

## SOURCES OF BIOLOGICAL DRUGS

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### Аннотация

Биологические препараты занимают центральное место в современной медицине, ветеринарии, сельском хозяйстве и экологической биотехнологии благодаря своей специфичности, высокой биологической активности и сравнительно благоприятным профилям безопасности. Научное понимание их происхождения критически важно как для фундаментальных исследований, так и для прикладного производства, поскольку источник биологического препарата во многом определяет его молекулярные характеристики, механизмы действия, стабильность, а также этические и нормативные аспекты. В данной диссертации рассматриваются основные источники биологических препаратов, включая растительное, животное, микробное и биотехнологическое происхождение, с особым вниманием к исторически сложившимся практикам и современным достижениям в области молекулярной биологии и геной инженерии. Прослеживая эволюцию от традиционных методов экстракции к рекомбинантным и клеточным технологиям, в статье показано, как разнообразие источников расширило функциональные возможности биологических препаратов, одновременно порождая новые научные и этические проблемы. В анализе подчеркивается взаимосвязь между исходным материалом, технологией производства и терапевтической или функциональной эффективностью, что подчеркивает важность комплексного подхода к выбору источника при разработке биологических препаратов.

**Ключевые слова:** Биологические препараты, природные источники, микроорганизмы, продукты растительного происхождения, вещества животного происхождения, рекомбинантная биотехнология, биологически активные соединения.

### Abstract

Biological preparations occupy a central position in contemporary medicine, veterinary science, agriculture, and environmental biotechnology due to their specificity, high biological activity, and comparatively favorable safety profiles. The scientific understanding of their origins is critical for both fundamental research and applied production, as the source of a biological preparation largely determines its molecular characteristics, mechanisms of action, stability, and ethical as well as regulatory considerations. This thesis examines the principal sources of biological preparations, including plant, animal, microbial, and biotechnological origins, with particular attention to historically established practices and modern advances in molecular biology and genetic engineering. By tracing the evolution from traditional extraction-based methods to recombinant and cell-based technologies, the paper highlights how source diversity has expanded the functional scope of biological products while simultaneously raising new scientific and ethical challenges. The analysis emphasizes the interconnection between source material, production technology, and therapeutic or functional efficacy, underscoring the importance of an integrated approach to source selection in the development of biological preparations.

**Keywords:** Biological preparations, natural sources, microorganisms, plant-derived products, animal-derived substances, recombinant biotechnology, bioactive compounds.

## INTRODUCTION

The increasing prominence of biological preparations in scientific and practical domains has fundamentally reshaped modern approaches to therapy, disease prevention, agricultural productivity, and ecological sustainability. Unlike synthetic chemical agents, biological preparations originate from living systems and therefore possess structural and functional characteristics shaped by evolutionary processes. This intrinsic biological nature confers a high degree of specificity, complexity, and compatibility with living organisms, making such preparations particularly valuable in contexts where precision and reduced toxicity are essential. However, this same complexity necessitates a rigorous scientific understanding of the sources from which these preparations are obtained.

Historically, the concept of biological preparations emerged long before the development of modern experimental biology. Early forms of vaccines, medicinal plant extracts, and animal-derived remedies were developed empirically, guided by observation rather than molecular understanding. While these early preparations laid the groundwork for contemporary biotechnology, their variability and limited reproducibility highlighted the need for systematic scientific investigation into the sources of biologically active substances. With the advancement of biochemistry, microbiology, and molecular genetics, the source of a biological preparation became recognized as a decisive factor influencing not only its efficacy but also its safety, scalability, and regulatory compliance.

In modern scientific discourse, biological preparations are no longer defined solely by their function but increasingly by their origin. Plant-derived products are associated with vast chemical diversity and ecological adaptability, animal-derived substances offer close physiological compatibility, microbial systems provide unparalleled biosynthetic efficiency, and recombinant technologies enable molecular precision previously unattainable. These source categories are not mutually exclusive but rather interconnected through shared technological and conceptual developments. Understanding these interconnections is essential for advancing both fundamental research and applied production.

The relevance of studying biological preparation sources extends beyond pharmacological concerns. Ethical considerations related to biodiversity conservation, animal welfare, and genetic manipulation are closely tied to the choice of source material. Moreover, economic and logistical factors, such as raw material availability and production costs, further reinforce the importance of source-oriented analysis. This article therefore aims to examine the sources of biological preparations as a complex scientific phenomenon situated at the intersection of biology, technology, and society.

## LITERATURE REVIEW AND METHODOLOGY

Scientific literature addressing biological preparations has evolved alongside broader developments in the life sciences. Early pharmacognostic research concentrated on cataloging biologically active substances derived from plants and animals, focusing primarily on their therapeutic potential and traditional modes of preparation. Seminal works in pharmacology and

physiology established the biochemical basis for the activity of alkaloids, glycosides, hormones, and enzymes, thereby providing the first mechanistic explanations for the efficacy of biological preparations.

The mid-twentieth century marked a paradigm shift with the discovery of antibiotics and enzymes produced by microorganisms. This breakthrough redirected scientific attention toward microbial metabolism as a powerful source of bioactive compounds. Researchers demonstrated that microorganisms could synthesize complex molecules with high efficiency and under controlled conditions, leading to the rapid expansion of industrial microbiology. Literature from this period emphasized fermentation technology, microbial strain selection, and metabolic regulation, laying the foundation for large-scale production of biological preparations.

Subsequent advances in molecular biology introduced recombinant DNA technology, fundamentally altering the conceptual framework of biological sources. Scholarly works increasingly focused on genetically engineered organisms and cell cultures as controlled production platforms for specific proteins and metabolites. This body of literature highlighted the advantages of reproducibility, safety, and molecular precision, while also addressing potential risks associated with genetic modification. Regulatory guidelines and bioethical analyses became integral components of this discourse, reflecting the growing complexity of source-related considerations.

Despite the extensive volume of research, much of the literature remains segmented by source type. Plant-based studies rarely engage with microbial biotechnology, and discussions of recombinant systems often overlook their conceptual dependence on natural biological diversity. This fragmentation underscores the need for integrative analyses capable of synthesizing insights across source categories. The present article builds upon this gap by treating biological sources as an interconnected system rather than isolated phenomena.

The methodological framework of this study is grounded in qualitative synthesis and comparative analysis of authoritative scientific sources. Peer-reviewed journal articles, internationally recognized textbooks, and regulatory documents were systematically examined to ensure both theoretical depth and practical relevance. Particular attention was paid to sources that provided mechanistic insights into the relationship between biological origin and functional properties of preparations.

Comparative methodology was applied to evaluate plant, animal, microbial, and recombinant sources with respect to their biosynthetic capacity, standardization potential, and applicability across different sectors. Historical analysis was used to trace conceptual shifts in source utilization, while synthesis methodology enabled the integration of findings from diverse disciplines. Rather than relying on statistical aggregation, the study emphasizes conceptual coherence and logical progression, aligning with the exploratory nature of source analysis in biological preparation science.

This approach allows for a nuanced assessment of complex biological systems and avoids reductionist interpretations that may obscure interdependencies among source categories. The methodology is thus particularly suited to advancing theoretical understanding and informing future research directions.

## RESULTS

The analysis demonstrates that plant-based sources remain a critical foundation for biological preparations, particularly due to their chemical diversity and ecological adaptability. Secondary metabolites synthesized by plants exhibit a wide range of biological activities, reflecting evolutionary responses to environmental pressures. However, variability in raw material quality and environmental dependence limit their scalability.

Animal-derived sources, while historically central, have experienced a relative decline in direct application. Their primary contemporary role lies in providing biological models and complex molecules that inform recombinant design. Ethical constraints and safety concerns significantly restrict large-scale reliance on animal extraction.

Microbial sources emerge as highly efficient and versatile systems for producing biological preparations. Their rapid growth, genetic plasticity, and compatibility with industrial fermentation systems enable large-scale, standardized production. Recombinant technologies further enhance these advantages by allowing precise control over molecular structure and expression.

The results indicate a clear trend toward integration, where natural biological diversity informs engineered production systems rather than being replaced by them.

#### DISCUSSION

The findings highlight that the evolution of biological preparation sources reflects broader scientific transformations. The shift from natural extraction to recombinant production represents not a discontinuity but a refinement of biological knowledge. Ethical, ecological, and regulatory considerations increasingly shape source selection, reinforcing the need for interdisciplinary approaches.

From a scientific perspective, the integration of traditional and modern sources enhances innovation while preserving biological relevance. This balance is essential for ensuring long-term sustainability and societal acceptance of biological preparations.

#### CONCLUSION

The sources of biological preparations constitute a foundational axis of their scientific, technological, and ethical evaluation. Understanding these sources as dynamic and interconnected systems enables more rational, safe, and effective development of biological products. Future research should continue to integrate natural biological diversity with advanced biotechnological methods, ensuring that progress remains grounded in both scientific rigor and social responsibility.

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