications. In genomics, species-specific probes or primers are available along with conventional techniques. These techniques will give more information on the DNA sequences of parasites will reveal many more unique sequences which can be used for identification, diagnosis of parasitic infections. Genomics is crucial for the assessment of evolutionary biology, molecular epidemiology, physiology of parasites and vaccine development. These techniques may also help in the selection of genetically resistant hosts to parasite infection and discovery of new antiparasitic drugs, improvements to existing chemotherapeutic families and monitoring of drug resistance. From the last decade utilization of the aspects of molecular biology and their applications increased and it is essential to teach and train the veterinary parasitologists....

Keywords: Molecular works; Genomics; Proteomics; Advanced diagnosis; Parasitic diseases

Introduction

Infectious diseases in the different animals play an important role in veterinary medicine. They cause huge economic losses by direct losses (death of the individual animals) reduction in the production of food products. Diagnosis is the vital component in successful control of animal diseases. Diagnosis of the parasitic diseases can be done by old standard methods including examination of the parasitic ova, identification of gross parasites, direct visualization of external parasites under microscope, blood smear examination [1,2].

Serological tests are next to the basic diagnostic methods and these methods are used to determine the level of antibody in the given sample [3,4]. Molecular tools, applications of genomics, proteomics in veterinary parasitology has limited when compare to the human medicine. Commonly applications are utilized for the investigation of herd health and disease strategies [5]. So many relevant reviews are available in relation to the generalised medicine. But, application of the molecular technologies is limited to the field level diagnosis of the parasitic diseases [6]. Present communication focussed on developments in relevant genomics, proteomics for diagnosis, vaccine development, the search for new chemotherapeutic agents and understanding drug resistance in veterinary parasites.

Different Molecular Tools

Genomics

The first approach in the diagnosis of the parasitic diseases even in minute amounts of target template is the PCR and sequencing which used specifically, for detection of infection, identification of strain or intra specific variant, determination of drug resistance and quantification of parasitic load/DNA. Various molecular diagnostic techniques that have been developed and combined with the diagnosis of parasites apart conventional PCR are RAPD-PCR, RFLP-PCR, Nested-PCR, Multiplex-PCR, Real-time PCR, Reverse transcriptase PCR, Micro-array technology, Loop-mediated isothermal amplification (LAMP), Microsatellite marker method, PCR-ELISA, SSCP-PCR and Proteomics. The development of the multiplex PCR gave the opportunity

to diagnose in a single reaction different nematode genera and/or species. Real-time PCR assess the quantification of the DNA which indicates the proportion of each genus or species in given sample [7].

A sensitivity of the identification of the strains improved by using random amplified polymorphic deoxyribonucleic acid 'DNA' (RAPD). For genotypes differentiation of different parasites PCR - Restriction Fragment Length Polymorphism is used. Recently, semi-nested PCR-RFLP was used for detection of persistent anaplasmosis [8]. The RFLP technique is currently one of the most commonly used molecular methods for diagnosis of species and genotypes of parasites such as *Toxoplasma gondii* [9]. This technique was first used to detect variations at the DNA level [10]. To eliminate non-specific amplification products Nested PCR is recommended and it is used for the detection of the multiple genotypes in the given single sample. Nested-PCR also improves the sensitivity and severity of amplifications [11]. *In situ* PCR combines the histological localization with sensitivity of PCR. The reaction is detected in the cells by standard immune-cytochemical staining. The PCR based SSCP can be employed for identifying parasites to species or strains where morphology is unreliable and has been used in the identification of hookworms, *Strongyloides*, *Schistosoma* and *Echinococcus* species [12]. The method which can detect both the sensitivity of ELISA and the specificity of PCR is the in PCR-ELISA. Reverse line blot (RLB) hybridization, combines a genus specific PCR with hybridization to membrane-bound type/species-specific oligonucleotide for differential detection. Loop-mediated isothermal amplification (LAMP) is a novel

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strategy for gene amplification which relies on the auto-cycling strand displacement synthesis of target deoxyribonucleic acid (DNA) by *Bst* DNA polymerase under isothermal conditions. DNA Microarray combines the DNA amplification with subsequent hybridization to oligonucleotide probes specific for multiple target sequences. It allows analysis of a larger number of genetic features in a single trial. It has been used in detection and genotyping of *Plasmodium*, *Toxoplasma* and *Trypanosoma* [13]. Microsatellites are the short DNA sequences which consist of tandem repeats of one to six nucleotides, with approximately one hundred repeats. These are utilized because of the frequent polymorphism, codominant inheritance, high reproducibility, high resolution of the genes.

Proteomics

It refers to the molecular study of the proteins, including their structures and functions. It defined as the set of proteins expressed by the genetic material of an organism under the defined environmental conditions. Since proteins are the main catalysts, structural elements, signaling messengers, and molecular machines of biological tissues, proteomic studies are able to provide substantial clinical relevance. Proteins can be utilized as biomarkers for tissues, cell types, developmental stages, and disease states as well as potential targets for drug discovery and interventional approaches. The next generation of diagnostic tests for infectious diseases will emerge from proteomic studies of serum and other body fluids. Techniques used for the expression analysis of proteins are matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF MS), surface-enhanced laser desorption ionization time of flight mass spectrometry (SELDI-TOF MS), liquid chromatography combined with MS (LC-MS-MS), isotope-coded affinity tags (ICAT), and isotope tags for relative and absolute quantification (iTRAQ). The development of automated, high-throughput proteomic technologies such as MALDI-TOF and SELDI-TOF MS has enabled large numbers of clinical samples to be analyzed simultaneously in a short time. These platforms have made “population-based proteomics” feasible for the first time. SELDI technique has been applied to the study of serum biomarkers of parasitic diseases such as fascioliosis and cysticercosis [14,15].

Conclusion

Present communication gives the information of molecular tools genomics and proteomics in veterinary parasitology which will help in better understanding of host parasite interaction for improving diagnosis and control.

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