

Herbal Drugs as Natural Immunity Enhancers

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Abstract: In recent years, enhancement of immunity has gained significant importance in preventive healthcare due to increased susceptibility to infections, lifestyle disorders, and stress-related illnesses. Immunity is the body's natural defense mechanism that protects against pathogens and maintains physiological balance. However, factors such as poor nutrition, environmental pollution, chronic stress, sedentary lifestyle, and excessive use of synthetic drugs have contributed to weakened immune responses in the population. This has led to a growing demand for safe, natural, and holistic approaches to strengthen immune function. Herbal medicines have been used for centuries in traditional systems such as Ayurveda, Unani, and Siddha for health promotion and disease prevention. Medicinal plants contain a wide range of bioactive phytoconstituents including flavonoids, phenolics, alkaloids, glycosides, terpenoids, and essential oils, which exhibit antioxidant, anti-inflammatory, antimicrobial, and immunomodulatory activities. Compared to synthetic immune boosters, herbal medicines are considered safer, cost-effective, and suitable for long-term use with minimal adverse effects. The World Health Organization (WHO) also recognizes the role of herbal medicines in primary healthcare.

Herbal tea serves as an effective and convenient dosage form for delivering immune-enhancing herbs due to its ease of preparation, pleasant taste, and suitability for daily consumption. Herbal tea bags offer additional advantages such as uniform dosing, improved stability, hygiene, and consumer acceptability. The present study focuses on the formulation and evaluation of an immunity-boosting polyherbal tea bag using selected medicinal herbs such as Tulsi (*Ocimum sanctum*), Giloy (*Tinospora cordifolia*), Lemongrass (*Cymbopogon citratus*), Mint (*Mentha species*), Cardamom (*Elettaria cardamomum*), and Butterfly pea flower (*Clitoria ternatea*), which are well documented for their antioxidant and immune supportive properties.

The formulated herbal tea bag was evaluated for organoleptic characteristics, physicochemical parameters, powder properties, and qualitative phytochemical screening. The presence of active phytoconstituents supports the formulation's potential role in enhancing immune response through reduction of oxidative stress, modulation of immune cells, and antimicrobial action. Thus, the developed polyherbal tea bag represents a safe, natural, and effective functional beverage that can be incorporated into daily routine for immune support and overall health maintenance.

Index Terms: *Ocimum sanctum*, *Tinospora cordifolia*, *Clitoria ternatea*, *Cymbopogon citratus*, *Elettaria cardamomum* etc.

1. INTRODUCTION

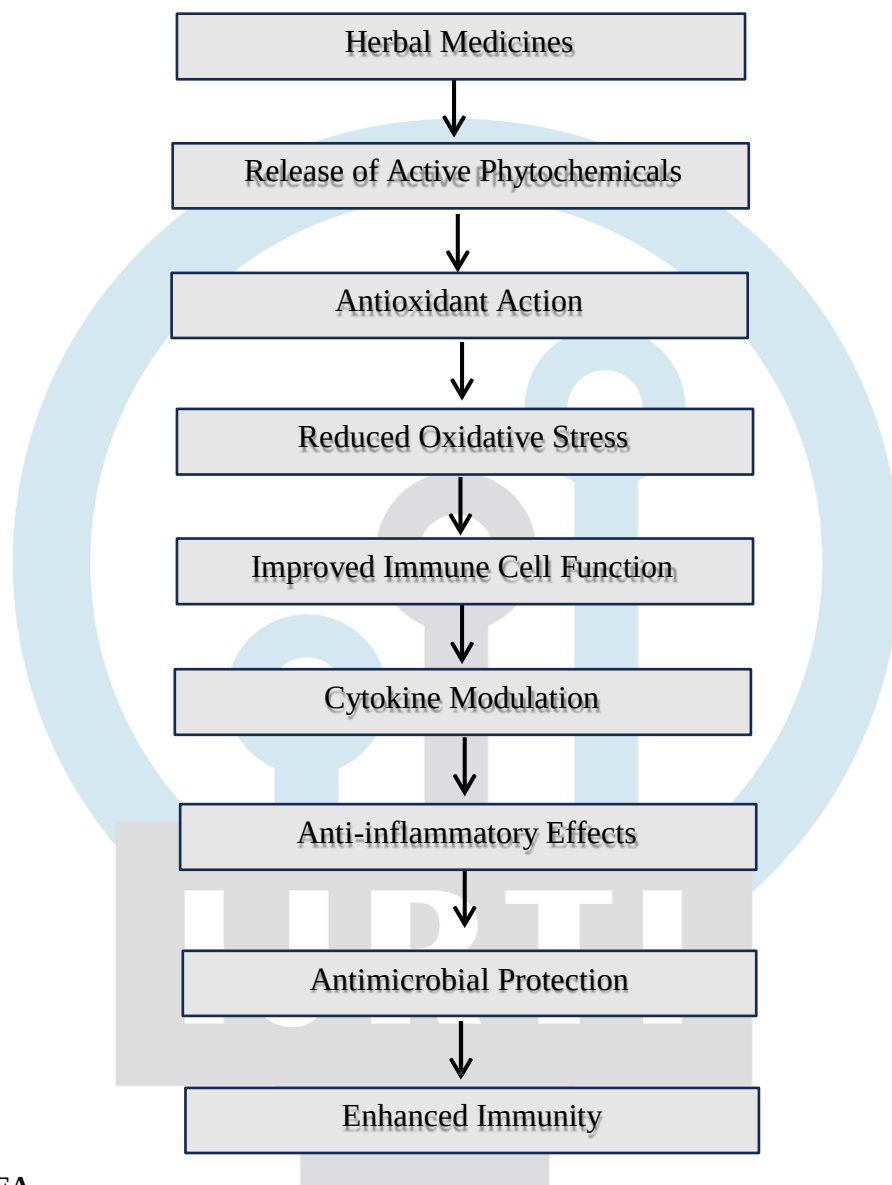
1.1 IMMUNITY

Immunity is the body's natural protective system that prevents the entry, growth and spread of disease-causing microorganisms. It is composed of two major types: innate immunity, which provides immediate, non-specific defence, and acquired immunity, which develops gradually through exposure to pathogens or through vaccination. A well-functioning immune system involves the coordinated action of immune cells, antibodies, cytokines, the lymphatic system and various biochemical pathways. Modern lifestyle factors such as increasing stress levels, irregular sleep patterns, processed food consumption, environmental pollution and sedentary habits have contributed to weakened immunity among individuals. As a result, people today are more susceptible to frequent infections, fatigue, allergies and lifestyle disorders. Strengthening immunity through natural, safe and holistic approaches has therefore become an essential component of preventive healthcare.

1.2 HERBAL MEDICINE

Herbal medicine, also known as phytomedicine, is one of the oldest forms of healthcare practiced across cultures. Ayurveda, Traditional Chinese Medicine (TCM), Siddha, Unani and folk medicines have utilized herbs for thousands of years to promote health and manage various diseases. Herbal medicines contain a rich variety of bioactive compounds such as alkaloids, flavonoids, phenolics, glycosides, terpenoids, saponins and essential oils, each contributing specific therapeutic actions. These compounds exhibit a wide range of pharmacological properties, including antioxidant, anti-inflammatory, antimicrobial, adaptogenic and immunomodulatory effects. Herbal medicines are considered relatively safe, easily accessible and cost-effective, with fewer side effects compared to many synthetic drugs. The World Health Organization (WHO) also encourages the use of medicinal plants in primary healthcare. Due to the increased global interest in natural and plant-based wellness practices, herbal medicine has gained renewed scientific and commercial importance.

1.3 MECHANISM OF ACTION OF HERBAL MEDICINE (IMMUNITY BOOSTING ACTION)



1.4 HERBAL TEA

Herbal tea is a popular beverage prepared by steeping dried plant materials such as leaves, flowers, roots or spices in hot water. Unlike conventional tea made from *Camellia sinensis*, herbal tea is naturally caffeine-free and primarily consumed for its therapeutic and soothing effects. Herbal teas are rich in essential oils, polyphenols, aromatic compounds and volatile constituents that help in relaxation, digestion, respiratory comfort and immune enhancement. They are easy to prepare, pleasant in aroma and flavour, and suitable for regular daily consumption. Herbal teas have been traditionally used as home remedies for boosting immunity, relieving cold and cough, improving digestion, reducing stress, and promoting general well-being. Due to the increasing demand for natural, plant-derived wellness beverages, herbal tea has become a widely accepted preventive health drink.

2. PATHOPHYSIOLOGY

The immune system protects the body against infections through the coordinated action of immune cells, signaling molecules, and defense pathways. In conditions of low immunity, factors such as oxidative stress, chronic inflammation, stress, poor nutrition, and infections impair immune cell function, resulting in frequent illness and delayed recovery. Herbal medicines enhance immunity by acting on these underlying pathological processes rather than providing only symptomatic relief.

One of the major mechanisms involved in immune suppression is increased oxidative stress caused by excessive production of free radicals during infection or stress. These reactive oxygen species damage immune cell membranes, reduce lymphocyte activity, and disturb cytokine signaling.

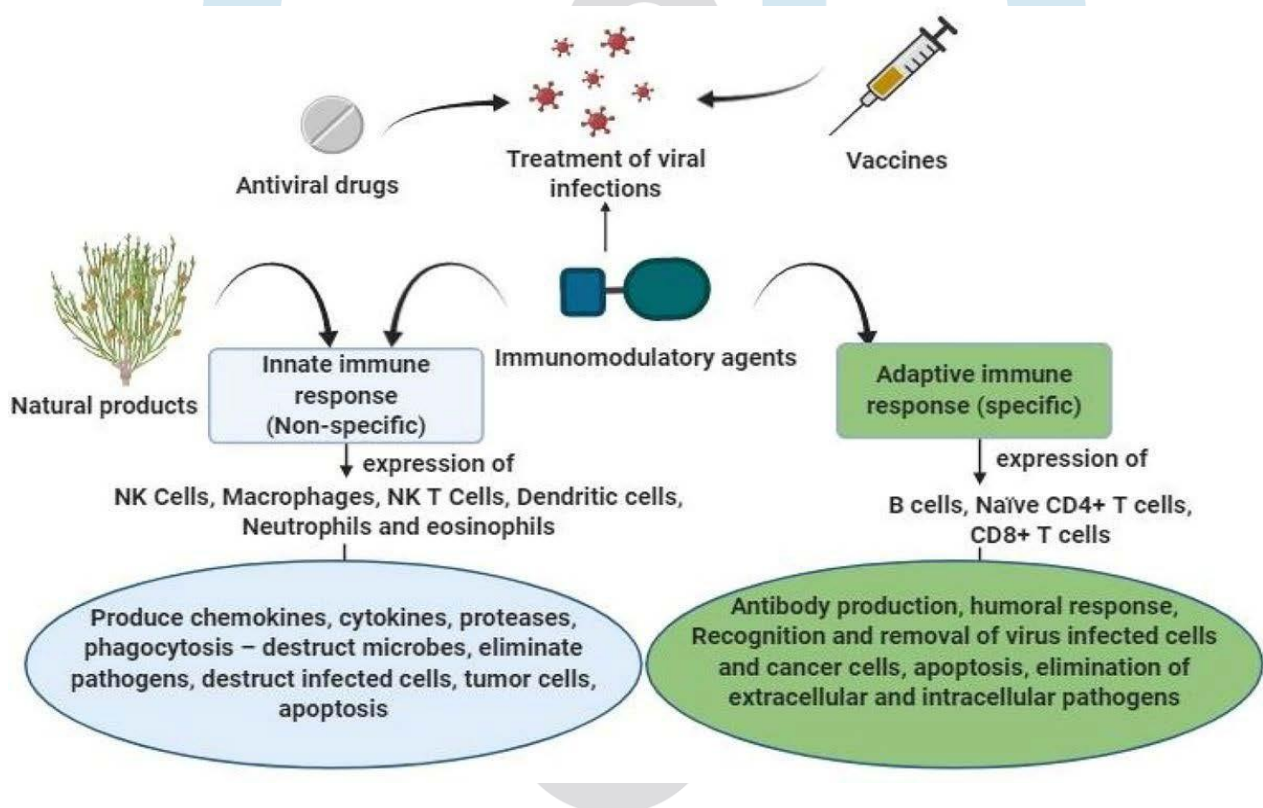
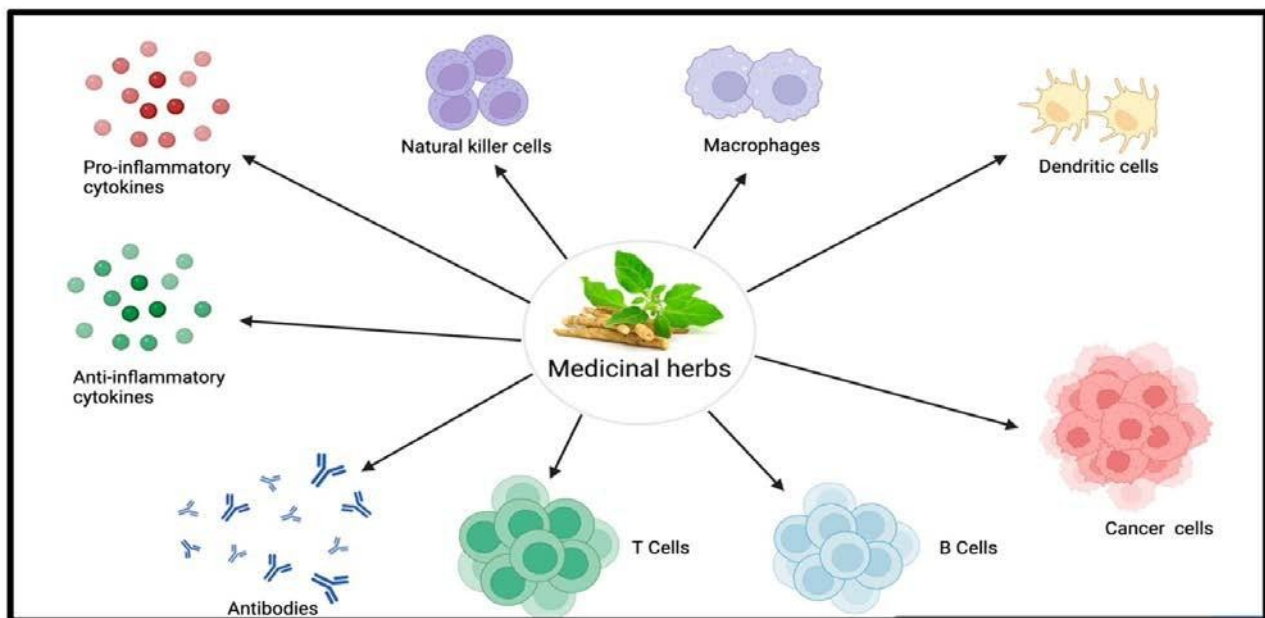
Herbal medicines are rich in antioxidant phytoconstituents such as flavonoids, phenolic compounds, anthocyanins, and terpenoids, which neutralize free radicals and protect immune cells from oxidative damage. By reducing oxidative stress, herbal medicines help restore normal immune cell function.

Herbal medicines also exhibit strong immunomodulatory activity by enhancing both innate and adaptive immune responses. They stimulate the activity of macrophages and natural killer cells, improve phagocytosis, and promote the activation of T and B lymphocytes. At the molecular level, herbal constituents regulate the release of cytokines such as interleukins, tumor necrosis factor- α , and interferons, which are essential for immune communication. This balanced immune modulation strengthens defense mechanisms without causing excessive immune reactions.

Chronic inflammation is another important factor that weakens immunity by damaging tissues and exhausting immune cells. Many herbal medicines possess anti-inflammatory properties and inhibit key inflammatory pathways such as cyclooxygenase, lipoxygenase, and nuclear factor- κ B. This reduces the production of inflammatory mediators, protects immune tissues, and maintains immune balance. Additionally, herbal medicines provide antimicrobial protection by inhibiting the growth of bacteria, viruses, and fungi, thereby reducing pathogen load and allowing the immune system to function efficiently.

Herbal medicines also support immunity through adaptogenic and stress-reducing effects. Chronic stress activates the hypothalamic-pituitary-adrenal axis, increasing cortisol levels that suppress immune responses. Adaptogenic herbs help regulate stress hormones, stabilize neuroendocrine function, and improve resistance to physical and mental stress. Furthermore, herbal medicines improve gut health by maintaining healthy intestinal microflora and supporting gut-associated lymphoid tissue, where a large proportion of immune cells reside. Healthy gut function enhances nutrient absorption and antibody production, contributing to overall immune strength.

In polyherbal formulations, multiple herbs act through different mechanisms simultaneously, producing a synergistic effect. This combined action improves antioxidant defense, immune modulation, inflammation control, stress adaptation, and microbial protection. As a result, herbal medicines enhance immunity at cellular, molecular, and systemic levels, making them effective, safe, and suitable for long-term immune support.



3. TYPES OF IMMUNODEFICIENCY DISEASES

❖ Types of Low Immunity Diseases

Low immunity diseases can be broadly classified into primary immunodeficiency, secondary immunodeficiency, autoimmune disorders, and allergic disorders, depending on their cause and mechanism.

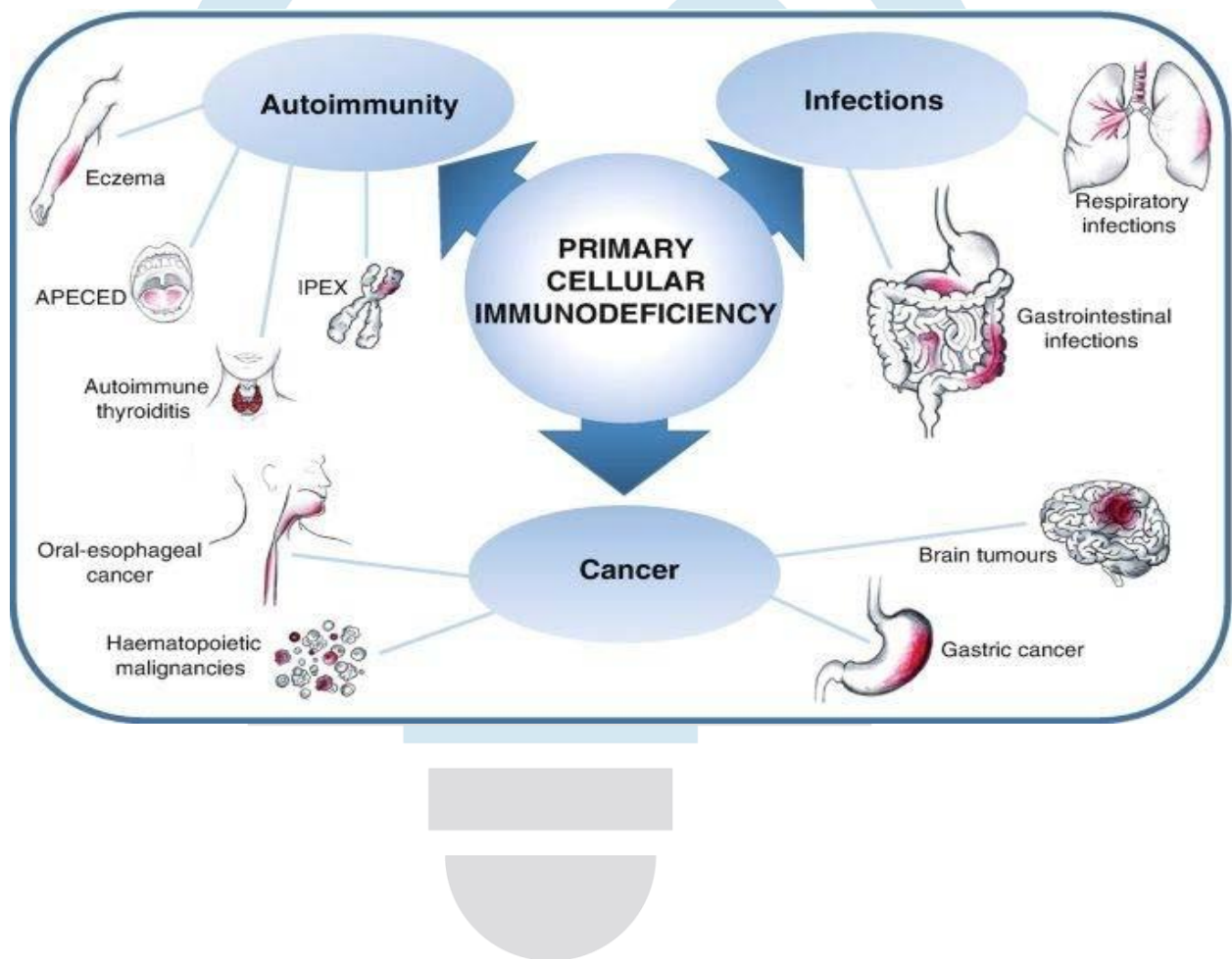
- **Primary immunodeficiency diseases:-** These are usually inherited and present from birth due to genetic defects affecting immune cells such as T cells, B cells, or antibodies. Individuals suffering from primary immunodeficiency experience frequent, severe, and recurrent infections from an early age because their immune system fails to develop or function normally. Examples include Severe

Combined Immunodeficiency (SCID) and Common Variable Immunodeficiency (CVID).

- **Secondary immunodeficiency diseases:-** These are more common and develop later in life as a result of external factors such as infections, malnutrition, chronic stress, aging, cancer, or prolonged use of immunosuppressive drugs. Conditions like HIV/AIDS,

diabetes, and cancer therapy-induced immunosuppression weaken immune responses, making the body more vulnerable to infections. In these cases, the immune system is initially normal but becomes impaired due to underlying conditions or lifestyle factors.

- **Autoimmune diseases:-**It represent another category of immune disorders in which the immune system becomes imbalanced and mistakenly attacks the body's own tissues instead of protecting them. Although immune activity is present, it is poorly regulated, leading to tissue damage and chronic inflammation. Diseases such as rheumatoid arthritis, systemic lupus erythematosus, and type 1 diabetes are examples. Over time, chronic immune activation can exhaust immune cells, resulting in reduced resistance to infections.
- **Allergic disorders:-** These also reflect immune dysfunction, where the immune system overreacts to harmless substances like pollen, dust, or food. Conditions such as asthma, allergic rhinitis, and eczema occur due to hypersensitive immune responses. Continuous allergic reactions can weaken immune balance and increase susceptibility to infections, especially of the respiratory system.



4. CAUSES OF LOW IMMUNITY DISEASES

- **Genetic Defects:** Inherited abnormalities in immune system development led to defective or absent immune cells, causing frequent and severe infections from birth.
- **Malnutrition and Nutrient Deficiency:** Deficiency of essential nutrients such as proteins, vitamins, and minerals impair immune cell function and reduces resistance to infections.
- **Chronic Stress and Unhealthy Lifestyle:** Long-term stress increases cortisol levels, which suppress immune responses; poor sleep, smoking, alcohol consumption, and inactivity further weaken immunity.
- **Infections:** Certain infections, especially HIV, directly destroy immune cells and result in immunodeficiency.
- **Long-term Use of Immunosuppressive Drugs:** Prolonged use of corticosteroids, chemotherapy, and immunosuppressants reduces immune function and increases infection risk.
- **Chronic Diseases and Aging:** Conditions like diabetes, cancer, and natural aging impair immune cell activity, making individuals more prone to infections.

5. SYMPTOMS OF IMMUNODEFICIENCY

- **Frequent Infections:** Individuals with low immunity often suffer from repeated infections such as cold, cough, fever, throat infections, urinary tract infections, and respiratory infections. These infections occur more often than usual because the immune system is unable to effectively fight disease-causing microorganisms.
- **Slow Healing of Wounds:** Cuts, wounds, and injuries take a longer time to heal in people with low immunity. This happens due to reduced immune cell activity and poor tissue repair, increasing the risk of secondary infections.
- **Persistent Fatigue and Weakness:** Continuous tiredness and lack of energy are common symptoms of low immunity. The body remains in a constant state of defense, which leads to physical exhaustion even after proper rest.
- **Recurrent Digestive Problems:** Frequent diarrhea, indigestion, bloating, and stomach infections indicate poor gut immunity. Since a large portion of immune cells are present in the digestive tract, weakened gut health directly affects overall immunity.
- **Repeated Skin and Fungal Infections:** Low immunity makes the skin more vulnerable to infections such as rashes, boils, oral thrush, and nail fungal infections. These infections tend to recur or persist for long periods.
- **Increased Susceptibility to Stress:** Individuals with weak immunity often fall sick during periods of mental or physical stress. Stress hormones suppress immune function, leading to frequent illness.
- **Poor Response to Vaccination:** People with low immunity may not develop adequate protection after vaccination due to reduced antibody formation and weakened immune memory.
- **Hair Fall, Brittle Nails, and Poor Appetite:** Nutrient deficiencies and weakened immune function can lead to hair loss, weak nails, loss of appetite, and poor overall health.
- **Frequent Allergic Reactions:** Low immunity can result in frequent allergies such as sneezing, skin itching, or asthma-like symptoms due to immune imbalance.

6. DIAGNOSIS OF LOW IMMUNITY

Diagnosis of low immunity involves a combination of clinical evaluation, laboratory investigations, and medical history assessment. Since immunity is a complex system, no single test confirms low immunity; instead, multiple parameters are considered.

- **Clinical Evaluation:** The diagnosis usually begins with a detailed clinical history. Doctors look for signs such as frequent infections, recurrent fever, slow wound healing, chronic fatigue, repeated skin or fungal infections, and poor response to treatment. A history of repeated antibiotic use or infections that are unusually severe or long-lasting often indicates weakened immunity.

- **Complete Blood Count (CBC):** A CBC test is commonly used to assess immune status. It measures white blood cell (WBC) count, including neutrophils, lymphocytes, monocytes, eosinophils, and basophils. Low WBC or lymphocyte count suggests reduced immune defense and increased susceptibility to infections.
- **Immunoglobulin Level Testing:** Measurement of serum immunoglobulins (IgG, IgA, IgM, and IgE) helps assess humoral immunity. Low levels of these antibodies indicate impaired antibody production and are commonly seen in immunodeficiency conditions.
- **Lymphocyte Subset Analysis:** This test evaluates different types of lymphocytes such as T cells (CD4, CD8), B cells, and natural killer (NK) cells. Reduced number or abnormal function of these cells indicates weakened cellular immunity.
- **Inflammatory and Immune Markers:** Markers such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and cytokine levels may be assessed to detect immune dysfunction or chronic inflammation associated with immune imbalance.
- **Vaccine Response Test:** Immune function can also be assessed by checking the body's response to vaccines. Poor antibody formation after vaccination indicates weak immune memory and reduced immune responsiveness.
- **Nutritional and Hormonal Assessment:** Deficiencies of vitamins (Vitamin D, Vitamin C, Vitamin B12) and minerals such as zinc and iron are commonly associated with low immunity. Hormonal imbalances, especially elevated cortisol due to stress, may also suppress immune function.

7. TREATMENT

- a) **ALLOPATHIC DRUGS**
- b) **HERBAL DRUGS**

❖ ALLOPATHIC DRUGS :

Allopathic Drugs Used for Enhancing Immunity

1. **Levamisole**
Class: Immunomodulator
Levamisole is used to stimulate depressed immune responses by enhancing T-cell function. It is sometimes used as an adjunct therapy in infections and certain immune-related conditions.
2. **Interferons (Interferon- α , β , γ)**
Class: Cytokines / Biological response modifiers
Interferons enhance immunity by activating immune cells such as natural killer cells and macrophages. They are commonly used in viral infections, cancers, and autoimmune disorders.
3. **Thymosin Alpha-1**
Class: Immunomodulatory peptide
Thymosin improves T-cell differentiation and function, thereby enhancing cellular immunity. It is used in chronic infections, immunodeficiency states, and cancer therapy support.
4. **Colony Stimulating Factors (CSFs)**
Examples: Filgrastim, Sargramostim
Class: Hematopoietic growth factors
These drugs stimulate the production of white blood cells, especially neutrophils, improving the body's ability to fight infections, particularly in immunocompromised patients.
5. **Intravenous Immunoglobulins (IVIG)**
Class: Immunoglobulin preparations
IVIG provides passive immunity by supplying antibodies. It is used in primary and secondary immunodeficiency disorders and certain autoimmune diseases.
6. **Vaccines**
Class: Active immunizing agents
Vaccines stimulate the immune system to produce antibodies and immune memory against specific pathogens, thereby enhancing long-term immunity.

7. **Vitamin and Mineral Supplements****Examples:** Vitamin C, Vitamin

D, Zinc

Class: Nutritional

immunomodulators

These supplements enhance immune function by supporting immune cell activity, antioxidant defense, and antibody production.

8. **BCG (Bacillus Calmette–Guérin)****Class:** Immunostimulant vaccine

Apart from tuberculosis prevention, BCG is used as an immunostimulant in bladder cancer and is known to activate cellular immunity.

❖ **HERBER DRUGS:**1. **LEMONGRASS****Botanical Name:** *Cymbopogon citratus***Family:** Poaceae**Common Names:** Lemongrass, Bhustrina

Description: Lemongrass is an aromatic perennial grass commonly used in herbal teas due to its refreshing citrus aroma. It contains essential oils such as citral that contribute to its medicinal properties.

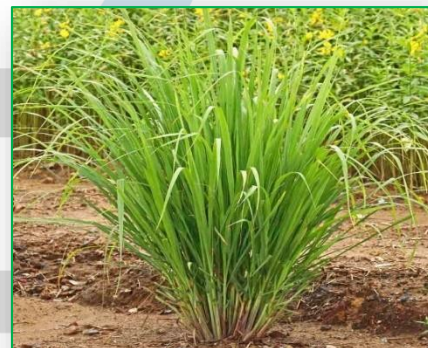
Phytoconstituents:

- Citral
- Geraniol
- Limonene
- Flavonoids
- Phenolic compounds

Medicinal Properties:

- Antioxidant
- Anti-inflammatory
- Antimicrobial
- Stress-relieving
- Digestive stimulant

Role in Formulation: Lemongrass enhances the aroma and taste of herbal tea and contributes antioxidant and mild immune-supporting properties.

**Mechanisms of action:** Lemongrass (*Cymbopogon citratus*)

enhances immunity due to the presence of bioactive constituents such as citral, flavonoids, and phenolic compounds. These compounds exhibit strong antioxidant activity, which helps neutralize free radicals and reduce oxidative stress that can damage immune cells. Lemongrass also possesses anti-inflammatory properties that regulate inflammatory mediators, preventing immune cell exhaustion and maintaining immune balance. Its antimicrobial action against bacteria, viruses, and fungi reduces pathogen load, allowing the immune system to function more effectively. In addition, lemongrass supports digestion and reduces stress, both of which are closely linked to immune health. Through these combined antioxidant, anti-inflammatory, antimicrobial, and supportive effects, lemongrass acts as a natural and effective immunity-enhancing agent.

2. **MINT****Botanical Name:** *Mentha arvensis* / *Mentha spicata***Family:** Lamiaceae**Common Names:** Mint, Pudina

Description: Mint leaves contain essential oils rich in menthol, giving a cooling effect and refreshing aroma. It is widely used in teas for digestive and soothing effects.

Phytoconstituents:

- Menthol
- Menthone
- Limonene
- Rosmarinic acid
- Flavonoids



Medicinal Properties:

- Digestive stimulant
- Antioxidant
- Antibacterial
- Decongestant
- Mild immune support

Role in Formulation: Improves taste, freshness, and overall acceptability of the herbal tea blend.

Mechanism of Action: Mint enhances immunity primarily through its antioxidant and antimicrobial properties due to the presence of menthol, flavonoids, and phenolic compounds. These constituents protect immune cells from free radical damage and inhibit the growth of pathogenic microorganisms. Mint also supports immune health indirectly by improving digestion and gut function, as a large portion of the immune system is associated with the gastrointestinal tract. Its cooling and soothing effect helps relieve stress and inflammation, thereby contributing to better immune regulation.

3. ATULSI

Botanical Name: *Ocimum sanctum*

Family: Lamiaceae

Common Names: Holy Basil, Tulsi

Description:

Tulsi is one of the most revered medicinal herbs in Ayurveda. It is known for its adaptogenic and immune-boosting effects, traditionally used to treat respiratory and inflammatory conditions.

Phytoconstituents:

- Eugenol
- Ursolic acid
- Apigenin
- Flavonoids
- Essential oils

Medicinal Properties:

- Immunomodulatory
- Antioxidant
- Antiviral
- Anti-inflammatory
- Stress reducing



Role in Formulation: Acts as the primary immunity enhancer in the polyherbal tea

Mechanism of Action :

Tulsi enhances immunity through its rich content of bioactive compounds such as eugenol, ursolic acid, flavonoids, and essential oils. These constituents exhibit strong antioxidant activity that protects immune cells from oxidative damage and improves their functional efficiency. Tulsi also acts as a potent immunomodulator by stimulating macrophage activity and enhancing both cellular and humoral immune responses. Its anti-inflammatory and antiviral properties help control infections and reduce inflammatory stress on the immune system. Additionally, Tulsi reduces stress by regulating cortisol levels, thereby preventing stress-induced immune suppression and supporting overall immune balance.

4. BUTTERFLY PEA / APARAJITA

Botanical Name: *Clitoria ternatea*

Family: Fabaceae

Common Names: Butterfly Pea, Shankpushpi (in some regions), Aparajita

Description:

Clitoria ternatea flowers are rich in anthocyanins, giving them their characteristic blue color. They exhibit strong antioxidant and neuroprotective activity.

Phytoconstituents:

- Anthocyanins
- Flavonoids
- Triterpenoids
- Cyclotides

Medicinal Properties:

- Antioxidant
- Memory enhancing
- Stress reducing
- Anti-inflammatory

Role in Formulation: Provides natural blue color, antioxidant support, and enhances overall health benefits.

Mechanism of Action:

Butterfly pea enhances immunity mainly due to its high content of anthocyanins and flavonoids, which exhibit strong antioxidant activity. These compounds protect immune cells from oxidative damage and improve immune response. Butterfly pea also shows anti-inflammatory and stress-reducing effects, which help prevent immune suppression caused by chronic inflammation and mental stress. By reducing oxidative stress and supporting overall physiological balance, butterfly pea contributes to enhanced immune function and general well-being.



5. CARDAMOM

Botanical Name: *Elettaria cardamomum*

Family: Zingiberaceae

Common Names: Green Cardamom, Elaichi

Description:

Cardamom is an aromatic spice containing essential oils like cineole and terpinyl acetate. It adds flavour and improves digestion.

Phytoconstituents:

- Cineole
- Terpinyl acetate
- Limonene
- Flavonoids

Medicinal Properties:

- Digestive stimulant
- Antioxidant
- Anti-inflammatory
- Respiratory support

Role in Formulation:

Improves aroma, taste, and palatability

Mechanism of Action:

Cardamom enhances immunity through its antioxidant, anti-inflammatory, and antimicrobial activities attributed to essential oils such as cineole and terpinyl acetate. These compounds help reduce oxidative stress and inflammation, protecting immune cells from damage. Cardamom also supports respiratory health and improves digestion, which indirectly strengthens immune function. By



enhancing nutrient absorption and reducing microbial growth, cardamom contributes to overall immune support and improved resistance to infections.

6. GILOY

Botanical Name: *Tinospora cordifolia*

Family: Menispermaceae **Common Names:** Guduchi, Giloy

Description:

Giloy is a Rasayana herb in Ayurveda known for boosting immunity and recovery from infections. It contains alkaloids, glycosides, and diterpenoids.

Phytoconstituents:

- Berberine
- Tinosporin
- Cordifolioside
- Glycosides

Medicinal Properties:

- Immunomodulatory
- Antioxidant
- Antipyretic
- Anti-inflammatory

Role in Formulation:

Acts as the main immune-strengthening component

Mechanism of Action:

Giloy is a well-known immunomodulatory herb that enhances immunity by activating immune cells such as macrophages, lymphocytes, and natural killer cells. It contains alkaloids, diterpenoid lactones, and glycosides that stimulate antibody production and improve phagocytic activity. Giloy also exhibits strong antioxidant and anti-inflammatory effects, which reduce oxidative stress and chronic inflammation that weaken immunity. Its antipyretic and antimicrobial properties help the body fight infections effectively, making Giloy a key herb for strengthening immune resistance and recovery.



7. ASHWAGANDHA

Botanical name: *Withania somnifera*

Family: Solanaceae

Common name: Ashwagandha, Indian Ginseng

Description:

Ashwagandha is a small woody shrub native to India. The roots are thick, fleshy, and have a characteristic odor. It is widely used in Ayurveda as a rejuvenating and adaptogenic herb.

Phytoconstituents:

- Withanolides
- alkaloids
- sitoindosides
- steroidal lactones

Medicinal properties:

- Immunomodulatory
- antioxidant
- anti-inflammatory
- adaptogenic
- anti-stress

Role in formulation:

Acts as a natural immunity booster and stress reducer, supporting long-term immune health.

Mechanism of action:

Ashwagandha enhances immunity by reducing stress-induced immune suppression through regulation of cortisol levels. Its antioxidant constituents protect immune cells from oxidative damage and stimulate macrophage, T-cell, and natural killer cell activity.



8. AMLA

Botanical name: *Embllica officinalis***Family:** Euphorbiaceae**Common name:** Amla, Indian Gooseberry**Description:**

Amla is a deciduous tree bearing small, greenish-yellow Fruits with sour taste. It is a rich natural source of vitamin C.

Phytoconstituents:

- Vitamin C
- tannins
- flavonoids
- polyphenols.

Medicinal properties:

- Antioxidant
- Immunostimulant
- Anti-inflammatory
- Rejuvenating.

Role in formulation:

Provides strong antioxidant support and improves immune resistance.

Mechanism of action:

Amla enhances immunity by scavenging free radicals and improving antibody production. It strengthens immune cell function and supports gut health, which indirectly boosts immune response.



9. GINGER

Botanical name: *Zingiber officinale***Family:** Zingiberaceae **Common name:** Ginger**Description:**

Ginger is a perennial herb with underground rhizomes widely used as a spice and medicine. **Phytoconstituents:**

- Gingerols
- shogaols,
- zingerone,
- volatile oils.

Medicinal properties:

- Antioxidant
- Anti-inflammatory,
- Antimicrobial,
- Aigestive stimulant.

**Role in formulation:**

Enhances digestion, improves absorption of nutrients, and provides antimicrobial protection.

Mechanism of action:

Ginger boosts immunity by reducing inflammation and oxidative stress while inhibiting microbial growth. Improved digestion enhances gut-associated immune responses.

10. TURMERIC

Botanical name: *Curcuma longa***Family:** Zingiberaceae **Common name:** Turmeric**Description:**

Turmeric is a perennial herb with bright yellow rhizomes used extensively as a spice and medicinal agent. **Phytoconstituents:**

- Curcumin,
- Demethoxycurcumin,
- volatile oils.

Medicinal properties:

- Anti-inflammatory
- Antioxidant
- Antimicrobial
- Immunomodulatory.

Role in formulation:

Provides immune regulation and inflammation control.

Mechanism of action:

Curcumin modulates immune cell signaling pathways, regulates cytokine production, and protects immune cells from oxidative damage, thereby strengthening immune defense.



11. LICORICE

Botanical name: *Glycyrrhiza glabra* **Family:** Fabaceae**Common name:** Mulethi, Licorice**Description:**

Licorice is a perennial herb with sweet-tasting roots used traditionally for respiratory and immune disorders.

Phytoconstituents:

Glycyrrhizin, flavonoids, saponins.

Medicinal properties:

Antiviral, anti-inflammatory, immunomodulatory, adaptogenic.

Role in formulation:

Supports respiratory immunity and antiviral defense.

Mechanism of action:

Licorice enhances immunity by stimulating interferon production, reducing inflammation, and improving resistance to viral infections.



12. NEEM

Botanical name: *Azadirachta indica***Family:** Meliaceae**Common name:** Neem**Description:**

Neem is a large evergreen tree widely used in traditional medicine for its strong antimicrobial properties.

Phytoconstituents:

- Azadirachtin,
- nimbin,
- nimbidin,
- flavonoids.

Medicinal properties:

- Antimicrobial,
- Immunostimulant,
- Anti-inflammatory,
- Antioxidant.



Role in formulation:

Provides protection against infections and supports immune activation.

Mechanism of action:

Neem enhances immunity by activating macrophages and lymphocytes while reducing microbial load and oxidative stress.

13. GARLIC

Botanical name: *Allium sativum*

Family: Amaryllidaceae

Common name: Garlic

Description:

Garlic is a bulbous plant commonly used as food and medicine due to its strong aroma and therapeutic value.

Phytoconstituents:

Allicin, sulfur-containing compounds, flavonoids.

Medicinal properties:

Antimicrobial, antioxidant, immunostimulant, anti-inflammatory.

Role in formulation:

Improves immune defense against infections.

Mechanism of action:

Garlic enhances immunity by increasing natural killer cell activity, modulating cytokine release, and reducing pathogen growth.



14. ECHINACEA

Botanical name: *Echinacea purpurea*

Family: Asteraceae

Common name: Echinacea

Description:

Echinacea is a flowering plant traditionally used to prevent and treat infections, especially respiratory illnesses.

Phytoconstituents:

Alkylamides, polysaccharides, flavonoids.

Medicinal properties:

Immunostimulant, anti-inflammatory, antimicrobial.

Role in formulation:

Used to enhance innate immunity and reduce infection severity.

Mechanism of action:

Echinacea stimulates macrophage activity, increases phagocytosis, and enhances cytokine production, strengthening immune response.



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