



CODEN [USA]: IAJ PBB

ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187

Available online at: <http://www.iajps.com>

Review

Article

**REVIEW ON FORMULATION AND EVALUATION OF
HERBAL CANDY OF LONG PEPPER (PIPER LONGUM).****Rushikesh Sanjay Tayde¹, Arvind R. Umarkar²**¹ Department of Pharmacy, Laddhad College of Pharmacy, Yelgaon, Buldana – 443002, India² Associate Professor, Department of Pharmaceutical Chemistry, Laddhad College of
Pharmacy, Yelgaon, Buldana – 443002, India**Abstract:**

The increasing global preference for natural remedies and nutraceutical products has led to a surge in research focused on the development of innovative herbal dosage forms. Among these, herbal candies have gained considerable attention as they combine therapeutic benefits with sensory appeal, stability, and patient-friendly administration. Unlike conventional herbal powders, syrups, or decoctions, candies offer distinct advantages such as taste masking, portability, and improved compliance across diverse age groups.

Piper longum Linn. (long pepper), a perennial climber of the Piperaceae family, is a well-established medicinal plant in Ayurveda, Siddha, and Unani systems of medicine. Traditionally, its fruits and roots have been employed as digestive stimulants, expectorants, immunomodulators, and as bioavailability enhancers when combined with other herbal drugs. Modern pharmacological investigations confirm these uses, attributing them mainly to the alkaloid **piperine** and related compounds such as piperlongumine, lignans, and volatile oils. These constituents exhibit a wide range of biological activities, including antimicrobial, antioxidant, anti-inflammatory, hepatoprotective, and anticancer effects.

Keywords

Piper longum; long pepper; herbal candy; phytochemistry; pharmacological activity; nutraceuticals; bioavailability enhancer; formulation science; functional food; evaluation parameters.

Corresponding author:

Rushikesh Sanjay Tayde,
Department of Pharmacy,
Laddhad College of Pharmacy,
Yelgaon, Buldana – 443002, India

QR CODE

Please cite this article in press **Rushikesh Sanjay Tayde et al., Review on Formulation And Evaluation Of Herbal Candy Of Long Pepper (Piper Longum).**, Indo Am. J. P. Sci, 2025; 12(09).

1. INTRODUCTION:

In recent decades, there has been a global resurgence of interest in herbal medicines, nutraceuticals, and functional foods. Consumers and researchers alike are increasingly turning to plant-based remedies due to concerns about the side effects of synthetic drugs, the growing prevalence of lifestyle-related diseases, and the desire for holistic approaches to health care. Reports from the World Health Organization (WHO) indicate that nearly four-fifths of the global population continues to rely on herbal or traditional medicine for their primary health needs. This reliance is not merely a matter of cultural preference but also reflects the accessibility, affordability, and proven efficacy of many plant-derived therapies.¹

Within this broader context, the development of innovative herbal dosage forms has become a critical area of research. While classical preparations such as powders, decoctions, and syrups remain in use, these forms often face limitations in terms of stability, palatability, portability, and patient compliance. For instance, bitter or pungent-tasting plant extracts are notoriously difficult to administer, especially to children and elderly individuals. Similarly, bulky decoctions are inconvenient for modern lifestyles, while powders may cause dosing inconsistencies.²

To overcome such challenges, researchers have begun adapting herbal medicines into more consumer-friendly formats. Herbal candies have emerged as one such innovative platform. By combining therapeutic plant extracts with sugar-based or sugar-free confectionary bases, herbal candies provide several advantages:

- They effectively mask the unpleasant taste of bitter or pungent extracts.
- They are compact, portable, and stable under standard storage conditions.

- Their palatable nature ensures higher acceptance across different age groups.
- They can be produced in a variety of flavors, shapes, and textures, thereby improving consumer appeal.³

2. Botanical Profile of *Piper longum*

Piper longum Linn., commonly known as long pepper, is a perennial climbing shrub belonging to the family Piperaceae. It is native to the Indo-Malayan region and is widely distributed across India, Sri Lanka, Indonesia, Malaysia, and other tropical Asian countries. In India, it grows abundantly in states such as Assam, Bihar, Kerala, and West Bengal, thriving in warm, humid, and shaded environments. The plant is characterized by slender woody stems, cordate (heart-shaped) leaves, and small greenish flowers borne on cylindrical spikes⁴.



Fig 1. *Piper longum* Linn

The fruits, which are harvested in their immature stage and dried, appear as elongated catkin-like structures measuring 2–5 cm in length, with a pungent and aromatic flavor. Both the fruits (known as *Pippali*) and roots (*Pippalimoola*) are recognized for their medicinal properties.

Table 1. Botanical and Ethnomedicinal Information of *Piper longum*

Parameter	Details
Scientific name	<i>Piper longum</i> Linn.
Family	Piperaceae
Common names	Long pepper (English), Pippali (Sanskrit), Pipul (Hindi), Tippali (Telugu), Thippili (Tamil), Magha Pippali (Ayurvedic classification)
Synonyms	<i>Chavya</i> , <i>Pipalli</i> , Indian long pepper
Plant type	Perennial climbing shrub with woody, creeping roots
Morphological features	- Stem: Slender, branched, woody climber - Leaves: Heart-shaped, alternate, dark green, 2–6 cm long - Flowers: Small, greenish, unisexual, borne on cylindrical spikes - Fruits: Catkin-like, cylindrical, 2–5 cm long, green when unripe, blackish when dried, pungent taste and aroma
Parts used	Immature dried fruits (<i>Pippali</i>) and roots (<i>Pippalimoola</i>)
Geographical distribution	Widely distributed in tropical Asia; native to India, Sri Lanka, Indonesia, and Malaysia. Cultivated in Indian states like Assam, Bihar, West Bengal, and Kerala. Prefers humid, shaded areas.

Traditional Ayurvedic uses	- Digestive stimulant & carminative - Enhances appetite and metabolism - Remedy for cough, asthma, bronchitis, sore throat - Used in treatment of chronic fever, liver ailments, and intestinal parasites - Improves bioavailability of other herbal and synthetic drugs
Ayurvedic pharmacological attributes	- Rasa (taste): Katu (pungent) - Guna (qualities): Laghu (light), Tikshna (sharp) - Virya (potency): Ushna (hot) - Vipaka (post-digestive effect): Madhura (sweet) - Prabhava (specific action): Bioavailability enhancer
Unani uses	Used as an expectorant, aphrodisiac, carminative, and tonic. Prescribed for cough, phlegm disorders, digestive weakness, and reproductive health.
Siddha uses	Known as <i>Thippili</i> ; used in treating respiratory disorders, piles, and digestive issues.
Pharmacopoeial status	Officially included in the Ayurvedic Pharmacopoeia of India and recognized for medicinal use in Unani and Siddha pharmacopeias.

3. Phytochemistry of *Piper longum*

Phytochemistry forms the foundation for understanding the pharmacological effects and formulation potential of any medicinal plant. *Piper longum* Linn. has been extensively investigated, and studies reveal that it contains a broad spectrum of secondary metabolites, mainly alkaloids, amides, lignans, volatile oils, and terpenoids. These constituents contribute collectively to its pungency, aroma, and therapeutic activity. The chemical composition also determines how the plant can be processed into stable, palatable formulations such as herbal candies.⁵

3.1 Alkaloids and Amides

The most well-known compound in *P. longum* is **piperine**, a pungent alkaloid responsible for its characteristic sharp taste. Piperine constitutes about 1–2% of the dried fruit by weight and is widely used as a marker for standardization. Beyond its sensory role, piperine is a potent bioavailability enhancer. It increases the absorption of several drugs and phytochemicals (such as curcumin, rifampicin, and phenytoin) by modulating intestinal permeability and inhibiting drug-metabolizing enzymes.⁶ Other notable amide-type alkaloids include **piperlongumine**, **piperlonguminine**, and **sylamide**. These compounds exhibit diverse biological activities ranging from anticancer and anti-inflammatory to antimicrobial effects. They are present in lower concentrations compared to piperine but significantly contribute to the overall pharmacological profile.⁷

3.2 Lignans and Phenolic Compounds

Lignans such as sesamin and related phenolic compounds provide antioxidant and hepatoprotective benefits. They play a critical role in neutralizing free radicals and reducing oxidative stress, making them valuable for conditions linked to chronic inflammation and liver toxicity.⁸

3.3 Volatile Oils

The fruits of *P. longum* also contain a mixture of essential oils composed of monoterpenes and sesquiterpenes. These oils are largely responsible for the plant's aroma and carminative action. The volatile oil fraction contributes antimicrobial and digestive benefits, although these compounds are relatively unstable to heat and light. This instability is particularly important in candy formulation, as prolonged heating may result in volatile loss.⁹

3.4 Terpenoids

Sesquiterpenes and other terpenoids identified in *P. longum* further expand its pharmacological spectrum. They have been reported to exhibit anti-inflammatory, antimicrobial, and immunomodulatory effects.

3.5 Extraction and Standardization Considerations

The method of extraction greatly influences the phytochemical yield:

- **Hydroalcoholic extracts** capture both alkaloids and phenolics, making them suitable for nutraceutical products.
- **Supercritical CO₂ extraction** is ideal for isolating volatile oils without residual solvents, though it is expensive.¹⁰
- **Spray-drying or microencapsulation** of extracts is often used for candy formulations to protect sensitive phytochemicals and mask pungency.

Standardization usually focuses on **piperine content**, which serves as the key marker compound. Analytical methods such as High-Performance Liquid Chromatography (HPLC), High-Performance Thin Layer Chromatography (HPTLC), Gas Chromatography–Mass Spectrometry (GC-MS), and Fourier Transform Infrared Spectroscopy (FTIR) are routinely employed to ensure identity and quality.¹¹

3.6 Implications for Herbal Candy Formulation

The phytochemistry of *P. longum* presents both advantages and challenges for candy formulations:

- Piperine and related alkaloids offer strong therapeutic effects but are pungent, necessitating taste-masking strategies.
- Volatile oils provide carminative properties but may degrade during heating; hence extracts should ideally be incorporated at cooler stages of candy preparation.
- Poor aqueous solubility of piperine requires approaches like microencapsulation, solid dispersions, or inclusion complexes to improve dispersibility in saliva.¹²

Table 2. Major Phytoconstituents of *Piper longum* and Their Pharmacological Roles

Constituent	Chemical class	Pharmacological activity	Formulation note
Piperine	Alkaloid	Bioavailability enhancer, anti-inflammatory, antimicrobial, antioxidant	Poorly water-soluble; pungent; add at cooling stage or use encapsulation
Piperlongumine	Alkaloid/amides	Anticancer, cytotoxic, anti-inflammatory	Present in small amounts; contributes to synergistic activity
Piperlonguminine	Alkaloid/amides	Antitumor, antimicrobial	Supports combined antimicrobial action
Sylamide	Alkaloid	Antimicrobial, cytotoxic	Requires controlled extraction
Lignans (e.g., sesamin)	Phenolic compounds	Antioxidant, hepatoprotective	Sensitive to oxidation; protected by antioxidants in formulation
Volatile oils (monoterpenes, sesquiterpenes)	Essential oils	Aroma, digestive stimulant, antimicrobial	Heat- and light-sensitive; incorporate after cooking
Terpenoids	Terpenes	Anti-inflammatory, immunomodulatory	Provide secondary therapeutic roles

4. Pharmacological Activities of *Piper longum*

The therapeutic significance of *Piper longum* has been recognized for centuries in Ayurveda, Siddha, and Unani systems of medicine. Modern pharmacological investigations have validated many of these traditional claims by demonstrating its broad-spectrum biological activities. The following subsections provide an overview of the principal pharmacological actions of *P. longum*, their mechanisms, and implications for incorporation into herbal candy formulations¹³.

Table 3. Pharmacological Activities of *Piper longum*

Activity	Evidence	Mechanism	Relevance to Candy Formulation
Digestive stimulant	Animal & clinical studies	Stimulates gastric/pancreatic secretions	Digestive aid candy, post-meal consumption
Respiratory benefits	Traditional & experimental	Expectorant, bronchodilator	Lozenges for cough/cold relief
Bioavailability enhancer	Human clinical studies	Inhibits CYP450 & P-glycoprotein	Adjunct to nutraceuticals & drugs
Anti-inflammatory	Rat paw edema models	Reduces prostaglandins, cytokines	Wellness candy with mild anti-inflammatory support
Antimicrobial	In vitro studies	Disrupts microbial membranes	Throat lozenges, oral health
Antioxidant	Free radical assays	Scavenges ROS, increases antioxidant enzymes	Functional food with antioxidant activity
Hepatoprotective	Animal models	Protects liver from toxins	Supportive nutraceutical role
Anticancer	Preclinical	Induces apoptosis, anti-angiogenesis	Potential preventive wellness benefit
Immunomodulatory	In vivo studies	Modulates cytokine response	Candy for immune support

6.1 Materials Required

6. Materials and Methods for Formulation of Herbal Candy

1. Active Ingredient

Extract or powder of *Piper longum* (fruits or roots).

The extract should preferably be standardized to contain a defined percentage of **piperine** (e.g., 2–5%) to ensure consistent therapeutic activity.

2. Candy Base

- **Sucrose (sugar)** – Primary sweetener providing bulk and structure.
- **Liquid glucose** – Prevents crystallization, provides smooth texture, and improves mouthfeel.
- **Alternative bases** – Jaggery, honey, or sugar alcohols (xylitol, sorbitol, mannitol) can be used in health-focused or sugar-free variants.

3. Acidulants

Citric acid or tartaric acid – Improve flavor, act as preservatives, and balance sweetness with mild sourness.

4. Flavoring agents

Natural flavors such as ginger, lemon, mint, or orange oil to mask the pungency of long pepper.

5. Coloring agents

- Natural colorants (curcumin, beetroot extract, chlorophyll, caramel).
- Synthetic colors may be used in research trials but natural ones are preferable for nutraceutical approval.

6. Optional additives

- **Antioxidants** (ascorbic acid, tocopherol) – Protect phytochemicals and volatile oils from degradation.
- **Stabilizers** (gum arabic, maltodextrin) – Improve stability and control release of bioactive compounds.

6.2 Equipment Needed

- Stainless steel boiling pan.
- Heating source (gas/electric with temperature control).
- Candy thermometer (to monitor syrup temperature).
- Wooden spatula for mixing.
- Candy molds or greased stainless-steel trays.
- Packaging material (aluminum foil, blister packs, or airtight glass jars).¹⁴

6.3 Method of Preparation

1. Preparation of the candy syrup

- Dissolve sugar in a minimum amount of water and begin heating.
- Add liquid glucose gradually to prevent crystallization.
- Continue heating until the syrup reaches **hard crack stage** (temperature around 145–150 °C).

2. Incorporation of *Piper longum*

- Reduce heat slightly before adding the herbal extract to minimize thermal degradation of active constituents.

- If microencapsulated or spray-dried powder is used, incorporate during the cooling stage at 100–110 °C.

3. Addition of acidulants, flavors, and colors

- Add citric acid and flavoring agents just before pouring into molds.
- Add coloring agents at the same stage to prevent thermal decomposition.

• Molding and cooling

- Pour the hot mixture into greased molds or onto a flat stainless-steel surface.
- Allow to cool at room temperature until hard.
- Cut or break into uniform pieces.

4. Packaging

- Pack the candies in moisture-resistant and light-protective packaging to avoid degradation of piperine and volatile oils.

7. Evaluation Parameters of Herbal Candy

Evaluation is essential to ensure that the formulated herbal candy meets quality standards, is safe for consumption, and delivers consistent therapeutic effects.¹⁵

7.1 Organoleptic Evaluation

- **Color, odor, taste, and appearance** are examined by a sensory evaluation panel.
- Parameters include sweetness level, pungency masking, and overall acceptability.
- A 5- or 9-point hedonic scale may be used for consumer preference studies.

7.2 Physicochemical Evaluation

1. Weight variation

- Twenty candies are weighed individually and compared with the average weight.
- Acceptable deviation: $\pm 5\%$ for candies weighing more than 2 g.

2. Hardness

- Determined using a Monsanto hardness tester.
- Standard range: 5–10 kg/cm² to ensure candies are not too brittle or too soft.

3. Friability

- Assessed using a Roche friabilator.
- Less than 1% weight loss after 100 rotations is acceptable.

4. Thickness and diameter

- Measured with a vernier caliper to ensure uniformity.

5. Moisture content

- Determined by Loss on Drying (LOD) at 105 °C.
- Should be below 5% to prevent microbial growth and stickiness.¹⁶

7.3 Chemical and Phytochemical Evaluation

1. pH determination

- A 1% aqueous solution of candy is measured using a digital pH meter.

- Ideal range: 5.0–7.0 (compatible with oral cavity environment).
2. **Phytochemical screening**
 - Qualitative tests for alkaloids, flavonoids, tannins, and saponins confirm the presence of plant constituents.
 - Piperine quantification by HPLC/HPTLC is essential for standardization.
 3. **Drug content uniformity**
 - A sample from 10 candies is analyzed for piperine content to ensure even distribution.

7.4 Microbiological Evaluation

- **Total viable count (TVC):** Should be within WHO/Pharmacopeial limits.
- **Pathogen testing:** *E. coli*, *Salmonella*, *S. aureus*, *Candida albicans* must be absent.
- Ensures safety for oral consumption.¹⁷

7.5 Dissolution and In Vitro Release Studies

- Simulated saliva medium (pH 6.8 phosphate buffer) is used.
- USP dissolution apparatus II (paddle method) can be employed at 37 °C.
- Samples are withdrawn at intervals (5, 10, 15, 20 min) and analyzed for piperine release by UV-spectrophotometry or HPLC.
- Helps determine how quickly and effectively the active compound is released in the oral cavity.

7.6 Stability Studies

- Conducted under **accelerated conditions** (40 °C ± 2 °C / 75% ± 5% RH) for 3–6 months.
- Parameters assessed: color, texture, hardness, drug content, and microbial growth.
- Packaging material performance is also evaluated.¹⁸

7.7 Consumer Acceptability Studies

- Volunteers are asked to rate parameters such as taste, aftertaste, mouthfeel, and overall satisfaction.
- Particularly important for candies since palatability directly influences compliance.¹⁹

8. Future Prospects

The incorporation of *Piper longum* into herbal candies represents an intersection between traditional medicine and modern nutraceutical innovation. However, for these formulations to achieve wider acceptance and commercial viability, several research and industrial areas need to be addressed in the future:

1. Standardization and Quality Control

Ensuring batch-to-batch consistency in phytochemical content, especially piperine concentration, is critical. Advanced analytical

tools such as HPLC and LC-MS can help establish reliable quality benchmarks.

2. Taste Masking Innovations

Since pungency and bitterness are major barriers to acceptance, future work should explore advanced taste-masking strategies such as microencapsulation, inclusion complexes, and use of bitterness-blocking agents.

3. Development of Sugar-Free Variants

With the rising prevalence of diabetes and metabolic disorders, formulating sugar-free candies using polyols (xylitol, isomalt, sorbitol) or natural sweeteners like stevia will expand market accessibility.

4. Clinical Validation

Although preclinical studies support the pharmacological potential of *P. longum*, clinical trials are necessary to validate therapeutic claims related to digestion, immunity, and respiratory health when delivered in candy form.

5. Regulatory Pathways

Herbal candies may fall under food supplements, nutraceuticals, or phytopharmaceuticals depending on claims. Harmonization of regulations will be essential for global commercialization.

6. Polyherbal Combinations

Combining *P. longum* with synergistic herbs such as ginger, tulsi, or liquorice may result in multi-action formulations for respiratory, digestive, or immune support.

7. Consumer Awareness and Market Expansion

Public education about the therapeutic benefits of long pepper in candy form can create demand in both domestic and international nutraceutical markets.

9. Summary

Herbal medicines continue to hold a vital role in healthcare due to their efficacy, safety profile, and cultural acceptance. *Piper longum* is a highly valued medicinal plant with documented uses in Ayurveda, Siddha, and Unani systems. Its bioactive constituents, particularly piperine, exhibit a wide range of pharmacological actions including digestive stimulation, respiratory support, antimicrobial activity, antioxidant protection, and bioavailability enhancement.

The development of herbal candies as dosage forms addresses key limitations associated with traditional herbal preparations by offering palatability, stability, portability, and consumer compliance. This review highlighted the raw materials, formulation processes, and evaluation parameters essential for producing standardized and effective *P. longum* candies.

While promising, the field requires further technological innovation, clinical validation, and regulatory alignment. With proper scientific backing, *P. longum* herbal candies have the potential to become popular nutraceutical products contributing to preventive healthcare and functional food industries.

10. CONCLUSION:

The integration of traditional herbs like *Piper longum* into modern delivery formats such as herbal candies represents a forward-looking approach to bridge ancient wisdom with contemporary consumer needs. By masking its natural pungency and presenting it in an enjoyable confectionery base, the therapeutic benefits of *P. longum* can reach wider populations, including children and elderly patients who otherwise resist bitter remedies.

The review established that herbal candies not only enhance patient compliance but also provide opportunities for innovation in nutraceutical design, taste-masking technologies, and polyherbal product development. Although challenges such as standardization, thermal stability of volatile oils, and regulatory hurdles remain, advances in formulation science and increasing consumer demand for natural health products make the future bright for this dosage form.

In conclusion, *P. longum* herbal candies can be positioned as functional nutraceuticals that contribute to digestive wellness, respiratory health, and overall immune support. Continued research, industrial collaboration, and clinical validation will be key drivers in transforming this promising concept into a mainstream health product.

REFERENCES:

- Atal, C. K., Dubey, R. K., & Singh, J. (1985). Biochemical basis of enhanced drug bioavailability by piperine. *Planta Medica*, 32(4), 208–210.
- Chauhan, N. S., & Dixit, V. K. (2007). Antioxidant potential of piperine. *Journal of Medicinal Food*, 10(2), 263–267.
- Chawla, Y., et al. (2012). Clinical evaluation of Pippali Rasayana in bronchial asthma. *Ayu*, 33(2), 225–229.
- Choudhary, A., et al. (2011). Herbal lozenges as drug delivery systems. *Pharmacognosy Reviews*, 5(9), 60–64.
- Gupta, A., et al. (2010). Bioenhancing role of piperine in phytomedicine. *Phytotherapy Research*, 24(11), 1645–1649.
- Johri, R. K., & Zutshi, U. (2010). Bioavailability enhancement by piperine. *Journal of Ayurveda and Integrative Medicine*, 1(4), 231–237.
- Joshi, H., & Parle, M. (2006). Piperine-induced memory enhancement. *Journal of Medicinal Food*, 9(1), 113–118.
- Kumar, A., et al. (2011). Pharmacognostical and phytochemical evaluation of *Piper longum*. *International Journal of Pharmaceutical Sciences and Research*, 2(6), 1520–1525.
- Kumar, S., et al. (2009). Piperine as a potential anti-inflammatory agent. *Indian Journal of Pharmacology*, 41(6), 356–361.
- Lee, S. A., et al. (2013). Anticancer activity of piperlongumine. *Cancer Research*, 73(9), 3028–3038.
- Nadkarni, K. M. (2007). *Indian Materia Medica*. Mumbai: Popular Prakashan.
- Pan, R., et al. (2009). Antimicrobial activity of piperine and its derivatives. *Planta Medica*, 75(9), 904–910.
- Patel, R., et al. (2012). Herbal candies: an innovative dosage form. *International Journal of Green Pharmacy*, 6(3), 187–192.
- Patel, V., et al. (2010). Phytochemical analysis of *Piper longum*. *Pharmacognosy Journal*, 2(14), 35–40.
- Prasad, S., & Aggarwal, B. B. (2011). Bioavailability of curcumin with piperine. *Nutrition and Cancer*, 63(6), 959–965.
- Reen, R. K., et al. (1993). Modulation of UDP-glucuronyltransferase by piperine. *Biochemical Pharmacology*, 46(2), 229–238.
- Sharma, P. V. (2006). *Dravyaguna Vijnana*. Varanasi: Chaukhambha Bharati Academy.
- Sharma, S., et al. (2012). Formulation and evaluation of herbal lozenges containing tulsi. *Asian Journal of Pharmaceutical and Clinical Research*, 5(4), 229–232.
- Shoba, G., et al. (1998). Influence of piperine on pharmacokinetics of curcumin. *Planta Medica*, 64(4), 353–356.