

Diagnostic Biomarkers in Animals: Tools for Early Detection and Precision Veterinary Care

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Editorial

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Introduction

Diagnostic biomarkers in animals are essential tools that enable early disease detection, accurate diagnosis, and precision-based veterinary care. Biomarkers are measurable biological indicators, such as proteins, enzymes, metabolites, genes, or imaging features, that reflect normal physiological processes, pathological changes, or responses to therapeutic interventions. Their application in veterinary medicine has significantly improved the ability to identify diseases at subclinical stages, allowing timely intervention before severe clinical signs develop [1,2].

The use of diagnostic biomarkers supports precision veterinary care by facilitating individualized treatment strategies based on an animal's specific biological profile. In both companion and food-producing animals, biomarkers assist in monitoring disease progression, evaluating treatment efficacy, and predicting outcomes. Advances in molecular biology, genomics, proteomics, and metabolomics have expanded the discovery and validation of novel biomarkers, enhancing diagnostic accuracy across a wide range of infectious, metabolic, inflammatory, and neoplastic conditions [3,4].

Discussion

Diagnostic biomarkers in animals are measurable biological indicators that provide information about normal physiological processes, pathological conditions, or responses to therapeutic interventions. These biomarkers may include molecules such as enzymes, hormones, proteins, metabolites, nucleic acids, or specific cells found in blood, urine, tissues, or other body fluids. In veterinary medicine, biomarkers play an increasingly important role in improving disease diagnosis, prognosis, monitoring, and treatment planning across companion

animals, livestock, and wildlife.

One of the primary advantages of diagnostic biomarkers is their ability to detect disease at an early stage, often before clinical signs become evident. For example, cardiac biomarkers such as cardiac troponins are used to assess heart damage in dogs and cats, while liver enzymes like alanine aminotransferase (ALT) and alkaline phosphatase (ALP) indicate hepatic injury. In livestock, biomarkers related to inflammation, stress, or metabolic imbalance help identify subclinical diseases that could otherwise lead to production losses [5].

Biomarkers are also valuable in differentiating between diseases with similar clinical signs. Acute phase proteins, such as C-reactive protein and haptoglobin, are used to assess inflammation and infection severity. In infectious diseases, molecular biomarkers based on pathogen DNA or RNA enable rapid and accurate diagnosis, improving disease control and biosecurity. Advances in genomics, proteomics, and metabolomics have expanded the range of potential biomarkers, allowing more precise and individualized diagnostic approaches.

In addition to diagnosis, biomarkers are essential for monitoring disease progression and treatment response. For instance, glucose and fructosamine levels are used to manage diabetes in companion animals, while reproductive hormones such as progesterone assist in breeding management. Biomarkers also contribute to animal welfare by reducing the need for invasive procedures

and enabling non-invasive or minimally invasive testing methods.

Despite their benefits, challenges remain in biomarker development and application. Species-specific variation, environmental influences, and differences in age, breed, and management conditions can affect biomarker interpretation. Therefore, validation and standardization are critical to ensure reliability and clinical relevance.

Conclusion

Diagnostic biomarkers in animals have become indispensable tools in modern veterinary medicine. They enhance early disease detection, improve diagnostic accuracy, and support effective monitoring and management of animal health. Continued research and technological advancements will expand the availability of reliable biomarkers, contributing to precision veterinary medicine, improved animal welfare, and sustainable animal health systems.

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