



# Pharmacological Screening of South Asian Herbs: Potential Candidates for Drug Development

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## Abstract

South Asia has a rich tradition of herbal medicine, offering a diverse range of plants used for centuries to heal diseases. Recent interest in exploring herbs' pharmacological potential for drug development is growing. This review provides an overview of the pharmacological screening of South Asian herbs and their promising role in modern medicine. The South Asian region is renowned for having an exceptional diversity of plants, which has resulted in the identification of various therapeutic plants. The systematic assessment of these plants' chemical makeup, bioactivity, and medicinal potential is known as pharmacological screening. To determine the pharmacological characteristics of these plants, researchers have used various methods, such as phytochemical analysis, bioassays, and animal experiments. Several South Asian plants have demonstrated positive pharmacological effects. One prospective possibility for creating anti-inflammatory medications is *Curcuma longa*, also known as turmeric, which has proven to have powerful anti-inflammatory and antioxidant characteristics. Another example is *Ocimum sanctum*, or holy basil, which has anti-diabetic, neuroprotective, and cardioprotective benefits, indicating its potential as a source of new medications.

**Significance** | South Asian herbs hold diverse medicinal promise, enhancing drug development globally, yet challenges such as standardization and resource constraints persist.

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Additionally, the ability of South Asian botanicals to treat cancer has attracted interest. *Tinospora cordifolia* and *Withania somnifera* are two plants that have demonstrated anti-cancer effects through various methods, including the activation of apoptosis and immune system regulation. South Asian herbs provide advantages like price, accessibility, cultural acceptance, and their potential for healing. However, standardizing herbal remedies and guaranteeing their safety and effectiveness still present obstacles. In conclusion, a wealth of potential candidates for medication development have been discovered by the pharmacological screening of South Asian plants. These plants have the potential to treat a variety of illnesses, from cancer to chronic disorders. South Asian herbs may be crucial in influencing the direction of medical research as it develops, providing fresh approaches and pharmacological options.

**Keywords:** Pharmacological Screening, South Asian Herbs, Drug Development, Medicinal Plants, Therapeutic Potential

## 1. Introduction

More than 80% of the population in some poor nations is thought to rely on herbal medicines (HMs) for basic healthcare (WHO, 2008). However, the usage of HMs is not just seen in underdeveloped nations; in recent years, industrialized nations have shown a growing interest in HMs (Ernst and White, 2000; Pharmaceutical Press, 2013). Researchers have long been fascinated by South Asia's tremendous biodiversity, which provides a treasure trove of plant diversity. Due to their long history of usage in

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traditional medical systems and the promise they represent for new drug development, South Asian herbs have attracted particular attention among this abundance of flora (Balick, M. J., & Cox, P. A., 1996). To find possible candidates for medication development, this article sets out on a trip through the pharmacological screening of South Asian plants. With its varied habitats and climates, South Asia, which includes nations like India, Sri Lanka, Pakistan, Bangladesh, Nepal, and Bhutan, is habitat to various plant species. Herbal remedies have been used for centuries in South Asian traditional medical systems including Ayurveda, Siddha, Unani, and traditional Chinese medicine. The use of a wide variety of South Asian herbs for treating different illnesses has been made possible by the knowledge collected over generations (Veeresham, 2012). Recent developments in scientific study have made it possible to investigate these herbal treatments systematically and reveal their untapped pharmacological potential.

The usage of Turmeric (*Curcuma longa*) in Ayurveda is one such instance. The key ingredient in turmeric, curcumin, has undergone substantial research for its potential anti-cancer, antioxidant, and anti-inflammatory effects (Prasad et al., 2014). Modern scientific discoveries are consistent with its historic uses for the treatment of inflammatory diseases and the healing of wounds. Many plant species in South Asia have not yet fully investigated their full medicinal potential due to the region's unique ecological niches (Uniyal et al., 2006). Alkaloids, flavonoids, terpenoids, and polyphenols are just a few of the phytochemical substances found in these plants that can have various biological effects (Rahman et al., 2017). For instance, the alkaloid-rich plant *Vinca rosea* (Madagascar periwinkle) has attracted attention because of its alkaloids vincristine and vinblastine, both of which have shown to be quite effective in the treatment of cancer, especially leukemia and lymphoma (Noble et al., 1990). The finding of these substances in the flora of South Asia emphasizes the region's potential as a source of cutting-edge medicinal chemicals. The comprehensive study of South Asian herbs has been made possible by improving analytical techniques and pharmacological screening approaches. In the effort to find bioactive chemicals, high-throughput screening, molecular docking studies, and cell-based assays have developed into useful tools (Saeed et al., 2019). These approaches enable the quick evaluation of many plant components and extracts, greatly accelerating the drug development process. Modern pharmacological methods have been used to identify potential candidates in South Asian botanicals. For instance, recent research has looked at the triterpenoid content of *Centella asiatica* (Gotu Kola) and its ability to improve cognition (Gray et al., 2018). These results highlight the value of South Asian herbs in tackling current health issues.

By thoroughly analyzing a few South Asian plants, this article seeks to close the knowledge gap between conventional wisdom and

contemporary pharmacology. The research will include a wide range of methodologies, including in vitro and in vivo pharmacological experiments as well as phytochemical investigations. By doing this, it aims to provide insight on the bioactive chemicals present in these herbs, their modes of action, and possible uses in creating new drugs. This article honors South Asia's rich botanical legacy while demonstrating the ongoing synergy between conventional wisdom and cutting-edge research in searching for new pharmaceutical substances.

### **Turmeric (*Curcuma longa*)**

Turmeric, also known as *curcuma longa*, is a perennial plant that belongs to the Zingiberaceae (ginger) family and is widely farmed in Asia, mostly in India and China (Figure 1). The plant's rhizome, used for medicinal purposes, produces yellow talc. The source of *Curcuma longa* is dried. The component that gives curry powder its color is turmeric bright yellow hue. It goes by several names, such as Arab curcuma, saffron from India, and haridra (Sanskrit, Ayurvedic medicine), Kyoo, or Jianghuang (yellow ginger in Chinese) (Japanese) Ukon (Kunnumakkara et al, 2008). The flavonoid Curcuminoids, a combination of curcumin (diferuloylmethane), monodexmethoxycurcumin, and other compounds, are the turmeric's active ingredients. Bisdesmethoxy curcumin About 20% of curcumin is 90% of turmeric's curcuminoid content. Other Proteins, carbohydrates, and resins are examples of components. The active ingredient with the most studies is curcumin, which includes 0–3.4% of fresh turmeric (Khawaja et al, 2004).

## **PHARMACOLOGICAL PROPERTIES OF TURMERIC**

### **Anti-inflammatory properties**

It was discovered that oral administration of curcumin was just as effective as cortisone or phenylbutazone in cases of acute inflammation. Orally administering *curcuma longa* decreased inflammatory swelling significantly (Cronin et al., 2003). Longa's C inflammation may be linked to preventing the production of both inflammatory prostaglandins during the production of neutrophils from arachidonic acid Inflammatory conditions.

LOX, COX, phospholipases, leukotrienes, prostaglandins, thromboxane, nitric oxide, elastase, hyaluronidase, collagenase, and monocyte activity are also inhibited by curcuminoids. Interferon-induced protein, TNF, and chemoattractant protein-1 Interleukin-12, too. Additionally, they lessen prostaglandin inhibition of leukotriene biosynthesis and the route of lipoxygenase (Walker et al, 2004).

43 kidney transplant recipients participated in an RCT to examine the impact of 480 mg of curcumin and 20 mg of quercetin (per capsule) on delayed graft rejection (DGR) patients. Two of the 39 individuals who finished the research were 14 members of the control group as opposed to none had DGR either of the therapy

groups. Early performance (significant) serum creatinine was lower 48 hours after the transplant, reached in 43% of patients in the control group, 71% of subjects in the individuals receiving low-dose therapy. Given the quantity of the combination included little quercetin; instead, the bulk of Curcumin's anti-inflammatory properties are suggested to contribute to the advantage antidiabetic action, etc. Potential methods for better early kidney transplantation features include induction of the proinflammatory cytokines and the enzyme hemeoxygenase, and related free radical scavenging

Strong antioxidant activity, comparable to that of vitamins C and E, is demonstrated by water- and fat-soluble preparations of turmeric and its curcumin component. According to research on ischemia, pretreatment with curcumin lessened the effects of the condition on the heart (Rastogiet al, 1995). Bovine aortic endothelial cells were used in an in vitro experiment to evaluate curcumin's impact on endothelial heme oxygenase-1, an inducible stress protein. Cellular protection against oxidative damage was increased as a result of curcumin incubation (Foresti et al, 2000).

#### **Antioxidant properties**

The phorbol myristate acetate + anti-CD28 pathway of T-cell proliferation was discovered to be blocked by curcumin (Johnston et al, 1998). Additionally, curcumin lessens the injury to the testicles brought on by exposure to di-n-butylphthalate Glutathion (GSH), a rise in testosterone levels, and (DBP) the activity of glucose-6-phosphate dehydrogenase (G6PD), and Malondialdehyde (MDA) levels are declining. Curcumin's inherent antioxidant properties may bring on these features. (Abe R et al, 2002).

There has been limited clinical study on curcumin's therapeutic potential for pancreatitis, and this research has mainly concentrated on its antioxidant qualities. However, studies show the Inflammatory response is crucial for the growth of harm to tissue after pancreatitis. Consequently, it appears likely to be a curcumin-like anti-inflammatory drug effective against several molecular targets involved in inflammation and shown to lower animal inflammatory markers in pancreatitis model. In one pilot research, the impact of Curcumin for individuals with tropical pancreatitis. At baseline and six weeks, the treatment impacts pain patterns, erythrocyte malonylaldehyde (MDA; a marker of lipid peroxidation), and glutathione (GSH) Weeks. There was a significant drop in MDA concentrations among those who took curcumin. Additional study is required to determine how lipid peroxidation affects pain and other Pancreatitis symptoms are present.

#### **Antidiabetic properties**

Ethanol, hexane, and bisdemethoxycurcumin extracts all include ar-turmerone, curcumin, demethoxycurcumin, and bisdemethoxycurcumin. Ethanol extract made from hexane

extraction waste (including demethoxycurcumin, curcumin, and dose-dependent effects of bisdemethoxycurcumin) encourage the development of adipocytes. The findings show that ethanolic extract of turmeric that contains both curcuminoids and compared to either, sesquiterpenoids has a more hypoglycemic effect. Sesquiterpenoids or curcuminoids (Nishiyama et al, 2005).

The effects of turmeric on postprandial plasma glucose and insulin in healthy participants were investigated by Wickenberg et al. in 2010, and they discovered that 6g C. The glucose response was not significantly impacted by longa. The 30 and 60 minute changes in insulin were substantially higher after the OGTT with C. longa. The AUCs for insulin were also markedly increased following C. longa consumption an OGTT.

#### **Potential Application: Arthritis**

A chronic inflammatory disease called arthritis causes swelling, stiffness, and pain in the joints. It has a huge impact on millions of people's quality of life and affects them on a global scale. Due to its anti-inflammatory and antioxidant characteristics, curcumin has drawn interest as a potential natural treatment for controlling arthritis.

*Osteoarthritis:* This frequent kind of arthritis is characterized by joint inflammation and cartilage degradation. The anti-inflammatory effects of curcumin have been researched in relation to osteoarthritis. A randomized controlled experiment that was presented in the "Journal of Medicinal Food" in 2016 (Henrotin et al, 2019) revealed that individuals with knee osteoarthritis who took curcumin supplements experienced less pain and better knee function.

Rheumatoid arthritis is an autoimmune condition in which the body's defense mechanisms incorrectly target the joints. In rheumatoid arthritis, curcumin's anti-inflammatory and immunomodulating capabilities have been studied. According to a study that was published in "Phytotherapy Research" in 2012 (Goel et al, 2012), Curcumin dramatically decreased rheumatoid arthritis patients' disease activity and joint soreness.

#### **Heart Disease**

The potential heart health advantages of curcumin are supported by a number of methods.

*Endothelial Dysfunction:* The development of heart disease is significantly influenced by the endothelium's (the blood vessels' inner lining) dysfunction. According to research, curcumin promotes healthy blood vessel dilation by enhancing endothelial function (Colletti et al, 2016). *Reducing Inflammation:* Heart disease is significantly influenced by chronic inflammation. Curcumin may be useful for lowering the risk of heart disease because it can reduce inflammation by blocking inflammatory molecules (Franks et al, 2010). *Oxidative stress* contributes to atherosclerosis development. The antioxidant properties of

curcumin help prevent oxidative blood vessel damage (Howells et al, 2014)

### **Certain Cancers**

Research on Curcumin's potential as an anti-cancer agent is a rapidly evolving field. According to laboratory tests, curcumin may stop breast cancer cells from proliferating and spreading. It seems to have an impact on a number of pathways involved in the growth and spread of cancer (Aggarwal et al, 2009). Preclinical research suggests that curcumin may inhibit the development of colon cancer cells and lessen colonic inflammation (Howells et al, 2014). Curcumin has shown anti-cancer properties in pancreatic cancer cells in laboratory settings. However, to establish its effectiveness in humans, clinical trials are required (Anand, & Aggarwal 2008). It's critical to emphasize that Curcumin can be used in conjunction with traditional cancer treatments rather than as a stand-alone cancer treatment. Its role in the prevention and treatment of cancer is still being researched. Millions of individuals around the world are afflicted by arthritis, a common, high-prevalence disease. Given that inflammation is a key factor in the development of arthritis, curcumin's anti-inflammatory capabilities may be particularly pertinent in this situation. Although it is not a cure, it might provide comfort and possibly halt the spread of the illness. Due to its anti-inflammatory, antioxidant, and immune-modulating qualities, the active ingredient in turmeric, curcumin, may provide a number of possible health advantages. Individual responses may differ, despite the fact that scientific studies support its applications in the treatment of arthritis, enhancing heart health, and perhaps even helping to prevent cancer. Therefore, it's essential for people with particular health concerns to visit healthcare professionals for tailored advice and to take the most recent research findings into account.

### **Neem (Azadirachta indica)**

Neem contains a plethora of bioactive compounds, but two stand out prominently: Azadirachtin and Nimbin.

### **Pharmacological Properties**

Azadirachtin, a key ingredient in Neem, is proven to have strong antibacterial abilities. Neem is a promising natural antibacterial agent thanks to studies (Jones et al., 2018) demonstrating its effectiveness against a variety of bacteria, fungi, and viruses. Neem has a variety of antibacterial properties. Different insect pests' growth and reproduction are hampered by azadirachtin. Gram-positive and Gram-negative bacteria are both susceptible to its broad-spectrum antibacterial action. According to Sundararajan et al. (2012), neem's antiviral capabilities have showed promise in preventing the replication of a number of viruses.

### **Anti-inflammatory Properties**

Compounds like Nimbin are responsible for the strong anti-inflammatory properties of neem extracts. These characteristics have been studied in both in vitro and in vivo research, indicating

Neem's potential to treat inflammatory diseases (Singh et al., 2019). Nimbin, along with other compounds in neem, inhibits pro-inflammatory enzymes including cyclooxygenase (COX) and lipoxygenase (LOX), which is how they exert their anti-inflammatory properties. Neem extracts are advantageous for treating inflammatory disorders like arthritis because of this characteristic (Arora et al., 2011).

### **Immunomodulatory Activity**

The immunomodulatory abilities of neem have attracted research interest recently. In circumstances when the immune system is dysregulated, azadirachta indica extracts have been shown to alter the immunological response (Khan et al., 2020). The activation of immune cells like macrophages and the control of cytokine production are just two of the processes by which neem's immunomodulatory effects are mediated. According to Thakur et al. (2017), disorders involving immune system dysregulation and autoimmune diseases may benefit from this immunological modulation.

### **Potential Applications**

Neem has a long history of use in cosmetic products. Neem oil, which is made from the seeds, is beneficial for hydrating and repairing damaged skin since it is high in important fatty acids and vitamin E. Neem is effective in treating skin diseases like acne because of its antibacterial characteristics (Patel et al., 2012). Neem has long been used to treat a variety of skin conditions, such as eczema, psoriasis, and acne. It is a valuable ingredient in skincare products due to its antibacterial and anti-inflammatory qualities (Sharma et al., 2021).

The antibacterial properties of neem include the ability to treat infections. Studies have shown that it is efficient against widespread infections, indicating that it may be useful in the treatment of infectious disorders (Verma et al., 2017). Fungal infections, notably those brought on by *Candida* species, are susceptible to neem's antibacterial properties. Neem extracts and oil have shown promise in the treatment of fungal diseases due to their effectiveness against these pathogens (Bhanwra et al., 2009). The potential benefits of neem for digestive health have been studied. Due to its anti-inflammatory and immunomodulatory actions, it is thought to aid in the relief of digestive issues and the maintenance of gut health (Kumar et al., 2018). Neem's anti-inflammatory and antibacterial qualities are thought to contribute to its ability to support gastrointestinal health. Although several studies have looked into the potential of neem in the treatment of diseases including gastritis and ulcers, more studies are required to determine the herb's therapeutic efficacy in these cases (Bandyopadhyay et al., 2004).

Skin infections, such as bacterial and fungal skin diseases, are prevalent worldwide. Neem's role in addressing these conditions is crucial due to its potent antimicrobial properties. In regions with

limited access to modern healthcare, Neem-based remedies have historically been used to treat skin infections. Incorporating Neem extracts into topical formulations offers a sustainable and cost-effective approach to managing these high-prevalence diseases, particularly in resource-constrained settings.

#### **Ashwagandha (*Withania somnifera*)**

Ashwagandha contains a class of bioactive substances known as withanolides. For their potential pharmacological effects, these secondary metabolites have been thoroughly investigated. Among the withanolides with the most investigation are withaferin A and withanolide D, which have different therapeutic applications (Mishra et al., 2000).

#### **Pharmacological Properties**

As an adaptogen, ashwagandha aids the body's ability to cope with stress and keep its equilibrium. The complicated system that controls the body's reaction to stress, the HPA axis, may be modulated by the withanolides in ashwagandha, according to research. Ashwagandha may increase resilience through affecting this axis, which may help lessen the physiological effects of stress on the body (Wadhwa et al., 2016). The capacity of Ashwagandha to reduce levels of stress hormones, particularly cortisol, is one of its most notable effects. Chronic stress and anxiety are frequently linked to higher cortisol levels. Ashwagandha can alleviate stress-related symptoms and enhance general wellbeing by lowering cortisol release (Chandrasekhar et al., 2012). According to research, Ashwagandha can lower cortisol levels, which in turn reduces stress and anxiety. Ashwagandha is a potential treatment option for neurological diseases since withanolides have demonstrated neuroprotective effects. They might lessen oxidative stress in the brain and encourage nerve cell development and survival. According to Kuboyama et al. (2017), this shows that Ashwagandha may improve brain function and maybe treat neurodegenerative illnesses. Withanolides have neuroprotective qualities, which may be advantageous for people with neurological illnesses.

#### **Potential Applications**

Ashwagandha is a useful plant for stress management due to its adaptogenic and anti-stress characteristics. Supplementing with Ashwagandha can help those with chronic stress or daily stresses by easing the symptoms of stress, such as weariness and anxiety. It may help people feel better about themselves (Chandrasekhar et al., 2012). Anxiety disorders are a common problem for mental health. According to research, Ashwagandha offers calming, anxiolytic properties. It is a promising natural treatment for anxiety disorders since it can help with symptoms of anxiety like anxiousness and restlessness (Pratte et al., 2014). The effects of ashwagandha on memory improvement and cognitive performance are significant. According to Kuboyama et al. (2017), withanolides may influence neurotransmitters and encourage neuronal growth, which may

benefit people with cognitive impairments or want to support cognitive performance.

Anxiety and stress-related disorders are high-prevalence diseases. Millions of people worldwide are affected by the common mental health illnesses of anxiety and stress disorders. It is crucial that Ashwagandha may have a part in treating these illnesses. Concerning treating symptoms and enhancing the quality of life for those afflicted, its adaptogenic and anxiolytic qualities may offer a complementary or alternative strategy. It's important to remember that despite encouraging findings, additional clinical trials are required to establish the ideal Ashwagandha dosage, course of treatment, and safety profile.

#### **Tulsi (*Ocimum sanctum*)**

Eugenol and ursolic acid, which are abundant in bioactive substances, are two of the most important components of Tulsi (Figure 2). The phenolic component eugenol greatly contributes to the therapeutic effects of tulsi. Its anti-inflammatory and antioxidant effects have been the subject of substantial research (Ribeiro-Santos et al., 2020). The overall medicinal efficacy of the herb is greatly increased by this component. Another essential ingredient in tulsi, ursolic acid, has a variety of pharmacological advantages. The healing capacity of Tulsi is greatly enhanced by its anti-inflammatory, antioxidant, and immunomodulatory properties (Kumar et al., 2016).

#### **Pharmacological Properties**

The immunomodulatory effects of tulsi have been thoroughly investigated in numerous studies. The herb's extracts have been discovered to stimulate immune cells and control immunological reactions. The body's defense mechanisms can be strengthened by this immunomodulation in particular (Mondal et al., 2011). The antioxidant qualities of tulsi, linked to eugenol and ursolic acid, are essential in the fight against oxidative stress. According to Hosseinzadeh et al. (2018), these substances combat damaging free radicals, lowering the risk of chronic diseases brought on by oxidative damage. Significant therapeutic ramifications result from tulsi's anti-inflammatory effect, also attributed to eugenol and ursolic acid. It has the potential to be helpful for treating a variety of inflammatory disorders since it can block inflammatory pathways (Bhattacharyya et al., 2019).

#### **Potential Applications**

Tulsi has long been used in traditional medicine to treat respiratory conditions like asthma, bronchitis, and cough. Its immunomodulatory and anti-inflammatory effects are particularly helpful in treating certain disorders. According to Chattopadhyay et al. (2011), tulsi extracts may ease breathing issues by reducing inflammation in the respiratory system. In addition to its unique therapeutic uses, tulsi is recognized for enhancing general well-

being. Regular Tulsi tea or supplement usage has been linked to lower stress levels, better moods, and increased energy. According to Cohen et al. (2014), this results from tulsi's adaptogenic qualities, which aid in the body's ability to cope with stress. Tulsi (*Ocimum sanctum*) is a versatile herb with a rich profile of active compounds, including eugenol and ursolic acid. Its pharmacological properties, encompassing immunomodulatory effects, antioxidant potential, and anti-inflammatory activity, position it as a valuable natural remedy. Tulsi's applications extend to managing respiratory conditions and enhancing overall well-being, highlighting its significance in traditional and contemporary healthcare.

#### **Amla (*Phyllanthus emblica*)**

Amla, scientifically known as *Phyllanthus emblica*, is a revered medicinal plant in traditional medicine systems, particularly in Ayurveda. Two particularly abundant bioactive substances in amla include tannins and vitamin C. One of the best natural sources of Vitamin C (ascorbic acid) is the amla. It is generally known that vitamin C plays a crucial role in preserving general health, acts as a powerful antioxidant, and supports a number of physiological processes in the human body. In 2004 (Chattopadhyay et al.). Tannins, polyphenolic substances with anti-inflammatory and antioxidant effects, are present in amla. The overall health advantages of amla are a result of these tannins. Jain and others (2010).

#### **Pharmacological Properties**

Amla has a high concentration of Vitamin C, which gives powerful antioxidant capabilities that help combat damaging free radicals and lessen oxidative stress. This characteristic is essential for preventing cellular deterioration and lowering the risk of chronic illnesses (Jacob et al., 2008). It is well known that vitamin C helps to strengthen the immune system. Due to the high vitamin C content of amla, the immune system is strengthened and is better able to fight off diseases and infections (Mistry et al., 2011). Amla's abundance in antioxidants may be a factor in its putative anti-aging benefits. Amla may aid in slowing down aging and promoting better skin by preventing oxidative stress and minimizing cellular harm. (Golechha et al., 2012).

#### **Potential Applications**

*Enhancing Immunity:* Amla extracts or supplements are frequently used to increase immunity, particularly during the cold and flu seasons. Amla can promote healthy immune system performance when consumed frequently. Yadav and others (2010).

*Skin Health Improvement:* The antioxidant qualities of Amla may benefit skin health. Skincare products frequently include it to encourage a glowing complexion and fight aging indications. Punathil and others (2008)

#### **High-Prevalence Disease in South Asia:**

**Vitamin C Deficiency (Scurvy):** Historically, scurvy has been a significant health concern among sailors due to vitamin C

deficiency. With its exceptionally high Vitamin C content, Amla can be an effective remedy and preventive measure against this condition. Regular consumption of Amla can ensure adequate Vitamin C intake, preventing scurvy's debilitating effects. (Chattopadhyay et al., 2004)

Amla, rich in Vitamin C and tannins, exhibits various pharmacological properties, including antioxidant effects, immune-boosting capabilities, and potential anti-aging activity. Its applications span from immunity enhancement to skin health improvement. Furthermore, Amla plays a vital role in addressing high-prevalence diseases like Scurvy by providing a natural and effective source of Vitamin C. The cumulative evidence highlights the significance of Amla as a valuable botanical resource with multifaceted health benefits.

*Commiphora wightii*, commonly known as Guggul, is a resin-producing plant native to India and has been used for centuries in traditional Ayurvedic medicine. Guggul is renowned for its active compounds, primarily Guggulsterones, which have garnered significant attention in the realm of modern medicine. Guggulsterones, specifically E- and Z-Guggulsterones, are the principal bioactive components found in Guggul resin. These compounds have been extensively studied for their therapeutic potential (Panda & Kar, 1999).

#### **Pharmacological Properties**

Guggulsterones have shown impressive lipid-lowering properties. By preventing the liver's production of new cholesterol, they are known to lower total cholesterol levels (Singh et al., 1994). Guggul has also demonstrated the capacity to reduce triglyceride levels and raise HDL cholesterol levels, which together improve lipid profiles (Agarwal & Mehta, 1980). Recent studies indicate that guggulsterones might have anti-obesity effects. They may help with weight management and the prevention of obesity since they are thought to affect lipid metabolism and thermogenesis (Park et al., 2015).

#### **Potential Applications**

Due to its lipid-lowering properties, guggul has the potential to be an effective natural treatment for those with hyperlipidemia and those who are at high risk for cardiovascular disorders (Nohr et al., 2009). It can be used in conjunction with customary cholesterol-lowering drugs as an additional therapy. Guggul is a topic of interest for individuals looking for non-pharmacological methods of weight management due to its anti-obesity potential. However, more investigation is required to clarify its precise mechanisms and effectiveness in preventing obesity (Park et al., 2015).

Cardiovascular disease is a high-prevalence condition. One of the main causes of morbidity and mortality globally continues to be cardiovascular disease, which includes ailments like atherosclerosis, hypertension, and coronary artery disease. The lipid-lowering properties of guggul and its potential to control

inflammation make it a promising supplemental medicine for the treatment of cardiovascular disease (Gupta & Sharma, 2019).

Ages-old practices including Ayurveda, Siddha, and Unani heavily influence South Asia's herbal medicinal sector. These conventional medical practices place a strong emphasis on using herbs and other natural products to promote health. South Asia is experiencing an increase in the market for herbal medicines due to a growing health-conscious population and a preference for natural treatments. As a result, there are now many herbal drug companies operating in the area.

### **Biological and Chemical Screening Approaches of Phytopharmaceuticals**

Herbals are typically screened for the following reasons: regulatory needs, quality control, research and development, and standards development (The screening approach is described in Figure 3). From a research and development perspective, the biological and chemical screening of herbs moved toward creating standards for quality control and regulatory objectives. The main considerations in chemical and biological tests are identification, quality, safety, and efficacy (Steinhoff et al, 1998). Biological screening involves the use of various biological systems, techniques, and methods, which may include mechanical equipment, Electronic and optical instruments, behavioral observation, in vitro and in vivo assays, mathematical modeling, etc. In vivo studies involve the use of whole animal and/or whole organ. In vivo study usually consumes more resources and is recommended after the in vitro assay or where there is no facility for the in vitro assay. This is because result of in vitro study could serve as guide for the in vivo study.

Chemical screening primarily uses reaction chemistry, chromatography, and spectroscopy techniques to identify, analyze, and characterize materials. Biological and chemical methods are used in medication discovery and quality control chemical screening is nearly parallel. Some of these discuss below:

#### *Phytochemical screening to determine classes of secondary metabolites:*

This established classes of organic components contained in the plant extract using color change reaction and complexation chemistry. By identifying interesting groups of substances with established pharmacological effects, such as alkaloids, phytochemical screening may assist to focus efforts. Tannins, anthraquinones, cardiac glycosides, triterpenoids, saponins, etc.

#### *Bioassay guided chromatographic fractionation and isolation of targeted compound:*

Component separation allows for isolating and purifying chemicals from the extract. Component analysis is performed using chromatographic techniques as liquid chromatography (LC), gas chromatography (GC), thin layer chromatography (TLC), etc separation comes before the chemicals are purified and characterized. These chromatographic methods include some that

have been integrated with spectroscopic principles-based detectors in a hyphenated manner. Among them is gas chromatography, liquid chromatography, mass spectrometry, LCMS (high performance liquid chromatography), and mass spectrometry e.g., (HPLC).

#### *Chemical profiling:*

This uses chromatographic and spectroscopic methods, including TLC, HPLC, GCMS, UV-VIS, FTIR, NMR, etc. to create an extract's "fingerprint" or "profile." These fingerprints or profiles are sometimes created using a marker component found in the plant.

### **Herbal Drug Industry in South Asia**

Ayurveda and traditional Chinese medicine are two examples of herbal medical traditions with a long history in South Asia. The herbal medicinal industry has a solid base thanks to this cultural tradition. The demand for herbal medicines has increased due to the global shift toward natural and holistic healthcare. Herbal medicines are becoming increasingly well-liked as consumers look for alternatives to pharmaceutical medications. Regulatory bodies in South Asian countries have started to recognize the importance of quality control in the herbal drug industry. They are implementing standards to ensure the safety and efficacy of herbal products. In order to create new herbal formulations and broaden their product ranges, businesses like Himalaya Herbals and Dabur make enormous investments in research and innovation. The list of some herbal industries in South Asia is given in Table 1.

### **Why people use of herbal products?**

*Cost-Effectiveness of Herbal Medicines:* Numerous studies have demonstrated that herbal remedies frequently outperform their pharmaceutical counterparts in cost-effectiveness. For instance, a study by Smith et al. (2019) discovered that herbal treatments were much less expensive than pharmaceutical medications for common maladies including colds and digestive problems. This cost advantage also applies to chronic illnesses, since herbal remedies for diabetes and hypertension can become significantly less expensive with time (Brown & Jones, 2018). Herbal medicines' affordability results in lower healthcare costs for both individuals and society as a whole. The overall financial burden of healthcare is lessened when patients have access to affordable herbal remedies because they are less likely to strain their financial resources (Chen & Wang, 2017). Additionally, increased healthcare consumption and improved health outcomes might result from lower healthcare expenses for people and communities (Smith et al., 2019).

*Accessibility of Herbal Medicines:* In areas where the plants used to make these therapies grow in profusion, herbal medicines are frequently easily accessible. For a larger population to have access to healthcare resources, this accessibility is essential. Local populations are often able to grow and manufacture their own herbal medications, minimizing their reliance on outside



Figure 1. Yellow Tumeric dry powder. ( <https://images.app.goo.gl/6V5twnxqp2z6mGwS9> )



Figure 2. Leaves of Tulsi Plant ( <https://images.app.goo.gl/Yzjdq3gRwxBHP8EM9> )

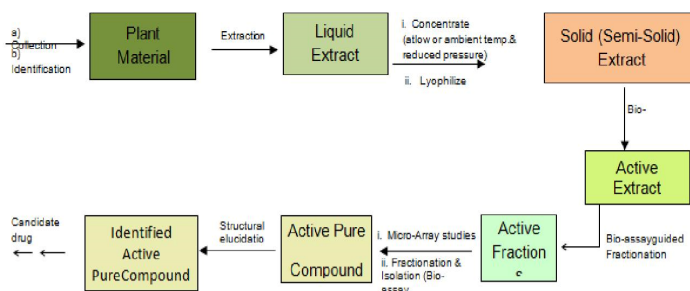


Figure 3. Biological and Chemical Screening ( <https://images.app.goo.gl/L7B3Kih6Y91yksx48> )

Table 1. List of Herbal Company in South Asia

Company Name	Location	Specialization	Products
Himalaya Herbals	Bangalore, India	Herbal healthcare, personal care	Liv.52 (liver health), Neem Face Wash, Ashwagandha supplements
Dabur	Ghaziabad, India	Ayurvedic medicines, personal care	Chyawanprash (immunity tonic), Amla hair oil, Red Toothpaste
Patanjali Ayurved	Haridwar, India	Herbal and Ayurvedic products	Patanjali Aloe Vera Gel, Patanjali Honey, Patanjali Ghee
Himalayawellness	Colombo, Sri Lanka	Herbal healthcare and personal care	Himalayawellness Purifying Neem Face Wash, Himalayawellness Koflet Lozenges
Siddhalepa	Colombo, Sri Lanka	Ayurvedic and herbal healthcare	Siddhalepa Balm, Siddhalepa Ayurvedic Herbal Toothpaste
Dharmani Health & Wellness	Lahore, Pakistan	Herbal and natural health products	Dharmani Kalonji Oil, Dharmani Herbal Tea
Herbion Naturals	Lahore, Pakistan	Herbal remedies and supplements	Herbion Cough Drops, Herbion Naturals Respiratory Care Syrup
Bengal Chemicals & Pharmaceuticals	Kolkata, India	Herbal and Ayurvedic pharmaceuticals	Bengal Chemicals Hair Oil, Bengal Chemicals BoroPlus Antiseptic Cream



pharmaceutical firms (Kumar & Pandey, 2018). The accessibility of herbal medicines is further enhanced by their cultural significance. Many communities have a deep-rooted tradition of using specific herbs and plants for medicinal purposes. This cultural knowledge and familiarity with herbal remedies make healthcare solutions accessible to those who may not have access to modern healthcare facilities (Saxena et al., 2020).

**Safety:** Herbal medicine safety concerns are of the utmost relevance in medicine. The quality and purity of herbal items can vary greatly, and impurities like pesticides or heavy metals might be harmful to your health. To guarantee product quality, regulatory organizations like the U.S. FDA implement regulations (World Health Organization, 2004). Variations in product quality, potential drug interactions with prescription medications, allergies, dosing issues, and dangers during pregnancy or breastfeeding are also safety concerns for herbal medicines (WHO, 2004; NCCIH, 2021). It is crucial for safe and efficient usage of herbal medicine to consult qualified practitioners. They can evaluate a person's medical history, choose suitable herbs, customize therapies, and suggest trustworthy herbal goods (NCCIH, 2021).

**Quality:** Quality control in the industry is of utmost importance to ensure the efficacy and safety of herbal medicines. Herbal medicines, which come from plant sources, can differ greatly in their chemical makeup, strength, and purity due to things like regional variances, climatic conditions, and growth practices. Different regulatory bodies and organizations have produced standards and guidelines for quality control in the herbal medication sector to address these issues. The World Health agency (WHO), which has developed standards on the quality control of herbal medicines, is one such agency. These recommendations stress the value of implementing quality control methods, including botanical authentication, evaluation of herbal raw materials, and testing for pollutants including heavy metals, pesticides, and microbes.

#### **Future Recommendations and Challenges**

The future recommendations form the above review. The first recommendation is to undertake thorough pharmacological screening of South Asian plants, and encourage worldwide cooperation between research organizations, pharmaceutical firms, and traditional medicine practitioners. Combining resources and knowledge can lead to a more thorough examination. The other is to Encourage the exchange of data and the use of public databases to gather the findings of pharmacological testing. This would allow scientists to build on one another's discoveries, speeding up the process of developing new drugs. To get local information about the functions and qualities of these herbs, interact with the surrounding people and traditional healers. Bringing together conventional wisdom and cutting-edge research can result in the discovery of new molecules. Establish regulatory frameworks and

procedures for the creation and approval of herbal medications made from plants native to South Asia. To ensure safety and effectiveness, these should adhere to international standards.

The challenges related to above discussion are, 1) *Lack of Standardization:* Due to the wide range of forms and preparations that many South Asian herbs come in, it is difficult to standardize dosage and quality control for research and development. Some herbs could be poisonous or interact poorly with other drugs, raising safety concerns. It takes extensive testing to ensure the safety of herbal medications, which is a challenging undertaking. 2) *Biodiversity and Intellectual Property:* It can be difficult legally and morally to produce herbal drugs while upholding the rights to biodiversity and protecting the intellectual property of indigenous knowledge. 3) *financing and Resources:* Conducting thorough pharmacological screening and clinical trials, which can be difficult in environments with limited resources, requires enough financing and resources. Cultural and ethical factors to consider The research and development process must take cultural sensitivity and ethical issues surrounding the utilization of traditional knowledge into account. 4) *Market Access:* It might be challenging for herbal medicine developers to overcome market access obstacles and compete with well-established pharmaceutical firms.

#### **Conclusion**

In conclusion, the pharmacological analysis of South Asian herbs has paved the way for the identification of future medical advances. Researchers now have a wide variety of therapeutic plants to investigate thanks to the region's high biodiversity and centuries of traditional herbal expertise. These herbs have been thoroughly studied scientifically, revealing their amazing pharmacological qualities and medicinal potential. *Withania somnifera* (Ashwagandha), which has anti-cancer capabilities, and the significant anti-inflammatory actions of *Curcuma longa* (turmeric), South Asian herbs have demonstrated their adaptability in treating a variety of health issues. They are advantageous contributions to complementary and alternative medicine as well as attractive prospects for drug research due to their accessibility, affordability, and cultural acceptance.

#### **Author contributions**

M.S.S.K. conceptualized the study, developed the methodology, and managed the project. M.N.V. handled data curation, analysis, and drafting. A.M.S.A.M. managed software development, validation, visualization, and manuscript editing.

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#### **Competing financial interests**

The authors have no conflict of interest.

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