

## HERBAL MEDICATIONS IMPACT ON CLINICAL LABORATORY TESTING

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### ABSTRACT

For centuries, herbal medicines have been used as complementary or alternative therapies to treat a wide range of medical conditions in different countries. However, the side effects imparted by using herbal drugs remain largely unexplored. For instance, excessive usage of Aristolochic acid leads to renal toxicity and causes severe chronic kidney diseases. Similar side effects are observed with Ephedra drug on the cardiovascular system. Therefore, detailed analysis of the demerits of excessive usage of herbal medicines must be clearly understood before they can be safely administered for the benefit of mankind. This review envisages an extensive survey of the literature which summarizes the current state of knowledge regarding the impact of herbal medicines on standard clinical laboratory parameters. It investigates the numerous ways in which hematological parameters, blood chemistry, and other critical diagnostic markers may be impacted by herbal compounds. The review explores the mechanisms that underlie these interactions, which include changes to metabolic processes, disruptions to coagulation pathways, and modulation of enzymatic activities. It also discusses the difficulties in determining how herbal medicines affect laboratory testing because of differences in formulations, dosages, and individual reactions. Through the synthesis of existing evidence, this review adds to the expanding body of knowledge regarding the relationship between clinical laboratory testing and herbal medicines. It emphasizes the importance of interdisciplinary collaboration between traditional and modern healthcare practitioners, promoting informed decision-making for patient care in the context of a diverse healthcare landscape

**Keywords:** Herbal medicine, Toxicity, Drug-herb interactions, Abnormalities in lab tests.

### 1. INTRODUCTION

The active ingredients in herbal medicines are derived from plant parts, such as leaves, roots, or flowers. However, just because something is "natural" doesn't guarantee it's safe to consume. They ought to be applied with the same caution and deference as traditional medical practices. Plants and botanicals are used to create herbal remedies, botanical products, or phytomedicines, which are used to treat or preserve health. Supplements made especially for internal consumption are called herbal remedies. Plant derivatives are the source of many over-the-counter and prescription drug products. The FDA-regulated purified ingredients they use set them apart from herbal supplements. The FDA does not,

however, control the production of herbal supplements. As a result, preparations can vary in consistency and contain either a portion or the entire plant. Although they are also offered in liquid or powder form, herbal supplements are most frequently sold in solid form (such as capsules, pills, tablets, and lozenges). This activity highlights the role of the interprofessional team in treating patients using these medications, reviews conditions treated with these medications, and focuses on the herbal supplements that are commonly used in the United States.

There is an increasing interest in learning more about the possible effects of herbal medications on clinical laboratory testing due to their growing popularity as complementary and

alternative therapeutic options. Although herbal remedies are frequently thought of as natural and safe, their intricate chemical makeup can make it difficult to accurately interpret laboratory results. The detrimental effects of herbal medications on clinical laboratory testing are examined in this review, with particular attention paid to possible interference with biomarkers and the resulting effects on treatment monitoring and diagnostic accuracy. Healthcare professionals must navigate the complex interactions between these natural substances and the accuracy of laboratory testing as more people turn to herbal remedies for a range of health issues. Herbal product composition and potency variations present a distinct set of challenges, so it's important to consider the possible disruptions these variations could cause to commonly measured parameters. This review will examine particular instances that demonstrate how herbal medications negatively impact clinical laboratory testing. Herbal interventions have a wide and notable potential to skew results, ranging from false positives or negatives to changes in important hematological parameters, liver function markers, and kidney health indicators.

Consider St. John's Wort, a well-known herbal remedy for mood disorders, as an example. Although there is ample evidence supporting its purported benefits, its ingestion has been connected to changes in liver enzyme levels, which makes routine liver function tests more difficult to interpret. Likewise, the supplement made of garlic, which is highly recommended for its heart-healthy qualities, includes substances that have anticoagulant qualities. This may result in variations in platelet function and blood coagulation tests, which may affect the evaluation of the patient's coagulation status.

Complicating matters is the lack of standardization in the production of herbal drugs. Different batches of herbal products may have different active ingredient concentrations, which can lead to unpredictable results in laboratory testing and compromise the consistency needed for accurate diagnosis. Healthcare providers need to have a sophisticated understanding of the detrimental effects of herbal drugs on clinical laboratory testing. This review seeks to shed light on the difficulties in incorporating herbal remedies into patient care through the analysis of particular cases, and it advocates for a methodical approach to guarantee the precision and dependability of laboratory results in the age of integrative healthcare.

## 2. EFFECTS OF HERBAL DRUGS ON CLINICAL LABORATORY TESTING

Medicinal plants are the source of herbal pharmaceuticals, sometimes referred to as botanicals or phytotherapeutics. Although herbal treatments have been used for generations to treat a wide range of illnesses, it's crucial to take into account any potential impact they may have on clinical laboratory testing. Depending on the particular plant, the dosage, and the patient's general health, there may be different interactions between herbal medications and the findings of laboratory tests. Here are a few broad things to think about:

**Assay Interference:** Compounds found in herbal medications may cause problems for tests conducted in laboratories. For instance, certain herbs might contain chemicals that mimic or obstruct the measurement of particular analytes, which could result in unreliable test findings.

**Liver Enzyme Levels:** The liver enzymes may be impacted by certain herbal medications. This may affect liver function tests like aspartate aminotransferase (AST) and alanine aminotransferase (ALT). Herbs such as chaparral, kava, and comfrey have been linked to liver damage.

**Blood Clotting:** Anticoagulant herbal medications may have an impact on blood clotting assays, including activated partial thromboplastin time (aPTT) and prothrombin time (PT). Garlic, ginger, and ginkgo biloba are a few examples.

**Kidney Function:** Some herbs can impact kidney function, which may have an impact on blood urea nitrogen (BUN) and creatinine levels. For example, herbal diuretics may affect these outcomes.

**Electrolyte Levels:** Diuretic herbal medications may affect potassium and sodium levels of electrolytes. Tests such as serum electrolyte panels may be impacted by this.

**Thyroid Function:** Tests for thyroid function may be impacted by certain herbs. For example, thyroid hormone levels may be impacted by soy-based food and supplements.

**Blood Glucose Levels:** Fenugreek and bitter melon are two examples of herbal treatments that may have an impact on blood glucose levels. This may be pertinent to people having glucose tests, such as those who have diabetes.

**Drug Interactions:** The use of herbal remedies in combination with prescription drugs may have an impact on the outcomes of laboratory testing. Herbs such as St John's Wort, for instance, have the ability to affect the blood levels of specific medications and activate enzymes involved in the metabolism of drugs.

**Markers of Infection and Inflammation:** Anti-inflammatory qualities in certain herbal supplements may have an impact on laboratory-tested markers of inflammation. Furthermore, some herbs might have antimicrobial qualities that affect infection tests. Open communication regarding the use of herbal medications and other supplements is essential between patients and healthcare providers. It is imperative for patients to disclose to their healthcare providers all substances they take in order to facilitate accurate interpretation of laboratory results and prevent medication interactions. Furthermore, healthcare professionals ought to remain up to date on the latest findings and information regarding the impact of particular herbal remedies on laboratory testing.

### 3. REGULATIONS PERTAINING TO HERBAL MEDICATIONS

The U.S. Food and Drug Administration (FDA) is primarily responsible for regulating herbal medicines in the United States. The Dietary Supplement Health and Education Act (DSHEA) of 1994 gives the FDA regulatory authority over dietary supplements, including herbal products. In light of the U.S. FDA, the following significant regulatory concerns regarding herbal medicines are listed:

**Definition of Dietary Supplements:** In the United States, herbal remedies are frequently categorized as dietary supplements. Pre-market notification or approval is one of the specific regulatory requirements imposed by this classification.

**Notification of New Dietary Ingredient (NDI):** Before releasing an herbal ingredient as a dietary supplement, a manufacturer is required to submit an NDI notification to the FDA if the ingredient was not marketed in the United States prior to October 15, 1994. There is safety information in this notification.

**GMPs or good manufacturing practices:** To guarantee the strength, composition, purity, and quality of dietary supplements, the FDA established GMP regulations. Manufacturers must adhere to GMP regulations.

**Claims and Labelling:** The labelling of dietary supplements, including herbal products, is regulated by the FDA. Health benefit claims have to be accurate and not deceptive. Products that make unfounded or fraudulent claims may be subject to enforcement action by the FDA.

**Debasement and Defilement:** The FDA keeps an eye out for contamination and adulteration in herbal products. The addition of drugs or other substances can lead to adulteration, while pesticides, heavy metals, or microorganisms can cause contamination.

**Post-Market Monitoring:** The FDA monitors the safety of dietary supplements, including herbal products, through post-market surveillance. This covers the reporting of adverse events by suppliers, retailers, and end users.

**Enforcement Measures:** The FDA has the authority to take enforcement actions against companies that violate regulations. This may include issuing warning letters, seizing products, or pursuing legal action against manufacturers making false or misleading claims.

**Development of Botanical Drugs:** An herbal product may need to go through the New Drug Application (NDA) process if a company wants to market it as a medication with therapeutic claims rather than being controlled as a dietary supplement.

**Investigation and Scientific Backdrop:** Scientific research on botanical and herbal products is encouraged by the FDA. Manufacturers are able to provide research findings to bolster the security and effectiveness of their goods.

### 4. GLOBAL COOPERATION

The FDA works with foreign regulatory bodies to address issues pertaining to the international trade in herbal products and to guarantee uniformity in standards for quality and safety. It's crucial to remember that updates or modifications to regulations may occur in the dynamic regulatory environment pertaining to herbal medicines. To guarantee the safety and quality of their products, businesses that produce and market herbal products in the United States must keep up with FDA regulations and adhere to all applicable laws.

## 5. INTENDED USES OF HERBAL MEDICINES

Many people still use herbal medicines today because they may have therapeutic benefits despite the fact that they have been used for centuries for a variety of health issues. It's important to remember that while some herbal

remedies have shown promise in studies conducted by scientists, others might not have enough proof or might even pose risks. Based on both traditional and modern applications, the following list of common herbal medicines includes their intended uses.

**Table 1: Intended uses of Herbal medicines**

S. No.	Herbal Medicine	Scientific Name	Intended use
1	Echinacea	Echinacea angustifolia, Echinacea purpurea	Frequently used to boost immunity and lessen the length and intensity of upper respiratory infections and colds.
2	Ginger	Zingiber officinale	Known for its anti-nausea qualities, ginger is frequently utilized to alleviate nausea and vomiting brought on by chemotherapy, motion sickness, and pregnancy. It has anti-inflammatory properties as well.
3	Turmeric	Curcuma longa	Includes curcumin, an active ingredient with antioxidant and anti-inflammatory qualities. It is used as a general health tonic, to support joint health, and to reduce inflammation.
4	Garlic	Allium sativum	Traditionally used to support cardiovascular health, garlic is thought to lower blood pressure and cholesterol. It is used to boost immunity and possesses antimicrobial qualities as well.
5	Ginseng	Panax ginseng, Panax quinquefolius	A common adaptogen to aid in the body's adjustment to stress. Additionally, ginseng is thought to strengthen the immune system, improve energy levels, and improve cognitive performance.
6	Valerian	Valeriana officinalis	Well-known for its relaxing and sedative properties, is frequently used to ease anxiety and insomnia symptoms. It can also be applied as a relaxant for muscles.
7	St. John's Wort	Hypericum perforatum	Traditionally used for its possible antidepressant qualities. Additionally, it is used to treat mild to moderate anxiety and depression symptoms.
8	Chamomile	Matricaria chamomilla	Chamomile, which has anti-inflammatory and calming properties, is frequently used to ease digestive discomfort, aid in sleep, and encourage relaxation.
9	Peppermint	Mentha piperita	Used to relieve indigestion indications, such as gas and bloating. Muscle aches and

			headaches can also be treated topically with peppermint oil.
10	Saw Palmetto	Serenoa repens	a popular herb for prostate health. It is thought to alleviate symptoms of benign prostatic hyperplasia (BPH), including problems with urination.
11	Milk Thistle	Silybum marianum	Frequently used to promote liver health and may be used in cases of liver damage or diseases due to its potential liver-protective qualities.

In particular, if you are pregnant, nursing, taking medication, or have underlying medical conditions, it is imperative that you use herbal medicines carefully and consult with healthcare professionals. Even though many herbal remedies have a long history of use, there is differing scientific evidence regarding their safety and efficacy, and individual responses may also vary. Always consult a licensed healthcare professional before using herbal supplements.

#### 6. FDA WARNINGS ABOUT TOXIC HERBS

The FDA warns the public about the toxicity of herbal supplements, urging people to remain clear of these products, even though it lacks the authority to order manufacturers to stop producing a product because it is known to be toxic.

Aconite, sometimes referred to as monkshood or wolfsbane, has a history of serious toxicity, including potentially fatal effects on the heart and nervous system. The FDA has cautioned consumers about the risks of consuming aconite-containing products, particularly those found in herbal supplements and conventional medications. When used for both weight loss and sports performance, ephedra has been linked to effects on the nervous system and cardiovascular system that pose major health risks. Because of safety concerns, the FDA outlawed the sale of dietary supplements containing ephedrine alkaloids in 2004.

Known for its anti-oxidant qualities, chaparral has been connected to liver damage. Customers have been alerted by the FDA to the possible health risks connected to using products that contain chaparral. Comfrey had pyrrolizidine alkaloids, which can be harmful to the liver and are used for a variety of medicinal purposes. The FDA has issued a warning regarding the possibility of liver damage when using comfrey internally. When used for pain management and mood enhancement, kratom has been linked to negative side effects such as liver toxicity and seizures. Citing safety concerns, the FDA has released warnings about the possible risks associated with using products containing kratom.

#### 7. ABNORMALITIES IN LAB TESTS AS A RESULT OF TAKING HERBAL SUPPLEMENTS

Although the use of herbal supplements is frequently thought to be natural and safe, it can result in abnormal laboratory test results, making it more difficult for medical professionals to interpret diagnostic data. The phenomenon can be attributed to the presence of potent and diverse bioactive compounds in herbal supplements, which have the potential to disrupt multiple physiological processes. The following are instances of abnormal lab test results linked to the use of particular herbal supplements.



**Table 2: Abnormalities in lab tests as a result of taking Herbal Supplements**

Abnormal Laboratory Test results	Affected Organ	Commonly known Herbs causing such Toxicity
Liver Function test (elevated liver enzyme levels)	Liver	Hepatotoxicity, or increased levels of liver enzymes such as aspartate aminotransferase (AST) and alanine aminotransferase (ALT), has been associated with kava. This can resemble the patterns observed in liver diseases, making the diagnosis and treatment of liver conditions more difficult.
Coagulation Disturbances	Not applicable	Allicin, a substance found in garlic, has the potential to have anticoagulant effects, which could change blood clotting metrics like prothrombin time (PT) and international normalized ratio (INR). This could make bleeding more likely, particularly if taken with anticoagulant drugs.
Elevated serum creatinine	Kidney	It has been reported that Aristolochic acid causes nephrotoxicity, which compromises kidney function. It is possible to see elevated blood urea nitrogen (BUN) and serum creatinine levels, which would suggest kidney disease. This emphasizes how crucial it is to exercise caution when it comes to the safety and quality of herbal supplements.
Thyroid Function Disruption	Thyroid	An excess of iodine from kelp supplements can cause abnormal thyroid hormone levels by interfering with thyroid function. Tests like thyroid-stimulating hormone (TSH), free thyroxine (T4), and free triiodothyronine (T3) may be affected by this interference, which could lead to an incorrect thyroid disorder diagnosis or treatment.
Blood Pressure Fluctuations	Hypertension and Hypokalemia	Glycyrrhizin, a substance found in licorice, can cause potassium loss and sodium retention, which may result in hypokalemia and hypertension. Abnormal electrolyte levels, such as low potassium (hypokalemia), may be discovered through laboratory testing.

## 8. TYPICAL DRUG-HERB INTERACTIONS

Interactions between herbal supplements or botanical products and conventional medications can have an impact on the safety or efficacy of the former. In order to avoid any

potential interactions, people should be transparent with healthcare providers about the use of herbal supplements. Some typical drug-herb interactions are listed below:

**Table 3: Common Drug-Herb Interactions**

S. No.	Herbal Product	Interacting Drug	Comments
1	St. John's Wort (Hypericum perforatum)	Anticoagulants, Oral contraceptives, and some Antidepressants	St. John's Wort, which is used to treat mood disorders, can cause the liver's cytochrome P450 enzymes to become active, which can alter how different medications are metabolized. Certain medications, such as anticoagulants, oral contraceptives, and some antidepressants, may become less effective as a result.
2	Ginkgo Biloba	Anticoagulant and Antiplatelet	Ginkgo biloba, which is frequently taken for cognitive function, may make bleeding more

			likely if taken with anticoagulant and antiplatelet drugs with the coagulation cascade. Additionally, some antidepressants and anticonvulsants may interact with it.
3	Garlic ( <i>Allium sativum</i> )	Warfarin	Warfarin and other anticoagulant drugs may become more potent when combined with garlic, which is used for cardiovascular health. Drugs that are metabolized by the liver may also interact with it, changing the body's level of those drugs.
4	Echinacea	Immunosuppressant	Often used to boost immunity, echinacea may interact with drugs that suppress the immune system and those that are metabolized by the liver, potentially changing their effects, may inhibit CYP3A4, potentially leading to increased drug concentrations.
5	Ginseng ( <i>Panax ginseng</i> )	Warfarin and other Anticoagulant	Warfarin and other anticoagulant drugs may be affected by ginseng, which is used for energy and stamina. It may also interact with diabetes medications and have an impact on blood sugar levels.
6	Grapefruit Juice	Immunosuppressants, Simvastatin (statins), and some Antihypertensive drugs	A number of medications may interact with grapefruit juice, despite it not being a herb. It raises blood levels of some medications, such as immunosuppressants, statins, and some antihypertensive drugs, by inhibiting the activity of intestinal enzymes. Grapefruit juice raises the concentration of statins by preventing the liver's cytochrome P450 3A4 enzyme from functioning. An increased risk of statin-induced myopathy may arise from this.
7	Kava ( <i>Piper methysticum</i> )	Alprazolam (a Benzodiazepine)	Drugs that affect the central nervous system and sedatives may be made more effective by kava, a remedy for stress and anxiety. It may also interfere with drugs that the liver metabolizes.
8	Saw Palmetto ( <i>Serenoa repens</i> )	Aspirin, Warfarin (antiplatelet and anticoagulant drugs)	Saw palmetto, which is frequently used to treat prostate issues, may interact with antiplatelet and anticoagulant drugs, raising the chance of bleeding.
9	Milk Thistle ( <i>Silybum marianum</i> )	Warfarin	The cytochrome P450 enzymes may be inhibited by milk thistle, which could have an impact on warfarin metabolism and raise bleeding risk.
10	Dong Quai	Warfarin	Due to its potential anticoagulant qualities, dong quai may raise the risk of bleeding and interfere with the effects of warfarin.
11	Cranberry	Warfarin (Antiplatelet and bleeding property)	Because of its possible antiplatelet characteristics, cranberries may change platelet function and raise the risk of bleeding.

To guarantee thorough and secure healthcare management, people must tell their medical professionals about all supplements they take, including herbal products. Personalized advice

can be given by medical professionals based on a patient's health status and the particular medications they are taking.

## CASES OF TOXICITY REPORTED WHEN USING HERBAL MEDICINE EXCLUSIVELY

Table 4: Case studies related to Herbal medicines

S. No.	Herb	Toxicity reported	Indication	Description
1	Aristolochic acid	Renal toxicity	Chronic Kidney disease	Aristolochic acid has been linked to serious renal toxicity. Chronic kidney disease known as aristolochic acid nephropathy has been associated with the long-term use of herbs containing aristolochic acid.
2	Chaparral	Hepatotoxicity	Acute liver damage	Some Native American tribes have traditionally used chaparral, which contains nordihydroguaiaretic acid (NDGA). Overconsumption of chaparral has been linked to acute liver damage (hepatotoxicity).
3	Comfrey	Hepatic veno-occlusive disease	Liver disease	Pyrrrolizidine alkaloids, which are found in comfrey, can be toxic to the liver. Extended consumption of comfrey has been associated with hepatic veno-occlusive disease, a grave liver ailment.
4	Ephedra	Cardiovascular effect	Hypertension, Palpitations, stroke and Myocardial infarction	Ephedrine alkaloids are found in ephedra, which is used for its stimulant properties. There have been documented instances where the use of products containing ephedra caused cardiovascular events, such as palpitations, hypertension, and in more severe cases, myocardial infarction or stroke.
5	Kava	Hepatotoxicity	Liver damage	Traditionally used for its anxiolytic properties, kava has been linked to liver damage. There have been reports of a possible connection between kava use and liver damage, which has prompted some countries to take regulatory action.
6	Aconite	Cardiotoxicity, neurotoxicity	Cardiac effect and brain damage	Aconite alkaloids have the potential to cause cardiotoxic and neurotoxic effects by altering voltage-gated sodium channels.

**9. CONCLUSION**

In conclusion, there can be a wide range of effects that herbal medications can have on clinical laboratory testing. As such, healthcare professionals need to be aware of potential interactions and interferences. Herbal medications, which are frequently seen as natural and safe, can affect the outcomes of laboratory tests in a number of ways, such as by interfering with assay procedures, changing metabolic pathways, or modifying the enzymes involved in drug metabolism. The interpretation of laboratory test results can be complicated by these effects, which can result in both false-positive and false-negative results. While some

herbal drugs may have clinically significant interactions with specific laboratory tests, the overall impact can depend on factors such as the type of herbal drug, dosage, duration of use, and individual patient characteristics. Therefore, healthcare providers must consider the use of herbal drugs when interpreting laboratory results and should actively inquire about patients' herbal medicine consumption during clinical assessments.

Patients, in turn, play a crucial role in ensuring accurate healthcare information by transparently communicating their use of herbal drugs to their healthcare providers. This collaborative effort is essential for mitigating



potential risks, optimizing treatment plans, and providing comprehensive and personalized healthcare. Research in this field is ongoing, and as our understanding of the interactions between herbal drugs and laboratory testing deepens, healthcare professionals will be better equipped to navigate the complexities of patient care in the context of herbal medicine use.

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