



An overview of the Bioactive Chemicals found in Medicinal Plants and their Prospective use in the Development of new Pharmaceuticals or Natural Therapies

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Abstract

For millennia, nature has provided medical chemicals, and several contemporary medications have originated from natural sources. Historically, plants have functioned as traditional herbal cures for many maladies, and their unique natural ingredients have impacted the formulation, discovery, and development of new medications. The identification of novel molecular targets from proteins has increased the demand for distinctive chemical diversity. Bioactive compounds are crucial for human health owing to their many biological effects, including antioxidant, anticarcinogenic, antiallergenic, anti-inflammatory, antimutagenic, and antibacterial activities. These compounds may assist in the prevention and treatment of noncommunicable diseases, such as autoimmune, inflammatory, cardiovascular, oncological, metabolic, and neurodegenerative disorders. A collaborative research investigation is discovering these components and establishing their advantageous health impacts. An essential component of several drug development initiatives has been the investigation of natural sources for new physiologically active metabolites.

Many currently recognized lead compounds for medicinal treatments are natural chemicals or their derivatives. Ethnomedicinal research is essential for identifying novel pharmaceuticals derived from indigenous medicinal flora. Green medicines are gaining prominence and significant relevance due to the unparalleled abundance of chemical variety and natural products, which provide extensive prospects for novel therapeutic discoveries, either as pure chemicals or as homogeneous plant extracts. Consequently, the demand for herbal medicines and various natural products derived from diverse plant species has steadily risen in recent years. To put it briefly, medicinal plant species are more than just extractable and exploitable chemical factories. Instead, they could have enhanced human health, prolonged human lifespans, and formed contemporary society as symbiotic partners.

Keywords: drug discovery; Traditional medicine, medicinal plant; natural products.

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Introduction

The World Health Organization (WHO) defines medicinal plants as those with therapeutic potential or serving as precursors to pharmaceutical medications [1]. In many traditional medical systems worldwide, using natural items to prevent and treat illnesses has been practiced for thousands of years [2]. Because it helps prevent illnesses and disorders, natural treatment has become increasingly popular worldwide to preserve good health. It has been applied to treating curable and incurable illnesses as a conventional and complementary therapy [3]. The use of natural products as alternative and complementary therapies has gained more attention 60% of anti-infectious medications now on the market and in development are of natural origin, and around 25% of modern medications are derived from plants [4].

Recent technological developments have made it possible to employ plants as "factories" to create natural medicinal compounds that may be used to create biotech medications, cures, and treatments [5]. Since morphine was extracted from *Papaver somniferous* in the early 1800s, the utilization of plants for medical reasons has required the isolation of their active components [6,7]. The discovery of early medicines derived from medicinal plants, for example digitoxin, cocaine, pilocarpine, codeine, and quinine, was a significant medical achievement [8].

These substances are still recognized for their therapeutic use today after being isolated and examined for their medicinal properties. In addition, since these preliminary discoveries, a number of other compounds derived from plants have been discovered. After undergoing a protracted process of research and development, these chemicals were eventually brought to market as pharmaceutical drugs [8; 9].

Influenza, cancer, asthma, tuberculosis, coronary artery disease, diarrhea, diabetes mellitus, and are among the potentially fatal conditions that the medical community can treat with "plant-made pharmaceuticals" [10; 11;112].

In drug development, plant-based pharmaceutical techniques offer a secure, practical, and cost-effective different to

conventional animal cell cultures or microbial fermentation techniques. Hence, medications derived from naturally occurring plant compounds might make therapy more accessible and faster for patients [13, 14]. The most noteworthy aspect of natural materials is their mostly unexplored structural variety, contributing to their ongoing significance in drug development. This paper presents an overview of natural plant chemicals as possible candidates for drug discovery and development.

For ages, several civilizations worldwide have employed essential oils for a wide range of applications, such as aromatherapy, cosmetics, medicine, feed, feed additives, bactericides, insecticides, fungicides, and fragrance [8]. Research in these areas is ongoing and serves as a means of both obtaining new supplies and goods and searching for alternatives to more effective medications.

Methodology

A variety of scientific literature search engines, including Scopus, Web of Science, PubMed, Google Scholar, ResearchGate, ScienceDirect, MDPI, Academia.edu, Bentham, Thieme, Springer Link, and Sci Finder, were used to collect the data on bioactive compounds used as a source for developing new pharmaceuticals.

Historical Importance

Herbal medicine's historical significance emphasizes how people have always connected with nature in their quest for health and well-being [15]. Throughout history, numerous civilizations globally have recognized and employed the medicinal properties of plants. Herbal remedies have been used for centuries; archaeological findings suggest their use dates back to the Paleolithic era, around 60,000 years ago. [16, 17]. The Sumerians, maintained botanical catalogues and documented herbal remedies for almost 5000 years. Since that time, the prevalence of utilizing plants for medicinal reasons has fluctuated; in some instances, ancient civilizations, such as the Greeks, Romans, and Egyptians, depended significantly on herbal treatments. These practices have persisted through time and have profoundly influenced the progress of modern

medicine and pharmacology [18]. A thorough comprehension of this enduring link may be achieved by examining pivotal moments in the history of plant-based medicine.

The Significance of Medicinal Plants in Pharmacological Reviews

Compounds for drug development have been acquired by several methodologies, including extraction from plants and other “natural sources” [19]. Despite the growing interest of pharmaceutical companies and funding organizations in molecular modelling, combinatorial chemistry, and other synthetic chemistry methodologies, medicinal plants remain a crucial source of novel drugs, drug leads, and new chemical entities (NCEs) [20]. About 25% of the leading pharmaceutical products globally in 2001 and 2002 originated from plants [21]. Plants have been essential since around 28% of new chemical entities (NCEs) were derived from them between 1981 and 2002. During this period, 20% more NCEs were categorized as natural product mimics, signifying that the synthetic molecule was derived from examining natural substances [22].

Within these categories, almost 48% of the new chemical entities (NCEs) recorded between 1981 and 2002 are related to natural product research. With their varied structures and frequently many stereocenters that might be difficult to synthesize, natural products are a starting point for new synthetic molecules [23;24;25]. Numerous structural features present in natural products—such as chiral centers, aromatic rings, intricate ring systems, molecular saturation levels, and the quantity and proportion of heteroatoms—are crucial for drug development [26, 27].

Moreover, many synthetic and medicinal chemists are interested in merging combinatorial chemistry's ability to produce molecules with the structural characteristics of natural products to create natural products and libraries that mimic natural products. As combinatorial chemistry has gained popularity, it has been realized that these chemical libraries may be somewhat varied [28, 29, 30]. In addition to being new medications in and of themselves, pharmaceuticals made from medical plants can also be drug leads that synthetic and medicinal

chemists can optimize. If new chemical structures from medicinal plants are not found during the drug development process, significant drug leads can be derived from known compounds with unique biological activity. Since the human genome sequencing, hundreds of novel molecular targets have been associated with so many illnesses [31].

Chemical Variety

Natural plant products are distinguished by the wide range of secondary metabolites that contribute to their exceptional chemical variety. The metabolites include a variety of chemicals, including flavonoids, phenolic compounds, alkaloids, and terpenoids. Finding and developing novel medications has been greatly aided by the diverse array of chemical components in natural goods made from plants. Many of these chemicals are currently being studied for their potential medical uses after being utilized for several years in traditional medicine. New drugs and treatments for various diseases and conditions have been developed due to the identification and examination of these compounds [32,33]. These substances have a variety of pharmacological actions and unique chemical structures. Because of their composition, natural chemicals originating from plants are a great way to find potential drug candidates. Researchers in the pharmaceutical industry might explore this vast array of compounds to find novel compounds with therapeutic promise.

Bioactive Substances and Their Potential for Treatment

Plant compounds that are not nutritionally significant yet provide protection against various diseases. Secondary metabolites or phytochemicals come from plants and have unique structural and functional properties. Familiar sources include fruits, vegetables, grains, seeds, and nuts. These metabolites are frequently divided into six categories based on their metabolic processes: polysaccharides, glucosides, alkaloids, saponins, phenolics, and terpenes. The photoactive chemicals are schematically categorized in Figure 1, while their therapeutic effectiveness is summarized in Figure 2. Many ailments, including type 2 diabetes, have been treated with photoactive compounds in traditional medicine. Numerous

animal models have shown that these photoinactive have improved antidiabetic effectiveness, and because of their varied effects and easier accessibility, plant bioactive-based medications are in high demand. Figure 3 shows the several molecular mechanisms by which photoinactive can help control type 2

diabetes. According to Ganesan et al. (2017), type 2 diabetes is associated with several comorbidities, and only a small number of regularly used photoactive compounds in food have shown antidiabetic effectiveness, including reducing medicinal burdens during treatment [34].

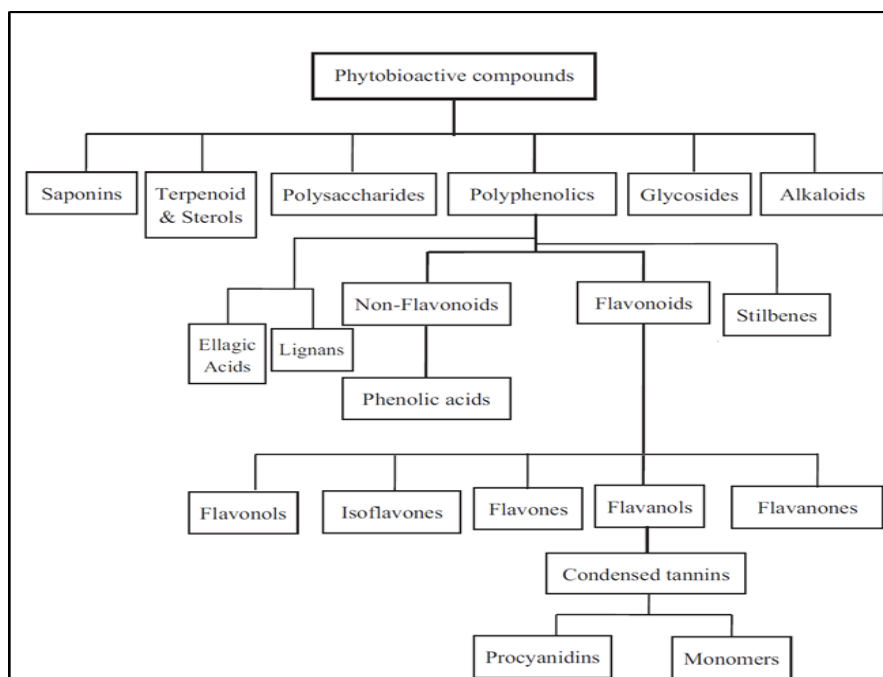


Figure (1) Classification of phytoactive compounds

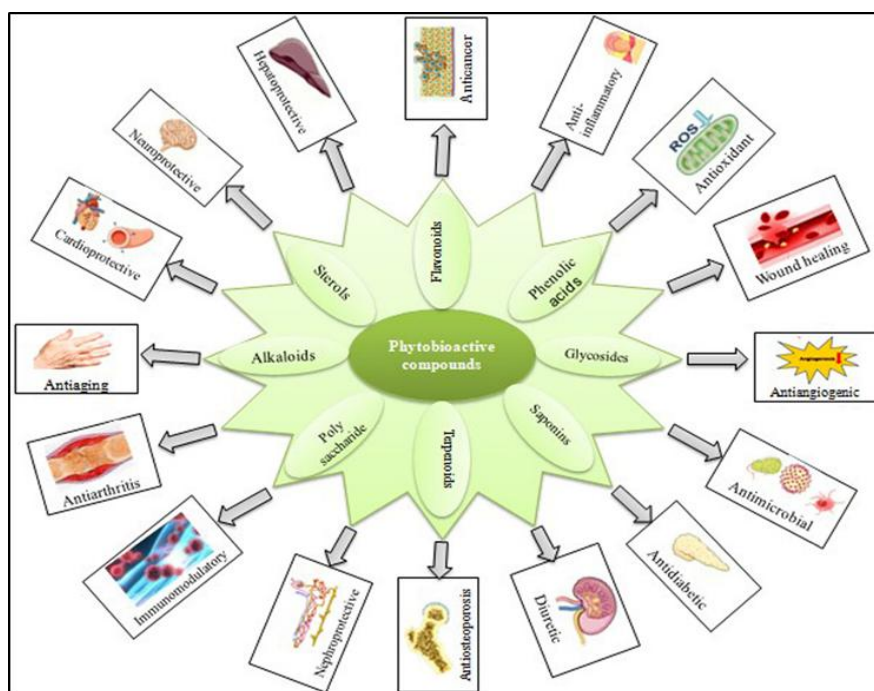


Figure (2) Overview of the therapeutic efficacy of phytoactive substances[25].

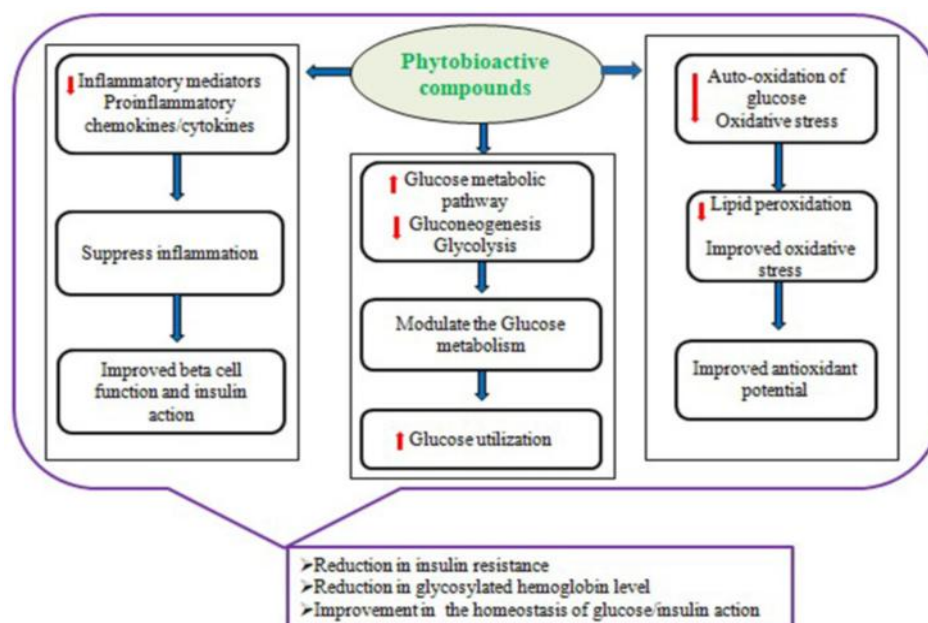


Figure (3) Illustrate the mechanism of phytoactive chemicals in the treatment of type 2 diabetes [25].

Conclusions

Bioactive compounds have been utilized as traditional medicine for the treatment of many ailments worldwide since ancient times. Numerous investigations on their therapeutic potential are recorded, since they are regarded as natural sources for the development of novel medications with enhanced effectiveness and biocompatibility. Natural products have a proven track record of treating various medical disorders. Because certain medicinal natural items are known to have dangerous side effects, such as drug-drug and drug-food interactions, they must also be used carefully and ideally after consulting a healthcare professional.

Plant-derived natural chemicals have a longstanding history. They will remain vital sources of therapeutic agents and models for developing and manufacturing several medications utilized in treating diseases in humans and animals. With the growing interest in formulating herbal remedies that exhibit minimal unwanted effects, there are more opportunities to explore untested natural substances' biological and therapeutic properties. In the research and development of plant-derived pharmaceuticals, plant phytochemicals are optimized to yield potential analogues with the necessary efficacy

and safety. The increasing interest of medicinal chemists in creating natural substance pharmaceuticals has led to several innovative methods and advancements in natural compounds' selection, identification, isolation, characterization, and biological screening.

The technological limitations of developing natural products are lessened by these new methods, which also address the difficulties in researching and creating new natural drugs because of their intricate behaviors. Plants are expected to keep generating unidentified biomolecules that will help develop novel treatments for microbial infections and diseases. Their survival is in jeopardy due to the growing need for medicinal plants in traditional medicine and pharmaceutical research. To ensure that future generations may use and manage these species more sensibly and effectively, genetic resources that are endangered, fragile, and overexploited must be preserved.

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نظرة عامة على المواد الكيميائية النشطة بيولوجيًا الموجودة في النباتات الطبية واستخداماتها المستقبلية في تطوير الأدوية الجديدة أو العلاجات الطبيعية

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الخلاصة

منذ آلاف السنين، قدمت الطبيعة المواد الكيميائية الطبية، وقد نشأت العديد من الأدوية المعاصرة من مصادر طبيعية. عملت النباتات كعلاجات عشبية تقليدية للعديد من الأمراض، وقد أثرت مكوناتها الطبيعية الفريدة على صياغة واكتشاف وتطوير الأدوية الجديدة. أدى تحديد الأهداف الجزيئية الجديدة من البروتينات إلى زيادة الطلب على التنوع الكيميائي المميز. المركبات النشطة بيولوجيًا ضرورية لصحة الإنسان نظرًا لتأثيراتها البيولوجية العديدة، بما في ذلك الأنشطة المضادة للأكسدة ومضادة للسرطان ومضادة للحساسية ومضادة للالتهابات ومضادة للطفرات ومضادة للبكتيريا. قد تساعد هذه المركبات في الوقاية من الأمراض غير المعدية وعلاجها، مثل الاضطرابات المناعية الذاتية والالتهابية وأمراض القلب والأوعية الدموية والأورام والألياف والعصبية التنكسية. يعمل تحقيق بحثي تعاوني على اكتشاف هذه المكونات وتحديد تأثيراتها الصحية المفيدة. كان أحد المكونات الأساسية للعديد من مبادرات تطوير الأدوية هو التحقيق في المصادر الطبيعية للمركبات الأيضية النشطة فسيولوجيًا الجديدة.

العديد من المركبات الرائدة المعترف بها حاليًا للعلاجات الطبية هي مواد كيميائية طبيعية أو مشتقاتها. إن البحث في مجال الطب الشعبي ضروري لتحديد المستحضرات الصيدلانية الجديدة المشتقة من النباتات الطبية المحلية. وتكتسب الأدوية الخضراء أهمية كبيرة بسبب الوفرة غير المسبوقة من التنوع الكيميائي والمنتجات الطبيعية، والتي توفر آفاقًا واسعة لاكتشافات علاجية جديدة، إما كماد كيميائية نقية أو كمستخلصات نباتية متجانسة. ونتيجة لذلك، ارتفع الطلب على الأدوية العشبية والمنتجات الطبيعية المختلفة المشتقة من أنواع نباتية متنوعة بشكل مطرد في السنوات الأخيرة. ونقترح أن ننظر إلى الناس والنباتات الطبية باعتبارهم شركاء يشمل ارتباطهم مجموعة معقدة وغير مدروسة من التفاعلات (الاجتماعية) البيئية، مثل التكافل، والتعايش، والتدجين. وباختصار، فإن أنواع النباتات الطبية أكثر من مجرد مصانع كيميائية قابلة للاستخراج والاستغلال. بل إنها بدلاً من ذلك قد تعمل على تعزيز صحة الإنسان، وإطالة أعمار البشر، وتشكيل المجتمع المعاصر كشركاء تكافليين.

كلمات مفتاحية: الطب التقليدي، النباتات الطبية، المنتجات الطبيعية.