



# Journal of Innovations in Applied Pharmaceutical Science [JIAPS]

Content available at: [www.saap.org.in](http://www.saap.org.in) ISSN: 2455-5177



## A REVIEW ON: ESTIMATION AND UTILIZATION OF PHYTOCONSTITUENTS IN DIGOXIN, ATROPINE, VINBLASTINE

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### Article History

Received: 14-07-2025

Revised: 24-09-2025

Accepted: 02-10-2025

### Keywords:

Natural Sources,  
Primary Metabolites,  
Sources, Cultivation.



### Abstract

The word Pharmacognosy comes from the Greek language. Pharmakon means drug, and gignosco means to acquire knowledge. Medicinal plants are rich in bioactive phytoconstituents that play an important role in therapy. Digitoxin, atropine, and vinblastine are classical examples of plant-derived drugs with high clinical value. Estimated by spectrophotometry, HPLC, and immunoassays for therapeutic drug monitoring. Crude drugs are natural substances obtained from plants, animals, minerals, marine life, or microorganisms. Pharmacognosy is the scientific study of drugs that come from natural sources such as plants, animals, and microorganisms. Primary metabolites, such as sugars, amino acids, and lipids, are essential for plant growth and development. Secondary metabolites, on the other hand, are not directly involved in growth but play a vital role in the survival of plants.

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<https://doi.org/10.37022/jiaps.v10i3.742>

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### Introduction

The word Pharmacognosy comes from two Greek words: Pharmakon meaning drug or medicine, and Gnosis meaning knowledge. It is the study of drugs that come from natural sources. Pharmacognosy involves studying the physical, chemical, biochemical, and biological properties of natural drugs. It also includes the search for new medicines from nature. Pharmacognosy teaches us about the medicinal uses of natural drugs, their history, sources, and distribution. It also explains how plants are cultivated, what active compounds they contain, how to test and identify them, how they are preserved, and how substitutes or adulterants are detected. Plant preparations used for health purposes are called medicinal or herbal [1].

The study of drugs from plants covers three main fields: botany, which deals with plant identification, genetics, and cultivation; chemistry, which focuses on isolating, identifying, and measuring plant chemicals; and pharmacology, which studies the effects of these chemicals on cells, animals, and humans. Pharmacognosy also checks three key aspects of drugs: their quality (identity, purity, and consistency), efficacy

(how well they work), and safety (possible side effects, interactions, and precautions).

### Crude Drugs

Crude drugs are natural substances obtained from plants, animals, minerals, marine life, or microorganisms. They are mostly used in their natural form, with only simple processing like drying or size reduction. These drugs are natural products that are not modified or improved by any artificial process. Proper packaging and storage are very important to prevent spoilage and to keep their medicinal value intact. Pharmacognosy is the scientific study of drugs that come from natural sources such as plants, animals, and microorganisms. It also studies other useful compounds made from these sources. The subject includes learning about the history, distribution, and cultivation of natural substances, as well as their collection, preparation, identification, and evaluation. Pharmacognosy explains how these natural products are used for treatment and focuses on their physical, chemical, biochemical, and biological properties.

The word Pharmacognosy comes from the Greek language. Pharmakon means drug, and gignosco means to acquire knowledge. Together, the term simply means "gaining knowledge about drugs. Pharmacognosy is the study of natural drugs in their raw form. It is a branch of Pharmacology, which is the science of medicines. Pharmacology itself includes different areas: Pharmacognosy, which deals with crude or raw drugs; Pharmacy, which is the preparation of drugs for medical use; and Pharmacodynamics, which studies the effects of drugs on living organisms. Pharmacognosy mainly focuses on drugs

obtained from plants and animals, studying their botany, chemistry, and origin. Drugs made by artificial chemical processes such as salts, acids, or alkalis are usually not included, since most of the substances studied in pharmacognosy are of natural origin [2]. In the case of plants, pharmacognosy examines their habitat, features, position in the plant kingdom, and the specific parts of the plant used as medicine. The word Pharmacognosy comes from the Greek terms Pharmakon, meaning drug or medicine, and Gnosis or Gignosis, meaning knowledge or to acquire knowledge. Therefore, Pharmacognosy means knowledge of drugs. It is the science of studying crude drugs using proper scientific methods. This field mainly deals with natural products obtained from plants, animals, and minerals. Pharmacognosy not only studies these substances but also looks into their history, distribution, cultivation, collection, preparation, identification, evaluation, and preservation. It also covers the history of natural products in medicine, their value and importance, their production, and their role in the discovery of new drugs.

### **Importance of Pharmacognosy**

Pharmacognosy is very important in medicine because it plays a major role in the discovery and preparation of new medicines [3]. Many crude or raw drugs are directly used in making medicines, and about 80% of people in the world still rely on crude drugs and folk medicine. The demand for herbal drugs is growing worldwide, which shows the wide scope of pharmacognosy in pharmacy.

**Cultivation of Medicinal Plants** India imports many medicinal plants, but if these plants are cultivated within the country, it can save foreign money and support national development. Cultivation is also necessary to meet industrial demand for certain plants such as Mentha, Sandalwood, Isabgol, and Tulsi.

**Analysis of Phytochemicals** Pharmacognosy also focuses on isolating bioactive molecules from crude drugs. These molecules are tested and analyzed using modern scientific methods such as chromatography.

**Preparation of Tonics and Stimulants** Modern medicine is not always effective in curing every disease, and in such cases crude drugs play an important role. Diseases like liver problems, arthritis, cancer, and AIDS can be managed with the help of natural medicines. Ayurvedic drugs such as Liv-52, Livomin, Ginseng, Tulsi, Ashwagandha, and Brahmi are widely used as tonics and stimulants.

**Steroid Industry** Pharmacognosy also supports the steroid industry, where plants like Dioscorea are used to prepare steroid-based medicines. These medicines include sex hormones, contraceptives, and corticosteroids [4].

**Herbal Preparation** Herbal medicines are becoming more popular because they are cheap, easily available, effective, and have fewer side effects compared to synthetic drugs. An example is Adhatodavastica, which is widely used in herbal treatments. From old times, people used plants and animals not only as food but also as medicine, as they helped to cure sickness and were called "drugs." Many great scholars studied about medicines; in India, Charak and Sushruta wrote important books on Ayurveda, while Hippocrates, known as the "Father of Medicine," contributed greatly to medical

knowledge. Aristotle studied animals and plants, and Dioscorides wrote the famous book *De Materia Medica* about useful plants [5]. Galen further explained how to prepare medicines from natural sources. All these records of natural medicines were collected in a big work called *Materia Medica*. Ayurveda, the Indian system of medicine, began thousands of years ago and still holds great importance today.

### **History and Development of Pharmacognosy**

Pharmacognosy is the study of drugs discovered from natural products, which are important sources of medicines used for the prevention and treatment of diseases. Among natural sources, plants are the main and better source for drug discovery. The word "Pharmacognosy" comes from the Greek words Pharmakon meaning drug and Gnosis meaning knowledge, so it means "knowledge of drugs." This term was first used by C.A. Seydler. In 77 AD, the Greek physician Dioscorides wrote the famous book *De Materia Medica*, which described about 600 crude drugs and became an important reference in pharmacology and botany [6].

In 1815, the German scientist C.A. Seydler first used the word "pharmakognosie" in his book *Analecta Pharmacognostica*, and he is known as the father of pharmacognosy. Earlier, the Greek pharmacist Galen (131–200 A.D.) worked on extracting chemicals from plants and developed many methods of extraction, which led to the branch of pharmacy called Galenical Pharmacy. Hippocrates (460–360 B.C.), known as the father of medicine, studied human anatomy and physiology, especially the circulatory and nervous systems, and wrote books for physicians that are still valued today. In India, the history of pharmacognosy is about 5500 years old, with medicinal plants described in the Rigveda and Atharvaveda. Ancient Ayurvedic texts like *Charaka Samhita* and *Sushruta Samhita* also recorded the properties and uses of many medicinal plants. Many medicines were first discovered from natural products, which remain important for drug development and disease treatment. Plants with medicinal properties have been the main and most useful sources of drugs. The term "Pharmacognosy," meaning "knowledge of drugs," comes from the Greek words Pharmakon (drug) and Gnosis (knowledge) and was first used by C.A. Seydler. In 77 AD, the Greek physician Dioscorides wrote *De Materia Medica*, describing about 600 crude drugs and making a significant contribution to both pharmacology and botany.

The word "Pharmacognosy" was first used in the early 19th century by Austrian doctors Schmidt and Seydler. Initially, it focused on studying crude plants, animals, and minerals, with scientists describing, identifying, and collecting these natural drugs. Later, active compounds like alkaloids were discovered in plants, which greatly contributed to the development of modern medicine.

The history of pharmacognosy began in ancient times, when Egyptians and Mesopotamians used plant-based medicines and created the first pharmacopoeias [7]. The word "pharmacognosy" was introduced in the 19th century, and during this time scientists began using microscopes and discovered active compounds in plants, which greatly contributed to the development of modern medicine. In the 1960s and 1970s, pharmacognosy developed into a combined

science of chemistry and biology. Today, modern tools like chromatography, HPLC, and NMR are used to isolate and analyze active compounds in plants. Pharmacognosy also studies natural products to develop new medicines, helping in the discovery of new drugs and therapies.

Egyptian writings. Many cultures around the world learned to use plants for healing through trial and error. In Egypt, the Ebers Papyrus recorded plant medicines, and early pharmacopoeias were also made in China and India. These ancient works became the foundation for modern pharmacognosy.

Modern pharmacognosy has led to the discovery of strong drugs like digitalis, belladonna, rauwolfia, and morphine from plants. Cardiac glycosides require a lactone ring for activity, while anthraquinone glycosides are active only if certain structural positions are satisfied. Methyl ergometrine shows stronger oxytocic activity than ergometrine, and steroid hormones can be synthesized from diosgenin. Morphine serves as a model for pain-relieving drugs, cocaine is used as a local anesthetic, atropine helps relieve spasms, and dicoumarol acts as an anticoagulant [8]. Natural substances such as antibiotics, steroids, and alkaloids remain important, and biosynthetic pathways in plants, including the Calvin cycle, shikimic acid pathway, and isoprenoid pathway, explain how these useful chemicals are produced.

### **Phytochemistry**

Phytochemistry is the branch of science that deals with the study of chemical compounds produced by plants. These compounds are usually called plant metabolites and are divided into two groups: primary metabolites and secondary metabolites. Primary metabolites, such as sugars, amino acids, and lipids, are essential for plant growth and development. Secondary metabolites, on the other hand, are not directly involved in growth but play a vital role in the survival of plants. They help plants protect themselves from harmful insects, pests, pathogens, herbivores, ultraviolet radiation, and environmental stress. Although these compounds are made for plant defense, they are also very important for humans because many of them have medicinal properties. Medicinal plants have been used since ancient times to cure various illnesses. Modern research has now confirmed that the healing properties of these plants come mainly from their phytochemical constituents. These phytochemicals are biologically active and naturally occurring compounds that provide health benefits. They can reduce the risk of chronic diseases like cancer, diabetes, and cardiovascular problems. They also show properties such as antioxidant, anti-inflammatory, antibacterial, antiviral, and anticancer effects. Because of these multiple benefits, phytochemicals are now seen as valuable resources for both preventive and therapeutic medicine [9].

There are thousands of phytochemicals present in nature, and more than 4,000 have already been identified by scientists. They are widely distributed in fruits, vegetables, legumes, grains, herbs, and spices. For example, garlic, ginger, turmeric, grapes, green tea, soybeans, broccoli, and carrots are common foods rich in phytochemicals. These compounds are usually found in specific parts of plants, such as seeds, roots, stems, leaves, flowers, or fruits. The levels of phytochemicals may

vary depending on the variety of plant, its growing conditions, and how it is processed or stored. Because of their wide occurrence, it is possible to get a large variety of phytochemicals just by following a plant-based diet. Phytochemicals are classified into several important groups, including alkaloids, terpenoids, flavonoids, tannins, saponins, and phenolic compounds. Each group has unique characteristics and health benefits. Alkaloids are nitrogen-containing compounds, many of which are used as medicines. For example, morphine is a strong pain reliever, and quinine is used to treat malaria. Terpenoids have many pharmacological activities, such as anticancer, anti-inflammatory, antiviral, and antibacterial effects. Flavonoids are well-known antioxidants found in fruits and vegetables; they protect the body's cells from oxidative damage. Phenolic compounds also have antioxidant and anti-aging effects. These examples show that phytochemicals are not only useful to plants but are also powerful agents for human health. Recent studies have shown that phytochemicals play a role in modulating the immune system, preventing DNA damage, regulating hormones, and supporting detoxification processes in the body. Some phytochemicals can even stop the growth of cancer cells or block harmful enzymes. Others improve cardiovascular health by lowering cholesterol and blood pressure. Because of such wide-ranging benefits, phytochemicals are sometimes called "bioactive compounds" [10]. They are biologically active in small amounts, and their effects go beyond basic nutrition. Unlike proteins, fats, and carbohydrates, which are needed in large amounts for energy and growth, phytochemicals work in smaller amounts to maintain health and prevent disease.

Phytochemistry as a field is important not only for understanding the chemistry of plants but also for drug discovery. Many modern medicines are either directly obtained from plants or inspired by phytochemicals. For example, the anti-cancer drug vinblastine, the heart medicine digoxin, and the pain reliever morphine are all derived from plant compounds. By studying phytochemicals, scientists are able to discover new drugs, improve existing treatments, and develop herbal formulations that are safe and effective. This makes phytochemistry a bridge between traditional herbal knowledge and modern pharmaceutical science [11].

The importance of phytochemicals is not limited to medicine alone. They are also widely used in food and nutrition. Dietary phytochemicals such as flavonoids, carotenoids, and polyphenols are recognized as natural antioxidants that keep food fresh and improve human health. They are also used in cosmetics and skincare products because of their anti-aging and protective effects. Furthermore, phytochemicals are being studied for their role in sustainable agriculture, as natural pesticides and growth promoters, reducing the need for harmful chemicals [12].

Table 01: Phytoconstituents of secondary metabolites

Class of Phytoconstituents	General Role in Plants	Pharmacological / Industrial Importance	Examples
<b>Alkaloids</b>	Defense against herbivores, bitter taste deterrent	Anticancer, analgesic, antimicrobial	Morphine, Vinblastine, Quinine
<b>Phenolics</b> (incl. flavonoids, tannins)	Protection against UV radiation, pathogens	Antioxidant, anti-inflammatory, cardioprotective	Quercetin, Resveratrol, Tannic acid
<b>Terpenoids</b>	Aroma, plant growth regulation, stress tolerance	Anticancer, antimicrobial, insecticidal	Taxol (Paclitaxel), Menthol, Artemisinin
<b>Glycosides</b>	Plant defense, storage forms of active molecules	Cardiotonic, laxative, anticancer	Digoxin, Sennosides
<b>Saponins</b>	Defense against microbes, deter herbivory (soap-like foaming)	Antifungal, cholesterol-lowering, immunostimulant	Diosgenin, Ginsenosides
<b>Endophytic metabolites</b> (from fungi/bacteria)	Symbiotic benefits, stress tolerance	Alternative sources of bioactive drugs	Paclitaxel from <i>Taxus</i> endophytes, Camptothecin-like compounds
<b>Others</b> (sterols, lignans, essential oils)	Structural and ecological roles	Nutraceuticals, aromatherapy, antimicrobial	$\beta$ -sitosterol, Lignans, Essential oils

### Modern History of Phytochemistry

The modern history of phytochemistry shows how important plant compounds have been in the development of medicine. One of the earliest major discoveries was quinine from the bark of the cinchona tree, which was used in the 17th century to treat malaria and other infectious diseases. In the 18th century, Friedrich Wilhelm isolated morphine, the first pure alkaloid, which became a powerful medicine for pain relief. Over the past 300 years, many other plant compounds have been discovered and studied, such as digitalis from foxglove in 1785

for heart problems, picrotoxin in the 1800s as a plant-based neurotoxin, curare in the mid-19th to 20th century as a muscle relaxant, and salicin from willow bark between 1860–1877, which later led to the development of aspirin. These discoveries proved the great medicinal value of plants and gave rise to the field of phytochemistry, which continues to study natural products for new therapeutic uses today [13].

### Phytochemical Constituents

Phytochemicals are widely found in fruits, vegetables, grains, legumes, nuts, and spices. For example, broccoli, garlic, grapes, tea, and soy foods are rich sources. The levels of these compounds may vary depending on the plant type, growing conditions, and processing methods. Because of their diverse health effects, phytochemicals have become a major focus in pharmacognosy and phytochemistry research. They not only help in discovering new drugs but also support the traditional use of medicinal plants. The present review highlights the importance of phytochemicals, their types, and their potential health benefits in human disease prevention and therapy.

Phytochemicals are usually classified as secondary metabolites, and the major groups include alkaloids, terpenoids, flavonoids, phenolics, tannins, glycosides, and saponins. Each group has different functions; for example, terpenoids show anti-malarial and anticancer activities, flavonoids act as strong antioxidants, and alkaloids are often used in medicines like morphine and quinine. Researchers have reported that more than 4,000 different phytochemicals have been identified, though many are still unknown. Studies suggest that phytochemicals play an important role in the prevention and treatment of chronic diseases such as cancer, diabetes, heart disease, and infections. Unlike nutrients, they are not required for survival but help improve quality of life by preventing cell damage and supporting the immune system.

Phytochemicals have significant commercial uses as they are employed in the production of flavors, fragrances, food preservatives, pigments, cosmetics, and even bioplastics (Pandey et al., 2022). The global demand for plant-based products is steadily increasing due to rising interest in natural medicines and nutraceuticals, making phytochemical research one of the fastest-growing fields in pharmaceutical sciences (Yadav & Agarwal, 2020). Research in phytochemistry typically emphasizes the identification, isolation, and characterization of active plant compounds, using advanced tools such as chromatography, spectroscopy, and metabolomics. These modern techniques not only enhance our understanding of plant diversity but also contribute to the discovery of new drug candidates and industrial biomolecules.

### Digoxin



Fig 01: Digoxin medicine

Digoxin is a medicine made from the foxglove plant. Long ago, doctors discovered that it could help people with heart problems. In the 18th century, a doctor named William Withering studied it carefully and explained how it worked. Digoxin helps the heart pump better, but it can be dangerous if taken in high doses [14]. It is still used today for some heart conditions, but doctors are careful because of its side effects. Digoxin is a medicine used for heart problems. It was first taken out from the foxglove plant *Digitalis lanata* in 1930 by Dr. Sydney Smith. The process involved extracting special chemicals from the plant, which produced digoxin. Later, scientists purified it further to make it safe for medical use. Digoxin can help the heart, but it must be used carefully. If taken in high amounts, it can be toxic. Signs of this toxicity include vomiting, slow heartbeat, fainting, convulsions, and even death in severe cases. It can also cause vision problems, such as seeing things with a yellow tint. Digoxin has been used for a very long time. In 1785, William Withering explained the medical uses of the digitalis plant. Later, in 1799, scientists discovered its direct action on the heart.

Digoxin is a medicine used for heart failure. It has been in use for more than 200 years since William Withering introduced it in the 18th century. It comes from the foxglove plant (*Digitalis purpurea*). At first, it was used to treat dropsy, which is now called congestive heart failure. The FDA officially approved digoxin for heart failure in the 1990s. Today, its use has reduced because of newer medicines, but it is still important in treating heart failure, irregular heartbeat, and atrial fibrillation. The foxglove plant, which gives digitalis, was mentioned in medical writings as early as 1250 by Welsh physicians. However, it was not used regularly until the 18th century. William Withering, an English doctor and botanist, studied the plant carefully. In 1785, he published a book describing its medical effects. His work made the foxglove plant popular for medical use.



Fig 02: Digoxin Plant

Digoxin is a medicine that belongs to a group called cardiac glycosides. These medicines help the heart. Digoxin comes from the foxglove plant (*Digitalis purpurea*), while another similar medicine, ouabain, comes from the *Strophanthus gratus* plant. These medicines have been used for thousands of years to treat heart problems. In 1785, Dr. William Withering discovered the medical use of foxglove. He found it helpful for treating dropsy (swelling caused by too much fluid) [15]. Digoxin also helps people with weak or irregular heartbeats by working as a natural diuretic.

Digoxin is one of the oldest medicines used for heart problems and is still used today. It has been studied for over 200 years

and is known to help the heart work better. The FDA approved digoxin in 1998 for treating heart failure and for controlling heart rate in people with atrial fibrillation. Doctors recommend it for patients with weak heart function or irregular heartbeats. However, its use has decreased in recent years because new medicines like diuretics, ACE inhibitors, ARBs, and beta-blockers are more common. Digoxin is still helpful, but it is used less often now. Digoxin is a helpful medicine for heart failure. It is the only oral drug of its type that does not increase the risk of death in chronic heart failure. When given in the right amount, it has only a few side effects. Digoxin does not raise blood pressure or harm the kidneys. It can be safely used with other heart medicines like ACE inhibitors, ARBs, beta-blockers, and aldosterone antagonists. It is also a cheap medicine, which makes it useful in countries where patients cannot afford expensive treatments. Many clinical trials have shown that digoxin is effective for treating chronic heart failure.

**Synonyms:** Digitalis glycoside, Lanoxin, Digoxinum

**Biological Source:** Digoxin is a cardiac glycoside that is obtained from the leaves of *Digitalis lanata* (Woolly Foxglove) – primary source sometimes also present in *Digitalis purpurea* (Purple Foxglove), but in much smaller amounts

**Geographical Source** : England, Germany, Poland, France, Northern America, India (in some hilly regions)

**Native regions** : Central and Southern Europe

**Scientific name** : *Digitalis lanata*

**Chemical Constituents** : Digitalis contains about 0.2 – 0.45% of both primary and secondary cardiac glycosides (cardenolides). Primary glycosides include purpurea glycoside A & B and glucogitaloxin. These have a structure with an aglycone at position C-3, linked to a chain of three digitoxose sugars, ending with glucose. Primary glycosides are not absorbed well and are less stable.

### Classification of Digoxin

Digoxin is classified as a cardiac glycoside, a group of naturally occurring compounds obtained mainly from the leaves of *Digitalis lanata* and *Digitalis purpurea*. Within the broader drug classification, it belongs to positive inotropic agents, as it increases the force of contraction of the heart muscle [16]. Therapeutically, digoxin is grouped under antiarrhythmic drugs (Class V, miscellaneous) because it helps control certain types of abnormal heart rhythms, especially atrial fibrillation. From a pharmacological view, digoxin consists of two parts: a steroidal aglycone nucleus responsible for its activity, and sugar residues (glycone part) that influence its solubility and pharmacokinetics. Thus, digoxin can be classified chemically as a cardenolide glycoside and medically as a digitalis preparation used in the treatment of heart failure and arrhythmias.

### Estimation of Digoxin

Estimation of Digoxin is the process of measuring the amount of digoxin present in the blood to ensure safe and effective treatment. Since digoxin has a very narrow therapeutic index, meaning the difference between a useful dose and a toxic dose is very small, careful monitoring is required. The normal therapeutic serum concentration of digoxin is usually between 0.5 to 2.0 ng/mL. If the level is lower than this range, the

medicine may not work properly, and if it is higher, the patient may develop toxicity. Signs of toxicity include nausea, vomiting, headache, dizziness, blurred or yellow vision, and abnormal heart rhythms. Laboratory methods such as immunoassay, ELISA, or radioimmunoassay are commonly used to estimate the level of digoxin in blood. Doctors also check kidney function and electrolytes along with drug levels because they influence how digoxin is processed in the body. Thus, estimation of digoxin is very important to guide correct dosage, prevent side effects, and achieve the best benefit in patients with heart disease.

- Clinical estimation – how doctors check the amount of digoxin in blood (therapeutic drug monitoring).
- Pharmacological estimation – the therapeutic range, toxicity level, and required dose.
- Practical/lab estimation – methods used in labs to measure digoxin (like immunoassay, ELISA, RIA)

Estimation of Digoxin means measuring the level of digoxin in a patient's blood to ensure the drug is safe and effective. Because digoxin has a narrow therapeutic index, small changes in dose can cause side effects or toxicity [17]. The therapeutic serum concentration is usually between 0.5 to 2.0 ng/mL. Levels below this may not be effective, while levels above this can cause toxicity (such as nausea, vomiting, vision changes, and dangerous heart rhythms). Estimation is usually done by laboratory methods like immunoassay techniques. Doctors regularly monitor digoxin levels, kidney function, and electrolytes to adjust the dose safely. Estimation of digoxin means checking the amount of this medicine in the blood. It is important because digoxin can be safe only in a small range. The normal level is between 0.5 to 2.0 ng/mL. If the level is too low, the medicine may not work. If it is too high, it can cause problems like vomiting, dizziness, vision changes, or irregular heartbeat. Doctors usually test blood with special methods, like immunoassay, to find the level. They also check kidney function and salts in the blood, because these affect how digoxin works. This helps to give the right dose and avoid side effects.

### Utilization of Digoxin

Digoxin is a cardiac glycoside that is mainly used in the treatment of certain heart conditions. It is commonly prescribed for heart failure, where it helps the heart pump more strongly and efficiently. It is also used in irregular heart rhythms such as atrial fibrillation and atrial flutter to slow down the heart rate and improve its rhythm. Digoxin works by increasing the force of heart contractions and controlling electrical signals in the heart. Because it has a narrow safety margin, the dose must be carefully adjusted, and patients are monitored to avoid side effects or toxicity. Overall, digoxin is an important medicine that helps improve symptoms, exercise capacity, and quality of life in selected patients with heart problems.

Digoxin is a medicine that comes from the foxglove plant. It is mainly used in heart problems.

- It helps in heart failure by making the heart pump stronger.
- It is also used in some irregular heartbeats (like atrial fibrillation) to control the heart rate.
- Doctors use it when other medicines are not enough.

- It must be taken carefully because a high dose can be harmful.

### Side Effects

- Confusion
- Loss of appetite
- Nausea and vomiting
- Diarrhea
- Blurred or yellow vision
- Feeling very tired (fatigue)
- Fast, slow, or irregular heartbeat
- Dizziness or feeling faint
- Trouble breathing
- Weakness
- Digitalis can affect the stomach, eyes, brain, and heart, and may cause tiredness and breathing problems [18].

### Atropine

Belladonna plants contain chemicals like atropine and scopolamine. These plants have been used since ancient times by doctors and were also known in India. In the Roman Empire and Middle Ages, belladonna was sometimes used as a poison. The plant's name, *Atropa belladonna*, comes from Atropos, a figure from Greek mythology who cut the thread of life. The name "belladonna" means "beautiful woman" and comes from Italian women using it to make their pupils larger. Even today, people sometimes use it for beauty. Atropine is also found in jimson weed, and scopolamine is found in henbane. In India, people used to burn jimson weed leaves and inhale the smoke to help with asthma. Later, British colonists also learned about these uses.



Fig 03: Atropine Sulfate Medicine Vial

In the early 1800s, extracts of atropine were used in medicine. Long before that, Cleopatra used henbane to make her pupils bigger, so she would look more attractive. During the Renaissance, women also used juice from belladonna berries for the same reason. This beauty practice appeared again in Paris in the late 1800s and early 1900s. Scientists studied the effects of atropine. In 1831, a German pharmacist made pure atropine for the first time. Later, in 1901, it was fully synthesized by another German chemist. Studies showed that atropine could block some heart effects and reduce saliva production. Over time, many related medicines were made to control stomach, bladder, and eye functions without causing side effects like dry mouth or very large pupils. Atropine has

been used for a long time as both a poison and a beauty aid [19].



Fig 04: Atropine Plant

Cleopatra used it to make her pupils larger, and women in the Renaissance did the same with belladonna. The drug comes from the deadly nightshade plant. In 1831, a German pharmacist named Heinrich Mein separated the pure substance, and in the 19th century it was named "atropine." Later, in 1901, Richard Willstätter made the first synthetic version. A long time ago, Cleopatra used extracts from the henbane plant to make her pupils bigger and look more attractive. In the Renaissance, women also used juice from belladonna berries to make their eyes look larger and more beautiful. Later, in 1831, a German pharmacist named Heinrich Mein separated pure atropine from belladonna. Around the same time, another German chemist, Friedlieb Ferdinand Runge, began studying the effects of belladonna. Other related plants like jimson weed and henbane were also used, for example, in India to ease asthma by inhaling their smoke. Later, British colonists used these plant extracts in medicines in the 1800s.

Atropine is a natural alkaloid obtained from plants like *Atropa belladonna* (deadly nightshade), *Datura stramonium* (jimsonweed), and *Mandragora officinarum*, which belong to the Solanaceae family. It is a secondary metabolite of these plants and is used as a drug with many effects [20]. Atropine works as a competitive antagonist of the muscarinic acetylcholine receptor and is classified as an anticholinergic drug. It is also listed by the World Health Organization (WHO) as a core medicine in the Essential Drugs List. Other names of atropine include dl-hyoscyamine, hyoscyamine, tropic acid ester with tropine, and dl-tropyl tropate.

Atropine is a medicine used to treat nerve agent and pesticide poisoning, slow heart rate, and to reduce saliva during surgery. It can be given through a vein, a muscle, or as eye drops. Eye drops of atropine are used for uveitis (inflammation of the eye) and early amblyopia (dim vision). The intravenous form works quickly, usually within a minute, and lasts for about half an hour to one hour. In some cases, large doses are needed to treat poisoning. Natural products are substances that occur naturally, usually as secondary metabolites, and are not directly involved in main life processes. They are often obtained from plants and have been used for a long time in treating human diseases. The use of natural products has also been one of the most successful ways for discovering new medicines. Atropine is a natural alkaloid obtained from *Atropa belladonna*. It acts as a competitive antagonist of muscarinic cholinergic receptors. After absorption from the

gastrointestinal tract, it is excreted in the urine. Atropine is metabolized in the liver and has a plasma half-life of 2–3 hours [21]. The ampoules should be kept away from light and must never be frozen. Atropine is a natural plant alkaloid and an anticholinergic medicine with many medical uses, especially for blocking muscarinic effects. It comes from plants like deadly nightshade (*Atropa belladonna*) and jimson weed (*Datura stramonium*). In the past, it was used as a poison and to dilate pupils for cosmetic purposes. Today, atropine is an important medicine listed by the World Health Organization. It is usually given by injection or as eye drops, while oral forms are less common.

**Synonyms** : Belladonna leaf, Belladonna folium

**Biological Source:** Belladonna herb consists of dried leaves and other aerial parts of *atropa belladonna*, *atropa acuminata*

**Family** : Solanacea

**Geographical Source**

It Is Indigenous to and Cultivated in England and Other European Countries in India, it is found in the western Himalayas from Shimla to Kashmir and adjoining areas of Himachal Pradesh

**Chemical Constituents**

Atropine is made up of two parts: atropine and tropic acid. When these two join together, they form atropine, which is a tropane alkaloid.

**Side Effects**

- Dry mouth
- Blurred vision
- Dilated pupils
- Increased heart rate
- Constipation
- Urinary retention
- Flushing
- Confusion or drowsiness

**Classification of Atropine**

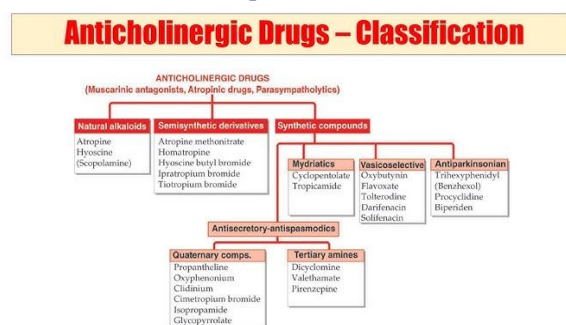


Fig 05: Classification of Atropine

**Estimation of Atropine**

Atropine can be estimated using the RP-HPLC method with a C18 column, methanol and phosphate buffer as the mobile phase, and detection at 264 nm. The retention time for atropine sulphate is about 4.8 minutes, with LOD and LOQ values of 23.07 and 69.91 ng/mL. Atropine can also be identified by Thin Layer Chromatography (TLC) using two solvent systems. The Rf values for standard atropine were 0.74 and 0.82, while extracted atropine showed Rf values of 0.72 and 0.81. Under UV light, atropine gives a bright blue color.

## Utilization of Atropine

Atropine is used for many medical purposes. It is commonly given before anesthesia to reduce mucus secretions like saliva and to maintain a normal heart rate during surgery [22]. Atropine sulfate is also used to block or reverse harmful effects of some medicines and pesticides. In eye care, atropine is used in examinations to dilate the pupil and to relieve pain from swelling and inflammation of the eye.

## Vinblastine



Fig 06: Vinblastine medicine

In the 1950s, Robert Noble and Charles Thomas Beer studied the Madagascar periwinkle plant (*Catharanthus roseus*) for its possible use in diabetes. Instead of lowering sugar, they found it reduced white blood cells in test animals. This led to the discovery of vinblastine and its ability to fight tumors. In 1965, the FDA approved vinblastine as a chemotherapy drug. In the 1950s, the Madagascar periwinkle (*Catharanthus roseus*) was used as a folk remedy for diabetes. Researchers Robert Noble and Charles Thomas Beer studied the plant to find anti-diabetic compounds. However, instead of lowering sugar, they found that the plant extract reduced white blood cell counts in rabbits. This unexpected result led to the discovery of vinblastine. Researchers noticed that the periwinkle plant extract lowered white blood cell levels. This led them to think it might help in treating blood cancers like leukemia and lymphomas. After more studies, they successfully separated a compound from the plant. They first called it vincalokoblastine, but later it became known as vinblastine. In the 1960s, researchers from the University of Western Ontario worked with the pharmaceutical company Eli Lilly to study and develop vinblastine. After successful research, vinblastine and a related drug, vincristine, were approved by the FDA in 1965 as chemotherapy medicines to treat different types of cancer. Vinblastine is a type of vinca alkaloid. It works by attaching to tubulin and blocking the formation of microtubules, which stops cancer cells from dividing. Along with this, they also studied how these embryos could be used to extract vinblastine, an important anticancer compound. Studies also showed that vinblastine production is linked to plant growth stages and specific enzymes. Thus, the history of vinblastine research reflects continuous scientific efforts to enhance its yield and make it more useful for medical treatments. Vinca alkaloids are natural compounds obtained mainly from the Madagascar periwinkle, also called "Sadabahar" or "Sadaphuli." These alkaloids belong to the indole group and are known for their important medicinal uses. They were first studied for their possible role in treating diabetes, but later, in the 1950s,

researchers discovered their anticancer activity. The Eli Lilly company carried out further studies and isolated useful anticancer alkaloids. Out of many alkaloids found, vincristine and vinblastine are the most important and are used as cancer medicines. However, they are obtained in very small amounts from large quantities of crude plant material [23]. Vinblastine is a medicine made from vinca alkaloids and is related to vincristine. It works by stopping the growth of microtubules, which are needed for cell division. This blocks cancer cells during mitosis and prevents them from multiplying. However, vinblastine can also cause side effects like bone marrow suppression, stomach problems, blisters, and ulcers. It may also form crystals inside the body. Vinblastine is an important medicine used in chemotherapy, especially for Hodgkin lymphoma. It is often combined with other drugs like bleomycin and methotrexate to make the treatment more effective and reduce side effects. Using vinblastine allows doctors to give lower doses of other drugs and provide longer rest periods between treatments. It is also used in special treatments for diseases like histiocytosis.

Vincristine and vinblastine are powerful drugs that stop cell division and are used to treat different types of cancers. Studies show that cells react differently to these drugs depending on the time of exposure. With short exposure (1–4 hours), some cells like L1210 and HL-60 are more sensitive to vincristine than to vinblastine. However, with continuous exposure, there is little difference between the two drugs in how cells respond. Vinblastine is released from cells faster than vincristine. Studies using labeled drugs showed that after 4 hours, cells released vinblastine more quickly, which is why it causes less toxicity compared to vincristine. This rapid release explains the difference in their effects after short exposures.



Fig 07: Vinblastine Plant

**Synonyms :** Vincalokoblastine, VLB, Vinblastine sulfate

**Biological Source:** From the plant *Catharanthus roseus*

**Common names of this plant :** Vinca rosea or Madagascar periwinkle

**Geographical Source:** First found in Madagascar Now also grown in India, Sri Lanka, Africa, USA and other warm regions

## Classification of Vinblastine

**Antineoplastic Agent:** Vinblastine is a cancer-fighting drug that slows down or stops the growth of cancer cells.

**Vinca Alkaloid:** It belongs to the vinca alkaloid group of chemotherapy drugs, made from the Madagascar periwinkle plant. **Antimicrotubule Agent / Spindle Poison:** Vinblastine is

called a spindle poison because it blocks microtubules, which are needed for separating chromosomes during cell division. Cell Cycle Phase-Specific: It works in a specific stage of the cell cycle, mainly during metaphase, to stop cancer cells from dividing.

### Side Effects

- It can lower blood cells, which may cause anemia, infection risk, or bleeding.
- It may cause nausea and vomiting. Some people feel tired. Some people feel tired. Hair may fall out.
- It can cause numbness, tingling, or weakness in hands and feet. Constipation may happen [24].
- Appetite may decrease. Mouth sores may appear.
- It can strongly affect the bone marrow, leading to high risk of infection, bleeding, or anemia.
- It may cause serious nerve problems like strong numbness, tingling, or weakness.
- Monitoring and care
- Doctors check blood counts, liver, and nerves regularly. The treatment dose may be changed to reduce side effects.

### Estimation of Vinblastine

Vinblastine and vincristine can be estimated by using HPTLC and HPLC methods. In the HPTLC method, precoated silica gel aluminum plates are used, and the mobile phase is a mixture of toluene, methanol, and diethylamine. The detection is done at 3.7 nm for vincristine and 235 nm for vinblastine, with Rf values of 0.39 and 0.49 respectively. In the HPLC method, a chromatolith performance RP-18c column is used, and detection is done using UV at 254 nm. The retention times are 16.97 minutes for vincristine and 26.93 minutes for vinblastine. In the TLC method, a small amount of crude extract is dissolved in ethyl acetate. The stationary phase used is silica gel-G with 0.5 mm thickness, and the mobile phase is chloroform and methanol in the ratio of 8:2. For detection, the plate is sprayed with ceric ammonium sulphate reagent. The vinca alkaloids show brilliant violet and purple colored spots, which help in their identification.

### Utilization of Vinblastine

Vinblastine is a medicine used in cancer treatment. It belongs to a group of drugs called vinca alkaloids, which are made from the periwinkle plant. Doctors use vinblastine to treat cancers such as Hodgkin's lymphoma, testicular cancer, breast cancer, and some types of lung cancer. It works by stopping the growth of cancer cells and preventing them from multiplying. Vinblastine is usually given by injection under the supervision of a doctor in hospitals [25].

### Conclusion

Digitoxin, atropine, and vinblastine are important plant-derived medicines. To use them safely and effectively, proper estimation methods like spectrophotometry, HPLC, or capillary electrophoresis are needed. These techniques help in checking their purity, strength, and safe dose. Digitoxin is mainly used for heart problems, atropine for eye, heart, and poisoning cases, while vinblastine is an anticancer drug. By improving

methods of estimation, we can ensure quality, safety, and better therapeutic use of this valuable phytoconstituents. It belongs to the vinca alkaloid group of chemotherapy drugs, made from the Madagascar periwinkle plant. Atropine sulfate is also used to block or reverse harmful effects of some medicines and pesticides. In eye care, atropine is used in examinations to dilate the pupil and to relieve pain from swelling and inflammation of the eye.

### Acknowledgement

Authors are thankful to the principal and Management of Dr. Samuel George Institute of Pharmaceutical Sciences College of Pharmacy, to carry out this work.

### Conflicts of Interest

The authors declare no conflicts of interest.

### Author Contribution

Both are contributed equally

### Financial Support

None

### Inform Consent and Ethical Statement

Not Applicable

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