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Review Article

Formulation and Evaluation of Herbal Immunity Booster Tablets

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Abstract:

The increasing global interest in natural remedies and preventive healthcare has accelerated the development of herbal formulations aimed at enhancing the immune system. This study focuses on the formulation and comprehensive evaluation of **herbal immunity booster tablets**, utilizing traditionally recognized medicinal plants with scientifically established immunomodulatory, antioxidant, and anti-inflammatory properties.

The formulation incorporates key herbs including **Ocimum sanctum (Tulsi), Withania somnifera (Ashwagandha), Tinospora cordifolia (Giloy), Emblica officinalis (Amla)**, and **Curcuma longa (Turmeric).** These herbs were selected based on Ayurvedic literature, ethnopharmacological evidence, and modern scientific data supporting their role in modulating immune responses and protecting against infections and oxidative stress.

The powdered plant materials were subjected to **standardization** and **quality control tests** before being formulated into tablets using the **direct compression method**. Pre-formulation studies included analysis of flow properties such as **angle of repose, bulk and tapped density**, and **Carr's Index**. Post-compression evaluation involved tests for **tablet hardness, thickness, friability, disintegration time, weight variation,** and **uniformity of content**, all of which conformed to pharmacopeial standards.

In addition, **phytochemical screening** confirmed the presence of bioactive compounds such as flavonoids, alkaloids, tannins, glycosides, and polyphenols. The tablets were also evaluated for **in-vitro antioxidant activity** using the DPPH assay and for **anti-inflammatory potential** using protein denaturation methods. Results revealed that the tablets possessed significant biological activity, indicating their potential to reduce oxidative damage and modulate immune function.

Further work such as **accelerated stability testing, clinical evaluation**, and **toxicological studies** is recommended to validate the safety and long-term efficacy of the formulation.

Keywords: Herbal formulation, Immunity booster, Immunomodulatory activity, Antioxidant properti es, Anti-inflammatory effects, Ayurvedic herbs, Phytochemical analysis

1. Introduction

Immunity:

This may be defined as the body's ability to identify and resist large numbers of infectious and potentially harmful microorganisms, enabling the body to prevent or resist diseases and inhibit organ and tissue damage. The immune system is not confined to any one part of the body. Immune stem cells, formed in the bone marrow, may remain in the bone marrow

until maturation or migrate to different body sites for maturation. Subsequently, most immune cells circulate throughout the body, exerting specific effects. [1] Immune systems: The basic architecture of the immune system is multilayered, with defenses on several levels. Most obvious and primary is the skin: The first barrier against infection. Another is physiological, where conditions such as the temperature and pH of the body provide inappropriate living conditions for foreign organisms. Once pathogens have successfully entered the body, they are addressed by the innate and/or the acquired or adaptive immune system. Both systems consist of a multitude of cells and molecules that interact in a complex manner to detect and eliminate pathogens. Detection and elimination depend on chemical bonding: Surfaces of immune system cells are covered with various receptors, some of which chemically bind to pathogens, while others bind to other immune system cells or molecules to enable the complex signaling system that mediates the immune response.

Types of Immunity:

- **Innate Immunity:** Innate Immunity, a non-specific form of defense that exists from birth which is achieved by building barriers that prevent foreign agents from entering our bodies. There are four different kinds of barriers to innate immunity.
    a) **Physical barriers:** The primary barrier preventing microorganisms from entering our bodies is the skin. The mucus layer, that coats the epithelium lining of our gastrointestinal, respiratory, and urogenital tracts, aids in the capture of microbes.
    b) **Physiological barriers:** Saliva in the mouth, tears in the eyes, Human milk, and acid in the stomach all inhibit the growth of microorganisms.
    c) **Cellular barriers:** They comprise certain leukocytes (WBCs) in our bodies, such as monocytes, natural killers (type of lymphocytes), polymorphonuclear leukocytes (PMNL-neutrophils), and macrophages.
    d) **Cytokine barriers:** Interferons are proteins secreted by virus-infected cells that shield uninfected cells from contracting new viruses.
- **Acquired Immunity:** Acquired immunity is pathogen specific and is characterized by memory.

Primary response: When the body encounters a pathogen, it produces a primary response of low intensity.

Secondary response: Later encounters with the same pathogen induce a highly intensified secondary response. This response is due to the memory plasma cells (B cells).

Humoral immune response: The action of antibodies is called humoral immune response, as the antibodies are found in the blood.

Cell-mediated immune response: The T-lymphocytes mediate CMI. In this, T-H cells encounter antigens due to the APCs (through the MHC complex). This activates T-H cells, which in turn activate cytotoxic T cells and macrophages for the CMI response. T-H cells also activate B-cells (for humoral response).

- **Active immunity:** When antibodies are created in response to the exposure of antigens (proteins or microorganisms), it is known as active immunity. It develops gradually and takes some time to fully show its effects. It is induced by intentionally injecting microbes during immunization or by infectious organisms entering the body naturally.
- **Passive immunity:** When artificially made antibodies are directly given to protect the host body against foreign agents, it is referred to as passive immunity. For example: A mother's milk is considered essential for a newborn infant. The yellowish fluid colostrum secreted by the mother during the initial lactation days has abundant antibodies (IgA) to protect the infant. The

foetus also receives some antibodies through the placenta from their mother.

Cells Involved in the Immune System: White blood cells (WBC) are immune response cells. These WBCs are lymphocytes and myeloid cells (granulocytes and monocytes), which are all generated in the bone marrow.

a) **T lymphocytes:** Maturing in the thymus gland, they exhibit cell-mediated immunity in the secondary lymphoid organs. They contain T-cell receptors on their surface. Helper T cells express CD4 molecules on their surface. They activate macrophages (for phagocytosis), cytotoxic T-cells (killing of pathogens) and B-cells (to secrete antibodies). Thus, they are central to the adaptive immune response. Cytotoxic T cells (TC) express CD8 molecules on their surface. They are directly involved in killing of intracellular pathogens as well as eliminating cancerous cells. Suppressor T cells (TS) are involved in suppressing humoral and cell-mediated immune responses.

b) **B lymphocytes:** After maturation in bone marrow, they migrate to secondary immune organs. The two most important roles that B cells play in the body's defence are the production of antigen-specific antibodies and the antigen-presenting cells to T helper cells for the adaptive immune response. T-helper cells activate B cells to produce plasma cells, memory cells. The plasma cells produce antibodies (immunoglobulins) specific to the antigen. Memory B cells acquire immunological memory for the same antigen, which is used in future. Because memory B cells live for a long time, they offer lifetime immunity against various pathogens. The B cell immune response is also referred to as the humoral immune response (humor or body fluid) because it necessitates the synthesis of antibodies in the blood and lymph in order to kill the antigen.

c) **Neutrophils:** They make up between 50-70 percent of circulating WBCs produced from myeloid progenitor cells. The first cells to arrive at an infection site are neutrophils, as the innate immune response.

d) **Macrophages:** Developed from the myeloid progenitor cell, they are the cells of the innate immune system. They release various cytotoxic proteins that help destroy a broad range of pathogens, such as tumour cells, intracellular bacteria, and virus-infected cells. They also function like antigen-presenting cells for T-helper cells; in turn, T-H cells activate them for phagocytosis. Phagocytosis involves engulfing and eliminating pathogens by using lysosomes.

Immunomodulators:

These are biological or synthetic substances that can stimulate, suppress, or modulate any aspect of the immune system including both adaptive and innate arms of the immune system. Classification of immunomodulators clinically, immunomodulators can be classified into the following three categories: Immunoadjuvants, immunostimulants and immunosuppressants.

Immunoadjuvants are used to enhance the efficacy of vaccines and therefore could be considered specific immune stimulants. Immunoadjuvants hold the promise of being the true modulators of the immune response. It has been proposed that they be exploited as selectors between cellular and humoral helper T1 (Th1) and helper T2 cells (Th2), immunoprotective, immunodestructive, and reagenic (immunoglobulin E [IgE]) versus IgG type immune responses disposing a real challenge to vaccine designers. Immunostimulants are inherently non-specific as they are envisaged as enhancements to a 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, that is, as immunopotentiators, by enhancing the basic level of immune response. In the individual with impairment of immune

response, they are expected to act as immunotherapeutic agents. Immunosuppressants are a structurally and functionally heterogeneous group of drugs, which are often concomitantly administered in combination regimens to treat various types of organ transplant rejection and immunity diseases.

2. Role of Herbs for Immunity:

Maintaining a strong immune system is crucial for overall well-being. While a healthy diet and lifestyle play a vital role, incorporating the certain herbs and spices into your meals can provide an additional boost to your immunity. Numerous scientific studies have proved that consuming herbs and spices is an effective way to manage heart disease, cancer, diabetes, blood pressure. The natural ingredients are packed with antioxidant, vitamin, and body defence system. Herbs and spices can transform any bland meal to a flavorful one and most of them are packed with the power of antioxidants. Ayurveda recommends regular use of many spices and herbs. in recent years, many of them have also been gaining popularity in the western world as superfood- from seasoning in baked goods, to being used in sauces and dressing, to herbal infusion, there are a variety of ways herbs and spices cam incorporated in our food. These herbs not only prevent illnesses but also aid in faster recovery.

One of the most well-known immune-boosting herbs is Echinacea, which stimulates white blood cell production and helps the body fight infections like the common cold. Similarly, turmeric, with its active compound curcumin, reduces inflammation and enhances immune cell activity. Ginger is another powerful herb with antiviral and antibacterial properties, often used to soothe sore throats and improve digestion, which is closely linked to immune health. Garlic, rich in allicin, acts as a natural antibiotic, fighting harmful bacteria and viruses while supporting immune cell function. Ashwagandha, enhances immune function by increasing white blood cell (WBC) production and reducing cortisol-induced immune suppression. Holy Basil rich in antioxidants, supports immune response, and has antiviral properties. Amla, extremely high in vitamin C, boosts immunity and detoxification.

3. Literature review:

- Amruta Chalak, et.al. (2022) describes a study on “Formulation and Evaluation of Herbal Immunity Booster Tablets”.
- Dolly Rathor, et.al. (2018) describes a study on “Standardization of In-House Prepared an Immunobooster Polyherbal Formulation”.
- Mrs. Seema A. Gadge, et.al. (2024) describes a study on “Design of Polyherbal Powder Drink Formulation as an Immunity Booster”.
- Seema Brar, et.al. (2021) describes a study on “A review on medicinal herbs as immunity booster”.
- Bhavesh Motwani, et.al. (2024) describes a study on “Formulation & Evaluation Of Ayush Kwath Powder & Tablet Used as An Immunity Booster in Covid-19”.
- Hiral S. Popaniya, et.al. (2024) describes a study on “A Concise Review on Herbal Immunity Booster”.
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- Veer M, et.al. (2025) demonstrate a study on “Formulation and Evaluation of Dispersible Polyherbal Immunity Booster Green Tea Tablets”.
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- Surabhi Shakya, et.al. (2020) A Review on “Herbal Immunity Boosters for

Improvement of Human Health In Covid-19".

- Yogesh Kaser, et.al. (2024) describes a study on "Preparation and Evaluation of Herbal Immunity Booster Syrup".
- Khumalo. B. M, et.al. (2018) describes a study on "evaluation Of Immune Booster Formulation By Traditional Health Practitioners: Phytochemical, Antioxidant and Mineral Elements".
- Raut Sanket, et.al. (2025) describes a study on "Formulation and Evaluation of Herbal Immunity Booster Tablet using Tinospora cordifolia Satva".
- Kamlesh S Pathak, et.al. (2024) describes a study on "The Formulation, Development, And Evaluation of an Immunity Booster Aimed at to Boost Immunity During Cancer Therapy".
- Ghogare S.D., et.al. (2023) demonstrated a study on "Formulation, Evaluation and Development of Immunity Power Boosting Herbal Tonic".
- Singh S.A., et.al. (2023) describes a study on "Formulation, evaluation, and antimicrobial study of immune-boosting herbal tea".
- Jokar Mayuri Dhondiba, et.al. (2024) describes a study on "Formulation and Evaluation of Syrup of Drumstick and Tamarind Plant Extract of Treatment for Immunity Enhancer".
- S. Jaya kumari, et.al. (2024) describes a study on "Formulation and evaluation of polyherbal cookies for immunity booster".
- Pranjali Indian, et.al. (2023) describes a study on "Formulation and Evaluation of Polyherbal Medicated Jelly".
- Mayuri Kupkar, et.al. (2022) describes a study on "Formulation and Evaluation of Herbal Chyawanprash Chocolate".

4. **Plant Profile**

1. **Liquorice**

Figure 1: An Overview of Liquroice

Synonyms: Glycyrrhiza glabra, Mulethi

Biological source: It is obtained from the dried roots and stolons of the plant Glycyrrhiza glabra

Family: Fabaceae

Geographical source: Liquorice is widely cultivated throughout Europe, the Middle East, and Asia. In India it is also cultivated in Punjab and sub-Himalayas tract.

Chemical constituent: Glycyrrhiza glabra L. roots contain several active compounds, including flavonoids, such as liquirtin, rhamnoliquirilin, liquiritigenin, prenyllicoflavone A, glucoliquiritin apioside, 1-metho-xyphaseolin, shinpterocarpin, shinflavanone, licopyranocoumarin, glisoflavone, licoarylcoumarin, and coumarin-GU-12, and saponins, namely, glycyrrhizin (60-times sugarier than sugarcane). Four isoprenoid-substituted phenolic constituents (isoangustone A, semilicoisoflavone B, licoriphenone, and 1-methoxyficifolinol), kanzonol R (prenylated isoflavan derivative) and several volatile components (pentanol, tetramethyl pyrazine, hexanol, terpinen-4-ol, linalool oxide A and B, geraniol, and α-terpineol). Whereas propionic acid, 1-methyl-2-formylpyrrole, 2,3-butanediol, benzoic acid, ethyl linoleate, furfuryl formate, trimethylpyrazie, furfuraldehyde, methyl ethyl ketone, and maltol were isolated from the essential oil. Glycyrrhizin, a saponin compound, as well as its aglycone glycyrrhetinic acid, are the potent components in G. glabra. Glycyrrhizin consists of glycyrrhetic acid and triterpenoid aglycone, associated with glucuronic acid disaccharide, and it can be found naturally as calcium and potassium salts in liquorice root. In humans, glycyrrhizin can be metabolized and converted to glycyrrhetinic acid and, thus, the pharmacological activities of glycyrrhizin are similar to those of glycyrrhetinic acid.

Uses: It contains bioactive compounds like phenolic compounds and flavonoids, which provide antioxidant protection against oxidative stress. Mulethi is also anti-inflammatory, effective in reducing ulcers and inflammation in the mouth, stomach, liver, and kidneys additionally, mulethi is anti-ulcerative, containing saponins and glycyrrhizin that aid in healing duodenal and peptic ulcers. Its antimicrobial properties inhibit bacterial growth, making it beneficial for oral health. Mulethi also exhibits antiviral activity against various viruses and protects the liver from damage. It has anti-carcinogenic effects, inducing apoptosis in tumor cells, and shows neuroprotective activity by improving memory and learning. Furthermore, mulethi acts as an antidepressant and offers skin benefits, including anti-inflammatory and UV protective effects, promoting hair growth and acting as a skin-lightening agent.

2. **Amla**

Figure 2: An Overview of Amla

Synonyms: Emblica, Indian gooseberry

Biological source: This consists of dried, as well as fresh fruits of the plant Emblica officinalis.

Family: Euphorbiaceae

Geographical source: It is found in throughout India, Pakistan, Uzbekistan, Sri Lanka, South East Asia, China and Malaysia.

Chemical Constituent: Amla is one of the most extensively studied plants. Various studies suggest that it contains tannins, alkaloids and phenols. Fruits have 28% of the total tannins distributed in the whole plant. The fruit contains two hydrolysable tannins Emblicanin A and B,21 which have antioxidant properties; one on hydrolysis gives gallic acid, ellagic acid and glucose wherein the other gives ellagic acid and glucose respectively. The fruit also contains Phyllemblin. Flavonoids like quercetin, alkaloids like phyllantine and phyllantidine are found. Along with these, it primarily contains amino acids, carbohydrates and other compounds. Its fruit juice contains the highest concentration of vitamin-C (478.56mg/100mL). Vitamin C levels are more than those in oranges, tangerines and lemons. In comparison with apple, the edible fruit tissue is rich with proteins 3-fold and ascorbic acid160-fold and contains considerably higher concentration of most minerals and amino acids. Glutamic acid, proline, aspartic acid, alanine, and lysine are 29.6%, 14.6%, 8.1%, 5.4%and 5.3% respectively of the total amino acids. Pulpy portion of fruit, after drying found to contain: gallic acid 1.32%, tannin, gum13.75%; albumin 13.08%; crude cellulose17.08%; mineral matter 4.12% and moisture3.83%. Amla fruit ash contains chromium2.5ppm, zinc-4 ppm and copper-3 ppm. Compounds isolated from amla fruit are gallic acid, ellagic acid, 1-Ogalloyl-beta-D-glucose, 3,6-di-O-galloyl-D-glucose, chebulinic acid, quercetin, chebulagic acid, corilagin, 1,6- di-O- galloyl beta-D-glucose, 3-Ethylgallic acid (3-ethoxy 4,5-dihydroxybenzoic acid), flavonoids and isostrictinin.

Uses: Amla, or Indian Gooseberry, is a nutrient-rich fruit that offers a wide array of health benefits. It enhances immunity by boosting the body's defense mechanisms with its antibacterial properties and by increasing white blood cells, which aid in detoxification. Amla is also beneficial for hair care, as its high antioxidant and iron content help reduce hair loss, retain color, and strengthen roots, while combating dandruff. Additionally, it serves as a stress reliever, aiding in sleep induction and headache relief. For eye health, amla's high carotene levels help with conditions like cataracts and nearsightedness. It is effective in treating respiratory issues such as flu, throat infections, and cough, and its iron content makes it beneficial for treating anemia. Amla also acts as a blood purifier when consumed with honey and has diuretic effects, enhancing toxin removal. It improves digestion due to its fiber content and aids in calcium absorption, which is crucial for healthy bones and teeth. Furthermore, amla's antioxidant properties contribute to anti-aging by reducing wrinkles and dark circles. It enhances mental performance by promoting nerve health, potentially preventing conditions like Alzheimer's and dementia, while also improving memory and focus. Lastly, amla supports weight control by increasing metabolism and reducing body fat. Overall, incorporating amla into one's diet can lead to significant improvements in overall health and well-being.

3. **Giloy**

Figure 3: An Overview of Giloy

Synonyms: Amrita, Guduchi

Biological source: It is a climbing shrub Tinospora cordifolia.

Family: Menispermaceae

Geographical source: It is native to tropical regions of Asia, particularly abundant in India, Sri Lanka, Bangladesh, and parts of Southeast Asia like Malaysia and Thailand.

Chemical Constituent: Tinospora cordifolia is known to contain a wide range of essential chemical constituents, including alkaloids, glycosides, steroids, flavonoids, phenols, tannins, terpenoids, polysaccharides, essential oils, and a combination of fatty acids, all of which have been isolated during preliminary screening. These crucial primary phytoconstituents of Tinospora cordifolia are the source of active phytochemical compounds such as b-sitosterol, clerodane furano diterpene, columbin, tinosporine, tinosporide, tinosporaside, cordifolide, cordifol, heptacosanol, and furano diterpene. All these phytoconstituents have different biological roles and importance and have already been reported in different disease conditions. T. cordifolia plant material is exhaustively extracted in different forms, such as aqueous, methanol, ethanol, hydro-alcoholic, n-hexane, chloroform, and ethyl acetate. Various analytical processes are applied to different extracts of the Tinospor a cordifolia plant to identify the primary phytoconstituents contained in the sample.

Uses: It acts as a potent immunity enhancer, rich in antioxidants that combat free radicals and keep cells healthy, thereby preventing diseases. Giloy is also effective in managing chronic fever, acting as an antipyretic agent that can help reduce symptoms of severe conditions like dengue, swine flu, and malaria. Additionally, it aids in digestion, treats bowel issues, and can be used to manage Type 2 diabetes by lowering blood sugar levels. Giloy's anti-inflammatory properties make it beneficial for treating arthritis and reducing asthmatic symptoms. It is also believed to improve vision and reduce signs of aging, offering anti-aging benefits for the skin. Furthermore, some studies suggest potential anti-HIV effects by enhancing immune cell activity. Overall, Giloy is a versatile herb that offers a wide range of health benefits when used appropriately.

4. **Ashwagandha**

Figure 4: An Overview of Ashwagandha

Synonyms: Withania somnifera, Indian winter cherry

Biological source: It consists of the dried roots and stem bases of Withania somnifera Dunal

Family: Solanaceae

Geographical source: Withania is widely distributed from southern Europe to India and Africa.

Chemical constituent: Withania somnifera, is renowned for its diverse and rich phytochemical composition, which includes withanolides (such as withaferin A), alkaloids (like isopelletierine, anaferine, and cuscohygrine), saponins (including sitoindosides), flavonoids (such as quercetin and its derivatives), phenolic acids (including gallic, caffeic, and ferulic acids), glycosides, steroids, and tannins. Additionally, it contains volatile oils, triterpenoids, and various free amino acids. The plant's roots and leaves are used for their therapeutic properties, which include anti-stress, antioxidant, and immunomodulatory effects. Ashwagandha is also a source of essential minerals like copper, iron, zinc, and magnesium. Its diverse chemical constituents contribute to its potential health benefits, which range from improving sleep and reducing anxiety to enhancing fertility and protecting against various diseases. Other notable compounds include scopoletin, chlorogenic acid, resins, lipids, and carbohydrates. Overall, ashwagandha's complex phytochemical profile supports its traditional use as a rejuvenator and adaptogen.

Uses: It is a highly revered herb in Ayurvedic medicine, celebrated for its adaptogenic, anti-stress, and rejuvenative properties. Traditionally, it is used to enhance vitality, improve cognitive function, and treat various health conditions such as nervous exhaustion, insomnia, and potency issues. Ashwagandha is believed to possess aphrodisiac and life-prolonging qualities, improving learning ability and memory capacity. Scientific research highlights its immunomodulatory effects, enhancing white blood cell count and macrophage activity, and its potential in cancer prevention by inhibiting tumor growth. Additionally, it exhibits cardiovascular and metabolic benefits, including hypoglycemic, diuretic, and hypocholesterolemia effects, which can aid in managing diabetes and cardiovascular health. Ashwagandha may also stimulate thyroid activity, potentially benefiting hypothyroidism treatment. It has shown efficacy in reducing anxiety and depression, comparable to pharmaceuticals, and is effective in treating conditions like osteoarthritis and inflammation. Overall, Ashwagandha is valued for its broad spectrum of health benefits and is increasingly studied in modern medicine for its therapeutic applications.

5. **Ginger**

Figure 5: An Overview of Ginger

Synonyms: Rhizoma zingiberis, Zingibere.

Biological source: Ginger consists of the dried rhizomes of the Roscoe Zingiber officinale

Family: Zingiberaceae

Geographical source: It is mainly cultivated in West Indies, Nigeria, Jamaica, India, Japan, and Africa.

Chemical constituent: Ginger is rich in a diverse array of chemical constituents, contributing to its aromatic flavor and medicinal properties. The volatile oils, comprising about 1–3% of fresh ginger, primarily include sesquiterpenes such as zingiberene, β-bisabolene, α-farnesene, and β-sesquiphellandrene. The pungency of ginger is attributed to phenolic compounds like gingerols (6-gingerol, 8-gingerol, 10-gingerol), which can transform into shogaols upon heat treatment or storage. Other phenolic compounds include paradols, zingerone, quercetin, gingerenone-A, and 6-dehydrogingerdione. Additionally, ginger contains lipids, organic acids, polysaccharides, and raw fibers, with carbohydrates making up about 50–70% of its composition. The bioactive compounds in ginger have been shown to possess antioxidant, anti-inflammatory, antimicrobial, and anticancer properties, making it a valuable ingredient in both culinary and therapeutic applications.

Uses: Ginger is renowned for its diverse health benefits, including its role as an immunity booster. Its anti-inflammatory and antioxidant properties, attributed to compounds like gingerol and shogaol, help combat free radicals and enhance immune function by modulating both cell-mediated and humoral immunity. Ginger's immunomodulatory effects make it a potential supplement for managing immune-related diseases. Additionally, ginger's antiviral and antibacterial properties can aid in fighting off infections, such as respiratory viruses. It is also used to alleviate symptoms of colds and flu, further supporting its role as an immune system enhancer. Overall, ginger's multifaceted benefits make it a valuable addition to a healthy lifestyle, offering protection against chronic diseases through its antioxidant and anti-inflammatory actions

6. **Turmeric**

Figure 6: An Overview of Turmeric

Synonyms: Indian saffron, Turmeric

Biological source: It is the dried rhizome of Curcuma longa Linn.

Family: Zingiberaceae

Geographical source: The plant is a native to southern Asia and is cultivated extensively in temperate regions. It is grown on a larger scale in India, China, East Indies, Pakistan, and Malaya.

Chemical constituent: Turmeric, derived from Curcuma longa, is rich in various chemical constituents that contribute to its medicinal and culinary properties. The primary coloring matter, curcuminoids, includes curcumin (about 60-77%), demethoxycurcumin (around 17%), and bisdemethoxycurcumin (approximately 3-6%). The essential oils, which make up about 3-7% of turmeric, contain zingiberene (25%), α-phellandrene, sabinene, turmerone, arturmerone, borneol, and cineole. Additionally, turmeric includes other compounds such as diarylheptanoids, phenylpropene, monoterpenes, sesquiterpenes, diterpenes, triterpenoids, sterols, and alkaloids. These diverse compounds contribute to turmeric's anti-inflammatory, antioxidant, and other bioactive properties, making it a valuable ingredient in both traditional medicine and modern applications.

Uses: Curcumin, the active compound in turmeric, has shown significant potential in supporting as an immunity booster, curcumin can enhance immune function by reducing inflammation and oxidative stress, which can help protect against infections. Furthermore, its ability to modulate immune responses may support overall health by preventing chronic diseases. However, curcumin's low bioavailability limits its effectiveness unless taken in supplement form or combined with bioavailability enhancers like piperine. It also has potential benefits in cancer treatment by inhibiting cancer cell growth and reducing metastasis. Additionally, curcumin may boost neurotransmitters like serotonin and dopamine, aiding in mood regulation and potentially serving as an adjunct treatment for depression. Beyond CNS health, curcumin's anti-inflammatory properties make it effective in reducing pain and inflammation in conditions such as osteoarthritis.

7. **Tulsi**

An Overview of Turmeric

Synonym: Holy basil, Sacred basil

Biological Source: Tulsi consists of fresh and dried leaves of Ocimum sanctum L. and Ocimum basilicum.

Family: Labiatae

Geographical source: Ocimum sanctum is native to tropical and subtropical regions of Asia and found in Latin America as well as in Southern hemisphere.

Chemical constituent: Fresh leaves and stem of Ocimum sanctum extract yielded some phenolic compounds (antioxidants) such as cirsilineol, circimaritin, isothymusin, apigenin and rosameric acid, and eugenol. The leaves of Ocimum sanctum contain 0.7% volatile oil comprising about 71% eugenol and 20% methyl eugenol. The oil also contains carvacrol and sesquiterpine hydrocarbon caryophyllene. Two flavonoids orientin and andvicenin from aqueous leaf extract of Ocimum sanctum have been isolated.

Uses: Tulsi is also known as "the elixir of life" since it promotes longevity. Different parts of the plant are used in Ayurveda and Siddha systems of medicine for prevention and cure of many illnesses and everyday ailments like common cold, headache, cough, influenza, earache, fever, colic pain, sore throat, bronchitis, asthma, hepatic diseases, malarial fever, as an antidote for snake bite and scorpion sting, flatulence, migraine headaches, fatigue, skin diseases, wound, insomnia, arthritis, digestive disorders, night blindness and diarrhoea. The leaves are good for nerves and to sharpen memory.

5. **Need of Study:**

Herbal Medicine is the oldest form of healthcare known to mankind. Herbs had been used by all cultures throughout history. It was an integral part of the development of modern civilization. Primitive man observed and appreciated the great diversity of plants available to him the immune system is one of the most intricate biological systems in the body. It is an intricate network of specialty cells, organs, proteins, and substances. It is critical for giving protection against a range of pathogens, such as bacteria, viruses, and fungi as well as malignant cells. Host immunity is generally understood to consist of both innate (non-specific) and adaptive (specific) immunity. An organism is more susceptible to infections when its immune system is compromised. These infections can lead to the development of diseases like inflammatory bowel disease, rheumatoid arthritis, and allergy disorders. Unprocessed or naturally occurring plant foods, which may or

may not contain bioactive components, are the basis for plant-based functional foods.

The consumption of traditional herbal medicine in those days, are now pursuing their interest by familiarizing themselves with traditional herbal products for the treatment of a range of health issues in diverse local, national, and international contexts (WHO). Undoubtedly, a significant increase in the last ten years has been seen by some skeptics. in the public's interest in and acceptance of natural remedies for practical use in both industrialized and developing nations. Due to this, herbal treatments are now available in tablet storage in preparation for commercialization, in addition to drug storage. Additionally, it has been meticulously and carefully estimated that up to four billion people, or 80% of the world's population, who live in poorer nations depend on herbal remedies. In the present experiment, an herbal formulation was made to prepare an effective immunity booster by using various herbal ingredients. Many of these ingredients are also having antiviral activity such as ashwagandha, tulsi and ginger. Amla is also rich in natural antioxidants, and ginger has anti-inflammatory and antimicrobial properties. Common possess antifungal properties along with flavour. The prepared formulation was evaluated for various phytochemical properties.

6. Methodology

Collection: The Liquorice, Amla, Giloy, Ashwagandha, Ginger, Turmeric and Tulsi used in preparation of herbal immunity tablet were collected from local market of Samastipur in march 2025. These crude drugs were then separately dried in shade, crushed and powdered and pass-through sieve no.60, lastly packed in a well closed container to protect from the moisture.

Authentication

Drying: Sun drying is the evaporation of water from the product by sun, or solar heat , assisted by movement of surrounding air. After the collection of Ginger, Tulsi, Turmeric, Liquorice, Amla, Ashwagandha and Giloy, they were sun dry for 48 hours. Place the trays in an area with direct sunlight. The sun's heat helps to evaporate moisture from the herbs, drying them naturally. It's essential to monitor the weather conditions and choose sunny, dry days for optimal drying. The drying time varies depending on factors such as the type of herbs, weather conditions, and thickness of the layers. It may take several days to a week for the herbs to fully dry.

Pulverization: The pulverization process plays a critical role in the formulation of immunity booster tablets, as it directly influences the uniformity, compressibility, and bioavailability of the final product. The objective of this step is to reduce the particle size of raw herbal and/or synthetic ingredients to ensure a homogeneous blend and optimal compaction during tablet manufacturing.

1. Selection and Preparation of Raw Materials

Raw materials e.g., Curcuma longa, Zingiber officinale, Withania somnifera, Ocimum sanctum, Glycyrrhiza glabra, Emblica officinalis and Tinospora cordifolia. The materials are air-dried or oven-dried (at 40–50°C to preserve bioactive compounds) before undergoing size reduction.

2. Primary Pulverization

Dried materials are subjected to coarse grinding using a hammer mill or cutter mill to break them down into moderately fine particles. This step aids in removing foreign matter and makes the material suitable for secondary pulverization.

3. Secondary Pulverization

The coarse powder is further processed using a ball mill, jet mill, or pulveriser (impact mill) to achieve a fine and uniform particle size. For herbal materials, a cryogenic grinding method may be employed to prevent heat-induced degradation of phytoconstituents.

- Particle size target: Typically, <250 microns for optimal blending and tablet formation.

- Equipment used: Pulverizer or high-speed mechanical mill with mesh sieves of varying sizes (60–120mesh).
- Cooling system: An optional cooling jacket or cryo-grinding chamber can be used to prevent overheating.

Sieving and Blending:

After pulverization, the powder is passed through a vibratory sieve shaker to ensure uniform particle size distribution. Sieved powder is collected and stored in airtight containers under controlled humidity to prevent degradation or moisture absorption.

Figure 7: Powdered Drugs

Evaluation of Powder:

1. **Organoleptic Evaluation:** The product was evaluated on the basis of Colour, Odour, Taste, Appearance etc.
2. **Physicochemical Evaluation:** Various physicochemical test was performed such as angle of repose, bulk density, tapped density, moisture content.

(A) **Angle of repose:** To evaluate the angle of repose, a fixed funnel method was selected for evaluation. A funnel was fixed at a predetermined height, over a grid paper placed on levelled surface. The tip of the funnel was blocked and the powdered formulation was filled in the funnel. After which the powder was allowed to flow from the funnel on to the graph paper, then mark was made on the paper along the circumference of the pile. The radius (r) of the pile and the height (h) was then measured. The angle of repose (θ) was determined by using: **$\tan \theta$ = height/radius**

Where,

θ = angle of repose, h= height of pile, r= radius of pile.

Table 1: Angle of repose and corresponding flow properties

Value of angle of repose	Flow properties
≤30°	Free flowing material
≥40°	Poorly flowing material
25°-30°	Excellent flow properties
31°-35°	Good flow properties
36°-40°	Fair flow properties

Figure 9: Angle of Repose

(B) **Bulk Density:** The fine-grained formulation was put into a dry 100ml measuring cylinder without compaction. The powder was precisely flattened, ensuring that powder was not compacted and the apparent volume (Vo) was recorded. Formula for calculation of bulk density is as follows:

ρ (b) = M / Vo (gm/ml)

Where, ρ (b) = Apparent Bulk density, M = sample's weight, Vo = volume of sample.

(C) **Tapped Density:** After the bulk density process, measuring cylinder containing the powder was tapped using Tap Density tester. The sample was tapped 100 times and the volume after tapping was recorded to the closest graduated unit, giving us the tapped volume (Vf). To calculate the tapped density, we use the formula:

ρ (tap) = M / Vf (gm/ml)

where, ρ (tap) = Tapped density, M = weight of sample, Vf = volume of sample.

Figure 10: Bulk and Tap density

(D) **Carr's Index (The Compressibility Index)**: Carr's Index is a measure of tendency of a powder formulation to be compacted, which is determined using the bulk and tapped densities. The less compactible the better flow property it is. It measures the inter-particulate interaction of material. In free-flowing powder. The formula used for calculation of Carr's Index is,

Carr's Index = {[ρ (b) – ρ (tap)]/ ρ (tap)} * 100

Where, ρ (b) = Bulk density, ρ (tap) = Tapped density.

Table no. 2 Carr's index table

Compressibility	Index properties
≤10	Excellent
11-15	Good
16-20	Fair
21-25	Passable
26-31	Poor

Hausner's Ratio:

Hausner's Ratio is the secondary measure of property of bulk material, the number associated to flowability of a powder formulation. The formula is as follows:

Hr = ρ (tap)/ ρ (b)

Where, ρ (tap) = Tapped Density, ρ (b) = Bulk Density.

Table 3: Hausner's Ratio and flow properties

Hausner's Ratio	Flow properties
1.00-1.11	Excellent
1.12-1.18	Good
1.19-1.25	Fair
1.26-1.34	Passable
1.35-1.45	Poor
1.46-1.59	Very poor

>1.60	**Very very poor**

7. **Formulation:**

Materials

Preparation of dry powder of Giloy, Ginger, Tulsi, Turmeric, Liquorice, Ashwagandha, Amla was triturated separately with the help of mortar and pestle. Fine powder was prepared. Other required ingredients were collected from laboratory in college and triturated along with the other ingredients together. Tablet formulation was done by wet granulation method and further compressed by using hand operating tablet punching machine. The excipients used in the formulation are: Microcrystalline cellulose is used as diluent, Magnesium stearate is used as a lubricant, Sucrose is used as the filler, Talc is used as a glidant and gives the pleasant appearance to the tablet, and Acacia is used as the binder for the preparation of wet granules.

Table 4: List of instruments and glassware

Sr no.	Instrument/glasswares name
1	Digital weighing balance
2	Morter pestle
3	Sieve no.22
4	Beaker
5	Funnel
6	Glass rod

Method of Preparation of Tablet

For making tablets, certain additives are also added to the medications. Tablets can be flat or biconvex and are typically round in form the molded or compressed solid dosage forms of powdered herbs.

The following steps are involved in the preparation of tablet:

Weighing of ingredients:

When using raw drugs, they must first be finely ground and sieved through a no.100 mesh. The fine powder (or other medications) and other ingredients need to be precisely weighed using a high-quality balance.

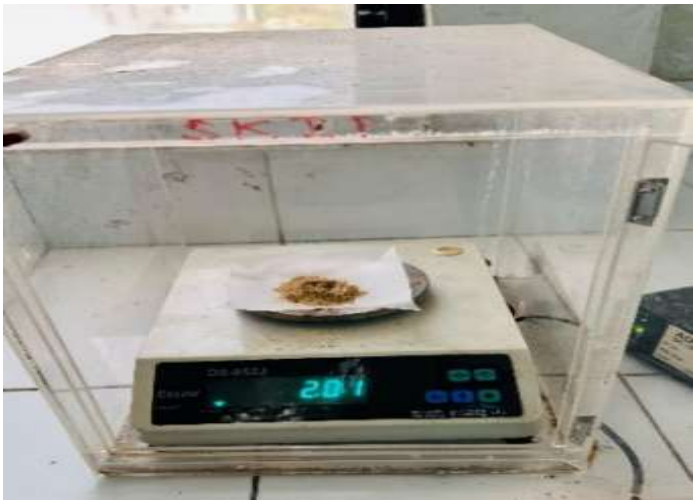

Figure 11: Digital Weighing Balance

Mixing

Mixing is uniformly combined. In order of increasing weight, the ingredients should be combined. In order to create a homogenous mass from which uniform tablets can be produced, all of the medications and excipients.

Figure 12: Mixing In Pestle Mortar

Preparation of 1% Acacia Solution

1.4 gm of acacia powder was dissolved in 140 ml distilled water, stir continuously to form a jelly like appearance.

The mixed ingredients can be converted into granules by the following method:

Wet granulation method: The most popular approach is this one. In order to create a cohesive mass, weigh all the ingradients accurately, mix well and triturate using morter and pestle the prepared 1% binding agent was added slowly to form a damp mass. The damp mass was then transfer through a sieve no.22. The granules are dispersed across trays and heated to 60°C in a hot air oven to dry. The dried granules were passed through sieve number 20. After passing through sieve number 20, to avoid slug formation, the well dried granules are ready for compression.

Figure 13: Dried Granules

Table 5: Formulation of Tablet Each 500 mg tablet has following ingredient

S.NO.	NAME OF DRUGS	QUANTITY
1.	Liquorice	2gm
2.	Turmeric	2 gm
3.	Dry ginger	2 gm
4.	Giloy	2 gm
5.	Tulsi	2 gm
6.	Amla	2 gm
7.	Ashwagandha	2 gm

Table 6: Excipient

S.NO.	EXCIPIENTS	QUANTITY	CATEGORY
1.	Microcrystalline cellulose	26.6g	Diluent
2.	Magnesium stearate	1.4g	Lubricants
3.	Sucrose	11.2g	Filler
4.	Acacia	1.4g	Binder
5.	Talc	0.14g	Glidant
6.	Starch	1.26g	Disintegrates

Tablet Compression

The one punch tablet machine was employed for preparation on a small scale. It can be operated manually or electrically.

Figure 14: Herbal Immunity Tablets

8. **Evaluation of Tablets:**

Physical evaluation of tablets:

The tablets were subjected to the following evaluation tests.

Weight variation test: The weight variation test was performed by following procedure. Weigh 20 tablets individually and consider as X1, X2,X3,…..X20. Determine the average weight of 20 tablets X= (X1+X2+X3+….+X20)/20. The individual weight was compared with the

upper limit and lower Limit. Not more than two of the tablets differs from the average Weight by more than the % error listed, and no tablets differ by More than double that percentage.

Table 7: IP Limits for Weight Variation

Average weight of tablets(mg)	Max% difference allowed
80 or less	10%
80-250	7.5%
More than 250	5%

Friability test:

Friability of a tablets can determine in a laboratory by Roche Friabilator. The friabilator consists of plastic chamber that rotates at 25rpm, dropping the tablets through a distance of six inches in the Friabilator, which is then operated for 100 revolutions. The tablets are Reweighed. Compress tablets loss less than 0.5% to 1.0% of the tablet weight are considered acceptable.

Figure 15: Roche Friabilator

Hardness and thickness test:

The hardness of the tablets was measured using the Monsanto hardness tester and the hardness of the tablets was recorded in kg/cm^2 unit. The tablet to be tested was placed between the spindle and anvil. The desired pressure needed to hold the tablet in position moved so that the indicator was fixed zero. The pressure was then applied till the tablet broken. The reading was noted, which indicate the pressure which was needed to break the tablet. Optimal Range: 4–10 kg/ cm^2**.**

Figure 16: Monsanto Hardness Tester

Disintegration Test:

The disintegration test is used to show how quickly the tablet breaks down into smaller particles, allowing for a greater surface area and availability of the drug when taken by a patient. Disintegration tests are however, useful for assessing the potential importance of formulation and process variables on the biopharmaceutical properties of the tablet, and as a control procedure to evaluate the quality reproducibility.

Disintegration Tester (Basket-rack assembly): Consists of 6 glass tubes (open at both ends) held vertically in a rack. Each tube has a 10-mesh stainless steel screen at the bottom.

- Fill the vessel with the appropriate disintegration medium (typically 800–1000 mL).
- Maintain the temperature at 37 ± 2°C.
- Place one tablet in each of the six tubes of the basket-rack assembly.
- If using disks (for floating or sticky tablets), place a perforated plastic disk on top of each tablet.
- Lower the basket-rack assembly into the medium.
- Operate the apparatus at 29–32 cycles per minute (up-down movement).
- Observe the tablets periodically.

Figure 17: Disintegration Tester

9. **Result and Discussion:**

Organoleptic evaluation:

Evaluation of powder:

Table 8: Organoleptic evaluation

S.NO	Organoleptic parameter	Result
1.	Colour	Brownish green
2.	Odour	Characteristic
3.	Taste	Bitter
4.	Texture	Fine

Physicochemical evaluation:

Angle of repose:

$\tan \theta$ = height/radius

$\tan \theta = 2.9/4.25$

$\tan \theta = 0.684$

$\theta = \tan^{-1}(0.684) = 34.3°$

Bulk Density:

ρ (b) = M / Vo (gm/ml)

ρ (b) = 14gm/ 35ml

ρ (b) = 0.4gm/ml

Tapped Density:

$$\rho (tap) = M / Vf (gm/ml)$$

$$\rho (tap) = 14gm / 26ml$$

$$\rho (tap) = 0.538gm/ml$$

Carr's Index (The Compressibility Index):

$$\text{Carr's Index} = \{[\rho (b) - \rho (tap)]/ \rho (tap)\} * 100$$

$$\text{Carr's Index} = (0.5380.538-0.4) \times 100$$

$$\text{Carr's Index} = 25.65\%$$

Hausner's Ratio:

$$Hr = \rho (tap)/ \rho (b)$$

$$\text{Hausner Ratio} = 0.4/538$$

$$\text{Hausner Ratio} = 1.345$$

Table 9: Physicochemical evaluation

S.No	Physicochemical Parameter	Result
1.	**Angle of repose**	**34.3°**
2.	**Bulk density**	**0.4gm/ml**
3.	**Tap density**	**0.538gm/ml**
4.	**Carr's index**	**25.65%**
5.	**Hausner's ratio**	**1.345**

Evaluation of tablet:

Weight variation test:

Table 10: Weight Variation Test

Sr. no.	Weight of tablets(mg)	Sr. no.	Weight of tablets(mg)
1.	552mg	11.	579mg
2.	566mg	12.	575mg
3.	582mg	13.	588mg
4.	575mg	14.	547mg
5.	582mg	15.	574mg
6.	549mg	16.	564mg
7.	585mg	17.	585mg
8.	589mg	18.	581mg
9.	578mg	19.	583mg
10.	594mg	20.	572mg

Average weight=11500/20 = 575mg

5% of 575mg is 28.75mg (Weight variation range is +or-)

Lower limit= Average weight - (average weight %error)

Lower limit= 575-28.75 = 546.25mg

Upper limit= Average weight+ (average weight % error)

Upper limit= 575+28.75= 603.75mg

According to IP Average weight of tablets >250 allowed 5% of variation.

All the individual weight of tablets is within the upper and lower limit.

Friability test:

20 tablets are weight together

Initial weight = 11500

Final weight (after rotation) = 11460

Friability = Initial weight – Final weight/Initial weight * 100

Friability =11500-11460/11500 *100 = 0.34%

Hardness test:

Tablet 1 = 6kg/ cm^2**.**

Tablet 2 =4kg/ cm^2**.**

Tablet 3= 5kg/ cm^2**.**

All 3 tablets are within the range of hardness which is 4 to 10kg/cm^2**.**

Disintegration Test:

If 1 or 2 tablets fail → Repeat test with 12 additional tablets.

If more than 2 tablets fail in total → Test Fails.

For uncoated tablets disintegration time is <15 minutes.

All six tablets disintegrate within the specified time → Test Passes.

10. **Conclusion:**

Polyherbal tablet using Ginger, Turmeric, Giloy, Ashwagandha, Liquorice, Tulsi & Amla were prepared and evaluations were carried out for the following parameters physical appearance visual inspection, thickness, weight variation, hardness, friability and disintegration time. The formulated polyherbal tablets were not only safer than the chemical agents but also work as antioxidant and improve Immunity. The evaluation parameter data was shown in acceptance range. Further studies are appreciated for comparing this preparation with the marketed one and establishing some effective results for better quality and safety use of the Tablet.

Research on the possible advantages of herbal immune booster tablets is still underway, although opinions on how efficient they are have varied as have the findings. Certain herbs and components are frequently present in immunity booster tablets, like turmeric, ginseng, tulsi and giloy, have been linked in certain studies to immune system support and decreased risk of infection. It is crucial to remember that the effectiveness of herbal immune booster tablets might vary depending on a number of factors, such as the specific health problems of each individual and the quality and dose of the ingredients, as well as lifestyle choices in general. Herbal immunity boosting tablets may have beneficial effects for certain individuals, such as decreased disease frequency or increased vitality. Others might not detect any appreciable differences. It's critical to use cautious when using herbal supplements.

In summary, as our immune systems are crucial in protecting our bodies from disease, maintaining a good immune system is critical to our overall health. Keeping yourself healthy and living a healthy lifestyle might help strengthen your immune system. Even though there are allopathic drugs that can combat oxidative stress and increase immunity, it's important to explore alternatives because of these drugs' expensive side effects. Ayurvedic medications have a potential future in natural medicinal development. It is anticipated that the primary component of an immune modulator medication that is safe, effective, and reasonably priced will be herbs. Because of the COVID-19 pandemic, humanity as a whole is suffering.

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