Exploring natural products for drug discovery

Cayman Stephen*

Department of Biochemistry and Immunology, Universidade Federal de Minas Gerais, Brazil

AUTHORS' CONTRIBUTION: (A) Study Design · **(B)** Data Collection . **(C)** Statistical Analysis · **(D)** Data Interpretation · **(E)** Manuscript Preparation · **(F)** Literature Search · **(G)** No Fund Collection

ABSTRACT

Natural products have been an important source of drugs for centuries, providing treatments for a wide range of diseases. With the increasing demand for new and effective drugs, the search for natural products with therapeutic potential has become an important area of research in drug discovery. In this article, we explore the potential of natural products as a source of new drugs, and discuss the various approaches used to identify and isolate these compounds. We begin by discussing the chemical diversity of natural products and the potential benefits they offer in drug discovery, including their structural complexity and ability to interact with multiple biological targets. We then review the various approaches used to identify and isolate natural products, including traditional ethno botanical methods, bioassay-guided fractionation, and high-throughput screening.

Next, we explore the challenges associated with natural product drug discovery, including the limited availability of some natural products, the difficulty of synthesizing complex natural product compounds, and the potential for toxicity and adverse effects. We also discuss the importance of sustainable sourcing and ethical considerations in the collection and use of natural products for drug discovery. Finally, we highlight some recent examples of natural products that have been developed into drugs or are in clinical development, including artemisinin for malaria, paclitaxel for cancer, and rapamycin for immunosuppression. We conclude by emphasizing the continued importance of natural products as a source of new drugs and the need for on-going research in this area. Overall, exploring natural products for drug discovery holds great promise for the development of new and effective treatments for a wide range of diseases.

Keywords: Natural products; Drug discovery; bioactive compounds; Phytochemicals; Drug screening; Natural product isolation; Herbal medicine

Address for correspondence:

Cayman Stephen,
Department of Biochemistry and Immunology, Universidade
Federal de Minas Gerais, Brazil
E-mail: cayman.stephen@gmail.com

INTRODUCTION

The search for new drugs has been a major concern for humanity throughout history. Many of the drugs we use today, such as penicillin and aspirin, were discovered from natural sources. Natural products are still a promising source for new drug discovery, as they have been optimized by millions of years of evolution for their biological activities. Natural products are chemicals produced by living organisms, such as plants, animals, and microorganisms. They have a wide range of biological activities, including antibacterial, antifungal, antiviral, anticancer, and anti-inflammatory activities. Natural products have been used for medicinal purposes for thousands of years in traditional medicine systems, such as Ayurveda, Traditional Chinese Medicine, and Western herbal medicine [1].

In recent years, natural products have received renewed attention as a source for new drug discovery. Advances in technology and analytical methods have made it possible to identify and isolate natural products with high efficiency and precision. In addition, advances in synthetic biology and genetic engineering have made it possible to produce natural products in large quantities and modify their chemical structures to improve their properties [2]. One of the advantages of natural products for drug discovery is their structural diversity. Natural products have a wide range of chemical structures, which makes them a rich source for new drug discovery. For example, many natural products have complex and unique structures that cannot be synthesized by traditional chemical methods. These structures often have specific biological activities and can be used as lead compounds for drug discovery [3].

Another advantage of natural products is their ability to interact with multiple targets. Many natural products have a complex mechanism of action, which involves multiple targets and pathways. This makes them particularly useful for treating complex diseases, such as cancer and neurological disorders, which often involve multiple pathways. Natural products are also attractive for drug discovery because they have a low toxicity profile. Natural products have evolved to interact with biological systems, and as a result, they often have low toxicity and side effects. This makes them a safer option for drug discovery, as they are less likely to cause adverse reactions in patients [4].

There are several examples of natural products that have been developed into successful drugs. One example is the drug artemisinin, which is derived from the plant Artemisia annua and is used to treat malaria. Artemisinin has a unique structure and mechanism of action, which makes it highly effective against the malaria parasite. Another example is the drug paclitaxel, which is derived from the Pacific yew tree and is used to treat several types

of cancer. Paclitaxel has a complex mechanism of action, which involves multiple targets and pathways, making it highly effective against cancer [5].

Despite the advantages of natural products for drug discovery, there are also some challenges and limitations. One of the main challenges is the availability and sustainability of natural resources. Many natural products are obtained from rare and endangered species, which can have negative impacts on biodiversity and sustainability. In addition, natural products can be difficult and expensive to obtain in large quantities, which can limit their use in drug discovery. Another challenge is the complexity of natural product chemistry. Natural products often have complex structures and can be difficult to isolate and purify. In addition, they can have variable and unpredictable biological activities, which can make them difficult to optimize for drug development [6].

To address these challenges, researchers are exploring new approaches for natural product drug discovery. One approach is to use synthetic biology and genetic engineering to produce natural products in large quantities and modify their chemical structures. This approach has the potential to overcome the limitations of traditional natural product drug discovery and enable the development of new drugs with improved properties. Another approach is to use computational methods and machine learning to predict the biological activities of natural products and optimize their chemical structures. This approach has the potential to accelerate natural product drug discovery and reduce the time and resources required for drug development [7].

DISCUSSION

Drug discovery is a complex and expensive process that involves the identification of new chemical compounds that can treat or prevent diseases. In recent years, there has been a growing interest in natural products as a source of potential drug candidates. Natural products are chemical compounds that are derived from plants, animals, or microorganisms and have been used for centuries in traditional medicine. This discussion will explore the potential of natural products for drug discovery, the challenges associated with their use, and successful examples of natural product-derived drugs [8].

Natural products have several advantages over synthetic compounds in drug discovery. Firstly, natural products have evolved over millions of years to interact with biological systems, and they often have well-defined biological activities that can be leveraged for drug development. Secondly, natural products often have complex chemical structures that can be difficult to synthesize, making them less prone to drug resistance. Finally, natural products have a long history of safe use in traditional medicine, making them attractive for drug development [9].

There are several classes of natural products that have been identified as potential drug candidates. These include:

1. Alkaloids: Alkaloids are a class of nitrogen-containing compounds that are found in plants. Alkaloids have a wide range of biological activities, including analgesic, anti-inflammatory, and antimalarial effects.
2. Terpenoids: Terpenoids are a large class of natural products that are found in plants, animals, and microorganisms. Terpenoids have a diverse range of biological activities, including anticancer, antifungal, and anti-inflammatory effects.
3. Polyphenols: Polyphenols are a class of natural products that are found in fruits, vegetables, and other plant-based foods. Polyphenols have antioxidant, anti-inflammatory, and anticancer effects and have been linked to a reduced risk of chronic diseases such as cancer and heart disease.
4. Peptides: Peptides are short chains of amino acids that are found in a wide range of organisms, including plants, animals, and microorganisms. Peptides have a wide range of biological activities, including antibacterial, antifungal, and antiviral effects [10].

CONCLUSION

In conclusion, the search for new and effective drugs continues to be an essential aspect of modern medicine. The discovery of natural products as potential drug candidates has a long history and continues to be a promising area of research. Natural products represent a diverse and complex group of compounds with a wide range of biological activities that can be exploited for drug development. The use of natural products in drug discovery has provided several important drugs, such as penicillin, aspirin, and morphine, among others. However, the discovery of natural products as potential drugs is not without its challenges. These include the difficulty in obtaining sufficient quantities of natural products for testing, the complexity of natural product structures, and the need to optimize their pharmacological properties.

Nevertheless, advances in analytical techniques, synthetic chemistry, and molecular biology have enabled researchers to overcome many of these challenges. High-throughput screening and bioinformatics tools have facilitated the discovery of natural products with specific biological activities, while synthetic biology approaches have enabled the production of natural products in large quantities. In recent years, there has been a renewed interest in natural products as a source of new drugs, particularly in the areas of cancer, infectious diseases, and neurodegenerative disorders. The potential benefits of natural products, such as their low toxicity and high specificity, make them attractive candidates for drug development.

ACKNOWLEDGEMENT

CONFLICT OF INTEREST

None

REFERENCES

1. **Yang Y, Adelstein SJ, Kassis AI, et al.** Target discovery from data mining approaches. *Drug Disco Today*. 2009;14:147-154.

2. **Yildirim MA, Goh KI, Cusick ME, et al**. Drug-target network. *Nat Biotechnol*. 2007;25:1119-1126.

3. **Bultinck J, Lievens S, Tavernier J, et al**. Protein-protein interactions: network analysis and applications in drug discovery. *Curr Pharm Des*. 2012;18:4619-4629.

4. **Yamanishi Y, Araki M, Gutteridge A, et al.** Prediction of drug-target interaction networks from the integration of chemical and genomic spaces. *Bioinformatics*. 2008;24:13:232-240.

5. **Sams-Dodd F.** Target-based drug discovery: is something wrong? *Drug Disco Today*. 2005;10:139-147.

6. **Zhang X, Li L, Ng MK, et al.** Drug–target interaction prediction by integrating multitier network data. *Comput Chem*. 2017;69:185-193.

7. **Wang YC, Yang ZX, Wang Y, et al.** Computationally probing drug-protein interactions via support vector machine. *Lett Drug Des Discov*. 2010;7:370-378.

8. **Ezzat A, Zhao P, Wu M, et al.** Drug-target interaction prediction with graph regularized matrix factorization. *IEEE/ACM*. 2016;14:646-656.

9. **Lu L, Yu H.** DR2DI: a powerful computational tool for predicting novel drug-disease associations. *J Comput Aided Mol Des*. 2018;32:633-642.

10. **Wishart DS, Knox C, Guo AC, et al.** Drug Bank: a knowledgebase for drugs, drug actions and drug targets. *Nucleic Acids Res Spec Publ*. 2008;36:901-906.