



PLANT-DERIVED IMMUNOACTIVE JELLIES: FORMULATION STRATEGIES, CHARACTERIZATION, AND APPLICATIONS

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ABSTRACT

Plant-derived immuno-active jellies have gained increasing attention as innovative, palatable, and patient-friendly delivery systems for immune-supporting bioactive compounds. These semi-solid formulations integrate medicinal plant extracts with functional gelling matrices, offering improved acceptability, especially for pediatric, geriatric, and nutraceutical applications. This review provides a comprehensive overview of formulation strategies, characterization techniques, and applications of immune-boosting jelly formulations developed from plant sources. Various medicinal plants with established immunomodulatory potential, including *Ocimum sanctum*, *Withania somnifera*, *Tinospora cordifolia*, *Zingiber officinale*, *Curcuma longa*, *Embllica officinalis*, and *Aloe vera*, are discussed in relation to their phytochemical constituents and mechanisms of immune enhancement. Different types of jelly formulations—such as gelatin-based, pectin-based, agar-based, and sugar-free or functional polymer-based systems—are highlighted with respect to their formulation suitability and

performance. Key formulation considerations, including the selection of gelling agents, sweeteners, preservatives, and strategies to enhance stability and bioavailability, are critically examined. The review also summarizes essential physicochemical and biological characterization parameters, including organoleptic properties, pH, viscosity, texture profile, content uniformity, stability, and in vitro release behaviour. Furthermore, the therapeutic and

commercial applications of plant-derived immunoactive jellies in immune support, preventive healthcare, and functional foods are explored. Overall, this review emphasizes the potential of immunoactive jelly formulations as effective and consumer-acceptable platforms for immune enhancement and highlights future perspectives for their development and clinical translation.

KEYWORDS: Immunoactive, Jelly, Plants, Herbal jelly Application, Evaluation.

INTRODUCTION

Immunity

"Immunity" refers to the body's capacity to defend itself against the harmful effects of pathogenic microorganisms. Immunology is the study of immunity, and immunological preparations are the means by which immunity is induced.^[1]

The body's natural defence system against dangerous microorganisms like bacteria, viruses, fungi, and parasites is called immunity. It is essential for maintaining general health and preventing illness. Autoimmune illnesses can arise from the immune system attacking itself. The immune system is made up of numerous organs, tissues, and cells that cooperate to fight illness, infection, and cellular damage. The immune system is made up of numerous components that cooperate to protect the body from foreign intruders.^[2]

The complex immune system is divided into two types

Innate (or) Non-specific immunity: which involves the activation and involvement of already existing mechanisms, such as secretions and natural barriers (skin and mucosa).

Adaptive (or) Specific immunity: which targets previously identified particular microorganisms or antigens. The innate immune system first recognizes a pathogen that the host is unfamiliar with, and then the adaptive immune response is triggered. Various types of cells involved in different immunity are given in Table 1.^[1]

Table no 1: Types of cells.^[2]

Innate immunity		Adaptive immunity
Neutrophil		
Monocyte		
Dendritic cell		Secreted antibody
Natural killer cell	B-cell	Plasma cell
Eosinophil	T-cell	CD4+ T cell

Basophil		CD8+ T cell
Mast cell		
Macrophage		

Immuno-boosters

It is believed that "immune-boosters" enhance immune system function. They may include various vitamins and minerals, probiotics, herbal supplements, and lifestyle components, including physical activity and stress reduction techniques.

Benefits

1. Natural ingredient: Herbal immunity booster powder is usually made using natural substances that are said to have immune-boosting qualities, such as fruits, herbs, roots, and spices.
2. Support for the immune system: Many of the plants and herbs used in these powders have substances that are believed to strengthen the immune system.
3. Lower chance of adverse effects: Because herbal immune booster powders are composed of natural substances, they are frequently thought to have fewer adverse effects than manufactured supplements or drugs.

Types of Immuno-Boosters

☐ Natural Substances

Vitamins, minerals, and herbs are commonly used as organic immune boosters. They promote the immune system's efficient and healthy functioning. Garlic and Echinacea are examples of herbs with antiviral and antibacterial properties that are believed to help the body fight against infections.

☐ Vaccinations

A specific family of immuno-boosters known as vaccinations works by introducing a tiny amount of the pathogen into the body. To identify and combat the disease-causing pathogen itself in the future, this increases the immune system's creation of antibodies. Measles, polio, and COVID-19 are just a few of the infectious diseases that vaccinations are highly effective in preventing.

☐ Medications

They can be used to treat autoimmune diseases, persistent infections, and diseases like cancer. For example, interferon is a medication used to treat certain malignancies and viral

infections by boosting the immune system's reaction. Another class of immunomodulators called interleukins can be used to treat autoimmune illnesses like rheumatoid arthritis.

□ **Lifestyle changes**

A balanced diet, stress management, regular exercise, and getting enough sleep are all examples of changing one's lifestyle. The body may receive the building blocks it needs to sustain immunological function by eating a healthy diet full of fruits, vegetables, and whole grains.

□ **Vitamins and Minerals**

Vitamins and minerals significantly improve immune system support. For instance, vitamin C is necessary for the production of white blood cells, which are vital in the battle against infections.

□ **Probiotics**

Among other health advantages, probiotics are live microorganisms that have been demonstrated to strengthen the immune system. Probiotics can enhance the function of immune cells, such as T-cells and natural killer cells, which are crucial for identifying and eliminating foreign invaders.

□ **Medicinal herbs**

Herbs utilised in medicine are known as medicinal herbs. The immune system may be strengthened by a few medicinal herbs. For instance, echinacea is a popular herb used to strengthen the immune system. It can increase the synthesis of white blood cells and immune cell activity. Other plants such as astragalus, ginseng, and turmeric can also boost immune cell function.

□ **Exercise**

Exercise improves blood flow and reduces stress, both of which can boost immunity. Exercise improves the immune system by lowering inflammation.

□ **Sleep**

Not getting enough sleep is necessary to maintain immunological function. While you sleep, your body produces cytokines—proteins that help fight infections and inflammation. Lack of sleep increases the risk of illnesses and compromises immunity.^[2]

Immuno-modulators

Natural or synthetic compounds that suppress, enhance, or alter the immune response either positively or negatively are known as immunomodulators. Another name for them is "disease-modifying drugs" (DMDs).^[3]

Numerous proteins, amino acids, and natural substances, such as steroids and interferon- γ (IFN- γ), have demonstrated a notable capacity to control immunological responses. These chemicals have the ability to activate, inhibit, or modify any aspect of the immune system, including the innate and adaptive arms of the immune response. The following three categories can be used to categorise immunomodulators clinically (Fig1).^[4]

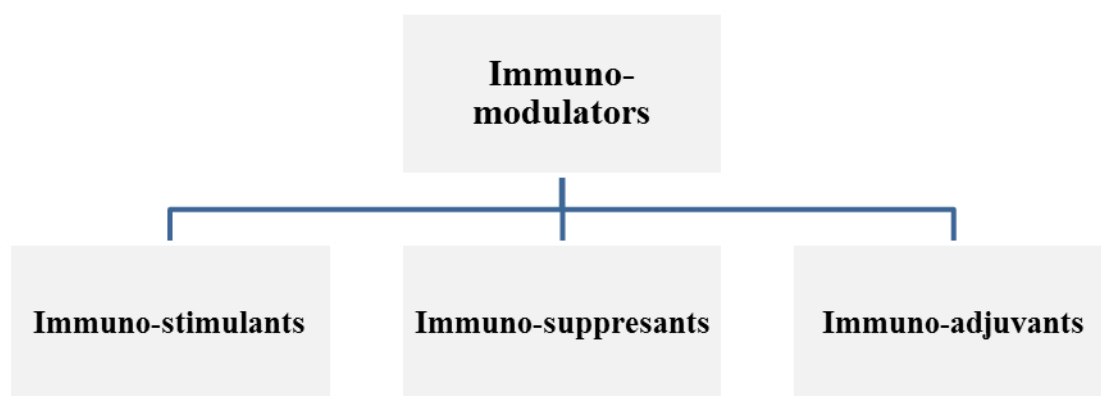


Figure 1.: Type of immunomodulator.

Immuno-stimulant: By boosting the fundamental level of immune response, immunostimulants are anticipated to work as preventive and promoter agents, or immunopotentiators. They are anticipated to function as immunotherapeutic drugs in individuals with immune response deficiency. Both innate and adaptive immune responses can be used by them.^[4]

Immunosuppressants: These drugs may be used to treat autoimmune diseases, graft rejection, graft versus host disease, acute or delayed hypersensitivity reactions, and immunological pathology associated with infections. These drugs are mostly used to treat autoimmune diseases and prevent transplant rejection. Although it can also be caused by pharmaceutical or environmental factors, immunosuppression mostly refers to a decrease in response to stress and diseases.^[3]

Immunoadjuvants: These substances could be regarded as particular immunostimulants since they are used to increase the effectiveness of vaccines. Immunoadjuvants have the potential to be the real immune response modulators.^[4]

When certain chemicals and vaccinations are used together, the level of protection is higher than when the two are used separately.^[3]

JELLY

The 17th edition of the Japanese Pharmacopoeia states that jellies intended for oral administration are non-flowable gelatinous compositions with a specific size and shape.^[5] Jellies are defined as clear or slightly opaque, non-greasy, semi-solid formulations intended for use both internally and externally.^[6]

Oral jellies are the most common and user-friendly route for drug delivery, as they are economical, simple to use, and promote better patient adherence to therapy. With recent progress in novel drug delivery systems (NDDS), there has been a strong focus on improving the safety, effectiveness, and convenience of dosage forms, which has led to the development of oral medicated jellies. These formulations enhance drug bioavailability, minimise extensive hepatic first-pass metabolism, reduce drug loss and the risk of dose dumping, and improve product stability along with effective taste masking. At present, jelly-based dosage forms are highly acceptable, particularly among children with fully developed dentition, as they are appealing due to their pleasant taste, chewable nature, and attractive flavours derived from fruit juices and extracts, combined with an appropriate level of sweetness. Immunoactive jellies have gained increasing attention as innovative, palatable, and patient-friendly delivery systems for immune-supporting bioactive compounds. These semi-solid formulations integrate medicinal plant extracts with functional gelling matrices, offering improved acceptability, especially for pediatric, geriatric, and nutraceutical applications.^[1]

Jelly dosage forms may be categorized according to various criteria such as the route of administration, therapeutic use, and formulation properties. This system of classification helps in comprehending the diverse nature and wide-ranging applications of jellies in contemporary pharmaceutical practice.^[5]

Medicated Jellies: Medicated jellies are mainly applied to the skin and mucous membranes for their spermicidal, local anaesthetic, and antiseptic effects. These preparations contain an

adequate amount of water, which evaporates after application, producing a cooling sensation at the site of use. The remaining thin layer forms a protective coating.

Example: Ephedrine sulphate jelly is employed as a vasoconstricting agent to control nasal bleeding.

Lubricating Jellies: Lubricating jellies are non-medicated formulations used to reduce friction and assist in the smooth handling and insertion of diagnostic and medical instruments. They are commonly utilized with surgical gloves, catheters, and cystoscopes to enhance ease of use and patient comfort.^[7]

Miscellaneous jellies: These are meant for various applications like patch testing, electro-cardiography etc.^[8]

Based on route of administration

Topical Jellies: These are semisolid preparations designed for external use on the skin or mucous membranes. These formulations are applied to cutaneous or mucosal surfaces and function as carriers for the localized delivery of therapeutic agents such as analgesics, antiseptics, and antifungal drugs. They are generally prepared using hydrophilic bases, which enhance spreadability, patient comfort, and easy removal.

Topical jellies are intended to produce localized drug action and are commonly employed in the management of skin disorders, including acne, eczema, and burns, as well as oral conditions like mouth ulcers and gingival infections where mucosal application is required. These jellies provide a cooling sensation, spread uniformly, and do not leave an oily or greasy residue, unlike ointments or creams. The active ingredient penetrates the skin or mucosa at the site of application, resulting in a targeted therapeutic effect with minimal systemic absorption, for example, lidocaine jelly used for local anaesthesia.

Vaginal and rectal Jellies: These are intended for localized therapeutic use within the vaginal or rectal cavities. These formulations commonly act as vehicles for the delivery of antimicrobial, contraceptive, or anti-inflammatory agents. Their mucoadhesive characteristics help prolong the retention of the formulation at the site of administration, thereby enhancing drug availability and therapeutic effectiveness.

Dental Jellies: Dental jellies are bioadhesive or mucoadhesive formulations intended for application to the gingival tissues. They are commonly used in the management of gingivitis, periodontitis, and for providing local anesthesia. Typical active ingredients incorporated in dental jellies include chlorhexidine and benzocaine.

Ophthalmic Jellies: Ophthalmic jellies are sterile, clear formulations designed to remain in the ocular cavity for an extended period. They are used in the treatment of eye infections and inflammatory conditions. Commonly used active drugs in these preparations include ciprofloxacin and acyclovir.

Based on Therapeutic Purpose

Prescription Jellies Prescription jellies are designed for the management and treatment of specific medical disorders, including conditions such as epilepsy (for example, diazepam rectal jelly), allergic responses, and long-term illnesses. These medicated jelly formulations contain active pharmaceutical ingredients (APIs) that produce a desired therapeutic effect. Depending on their intended application, they may be administered via the oral, topical, or mucosal routes.

These jellies are developed to ensure precise dosing while offering a palatable dosage form, thereby enhancing patient compliance. The formulation also aims to maintain drug stability within the jelly base and enhance the bioavailability of certain APIs. Prescription jellies are widely utilized in nutraceutical products, vitamin supplements, pain-relieving agents, antihistamines, and as adjuncts in chemotherapy. Multivitamin gummy jellies and antifungal jellies for oral thrush.

Over-the-Counter (OTC) Jellies: Over-the-counter jellies are intended for self-care without medical supervision and commonly contain vitamins, plant-derived ingredients, or mild pain-relieving agents. These formulations are developed with an emphasis on user safety, pleasant taste, and convenient administration, making them suitable for routine use by the general population.

Nutraceutical and functional jellies: They are formulated with nutritional supplements, beneficial microorganisms, or antioxidant compounds and are primarily intended to promote overall health and well-being rather than to manage or cure particular diseases.

Based on Formulation Characteristics

Sugar-Based Jellies: Sugar-based jellies are formulated with elevated levels of sugars along with suitable gelling agents, which impart a desirable sweetness and smooth consistency. These jellies are widely used in pediatric dosage forms and nutraceutical products due to their acceptable taste and patient-friendly texture.

Sugar-free or diabetic-friendly jellies: Sugar free jellies are prepared using non-sugar sweetening agents such as sucralose or stevia, making them appropriate for people with diabetes and those who prefer low-calorie formulations.

Fast-dissolving jellies: These are specially designed to disintegrate quickly in the mouth, allowing for a rapid therapeutic effect, and are commonly utilized for the administration of emergency medicines.

Sustained or controlled-release jellies: They are formulated with specialized polymers that enable the slow and continuous release of the active ingredient over an extended duration, thereby enhancing therapeutic effectiveness and minimizing the need for frequent dosing. [9]

Herbal Plant Drug Profile: Various plants have been reported to be utilized in preparation of jellies.

1) *Moringa oleifera*

Family- Moringaceae family.

synonyms- Saguna, Horseradish tree, and drumstick tree.

Biological Source- *Moringa oleifera* seed pods, which are long, thin, and triangular in shape, are used to make the plant material.

Chemical Constituents- *Moringa* leaves contain a wide range of bioactive substances, such as lignans like secoisolariciresinol, isolariciresinol, medioresinol, and epipinoresinol glycosides; flavonoids like apigenin, quercetin, luteolin, myricetin, and kaempferol; and phenolic acids and their derivatives, such as coumaroylquinic, caffeoylquinic, and feruloylquinic acids.

Uses- *Moringa*'s ability to strengthen the immune system is well known. The body is shielded from oxidative stress and pathogens by its potent antioxidant action. Additionally, iron and vitamin A are essential for sustaining and promoting effective immune system function.

2) Ashwagandha

Family-Solanaceae

synonym-Ashwagandha, Indian Winter Cherry, and Indian Ginseng.

Biological Source- Withania somnifera roots.

chemical constituents- Alkaloids (isopelletierine, anaferine), steroidal lactones (withanolides, withaferins), sitoindosides, and acylsteryl glucosides.

Use- acts as an anti-inflammatory and immunomodulator, boosts immunity, lowers susceptibility to illness, and, because of its iron content, promotes the production of red blood cells.

3) Tamarind

Family- Leguminosae

Synonyms- Imli, Fructus tamarind

Biological Source- Tamarindus indica Linn's dried, mature fruits.

Chemical constituents- Invert sugars, potassium hydrogen tartrate, organic acids (tartaric, citric, and malic), and trace amounts of nicotinic acid.

Uses- As an antiscorbutic, digestive, carminative, and moderate laxative. In addition to being helpful for digestive issues, bilious vomiting, stomatitis, haemorrhoids, and poisoning instances, it also serves as a soothing cooling agent.

4) Blackcurrant

Biological source- Ribes nigrum is a deciduous shrub.

Family- Grossulariaceae

Chemical constituents- Anthocyanins (dark hue compounds). The two primary varieties are delphinidin-3-glucoside and cyanidin-3-glucoside. Vitamin C (200% of the daily required intake). The seeds include an omega-6 fatty acid called gamma- linolenic acid (GLA), which has anti-inflammatory properties. Flavonoids (Quercetin and kaempferol) have anti-inflammatory and antioxidant properties. Tannins Because of their astringent qualities, these substances aid in digestion. Essential Oils These oils, which are present in leaves, have antibacterial and anti-inflammatory properties.

Use- Strengthens the immune system (because of high vitamin C), Inflammation reduction (particularly with seed oil for ailments like arthritis), Flavonoids Offers antioxidants to guard against long-term illness.^[1]

5) Clove

Synonym- clove blooms and buds.

Biological source- The dried blossom buds of *Eugenia caryophyllus* Thumb are the biological source of clove.

Family- Myrtaceae.

Chemical constituents- Volatile oil makes up 14–21% of clove. Eugenol, acetyl eugenol, gallotannic acid, two crystalline principles, caryophyllenes, methyl furfural, gum, resin, and fiber are the other components.

Uses- Clove is used as an antibacterial (60% to 90%eugenol content), stimulant, carminative, aromatic, and flavouring ingredient. It can also be used as an anodyne and antiemetic. Dentists use clove oil as an oral anesthetic and as a root canal disinfection. Because clove kills intestinal parasites and has broad antibacterial properties against bacteria and fungus, it is used to treat intestinal worms, diarrhea, and other digestive diseases.

6) Onion

Synonym- bulb onion and common onion.

Biological source- The bulb of the plant *Allium ascalonicum* is the most widely consumed vegetable in the *Allium* genus.

Family- Amaryllidaceae.

Chemical constituent-polyphenolic compounds, phenolic acids, flavonoids (fisetin, quercetin), ascorbic acid, and sulphur compounds.

Uses- Nasal congestion, boosts the immune system, Sulphur, zinc, selenium, vitamin C, quercetin are all found in onions. Your immune system is strengthened by these potent minerals. Both flavonoids and the antioxidant component of quercetin are brimming with antiviral properties. The vegetable is rich in vitamin C, which is essential for immune system maintenance. Onions also contain more selenium, a trace element that strengthens the immune system, than other vegetables. Selenium may help treat allergic and inflammatory viruses.^[3]

7) Cinnamon

Synonyms- Cinnamon, Dalchini, Ceylon cinnamon, True cinnamon.

Biological Source: Cinnamon consists of the **dried inner bark of** *Cinnamomum zeylanicum* Blume.

Family-Lauraceae

Chemical Constituents: Cinnamaldehyde (major active component), Eugenol, Cinnamic acid, Cinnamyl alcohol, Tannins, Proanthocyanidins, Volatile oils.

Uses- Carminative, digestive aid, Flavouring agent, Antioxidant, antimicrobial agent, Anti-inflammatory activity, helps regulate blood glucose levels, supports immune function by reducing oxidative stress and microbial load, widely used in polyherbal immune.^[10]

8) Noni fruit

Synonyms- Noni, Indian mulberry, Great morinda, Cheese fruit

Biological Source-Noni consists of the **fresh or dried fruit of *Morinda citrifolia* L.**

Family-Rubiaceous.

Chemical Constituents- Iridoid glycosides (deacetyl asperulosidic acid, asperulosidic acid), Scopoletin, Damnacanthol, Anthraquinones, Flavonoids, Polysaccharides, Vitamins (Vitamin C, Vitamin A), Minerals (potassium, calcium).

Uses- Immuno-modulator, antioxidant agent, Anti-inflammatory activity, Antimicrobial agent, antiviral effects, Used in traditional medicine for infections, fatigue and **Immune-boosting**.^[11]

9) Ginseng

Synonym- Asian ginseng, Chinese ginseng, five fingers, Japanese ginseng, and Jintsam.

Biological source- Panax ginseng C.A. Mey and other Panax species such as Panax japonicus (Japanese ginseng), Panax pseudoginseng (Himalayan ginseng), Panax quinquefolius (American ginseng), and Panax Vietnamese (Vietnamese ginseng).

Family-Araliaceae.

Chemical Constituents- Panax ginseng contains triterpene glycosides, also referred to as saponins or ginsenosides. Numerous active compounds, including proteins, polypeptides, phenols, amino acids, alkaloids, and vitamins B1 and B2, are present in every part of the plant.

Uses- It has been used to increase focus, improve stress tolerance, and increase physical stamina and reduce weariness. Preparations of Panax ginseng affect the hypothalamus-pituitary-adrenal axis and the immune system. In terms of stimulating the immune system, the researchers discovered that standardised ginseng extract outperforms liquid ginseng extract.^[3]

10) Carica papaya

Synonyms- Papaw, Pawpaw, Papaya, and Erandkarkati.

Biological Source- The fruit and leaves of *Carica papaya* L., either fresh or dried.

Family- Caricaceae.

Chemical Constituents- The proteolytic enzymes papain and chymopapain, Flavonoids (kaempferol, quercetin), Alkaloids (carpaine), Vitamins A, C, and E, Phenolic substances, Saponins.

Uses- Immunomodulatory action, anti-inflammatory, antioxidant properties, increases platelet count, Proteolytic enzymes help in digestion, wound-healing, antimicrobial qualities. *Carica papaya* strengthens the immune system by: Improving the innate immune response, lowering oxidative stress, supporting digestion with enzymes, and providing vitamins necessary for immune system performance.^[2]

11) Turmeric

Synonym- Saffron Indian, haldi, curcuma, and *Rhizoma curcuma*.

Biological Source- *Curcuma longa* Linn's dried rhizome is used to make turmeric.

Family- Zingiberaceae

Chemical components- consist of 60–70% carbohydrates, 6–13% water, 6–8% protein, 5–10% fat, 2–7% dietary oils, 3–7% dietary minerals, 1–6% curcuminoids, and fibre make up turmeric powder. Volatile oil contains mono-and sesquiterpenes like zingiberene (25%), phellandrene, sabinene, turmerone, arturmerone, borneol, and cineole. The choleric effects of the essential oil are believed to be caused by tolylmethyl carbinol.

Uses- Due to its high iron content, turmeric can significantly strengthen immunity. Treatments are available for Alzheimer's disease, diarrhoea, jaundice, liver issues, and urinary issues. Rhizome has antiperiodic, carminative, stimulant, and aromatic properties. Curcumin is a yellow-orange chemical found in turmeric. Because all immune cells have cholesterol receptors throughout the immunological response, curcumin helps lower cholesterol levels and maintain immune cell homeostasis. inhibits the growth of parasites.

^[12]Ginger

Synonym- Adarak, *Rhizoma zingiberis*, and Zingibere.

Biological source- Rhizomes, which are sun-dried.

Family- Zingiberaceae.

Chemical Constituents- Ginger contains 1 to 2% volatile oil, 5 to 8% pungent resinous material, and starch. Gingerol, a yellowish, oily, odorless molecule, is the source of the drug's strong flavour and fragrant odour. Volatile oil is composed of sesquiterpene hydrocarbons

such as "zingiberol," "sesquiterpene alcohol," "bisabolene," "farnesen," and "sesquiphellandrene". Additionally, there are less acidic components such gingerone and shogaol. When fresh rhizomes lack gingerol due to dehydration, shogal is produced.

Uses- Ginger helps boost immunity because of its anti-inflammatory and antioxidant qualities. In fact, drinking a cup of ginger tea or kashayam first thing in the morning may boost immunity and avoid illness. Honey and fresh rhizome juice are used to cure asthma and cough. Ginger rhizome contains a flavouring ingredient that has a warm, spicy flavour and a potent scent. Male endurance athletes who took ginger rhizome powder for six weeks showed a marked decrease in fatigue in a medical study.^[3]

12) *Acacia catechu*

Synonyms- Khair, Black catechu, Cutch tree.

Biological Source- *Acacia catechu* is obtained from the heartwood and bark of *Acacia catechu* (L.f.) Willd., which are processed to obtain the aqueous extract known as catechu

Family- Fabaceae (Leguminosae)

Chemical Constituents- Flavan-3-ols (catechin, epicatechin), Condensed tannins, Quercetin, Polyphenolic compounds, Gum and resins.

Uses- Immunomodulatory (affecting both arms of the immune system), aqueous extract enhances **cell-mediated immunity** by increasing neutrophil and improving phagocytic activity, along with protection against drug-induced neutropenia. Additionally, it stimulates **humoral immunity** by elevating serum immunoglobulin levels.^[12]

13). *Amla*

Synonym- Indian gooseberry, or emblica.

Biological Source- This is made up of both fresh and dried fruits from the plant *Emblica officinalis* Gaerth (*Phyllanthus emblica* Linn). Euphorbiaceae is the family.

Chemical components- include 37% emblicanin A, 33% emblicanin B, 14% pedunculagin, and 12% punigluconin. Amla also contains phyllanemblin A and punicafolin, along with other polyphenols such flavonoids, phyllanemblin, gallic acid, ellagic acid, and kaempferol. Increased levels of minerals, vitamins, amino acids, fixed oils, gallic acid, ellagic acid, and other polyphenol oils, as well as flavonoids like rutin, are among its many phytoconstituents.

Uses- Amla is a vitamin C-rich berry that helps heal a number of diseases and infections by boosting the body's production of white blood cells (WBC). Amla is much more rich in

calcium, iron, and a number of other minerals that contribute to the fruit's high nutritious content. Additionally helpful in decreasing cholesterol and managing diabetes.

13) GULVEL

Synonym- Guduch, Giloy, Amrita

Biological Source- It is made up of dried, fully grown *Tinospora cordifolia* Miers stems.

Family- Menispermaceae

Chemical constituents- N-methyl-2-(11-hydroxymustakone) and Cordifolioside A, pyrrolidone, N-formyl annonain, Magno florine, syringing, and tino

Uses- Anti-spasmodic, antimicrobial, anti-osteoporotic, anti-inflammatory, anti-allergic, and anti-diabetic properties. It affects the activity of cells known as macrophages (body and microorganisms) that fight foreign invaders, which promotes early recovery. Giloy's anti-inflammatory qualities are widely recognized, and it also helps with tonsils, colds, and coughs. Try Giloy powder, Kadha (tea), or pills for extra skin care. Toxins from the body without any problems. It also possesses pharmacological properties. Hepatoprotective, immunomodulatory, and hypoglycemia.^[3]

14) Black Pepper

Synonyms- Black pepper, Kali mirch, Peppercorn

Biological Source- Black pepper consists of the **dried unripe fruits (peppercorns) of *Piper nigrum* L.**

Family- Piperaceae

Chemical Constituents- Piperine (major active alkaloid), Piperettine, piperlongumine, Volatile oils (β -caryophyllene, limonene, pinene), Oleoresins, Flavonoids, Lignans.

Uses- Immunomodulatory activity (enhances immune response and improves bioavailability of other herbal constituents), Potent antioxidant and anti-inflammatory agent, antimicrobial activity against bacteria and fungi, Digestive stimulant, carminative, Widely used in polyherbal immune-boosting formulations, syrups, and jellies.^[13]

15) Adulsa

Synonyms- *Justicia adhatoda*, *Adhatoda vasica* Linn, Vasaka, Arusha, Malabar nut tree.

Biological Source- Adulsa is obtained from *Justicia adhatoda* / *Adhatoda vasica* Linn.,

Family- Acanthaceae.

Uses- Immune booster, treat pulmonary conditions (asthma, chronic bronchitis, and other respiratory disorders), and fever management due to antipyretic properties. Also used in wound healing by promoting tissue regeneration, accelerating healing, and reducing bleeding.

16) Liquorice

Synonyms- Mulethi, Sweet Root, Glycyrrhiza glabra

Biological source-The Glycyrrhiza glabra plant's roots and stolon's (underground stems).

Chemical constituents- Primary active ingredient is glycyrrhizin (glycyrrhizic acid), Liquiritin, (flavonoid), Glabridin (isoflavan).

Uses-Anti-inflammatory, Demulcent (calming substance), Antimicrobial, antiviral, Antiulcerogenic, Gastritis and peptic ulcers, Cough and sore throat (as a calming agent), Anti-inflammatory, Skin disorders (topical treatment for psoriasis and eczema).^[14]

Ingredients (or)/Other excipients used

Honey

Synonym-Madhu, Honey Purified, Mel, and Madh.

Chemical constituents- Dextrose, Levulose (Fructose), Sucrose, Dextrin and Gums and Ash.

Uses- The antimicrobial and wound-healing qualities of honey are well established. When a throat infection occurs, it is frequently used as a home remedy.^[15] Topical therapy for burns and wounds Sore throat and cough (oral), digestive disorders (such as gastritis and ulcers) Skin disorders (eczema, acne) Immune system support and general tonic.^[14]

Gelatin

Synonyms-Gelform, Puragel, and Gelatinum.

Family-Bovidae

Biological Source: An aqueous extract from the bones, skins, and tendons of numerous domesticated animals is evaporated to create gelatin, a protein derivative. Sheep, Bos taurus, and ox are notable sources.

Chemical Constituents: Gutin, the protein that makes up gelatin, hydrolyses to produce a mixture of amino acids. Glycine, alanine, valine, leucine, isoleucine, cystine and cysteine, methionine, tyrosine, aspartic acid, glutamic acid, arginine, lysine, and histidine.

Uses- Gelatin is used as a suspending agent, tablet binder, coating agent, and in the manufacturing of pastilles, paste, suppositories, capsules, pill coatings, and gelatin sponges. Gelatin also serves as a thickening, stabilizer, and texturizer in food items.

i. Sucrose syrup

Description: A dry, crystalline powder that is practically white or colourless, odourless, and sweet

Concentration- 66.7%

Uses- Pharmaceutical aid (sweetening agent; tablet excipient).

Storage- Keep in a dry, cool location.

ii. Stevia

Biological sources- Stevia rebaudiana leaves.

Uses: Stevioside, a diterpene glycoside with antitumor properties, by increasing insulin sensitivity and decreasing glucose absorption, stevia aids in blood sugar regulation. contains substances with antioxidant qualities that may aid in lowering inflammation and preventing disorders linked to oxidative stress. Shows antibacterial properties against specific bacteria and fungus, strengthening the immune system.

iii. Pectin

Uses- Pectin is used in baking and cooking as a thickening. used as a component of throat lozenges and to manage diarrhoea. In skincare products, pectin stabilizes emulsions.

iv. Agar

Synonyms- Kanten, Agar-agar.

Biological source: Rhodophyceae red algae, primarily Gracilaria and Gelidium.^[14]

Uses- In Microbiology, thickening and gelling agent in a variety of culinary applications (savory and sweet dishes). Its moisturizing and softening qualities make it suitable for use in face masks, acts as a natural laxative and appetite suppressant to aid in weight management.^[2]

v. Citric Acid

Class- Chelating agent, acidulant, or alkalinizing agent (depending on usage)

Mechanism- As a weak organic acid, citric acid neutralises excess acids or alkalis and buffers pH. Urine alkalinization is the process of raising the pH of urine to make it less acidic.

Uses- prevent kidney stones, in Effervescent tablets, pH control agent, Chelating agent(maintain stability), used as a flavoring and preservative.^[14]

Evaluation parameters of Jellies

Physical Evaluation: A physical component was examined at and recorded. Jellies' colour, texture, consistency, and look were assessed.

pH measurement: A digital pH meter was used to measure the jelly's pH. To do this, 0.5g of jelly and 50ml of distilled water were combined, and the pH was noted.

Stickiness and Grittiness: A jelly sample should be lightly rubbed between two fingers to visually evaluate the compositions for stickiness and grittiness.

Spreadability: Jelly had been placed between two glass slides and crushed to the required thickness using a 1000g weight for five minutes. The amount of time needed to separate two slides served as a gauge for spreadability. The formula for spreadability is

$$S = W \times \frac{L}{T}$$

Where S stands for spreadability, W for weight transferred to the upper slide, L for glass slide length, and T for the time needed to separate two slides.^[2]

Test for weight variation: First, five jellies were chosen. Weigh each of the five jellies together. Use this formula to determine the average weight.

$$\text{Average weight} = \frac{\text{weight of jellies}}{\text{no. of jellies}}$$

Next, weigh each of the five jellies individually and record their weights. Next, we used the formula to determine each jelly's percentage weight variation.

$$\% \text{Weight variation} = \frac{\text{Avg weight} - \text{Individual weight}}{\text{Average weight}} \times 100 \quad [1]$$

Stability study: The formulation's stability was examined for four weeks at a temperature between 25 and 30 °C.^[14]

Content Uniformity: Each formulation's jelly was first taken, crushed, and mixed. The appropriate medium was used to extract the medication equivalent from the mixture. A suitable analytical technique was used to determine the amount of medication contained in each extract, or a UV-visible spectrophotometer at the proper wavelength should be used to measure the absorbance of each solution. This test ensures that every. The dosage form in the batch contains the same quantity of "active pharmaceutical ingredients," or medicinal chemicals.

In-vitro dissolution study: The USP paddle-type apparatus was utilized for the *in-vitro* dissolution investigation with the dissolving media (900ml) kept at $37 \pm 0.5^\circ\text{C}$ and 50 rpm. Five millilitres of the sample should be taken out, diluted to ten millilitres in a volumetric flask, and then taken out at ten, twenty, thirty, forty, fifty, sixty, ninety, and one hundred minutes later. The 5 ml of sample that was extracted should be replaced with fresh medium to maintain the sink condition. The drug content of the sample was ascertained by using a UV spectrophotometer or a suitable analytical technique. The proportion of medication release was calculated after absorbance was measured.^[6]

Anti-microbial activity: The antimicrobial activity of different samples/compounds against both Gram-positive and Gram-negative bacteria was evaluated using the traditional agar well diffusion method. An autoclave was used to prepare and sterilize the nutrient agar medium at 121°C and 15 pounds of pressure for 20 minutes. Gram-positive (*Staphylococcus aureus*) and Gram-negative (*E. coli*) bacteria were individually added to sterile molten agar medium via aseptic transfer beneath a laminar air flow bench. The inoculated agar medium was immediately transferred onto sterile petri dishes and left to solidify. Wells were made on petri plates in the proper places using an 8 mm sterile borer. After adding the serum to the wells, the petri plates were set aside to let the sample diffuse through the agar medium. They were then incubated for 24 hours at 37°C .^[16]

Immunity testing for herbs- Various tests for plants have been prescribed in literatures for immunological activity are given in table no 2.

Table no 2: Immunity testing for herbs.

S. No	<i>In-vitro</i> methods	<i>In-vivo</i> methods
1	Mast cell inhibiting histamine release	Spontaneous autoimmune diseases in animals
2	Mitogen-induced proliferation of lymphocytes	Experimental autoimmune thyroiditis
3	T cell proliferation inhibition	Progressive anti-anaphylactic activity (Schultz-Dale reaction)
4	Chemiluminescence in macrophages	(GVHD) acute graft versus host rejection in Rats
5	Invitro PFC (plaque forming colony) assay	glomerulonephritis in rats caused by anti-basement membrane antibody
6	Inhibition of dihydro-orotate dehydrogenase	Preventing auto-immune uveitis in rats

Applications

◆ **Systemic Drug delivery** -Recent research suggests that oral medicated jellies can be effectively designed for systemic drug administration with modified, controlled, or sustained release characteristics. Maqbool demonstrated how medicated jellies can be designed to sustain steady plasma drug concentrations over extended periods of time, in addition to improving palatability and patient compliance. When compared to traditional solid dose forms, these formulations can provide improved therapeutic results by incorporating extended or controlled-release matrix. These developments imply that oral medicated jellies are a viable patient-centered approach for systemic drug administration, especially for individuals with swallowing issues or those in need of long-term medication.^{[9][21]}

◆ **Oral Health-** The use of oral medicated jellies in the management of oral health disorders has been well documented, particularly in conditions such as aphthous ulcers, gingivitis, and periodontal infections. Soft, jelly formulations have been shown in studies to enhance local drug retention and extend therapeutic effects on the oral mucosa, leading to considerable pain alleviation and quicker healing. Because these patient-friendly formulations are tasty and simple to take, they improve compliance and guarantee more reliable delivery of active ingredients to the affected areas. For oral medication delivery under oral cavity circumstances, the medicated jelly's prolonged residence duration on the mucosa makes it a practical and efficient method.^{[17][21]}

◆ **Geriatrics-** Oral medicated jellies have been extensively explored as a dosage form for geriatric patients, especially individuals affected by swallowing disorders or cognitive decline. According to sangmin, older adults encountered fewer swallowing difficulties and a reduced likelihood of aspiration when medications were delivered as jellies rather than traditional solid forms. Similarly, Abd Aziz noted better adherence to therapy, suggesting that the soft texture and ease of administration of oral jellies make them a more convenient, safer, and patient-oriented option for drug delivery in the elderly population.^{[18],[19][21]}

◆ **Pediatrics** -Multiple investigations have highlighted that oral medicated jellies are especially well-suited for pediatric use owing to their palatable flavor, soft and smooth consistency, and ease of ingestion. Studies conducted by Hosseini and sabri reported improved willingness and reduced resistance among children when medications were administered as jellies rather than conventional tablets or capsules. The jelly dosage form

efficiently conceals bitter taste and minimizes swallowing discomfort, leading to enhanced acceptability and improved therapeutic compliance in pediatric patients.^{[17],[20][21]}

CONCLUSION

Plant-derived immunoactive jellies offer a novel, palatable, and patient-friendly platform for delivering immune-boosting phytoconstituents. By combining medicinal plant extracts with functional jelly matrices, these formulations enhance patient compliance and suitability for pediatric, geriatric, and nutraceutical applications. Advances in formulation strategies and systematic physicochemical characterization support improved stability, dose uniformity, and bioavailability. Although challenges related to standardization, long-term stability, and regulatory acceptance persist, continued research and clinical validation can facilitate their translation into effective immune-support products. Overall, immunoactive jellies represent a promising approach for preventive healthcare and functional food development.

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REFERENCES

1. Mahajan PS, Barhate SD, Naik RR, Naik VV, Nanote SA. Formulation and evaluation of *Moringa oleifera* nutritive and immune boosting jelly [Internet]. Jamner: Shree Sureshdada Jain Institute of Pharmaceutical Education and Research; 2025 May 4.
2. Sushmitha K, Sirini PS, Tejaswini CH, Bhuvaneshwari CH, Kumar AS, Kumar AB. Formulation and evaluation of polyherbal medicated jelly. *Indian J Novel Drug Deliv.*, 2025; 17(2): 84–93.
3. Joshi SB, Rani KS, Patani P. A review on role of herbs and herbal plants as immunomodulators. *J Pharm., Negat., Results.* 2022; 13.
4. Mohan MR. Indian medicinal plants used as immunomodulatory agents: a review. *Int J Green Pharm.*, 2019; 13(4).
5. Taranum R, Mittapally S. Soft chewable drug delivery system: oral medicated jelly and soft chew. *J Drug Deliv., Ther., [Internet]*. 2018 Jul 14 [cited 2026 Jan 27]; 8(4): 65–72.
6. Indian P, Indian A, Aafreen. Formulation and evaluation of polyherbal medicated jelly. *JETIR.* 2023; 10(4): 1525–1527.
7. Sarojini S, Anusha K, Maneesha C, Mufaquam MA, Deepika B, Krishna Y. Oral medicated jellies: a review. *World J Pharm., Res.*, 2018; 7(6): 352–365.
8. Manali MR, Dhiren P. Oral medicated jelly: a recent advancement in formulation. *Int J Pharm., Sci.*, 2016; 7(2): 13–20.

9. Maqbool T, Naz H, Shahid R, Kazmi F, Qasim M, Attari M, et al. A review on pharmaceutical jelly formulations: new frontier in oral drug delivery. *Indus J Biosci., Res.*, 2025; 3(7): 53–57.
10. Rao PV, Gan SH. Cinnamon: a multifaceted medicinal plant. *Evid Based Complement Alternat Med.*, 2014; 2014: 642942.
11. Assi RA, Darwis Y, Abdulbaqi IM, Khan AA, Vuanghao L, Laghari MH. *Morinda citrifolia* (noni): a comprehensive review on its industrial uses, pharmacological activities, and clinical trials. *Arab J Chem.*, 2017; 10(5): 691–707.
12. Singh N, Tailang M, Mehta SC. A review on herbal plants as immunomodulators. *Int J Pharm., Sci., Res.*, 2016; 7(9): 3602–3610. doi:10.13040/IJPSR.0975-8232.7(9).3602-10.
13. Srinivasan K. Black pepper (*Piper nigrum*) and its bioactive compound, piperine. In: *Molecular targets and therapeutic uses of spices*. 2009; 25–64.
14. Rasal PB, Kondhare VA, Kadam RV. Formulation and evaluation of herbal edible gummies containing liquorice and adulsa for immune booster. *Int J Res., Publ., Rev.*, 2025; 6(5): 4435–4446.
15. Narkhede SB, Luhar SV, Vadgama NS, Patel JS, Patel JJ, Patel KK, et al. Preparation and evaluation of medicated herbal candy of mahua for sore throat. *EPRA Int J Res., Dev.*, 2023; 8: 310–331.
16. Shilakari G, U A, G A, IR L. Antimicrobial activity of cream containing polyherbal extract: development, formulation and evaluation. *Int J Pharm., Sci., Rev., Res.*; 2024: 84(4).
17. Sabri LA, Khasraghi AH, Sulaiman HT. Preparation and evaluation of oral soft chewable jelly containing flurbiprofen. *J Adv., Pharm., Technol., Res.*, 2022; 13(4): 306–311.
18. Sangnim T, Srimornsak P, Singh I, Huanbutta K. Swallowing gel for patients with dysphagia: a novel application of chitosan. *Gels.*, 2021; 7(3): 108. doi:10.3390/gels7030108.
19. Abd Aziz NS, Mohd Tayeb NA, Yaacob NS, et al. Preference, perception, and acceptability of fluid gels as a potential age-appropriate dosage form for elderly patients with dysphagia. *Gels*. 2022; 8(4): 218. doi:10.3390/gels8040218.
20. Hosseini A, Bagheri F, Mohammadi G, Azami M, Tahvilan R. Design and preparation of oral jelly candies of acetaminophen and its nanoparticles. *Appl., Nanosci.*, 2022; 12: 101–107.

21. Vijetha R, Daniel T, Jayasri R, Pavithra R, Prema S, Vidhya Devi M. Formulation and evaluation of oral medicated jelly: a review. *World J Pharm., Res.*, 2024; 13(24): 574–588.