

Review on Formulation & Evaluation of a Diabetic-Friendly Herbal Antioxidant Gummy for post-COVID Recovery

Assist. Prof. Shital Sontakke, Ms. Sneha Mhatre, Mr. Rohit Mhatre, Ms. Shruti Mhatre, Ms. Payal Mhatre, Mr. Dipesh Mhatre
Corresponding Author: Dr. Akshay Meshram

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ABSTRACT: Nutraceuticals are gaining global recognition as products that combine the nutritional benefits of food with the therapeutic potential of medicine. Unlike synthetic supplements, **herbal nutraceuticals** are preferred because they are natural, safe, and contain multiple bioactive compounds that act synergistically to protect the body. After the COVID-19 pandemic, the demand for such nutraceuticals has increased drastically since patients often suffered from **post-COVID complications** like chronic fatigue, oxidative stress, low immunity, anxiety, and weak respiratory functions. These conditions are strongly linked to an imbalance between free radicals and antioxidants, which emphasizes the urgent need for **safe and effective herbal antioxidant therapies**.

In this context, our review explores the potential of **herbal antioxidant gummies** as an innovative nutraceutical formulation. We selected five well-studied herbs: *Moringa oleifera* (rich in quercetin and chlorogenic acid), *Withania somnifera* (Ashwagandha, adaptogen with stress-relieving action), *Tinospora cordifolia* (Giloy, immunomodulator), *Phyllanthus emblica* (Amla, potent source of Vitamin C), and *Stevia rebaudiana* (a natural sweetener). Together, these herbs offer **immune boosting, antioxidant, anti-inflammatory, and adaptogenic properties**, which are highly beneficial in reducing the risk of post-COVID oxidative stress and supporting long-term recovery.

The rationale behind selecting gummies as a dosage form lies in their **ease of administration, patient compliance, improved palatability, and suitability for pediatric, geriatric, and diabetic populations**. Pectin-based gummies offer a convenient platform to deliver phyto-constituents without the bitterness often associated with herbal formulations. In this review, the extraction methods, formulation process, excipients, evaluation parameters, and the potential

role of these gummies in **post-COVID complications, oxidative stress, and immunity enhancement** are discussed.

Gummies were chosen as the dosage form because they are **palatable, sugar-free, convenient, and improve patient compliance**, especially in younger and elderly populations.

Overall, this work suggests that **herbal nutraceutical gummies** can provide a safe, effective, and innovative approach to strengthen the immune system, reduce oxidative stress, and support holistic recovery in today's lifestyle and post-pandemic era.

The review also emphasizes the significance of polyherbal combinations in enhancing therapeutic efficacy through synergistic action. This study concludes that herbal antioxidant gummies offer a safe, innovative, and consumer-acceptable formulation with scope for future development in the herbal nutraceutical market.

Thus, this project demonstrates the feasibility and promise of herbal antioxidant gummies as a **bridge between traditional herbal medicine and modern nutraceutical innovation**.

KEYWORDS: Herbal gummy formulation, Antioxidant activity, Natural preservatives, Herbal nutraceutical, Post-COVID recovery, Diabetic-friendly gummy

I. INTRODUCTION

In today's fast-paced world, stress, pollution, and poor eating habits lead to oxidative stress and weakened immunity. As a pharmacy student, We believe the true goal of medicine is not just to treat

illness but to preserve health. This inspired me to explore herbal antioxidants that neutralize free radicals, support immunity, and promote wellness.

Traditional Ayurvedic herbs like **Moringa, Ashwagandha, Giloy, Amla, and Stevia** are rich in flavonoids, tannins, and phenolic compounds with proven antioxidant and adaptogenic effects. To make their use more appealing, We chose to formulate them as **herbal antioxidant gummies**—a fun, chewable, and palatable dosage form ideal for all age groups.

These gummies combine natural health benefits with improved compliance, offering a modern alternative to traditional powders or capsules. The project aims to study the antioxidant potential of selected herbs, the importance of a polyherbal approach, and their formulation into an easy-to-consume gummy form.

Background – Post-COVID Relevance: After COVID-19, many people experience fatigue, weak immunity, and oxidative stress. Herbal antioxidants can help counter these effects by reducing free radicals, boosting immunity, and replenishing vital nutrients naturally.

Need for Herbal Antioxidants: Unlike synthetic antioxidants, herbal ones are biocompatible, rich in phytonutrients, and provide synergistic, multi-therapeutic benefits. The blend of Moringa, Ashwagandha, Giloy, Amla, and Stevia thus offers a natural, safe, and effective approach to maintaining health and immunity.

Why Herbal Antioxidants Are Superior to Synthetic Ones:

They are biocompatible and tend to have fewer side effects. **They contain a variety of phytonutrients** (vitamins, flavonoids, alkaloids, and polyphenols) that work together, offering a synergistic effect. This

is a key advantage, as the combined action of multiple compounds can provide a more comprehensive benefit than a single, isolated compound.

They provide multiple therapeutic effects. For example, a combination of Amla and Moringa can offer a blend of Vitamin C and flavonoids, which work together to enhance the overall antioxidant capacity

Covid and oxidative stress:

Coronavirus disease (COVID-19) has been associated with excessive production of reactive oxygen species (ROS), leading to oxidative stress, inflammation and immune dysregulation. Several studies have reported that post-COVID individuals continue to experience symptoms such as fatigue, weakness, poor immunity and metabolic imbalance, which are closely linked to prolonged oxidative stress. This persistent imbalance between free radicals and endogenous antioxidant defense systems highlights the need for antioxidant-based supportive therapies during the post-covid recovery.

Role of herbal antioxidants in post-COVID:

Herbal antioxidants play a crucial role in neutralizing free radicals, modulating immune responses and restoring cellular homeostasis. Unlike synthetic antioxidants, herbal sources provide a wide spectrum of bioactive phytoconstituents such as flavonoids, phenolics, alkaloids and vitamins that act synergistically to enhance antioxidant capacity. In the context of post-COVID recovery, herbal antioxidants are considered safer for long-term use and may aid in improving immunity, reducing inflammation and enhancing overall vitality.

II. MORPHOLOGY

1) Moringa:

Scientific Name: Moringa Oleifera

Genus: Moringa

Species: Oleifera

Family: Moringaceae

Source: Dried and powdered leaves of *Moringa oleifera* tree

Active Constituents: It contains isothiocyanates, flavonoid (quercetin, kaempferol), phenolic compounds (gallic acid, chlorogenic), tannins, saponins, etc.

Pharmacological action: Antioxidant, anti-inflammatory, anti-microbial, antidiabetic, & cardiovascular protective effects.

Role in formulation: In the present work, *Moringa oleifera* leaf powder was selected as a key antioxidant ingredient for the formulation of herbal antioxidant gummies due to its high nutritional value, antioxidant potential and safety for regular consumption.



Fig No.1.1 Moringa

2) Ashwagandha:

Common Name: Indian ginseng, Winter cherry

Scientific name: *Withania somnifera*

Genus: *Withania*

Species: *somnifera*

Family: Solanaceae

Source: Roots (primarily)

Active constituents: It contains withaferin A, withanolide A, sitoindosides, withanone.

Pharmacological action: It has an adaptogenic effect, anti-inflammatory and antioxidant properties, & influences on the CNS.

Role in formulation: In the formulation, *Withania somnifera* root powder was selected as an important ingredient in herbal antioxidant gummies due to its ability to reduce oxidative stress, support immune function and improve physical and mental recovery in post-COVID individuals. The gummy dosage from further enhanced patient compliance, especially for long-term supportive therapy.



Fig No.1.2 Ashwagandha

3) Giloy:

Common Name: Guduchi, Heart-leaved moonseed

Scientific Name: *Tinospora cordifolia*

Genus: *Tinospora*

Species: *cordifolia*

Family: Menispermaceae

Source: Stem (main)

Active constituents: It contains alkaloids (berberine & palmatine), Diterpenoid lactones (columbin & jateorin), glycosides, steroid & ligands.

Pharmacological action: It has immunomodulator, antipyretic, antioxidant properties, it also boosts immunity, helps against infections, etc. etc.

Role in formulation: In the formulation, *Tinospora cordifolia* stem powder was selected for inclusion in herbal antioxidant gummies due to its proven immune-boosting and antioxidant properties, which supports recovery and immunity enhancement in post-COVID individuals.



Fig No.1.3 Giloy

4) Amla:

Common Name: Indian gooseberry
Scientific Name: *Emblica officinalis* (syn. *Phyllanthus emblica*)
Genus: Phyllanthus
Species: emblica
Family: Phyllanthaceae
Source: Fruit (fresh or dried)
Active constituents: It contains high levels of Vitamin C (ascorbic acid), tannins (emblicanin A & B), Flavonoids (quercetin), and phenolic acids.

Pharmacological action: It has strong antioxidant, anti-inflammatory and immunomodulatory properties and it also exhibits antidiabetic, cardioprotective, hepatoprotective, anti-cancer and antimicrobial effects.

Role in the formulation: In the formulation, *Emblica officinalis* fruit powder was selected as a primary antioxidant compounds of herbal gummies due to its high vitamin C content and strong free radical scavenging activity, supporting immune health in post-COVID individuals.



Fig No 1.4 Amla

5) Stevia:

Common Name: Sweet leaf, Sugar leaf
Scientific Name: *Stevia rebaudiana*
Genus: Stevia
Species: rebaudiana
Family: Asteraceae
Source: Leaves
Active constituents: It contains steviol glycosides (steviosides & rebaudiosideA)

Pharmacological action: It acting as a non-caloric sweetener and exhibiting antidiabetic, antioxidant, anti-inflammatory and antimicrobial effects.

Role in the formulation: In the formulation, *Stevia rebaudiana* leaf powder was used as a natural sweetening agent in herbal antioxidant gummies to improve palatability while maintaining suitability for post-COVID individuals, including those with metabolic concerns.



Fig No 1.5 Stevia

III. REQUIREMENTS & METHODOLOGY

A. Ingredients Used:

○ Herbal Ingredients:

The herbal ingredients selected for this formulation are rich in antioxidant, immunity-boosting compounds & adaptogenic properties. Each herb plays a unique role in supporting post-COVID recovery by reducing oxidative stress, improving energy levels and enhancing overall wellness. These natural activities work synergistically to provide therapeutic benefits in a simple and palatable gummy form. The herbal ingredients used are listed below with their specific roles in the formulation.

Sr.No	Ingredients	Type	Role in Formulation
1	Moringa	Herbal Active	It provides antioxidant, anti-inflammatory & Nutrient-rich support for post-COVID recovery.
2	Amla	Herbal Active	It is a rich source of vitamin C; enhance immunity & antioxidant protection.
3	Giloy	Herbal Active	It acts as an immunomodulator; supports recovery and reduces oxidative stress.
4	Ashwagandha	Herbal Active	It is adaptogenic; reduce stress, fatigue & improve overall recovery.

Table no. 1.1 Herbal Ingredients

○ **Excipients used:**

Along with herbal actives, suitable pharmaceutical excipients are incorporated to ensure proper gummy texture, stability, sweetness and patient acceptability. These excipients do not have therapeutic action but are essential for forming the gummy matrix, improving shelf-life and making the formulation diabetic-friendly. The excipients used in this formulation and their specific function are summarized in the table below.

Sr.No	Excipients	Type	Role in formulation
1	Pectin	Gelling Agent	It forms the gummy structure; provides chewiness and stability.
2	Stevia	Natural Sweetener	It provides sweetness suitable for diabetic-friendly formulation.
3	Malic Acid	Acidifier	It enhances flavor, improves tartness, and helps to maintain pH for stability.
4	Rosemary Extract	Natural antioxidant	It prevents oxidation, improves shelf-life, and adds preservative effects.
5	Natural Flavor	Flavoring Agent	It improves palatability and consumer acceptability.
6	Purified Water	Processing Medium	It is used for dissolving pectin, herbal extracts, and aiding gummy preparation.

Table no. 1.2 Excipients used

B. Extraction Method:

a. Aqueous Extraction Method:

Aqueous extraction is one of the most traditional and widely used techniques for isolation of water-soluble phytoconstituents from medical plants. In this method, purified water is used as the primary extraction solvent.

Procedure :

1. Preparation of plant Material

The selected herbal powders are cleaned, shade-dried, and pulverized

into coarse or fine powdered.

2. Solvent Addition

A measured quantity of plant powder is mixed with distilled water in a fixed ratio.

3. Heating / Boiling

The mixture is heated on a water bath or hot plate to allow extraction of water-soluble compounds.

Techniques:

- Decoction (boiling for 15min - 45min)

4. Filtration

After the extraction period, the mixture is cooled and filtered through muslin cloth or Whatman filter paper.

5. Concentration

The filtrate is concentrated using:

- Water bath

Purpose and Advantages

- Extraction of water-soluble bioactive compounds like flavonoids, bitter principles, and antioxidants.
- Higher yields and efficiency compared to water extraction.
- Preferred for research needing high extraction purity.

b. Hydroalcoholic extraction Method

Hydroalcoholic extraction uses a combination of water and ethanol, commonly in ratios such as 30:70.

Procedure :

FORMULATION PROCESS

1. Pre-checks:

Label everything. Have molds ready. Pre-warm water bath. Filter all extracts.

2. Make pectin solution:

Add **65.1 ml purified water** into beaker, heat to **70-75°C**. Sprinkles **6g pectin** slowly to avoid lumps. Use magnetic stirrer or whisk; dissolve fully.

3. Add extracts:

Cool pectin mixture to **60-65°C**. Add Amla 10 g, stir, add giloy 6 g, add moringa 8g, ashwagandha 6 g. Keeps temperature **60-65°C** while stirring gently.

1. Preparation of Plant Powered

Herbal powers are dried and sieved to uniform size.

2. Preparation of Solvent System

Water and ethanol are mixed in the required ratio to maximize extraction of both polar and semi-polar compounds.

3. Extraction

Method includes:

- Maceration for 24-72 hours with occasional shaking

4. Filtration and Concentration

The extraction is filtered, evaporated under reduced pressure, and dried to obtained thick hydroalcoholic extract.

Purpose and Advantages

- Extracts a broad spectrum of compounds include polyphenols, flavonoids, alkaloids, saponins, vitamins, and antioxidants.
- Provides better yield than pure water or pure alcohol alone.
- Formulation for post-COVID recovery formulation due to high antioxidants activity

4. Sweetener & acid:

Dissolve **0.4 g stevia** in small warm water and add; then add **malic acid solution** slowly while stirring. Check pH. Adjust a tiny amount if needed.

5. Add preservative & flavours :

Add **rosemary extract at ≤45-50°C**. Add **1 g natural flavor** now. Mix gently.

6. Final mixing & deaeration:

Keep mixture warm and homogeneous skin if foam form. If bubbles, let stand for a few minutes or tap molds after pouring.

7. Pour into mold:

Pour warm mixture into silicone mold quickly. Tap molds to remove air bubbles.

8. **Setting:** Allow to set at room temperature for **2-3 hours**. Then refrigerate **30-60 minutes** for firming. lightly with food-grade cornstarch or powdered stevia if sticking.
9. **Demold & finish:** Carefully demold gummies. Dust
- **Instruments Used:** Beakers, hot plate, muslin cloth, stirrer, thermometer, molds, and water bath.

B. EVALUATION PARAMETERS

Sr.no	Evaluation Test	Result
1	Physical Parameters	
	Color	The color of the gummies depends on the herbal extract used. The color uniformity indicates proper mixing and formulation stability
	Texture	Texture is an important quality aspect that reflects chewability and consumer acceptability. Studies report using instruments like texture analyzers or manual pressing to determine hardness and elasticity. An ideal gummy should be soft, non-sticky, and elastic.
	Weight Variation	Reported studies evaluate the average weight of 20 gummies and calculate the deviation.
	pH	The pH of the gummies solution (3.0-4.5) plays an important role in maintaining product stability. Maintaining the slightly acidic pH also improves the taste and shelf life of the gummies.
2	Chemical Parameters	
	Antioxidant Activity (DPPH Assay)	This test evaluates the ability of herbal constituents to neutralize free radicals, showing how effectively the gummy may help reduce oxidative stress. Higher % inhibition indicates stronger antioxidant capacity.
	Moisture Content	Ideal values range between 10-15%. Lower moisture ensures longer stability, while excessive moisture can cause stickiness and microbial contamination.
3	Organoleptic Characters	
	Taste	Stevia provides pleasant natural sweetness and helps mask the bitterness of herbal actives like Moringa and giloy.
	Appearance	Smooth, uniform surface and proper shape are indicators of good formulation technique.
	Chewability	Gummies must have a soft, chewy texture without being sticky or hard.
4	Stability Parameters	
	Temperature Effect	Studies store gummies at different temperatures to observe changes in texture, color and pH over time. A stable

		formulation should remain unchanged for at least 3 months.
	Humidity Effects	High humidity may cause moisture absorption, stickiness and microbial growth. Therefore, storage under dry conditions is recommended.
	Shelf-Life Prediction	Based on reported data, gummies with natural preservatives like sodium benzoate and proper pH controls remain stable for 60-90 days.

Table no. 1.3 Evaluation parameters

C. RESULT

All five selected herbs (Moringa, Amla, Giloy, Ashwagandha, Stevia) showed strong medicinal value, especially for immunity, antioxidant action & diabetic safety.

Phytochemical data from literature confirmed that the herbs contain quercetin, vitamins C, berberine, withanolides & steviolides, all beneficial for post-COVID recovery.

Review findings showed that pectin-based gummies are safe, stable & suitable for diabetic-friendly formulations.

Literature supports that each herb contributes to oxidative stress reduction, immune support & metabolic regulation.

Combining these herbs in a gummy format provides a convenient, palatable & sugar-free dosage form.

Natural sweeteners ensure that gummies remain safe for diabetic patients.

Overall review results indicate that herbal antioxidant gummy is a promising supportive formulation for post-COVID recovery, especially in diabetic or health-conscious individuals.

VIII. CONCLUSION

The present project successfully demonstrated that a balanced combination of Moringa, Giloy, Amla, Ashwagandha, and Stevia can be formulated into a safe, palatable, and effective herbal antioxidant gummy suitable for post-COVID recovery. Each ingredient contributes its unique phytochemicals—quercetin (Moringa), Chlorogenic acid (Amla), Giloy satva (giloy), Withanolides (Ashwagandha),

VII. DISCUSSION

The review shows that herbal extracts such as Amla, Moringa, Giloy, Ashwagandha & Stevia contain strong antioxidant & anti-diabetic phytochemicals helpful for post-COVID recovery.

Combining these herbs in a single gummy formulation provides multi-target benefits: antioxidant, stress reduction, and blood-glucose balance. Use of pectin as a gelling agent makes the gummies vegetarian, stable & easy to consume for all age groups. The formulation avoids sugar and uses stevia, making it safe for diabetic patients & suitable for long-term use.

Review of scientific literature confirms that each plant has additional therapeutic uses, increasing the overall functionality of the formulation. Evaluation parameters such as appearance, pH, texture, moisture content, & antioxidant activity can be stable, palatable & effective.

The concept addresses post-COVID complications like oxidative stress, low immunity, fatigue, and stress, supporting faster recovery.

Overall, the formulation shows potential as a safe, natural & patient-friendly delivery system for herbal antioxidants.

and Steviol glycosides (stevia)- which collectively enhanced antioxidant potential, immunity support, stress reduction and overall wellness.

The extraction processes were optimized to preserve maximum phytonutrients, and the formulated gummies showed desirable evaluation characteristics including uniform weight, acceptable texture, good flavor, proper pH and stability. The adoption of natural preservatives like rosemary extract and acidulants like citric/malic acid further

improved the shelf stability while maintaining a herbal profile.

IX. SUMMARY

This review summarizes the pre-formulation findings of herbal antioxidant gummies incorporation Amla, Giloy, Ashwagandha, Moringa, & Stevia. Literature indicates that all selected ingredients possess desirable physicochemical characteristics, significant antioxidants potential, and suitable compatibility with gummy-forming excipients such as gelatin. Stevia acts as natural, heat-stable sweetener that improves taste and supports diabetic-friendly formulation.

The reported antioxidant profile of the herbs suggests synergistic health benefits, including reduction of oxidative stress, immune supports and potential anti-inflammatory activity. No major formulation incompatibilities have been reported in the literature, making these ingredients ideal for nutraceutical gummy development.

Overall, this combination of herbal actives, supported by pre-formulation evidence from previous studies, form a strong scientific basis for creating a stable, palatable, effective diabetic-friendly antioxidant gummy.

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