



EDIBLE HERBS AS NATURAL IMMUNOMODULATORS -A REVIEW

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ABSTRACT

For centuries, people have used herbal medicines to treat different health issues. Many plants contain important compounds, like alkaloids and polyphenols, which have medicinal properties. These compounds have been shown to help boost the immune system. Clinical studies have demonstrated that these bioactive compounds can act as immunomodulators. Several Indian plants which are believed to enhance immune function through both specific and non-specific mechanisms. In India, several plants are believed to improve immunity in different ways. Some well-known examples include *Allium sativum* (Garlic), *Cinnamomum tamala* (Bay Leaf), *Coriandrum sativum* (Coriander), *Cuminum cyminum* (Cumin), *Curcuma longa* (Turmeric), *Elettaria cardamomum* (Cardamom), *Mangifera indica* (Mango), *Murraya koenigii* (Curry Leaves), *Piper longum* (Long Pepper), *Piper nigrum* (Black Pepper), *Syzygium aromaticum* (Clove), *Trachyspermum ammi* (Carom Seeds), *Trigonella foenum-graecum* (Fenugreek), and *Zingiber officinale* (Ginger).

This review highlights on Edible herbs such as *Mentha spicata* (Pudina), *Ocimum sanctum* (Tulsi) and *Moringa Oleifera* (Moringa) are also recognized for their immune-boosting effects. While many of these plants are commonly used in traditional medicine, many others have yet to be fully explored for their immunological potential. There are still many others that haven't been fully studied for their potential to support immunity. More research is needed to understand how these plants work and how they could be used to create new, affordable, and safer immune-boosting treatments.

Keywords: Immunomodulators, Immune system, Edible herbs, Herbal medicine, Herbs

INTRODUCTION

Plants and minerals have been used for centuries to treat various ailments, and today, there is growing recognition that immunomodulation—modifying the immune response—could offer an alternative to conventional chemotherapy for a variety of diseases. This is particularly relevant when the immune system needs to be activated in cases of impaired immune function, or when a selective immunosuppressant is needed, such as in autoimmune diseases or organ transplantation. Immunity is a homeostatic process, a series of delicately balanced complex, multicellular and physiologic mechanisms that allow an individual to distinguish foreign material from “self” and neutralize and/or eliminate the foreign matter [1].

World Health Organization (WHO) reports that approximately three-quarters of the global population depends on traditional remedies, particularly herbs, for healthcare. Herbs and plants have been mankind's oldest companions, offering not only food and shelter but also serving as treatments for various ailments. Herbal medicine, often referred to as traditional or natural medicine, plays a significant role in healthcare across cultures. Ayurveda, one of the oldest systems of medicine, emphasizes the use of plant-based medicines and therapies. This system incorporates a wide range of

ethnopharmacological activities, including immunostimulation, tonics, neurostimulation, anti-aging, antibacterial, antiviral, antirheumatic, anticancer, and adaptogenic effects, among others [2].

An immunomodulators may be defined as a substance, biological or synthetic, which can stimulate, suppress or modulate any of the components of the immune system including both innate and adaptive arms of the immune response. The essence of immunomodulation is that a pharmacological agent acting under various dose and time regimens displays an immunomodulating effect [3, 4].

Immune system

The immune system is multi-layered, with defense on numerous levels. The most primary is the skin, which is the first barrier to infection. Another one is a physiological condition such as pH and temperature provide living conditions for foreign organisms. Once pathogens enter the body, they deal with the innate immune and acquired or adaptive immune system. Both systems are composed of a mess of cells and molecules that interact in a complex manner to detect and eliminate pathogens. Both detection and elimination of pathogen depend upon chemical bonding: surfaces of immune system cells are engulfed with various receptors, some of them chemically bound with pathogens and some of which

bind to other immune system cells or molecules to delegate the complex system of signalling that mediates the immune response

Types of Immune System

There are two types of immune responses namely innate immune system response and Adaptive immune system response

- **The Innate immune** response is a non-specific and very rapid to a foreign body (antigen) as this response operates during the early phase it is referred to as 1st line of Defence.

- **The Adaptive immune** response is a surveillance mechanism of all vertebrates and highly specific but has a slow response towards the antigen. The key difference between the two immune responses that the adaptive immune system has immunological memory and they are further classified into cell-mediated and humoral immunity [5].

Immunomodulation

Many infectious diseases and disorders arise because of stressful environmental conditions associated with suppression of immune system. Certain types of stress evoke physiological changes that influence susceptibility to infection and malignance. The ability to modify the immune response in animals and humans evolved from a desire to confer greater protection against infectious agents through a more complete understanding of the functioning of the immune system. Naturally occurring or

synthetic compounds capable of altering those mechanisms offered further possibilities for modulating immune responses. Clinically, immunomodulators have three categories:

Immunostimulants are inherently non-specific and enhances body 's resistance to infection. They can act through innate as well as adaptive immune responses. In healthy individuals, the immunostimulants are expected to serve as prophylactic and promoter agents, i.e., as immunopotentiators, by enhancing the basic level of immune response. In individual with impaired immune response, they are expected to act as immunotherapeutic agents.

Immunosuppressants are the drugs, which suppress both cells mediated and humoral immune response and are often used in combination regimens to treat various types of organ transplantation and autoimmune diseases.

Immunoadjuvants are used to enhance the efficacy of vaccines and so are considered as specific immune stimulants [6].

Methods for Testing Immunological Factors

The routine process for screening is to extract single ingredient or single distilled fraction from herbal drugs, determine its bioactivity by the classic pharmacological means. The whole animal model is the most classic pharmacological screening model,

which is very important at the aspect of medicine evaluation because it can apparently respond to the efficacy, side effect and toxicity of medicines in whole. Several in vitro, in vivo methods of pharmacological screening of medicinal plants having immunomodulatory activity have been listed [7].

In vitro methods:

- Inhibition of histamine release from mast cells
- Mitogen induced lymphocyte proliferation
- Inhibition of T cell proliferation
- Chemiluminescence in macrophages
- PFC (plaque forming colony) test in vitro
- Inhibition of dihydro-orotate dehydrogenase

In vivo methods:

- Spontaneous autoimmune diseases in animals
- Acute systemic anaphylaxis in rats
- Anti-anaphylactic activity (Schultz-Dale reaction)
- Passive cutaneous anaphylaxis
- Arthus type immediate hypersensitivity
- Delayed type hypersensitivity

- Reversed passive arthus reaction
- Adjuvant arthritis in rats
- Collagen type II induced arthritis in rats
- Proteoglycans - induced progressive
- Polyarthritic in mice
- Experimental autoimmune thyroiditis
- Prevention of experimentally induced myasthenia gravis in rats
- Glomerulonephritis induced by anti basement membrane antibody in rats
- Auto-immune uveitis in rats
- Inhibition of allogenic transplant rejection [8].

HERBS AS IMMUNOMODULATORS- *MENTHA SPICATA* (MINT)-

Common Names: Spearmint, Green Mint, Garden Mint, Pudina

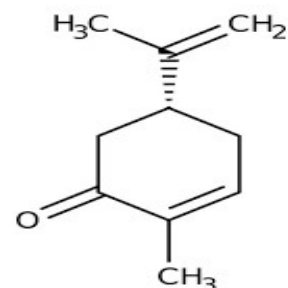
Scientific Name: *Mentha spicata*

Family: Lamiaecae (Mint family)

Geographical Source: Native to Europe and Asia but widely cultivated in temperate regions around the world.

Parts used: Leaves and stems are primarily used.

Chemical Constituents: Carvone, Limonene, Menthol, Eugenol, Rosmarinic acid.



Carvone

Figure 1: *Mentha spicata*

Mentha spicata is also known as spearmint. There are a couple of heterotypic synonyms for this species including *Mentha cordifolia*, *Mentha crispa* var. *crispata* f. *reticulata*, *Mentha viridis* (L.) L., *Mentha* × *cordifolia*, and *Mentha* × *villosa* var. *cordifolia*. It is an aromatic plant that belongs to the genus *Mentha*, family Lamiaceae. Mint grows widely in many environments, especially in wet, moist soil, and can even thrive in sunny, hot conditions [9].

Therapeutic Uses-

Mint is a leafy plant primarily recognized for its ability to freshen breath by creating a cool sensation in the mouth. It is commonly used in products like toothpaste, mouthwash, breath mints, and chewing gum. Beyond its breath-freshening properties, mint is also a popular flavoring for various foods and beverages, such as mint chocolate chip ice cream, mojitos, and lamb dishes [10].

Essential oils have been used for centuries and are widely utilized in industries like food, beverages, confectionery, and

cosmetics. In terms of medicinal uses, spearmint is valued in traditional remedies for treating conditions like colds, flu, respiratory issues, stomach pain, hemorrhoids, and general stomach discomfort. Spearmint is often extracted into oil for medicinal purposes. According to Bensabah *et al.*, spearmint leaves are commonly brewed into tea, which helps treat digestive issues, fever, and minor ailments due to its carminative properties. Additionally, spearmint is widely used to alleviate symptoms of nausea, vomiting, and other gastrointestinal disorders [11].

M. spicata (spearmint) was found to be quite effective in inhibiting TNF- (Tumor Necrosis Factor-alpha). Among the common monoterpenes found in mint essential oils, menthol was shown to have an effect similar to that of the essential oils in this study on TNF- inhibition, whereas menthofurane had no noticeable effect. Cheng *et al.* (2008) previously reported that menthone could suppress IL-1 and TNF- and was present in

M. piperita (peppermint) oil at about 4%, but was absent in the *M. spicata* oil analysed in this study (Orhan *et al.*, 2011). Therefore, menthol and menthofurane might contribute to the strong TNF- suppressing effect of *M. piperita* oil, while carvone, the main monoterpene found in *M. spicata* oil (75.07%), could be responsible for its strong TNF- inhibitory effect, as it has been reported to significantly reduce TNF- production [12].

OCIMUM SANCTUM (TULSI) -

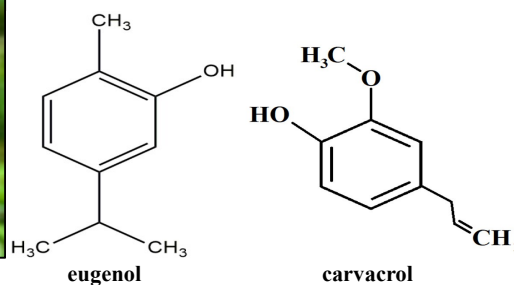


Figure 2: *Ocimum sanctum*

Therapeutic Uses:

Tulsi is a revered herb in Ayurveda, often called the "Elixir of Life" due to its wide-ranging healing benefits. It is traditionally used to treat a variety of health conditions, including:

- **Respiratory Issues:** Bronchitis, asthma, dyspnea (difficulty breathing), and coughs.
- **Pain & Inflammation:** Rheumatism, neuralgia, headaches, and skin inflammation.

- **Common Names:** Holy Basil, Tulsi, *Ocimum tenuiflorum*
- **Scientific Name:** *Ocimum sanctum*
- **Family:** Lamiaceae
- **Geographical Source:** Native to India and Southeast Asia
- **Parts used:** Entire plant
- **Chemical Constituents:** Contains compounds like oleanolic acid, ursolic acid, rosmarinic acid, eugenol, carvacrol, linalool, and beta-caryophyllene, with eugenol and carvacrol being prominent.

- **Digestive & Liver Health:** Used to treat gastric and hepatic disorders.
- **Infections & Diseases:** Tulsi is used for treating parasitic infections, malaria, and wounds.
- **Ear & Oral Care:** The juice of its leaves is applied to treat earaches, and the infusion is used to address oral conditions.
- **Other Uses:** Its roots and stems are traditionally used for treating mosquito and snake bites.

The various active compounds found in Tulsi, such as eugenol and carvacrol, contribute to its wide array of therapeutic properties, making it a key herb in traditional medicine for maintaining overall health and treating specific ailments [13].

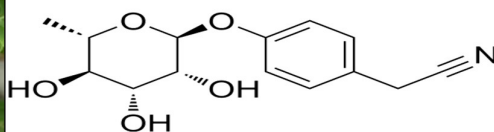
The plant is herbaceous perennial from the Lamiaecae family, growing 60-90 cm tall with a short stem and large, oblong leaves that can reach up to one meter in length. Its flowers are yellow-white, sterile, and do not produce viable seeds. In traditional Indian medicine, the fresh fruits and leaves are used to treat various health conditions. It is considered one of the holiest and most sacred herbs in India, worshipped by Hindus. The plant is known for its numerous health benefits, including antiseptic, analgesic, anti-inflammatory, antimicrobial, antistress, immunomodulatory, hypoglycemic, hypotensive, and antioxidant properties [14]. Godhwani and colleagues have highlighted the immunostimulant properties of both the 50% methanol extract and aqueous suspensions of *Ocimum sanctum* (Tulsi).

Their research found that both the methanol extract and the aqueous suspension of *O. sanctum* leaves could enhance the humoral immune response to SRBC (sheep red blood cells) and typhoid 'H' antigens. Additionally, these extracts were shown to increase the count of E-rosetting lymphocytes, which are important for immune function [15].

MORINGA OLEIFERA (DRUMSTICK)-

- **Common Names:** horseradish tree, drumstick
- **Scientific Name:** *Moringa Oleifera*
- **Family:** Moringaceae
- **Part Used:** leaves of the plant or whole plant
- **Geographical Source:** different parts of south Asia and Africa
- **Chemical Constituents:**

Moringa Oleifera leaves extract is rich in saponins and compounds like Niaziminin A, Niazirin, Quercetin-3-glucoside, Chlorogenic acid and Kaempferol.



Niazirin

Figure 3: *Moringa Oleifera*

Therapeutic uses-

Traditionally, the plant has been used to treat a wide variety of disorders. It is reported to have a broad range of pharmacological effects, including antifertility, antitumor, antipyretic, antiepileptic, antispasmodic, anti-inflammatory, diuretic, antiulcer, hypotensive, hypolipidemic, hypoglycemic, hepatoprotective, antifungal, and antibacterial properties [16].

Consuming the leaf extract of *Moringa Oleifera* has been shown to increase haemoglobin levels in pregnant women and help maintain ferritin serum levels, which could rise by up to 50%. Additionally, the aqueous extract of *M. oleifera* has demonstrated anxiolytic (anxiety-reducing) and antiepileptic effects, likely through GABA mimetic action, making it useful in treating epilepsy and anxiety. The moringa leaf extract also exhibited antioxidant properties, as well as the ability to suppress monoamine oxidase type B (MAO-B) and PDE-5 activity in rats. As a result, it could serve as a cost-effective alternative to traditional protein sources, offering no harmful effects on performance or blood parameters, and could be used as a food supplement to enhance growth performance [17].

The methanolic extract of *Moringa Oleifera* (MEMO) was evaluated for its immunomodulatory activity in experimental models of both cellular and humoral

immunity in animals. The extract showed the most significant effect at a low dose of 250 mg/kg (orally), while a higher dose of 750 mg/kg (orally) was found to have a moderate effect on modulating the immune system. The study used six different methods, each designed to assess the extract's impact on various components of the immune system [16].

CONCLUSION:

Herbs and medicinal plants have long been appreciated for their therapeutic benefits, offering numerous health advantages with better cultural acceptance, compatibility with the human body, and fewer side effects compared to synthetic drugs. These herbs are known for their immunomodulatory effects, especially during infections, with some plant extracts providing non-specific immune responses. Many plant-based products are regularly consumed in diets, which help strengthen the immune system and maintain overall health. The use of natural plant-based immunomodulators, when formulated effectively, can make treatments more potent.

Many plant-derived compounds have been identified for their immunomodulatory effects, making them essential in treating various diseases. Medicinal plants are valuable for their bioactive compounds, or phytochemicals, which play a key role in their therapeutic actions. This review emphasizes that medicinal plants contain a

variety of bioactive substances capable of modulating immune responses, offering an alternative to conventional chemotherapy. Using medicinal herbs for immunomodulation presents a promising approach to treating numerous health conditions, with the added benefit of reducing the side effects and high costs associated with synthetic drugs. Herbs have demonstrated a broad range of immunomodulatory effects, showing significant potential for boosting immune function and addressing immune-related diseases. However, more clinical studies are needed to understand their mechanisms better and optimize their use in therapy. In the meantime, herbs can serve as valuable supplements to modern treatments, offering natural immune system support in various health situations. This review highlights the importance of medicinal herbs and natural remedies as a safer, more cost-effective alternative to traditional chemotherapy for a variety of diseases.

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