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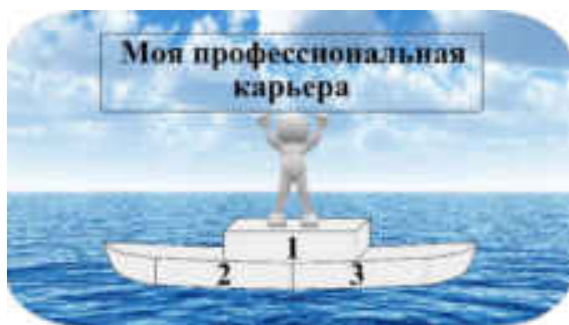


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**Международный научно-образовательный электронный журнал
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Название публикации: «PRIONS AND PRION DISEASES: DIAGNOSTIC RELEVANCE AND THE ROLE OF CHROMOGENIC CULTURE MEDIA IN MICROBIAL IDENTIFICATION»

ABSTRACT

This study analyzes the biology of prions, the origin and pathogenesis mechanisms of prion diseases, and the significance of culture media, particularly chromogenic media, in microbiological diagnostics. The research examined prions as infectious agents composed solely of protein molecules without nucleic acids, and their pathogenic forms arising from conformational changes of normal prion proteins, based on scientific literature. The study also explored the association of prions with severe neurodegenerative diseases in humans and animals, including Creutzfeldt–Jakob disease, Gerstmann–Sträussler–Scheinker syndrome, fatal familial insomnia, and bovine spongiform encephalopathy.

Additionally, the diagnostic relevance of culture media used for the detection and identification of microorganisms was evaluated. Chromogenic culture media, containing specific substrates that are enzymatically degraded by microorganisms to produce colored colonies, were found to facilitate rapid and accurate microbial identification. The results indicate that studying prion diseases is of significant scientific importance for modern medicine and biology, while the use of chromogenic

culture media enhances the speed and accuracy of microbiological laboratory diagnostics..

Keywords: *Prions, prion diseases, Creutzfeldt–Jakob disease, Gerstmann–Sträussler–Scheinker syndrome, fatal familial insomnia, bovine spongiform encephalopathy, scrapie, chronic wasting disease, pathogenic prion protein (PrP^{sc}), chromogenic culture media, microbial identification, laboratory diagnostics, neurodegenerative diseases.*

INTRODUCTION

The advancement of modern microbiology and molecular biology has enabled a deeper investigation of emerging infectious diseases and their etiological agents. Among such biological agents are prions, proteinaceous infectious particles with a unique structural composition. Unlike other microorganisms, prions lack nucleic acids, which fundamentally distinguishes their biological characteristics and pathogenesis mechanisms, making them a subject of significant scientific interest.

Prions are responsible for severe neurodegenerative diseases in humans and animals. These diseases include Creutzfeldt–Jakob disease, Gerstmann–Sträussler–Scheinker syndrome, fatal familial insomnia, and bovine spongiform encephalopathy in cattle. They are characterized by a slow onset, progressive neurodegenerative processes, and frequently culminate in death.

In laboratory diagnostics, the detection and identification of microorganisms are of critical importance. Various culture media, including chromogenic media, are widely employed for this purpose. Chromogenic media contain specific substrates that, when enzymatically degraded by microorganisms, produce colored colonies. This allows bacterial colonies to be visually distinguished and rapidly and accurately identified.

Therefore, studying the biological characteristics of prions, the origin of prion diseases, and modern laboratory diagnostic methods, as well as the application of chromogenic culture media for microorganism identification, holds significant scientific and practical importance in the fields of microbiology and medicine.

LITERATURE REVIEW

In recent years, the study of prions and associated diseases has become a prominent scientific direction in microbiology, neurology, and molecular biology. Prions were first identified in the second half of the 20th century during investigations into the etiology of transmissible spongiform encephalopathies (TSEs). Research in this field revealed that prions are infectious agents composed solely of protein molecules without nucleic acids, challenging the longstanding biological assumption that “all infectious agents must contain nucleic acids.”

Numerous studies have demonstrated that prion proteins (PrP) exist in both a normal cellular form (PrP^c) and a pathogenic form (PrP^{sc}). The pathogenic form induces conformational changes in the normal protein, accumulates in the central nervous system, and triggers neurodegenerative processes. This accumulation leads to spongiform changes in brain tissue. Scientific literature identifies human prion diseases, including Creutzfeldt–Jakob disease, Gerstmann–Sträussler–Scheinker syndrome, and fatal familial insomnia, while animal prion diseases, such as scrapie, bovine spongiform encephalopathy, and chronic wasting disease, have been extensively studied.

Epidemiological and pathogenic studies of prion diseases remain a central focus of scientific research. Findings indicate that these diseases may arise sporadically, hereditarily, or iatrogenically. Epidemiological studies related to bovine spongiform encephalopathy, in particular, have had significant implications for food safety and veterinary control.

In the field of laboratory diagnostics, rapid and accurate identification of microorganisms is of critical importance. For this purpose, various culture media have been developed to support microbial growth and determine differential characteristics. Culture media are formulated according to the physiological requirements of microorganisms and are enriched with nutrients essential for their growth.

In recent years, chromogenic culture media have become widely used in microbiological diagnostics. These media contain specific chromogenic substrates that, when enzymatically degraded by microorganisms, produce colonies of distinct colors.

This allows for rapid visual identification of different bacterial species. Chromogenic media are widely employed in clinical microbiology laboratories, particularly for detecting pathogens causing intestinal infections, urinary tract infections, and nosocomial infections.

Thus, the literature review demonstrates that prions and prion diseases possess biologically complex mechanisms, and their in-depth study is of considerable importance in medicine and biology. Moreover, the use of chromogenic culture media in microbial identification significantly enhances the speed and accuracy of the diagnostic process.

MATERIALS AND METHODS:

In this study, scientific data on prions and prion diseases were analyzed, along with the diagnostic significance of culture media, particularly chromogenic culture media, used for microbial identification. The research employed a scientific approach based on theoretical analysis, review of scientific literature, and methodologies applied in laboratory diagnostics.

The research materials included contemporary scientific literature, monographs, research articles, and publications from international scientific journals in the fields of microbiology, molecular biology, and medicine. Additionally, existing research results on prion diseases and microbial identification were systematically reviewed and analyzed.

Various culture media are utilized in microbiological diagnostics to cultivate and identify microorganisms. Within the scope of this study, the composition of culture media, their selective and differential properties, and their applications in laboratory diagnostics were examined. Culture media are enriched with carbohydrates, amino acids, vitamins, and mineral substances necessary for microbial growth, allowing effective bacterial cultivation.

Chromogenic culture media represent modern diagnostic media used for rapid microbial identification. They contain specific chromogenic substrates that are degraded by bacterial enzymes, producing colonies of distinct colors. This enables the identification of bacterial species based on the color of their colonies.

In laboratory diagnostics, microbial identification involves microbiological inoculation methods, incubation procedures, and assessment of colony morphological characteristics. The resulting data are analyzed to evaluate microbial growth patterns, color formation capabilities, and enzymatic activities.

Comparative analysis, generalization, and systematic review of scientific sources were applied to interpret the research findings. Using these methods, the study comprehensively examined prion biology, the origin of prion diseases, and the diagnostic relevance of chromogenic culture media in laboratory practice.

RESULTS:

During the study, the biology of prions, the mechanisms underlying prion diseases, and the diagnostic significance of culture media used for microbial identification were analyzed. The results confirmed that prions are infectious agents with unique biological properties.

Analysis indicated that prions lack nucleic acids and consist solely of protein. Their pathogenic form arises from conformational changes in the normal cellular prion protein. This process leads to the accumulation of pathological proteins in the central nervous system, causing spongiform changes in brain tissue.

A review of the literature revealed the occurrence of prion diseases in both humans and animals. Major human prion diseases include Creutzfeldt–Jakob disease, Gerstmann–Sträussler–Scheinker syndrome, and fatal familial insomnia. In animals, diseases such as scrapie, bovine spongiform encephalopathy, and chronic wasting disease have been documented. These diseases are primarily characterized by progressive degenerative damage to the central nervous system.

Analyses in the field of microbiological diagnostics demonstrated that various culture media play a critical role in detecting and identifying microorganisms. Culture media provide the nutrients necessary for microbial growth and allow for the evaluation of their morphological and physiological characteristics.

Chromogenic culture media were found to be highly effective for rapid and accurate microbial identification. The chromogenic substrates in these media are

enzymatically degraded by bacterial enzymes, resulting in colonies of distinct colors. This allows microorganisms to be visually differentiated and rapidly identified.

The study results indicate that the use of chromogenic culture media in laboratory diagnostics saves time, enhances identification accuracy, and simplifies differential diagnosis of microorganisms. Therefore, the widespread use of chromogenic media in modern clinical microbiology laboratories is of significant importance for improving diagnostic efficiency.

DISCUSSION

The results of this study further confirm the unique characteristics of prion biology and prion-related diseases. Prions fundamentally differ from other infectious agents, as they lack nucleic acids and consist solely of protein molecules. Consequently, their pathogenesis mechanisms differ significantly from those of classical microorganisms such as bacteria, viruses, and fungi. The formation of the pathogenic prion form through conformational changes of the normal cellular prion protein is well-documented in the literature, and the findings of this study support these scientific observations.

Prion diseases are primarily characterized by progressive degenerative damage to the central nervous system. Clinically, they exhibit slow progression, long incubation periods, and frequently result in death. The study findings indicate that prion diseases may arise sporadically, hereditarily, or via infectious transmission. In animals, diseases such as bovine spongiform encephalopathy and scrapie are of particular epidemiological significance, representing critical concerns for food safety and veterinary control.

The study also highlighted the importance of culture media in microbiological diagnostics. Culture media facilitate the growth, metabolic activity, and physiological characterization of microorganisms. In addition to conventional media, the use of chromogenic culture media in modern microbiology laboratories significantly streamlines the diagnostic process.

Chromogenic media contain specific substrates that, when enzymatically degraded by microorganisms, produce colored colonies. This allows for the visual

differentiation of bacterial colonies, accelerating microbial identification and improving diagnostic accuracy. Numerous studies have demonstrated that chromogenic media are highly effective in detecting pathogenic bacteria in clinical microbiology laboratories.

Overall, the study underscores that research on prion biology and prion diseases is a crucial scientific endeavor for modern medicine and biology. Likewise, the use of chromogenic culture media for microbial identification enhances the speed and accuracy of laboratory diagnostics, which is essential for the early detection of infectious diseases and the development of effective treatment strategies.

CONCLUSION

This study analyzed prion biology, the unique characteristics of prion diseases, and the diagnostic significance of culture media, particularly chromogenic media, in microbial identification. The findings confirm that prions are infectious agents composed solely of protein molecules, lacking nucleic acids, and that their pathogenic forms arise from conformational changes in normal cellular prion proteins. This process leads to the accumulation of pathological proteins in the central nervous system and contributes to the development of progressive neurodegenerative diseases.

Literature analysis revealed that prion diseases occur in both humans and animals, with clinical manifestations often severe and frequently fatal. Therefore, investigating prion diseases, understanding their mechanisms of origin, and improving diagnostic methods are crucial tasks in modern medicine and biology.

Furthermore, the study highlighted the importance of culture media in microbial identification. Culture media support microbial growth and facilitate the study of their biological characteristics. In particular, the use of chromogenic culture media allows for rapid, accurate, and efficient identification of microorganisms. The chromogenic substrates within these media are enzymatically degraded by bacterial enzymes, producing distinct colored colonies, which enhances the accuracy and speed of laboratory diagnostics.

Overall, the in-depth study of prions and prion diseases provides a scientific foundation for understanding the pathogenesis of infectious diseases, improving

diagnostic methods, and developing effective preventive and therapeutic strategies. Similarly, the application of chromogenic culture media significantly improves the efficiency and accuracy of microbiological laboratory diagnostics, which is essential for early detection and effective management of infectious diseases.

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