



## A Review on Pharmaceutical Jelly Formulations: New Frontier in Oral Drug Delivery

Tahmina Maqbool<sup>1</sup>, Hadia Naz<sup>1</sup>, Rabia Shahid<sup>1</sup>, Fabeha Kazmi<sup>1</sup>, Misbah Qasim<sup>1</sup>, Memoona Attari<sup>1</sup>, Muhammad Majid<sup>1</sup>

<sup>1</sup>Faculty of Pharmacy, Hamdard University, Madinat al-Hikmah, Hakim Mohammed Said Road, Karachi, Pakistan.

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**Correspondence to:** Tahmina Maqbool, Faculty of Pharmacy, Hamdard University, Madinat al-Hikmah, Hakim Mohammed Said Road, Karachi, Pakistan.  
Email: [Tahmina.adnan@hamdard.edu.pk](mailto:Tahmina.adnan@hamdard.edu.pk)

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### ABSTRACT

Pharmaceutical jelly-based formulations represent a novel, emerging and patient-friendly approach in oral and mucosal drug delivery, contributing a palatable, semi-solid alternative to traditional tablets and capsules. Particularly advantageous for patient populations experiencing dysphagia, including pediatric and geriatric populations. Functioning at the intersection of liquid and solid dosage forms, these semi-solid systems facilitate enhanced palatability, ease of administration, and improved physicochemical stability of active pharmaceutical ingredients. This review critically explained the enriching research studies of jelly formulations, offering a systematic classification based on administration routes, therapeutic objectives, and compositional attributes. It further elucidates formulation strategies, excipient rationalization, and recent technological advancements supporting the development of fast-dissolving, sustained-release, and nutraceutical variants. Regulatory developments, formulation challenges, and emerging trends such as precision dosing and stimuli-responsive jellies are also addressed. Despite certain physicochemical properties and storage constraints, jelly systems exhibit considerable promise in improving medication adherence and optimizing therapeutic performance in contemporary pharmaceuticals. Future directions indicate the development of advanced delivery systems utilizing nanotechnology, mucoadhesive polymers, and personalized medicine approaches. With increasing regulatory interest and market expansion, jelly formulations are poised to become a vital component of modern drug delivery systems.

### INTRODUCTION

Dosage forms are essential in pharmaceutical sciences as they facilitate safe and effective drug delivery to patients. The development of new dosage forms aims to improve patient compliance, enhance drug stability, and optimize drug release profiles [1]. Jelly dosage forms are innovative semisolid preparations gaining attention due to their soft texture, ease of swallowing, and rapid drug release characteristics [2, 3]. The pursuit of patient-friendly, effective, and innovative drug delivery systems has led to the emergence of novel dosage forms aimed at enhancing therapeutic compliance and clinical outcomes. Among these, jelly formulations have garnered increasing attention as a promising alternative to conventional oral dosage forms such as tablets, capsules, and syrups. These semi-solid, palatable, and easy-to-swallow formulations are particularly beneficial for populations with swallowing difficulties, such as pediatric, geriatric, and dysphagic patients [4, 5]. Jelly-based dosage forms combine the advantages of liquid and solid formulations, offering precise dosing, improved stability, and ease of administration without the need for water. Additionally,

they provide opportunities for taste masking, incorporation of sensitive active pharmaceutical ingredients (APIs), and potential for controlled or rapid drug release, depending on the formulation design. These characteristics make jellies not only suitable for chronic therapies but also ideal for over-the-counter (OTC) medications and nutraceuticals. Recent advancements in pharmaceutical technology have facilitated the development of jellies using various polymers, gelling agents, and excipients tailored to achieve desired rheological, mechanical, and release properties. Moreover, regulatory interest in such novel delivery systems is growing, with increasing market availability of jelly-based drugs in regions such as Japan, the United States, and parts of Europe.

This review aims to provide a comprehensive overview of jelly formulations as an emerging oral drug delivery system, focusing on their formulation strategies, excipient selection, advantages, challenges, regulatory considerations, and future potential in the pharmaceutical landscape.

## Classification of Jelly Dosage Forms

Jelly dosage forms can be classified based on several parameters, including route of administration, therapeutic application, and formulation characteristics. This classification provides a framework for understanding their versatility and potential applications in modern pharmaceutical practice. Details are available in Table 1.

### Based on the Route of Administration

#### Oral Jellies

These are the most common jelly formulations, designed for systemic drug delivery via the oral cavity. They are easy to ingest and do not require water, making them highly suitable for pediatric and geriatric populations. Examples include antipyretic, antihistaminic, and multivitamin jellies. They are designed to be swallowed easily without the need for water, making them especially useful for Pediatric patients, who often reject bitter or hard-to-swallow tablets. Geriatric patients may have difficulty with conventional solid forms due to dysphagia. Travel or on-the-go usage, where water may not be available. These jellies melt or dissolve quickly in the mouth, ensuring rapid drug release and fast onset of action. They can be sweetened and flavored to improve taste and patient compliance. Paracetamol and antihistamines are available in fruit-flavored jelly form [6, 7].

#### Topical Jellies

Topical jellies are semisolid formulations intended for external application on the skin or mucous membranes. Formulated for application on the skin or mucosal surfaces, these jellies serve as vehicles for local delivery of drugs such as analgesics, antiseptics, or antifungals. They typically consist of hydrophilic bases for better spreadability and ease of removal. They deliver drugs locally and are used for Skin conditions like acne, eczema, or burns. Oral ulcers or gum infections, where mucosal application is needed. These jellies have a cooling effect, spread easily, and do not leave a greasy residue like creams or ointments. The drug penetrates the skin or mucosa at the site of application, providing localized action with minimal systemic absorption, like lidocaine jelly for local anesthesia [8, 9].

#### Vaginal and Rectal Jellies

These are used for local action within the vaginal or rectal cavity [10], often as carriers for antimicrobials, contraceptives, or anti-inflammatory agents. Their mucoadhesive properties enhance drug residence time at the site of action[11].

### Based on Therapeutic Purpose

#### Prescription Jellies

Formulated for the treatment of specific medical conditions, such as epilepsy (e.g., diazepam rectal jelly), allergic reactions, or chronic diseases. Medicated jellies contain active pharmaceutical ingredients (APIs) that exert a therapeutic effect. They may be oral, topical, or mucosal, depending on the intended use. These jellies are formulated to provide accurate dosing in a palatable form. Ensure drug stability in a jelly matrix. Improve bioavailability for certain APIs. They are often used in nutraceuticals, vitamin supplementation, analgesics, antihistamines, and even chemotherapy adjuncts.

Multivitamin gummy jellies and antifungal jellies for oral thrush [9, 12]

#### Over-the-Counter (OTC) Jellies

Used for self-medication, these include jellies containing vitamins, herbal extracts, or minor analgesics. They are designed for safety, palatability, and ease of use.

#### Nutraceutical and Functional Jellies

These jellies contain dietary supplements, probiotics, or antioxidants and are aimed at enhancing general health and wellness rather than treating specific conditions[13].

### Based on Formulation Characteristics

#### Sugar-Based Jellies

Contain high concentrations of sugars and gelling agents, providing a pleasant taste and texture. Common in pediatric preparations and nutraceuticals.

#### Sugar-Free or Diabetic-Friendly Jellies

Formulated with non-sugar sweeteners like sucralose or stevia, these are suitable for diabetic patients and calorie-conscious consumers [14].

#### Fast-Dissolving Jellies

Engineered to dissolve rapidly in the oral cavity, these are ideal for rapid onset of action and are often used for emergency medications [15].

#### Sustained or Controlled Release Jellies

Designed using polymers that allow the gradual release of the active drug over a prolonged period, improving therapeutic efficacy and reducing dosing frequency.

### Different Jell Containing Formulations

Different jell-containing formulations primarily refer to pharmaceutical or nutraceutical products where a liquid phase is immobilized within a polymeric matrix, giving them a semi-solid texture. These formulations are diverse and chosen based on the desired drug delivery route, patient preference, and therapeutic needs. [1, 5, 16].Detail is provided in Table 1.

**Table 1**

*Different Types of Pharmaceutical Jellies*

Type of Jelly	Characteristics	Common Uses	Example Drugs/Actives	References
Oral Medicated Jellies	Soft, water-based gels designed for swallowing; flavored and sweetened for palatability	Paediatrics, geriatrics, and dysphagia patients	Paracetamol, Diphenhydramine, Vitamin C	[6, 7, 17-19]
Topical Jellies	Transparent or translucent semisolid gels applied to the skin	Burns, wounds, and pain relief	Lidocaine, Metronidazole, Aloe vera	[8, 9]
Dental Jellies	Bioadhesive or mucoadhesive gels for gingival application	Gingivitis, periodontitis, and local anaesthesia	Chlorhexidine, Benzocaine	[20]
Ophthalmic Jellies	Sterile, transparent jellies with prolonged retention in the eye	Eye infections, inflammation	Ciprofloxacin, Acyclovir	[21]
Rectal / Vaginal Jellies	Used for local delivery to mucosal tissues	Infections, contraception	Clindamycin, Metronidazole, Nonoxynol-9	[22]

Emulgel-Based Jellies	Combination of emulsion and gel; allows for both lipophilic and hydrophilic drug delivery	Transdermal and topical therapies	Diclofenac sodium, Ibuprofen	[23]
Ion-Gel Jellies	Formed via ionotropic gelation using cross-linking agents	Wound healing, calcium therapy	Calcium alginate, Pectin-based jellies	[24]
Nutraceutical Jellies	Functional food-like jelly formulations with vitamins and supplements	Dietary supplements, immunity boosters	Zinc, Vitamin D, Elderberry, Biotin	[25]
Thermo-reversible Jellies	Liquids at room temperature, gels at body temperature (e.g., poloxamer-based)	Nasal, ocular, vaginal drug delivery	Timolol, Clotrimazole, Xylometazoline	[4, 26]
Cosmeceutical Jellies	Aesthetic and skincare products in jelly form	Anti-ageing, moisturizing	Hyaluronic acid, Retinol, Collagen peptides	[27]

**Excipients in Gummy Formulations**

Excipients play a vital role in gummy formulations, contributing to their texture, taste, stability, and overall appeal. Based on the multiple research studies, following are the key excipients and their functions in the manufacturing of gummies; [28, 29].

**Table 2**

*Excipients used in the manufacturing of Pharmaceutical Jellies*

Excipient Type	Function	Common Examples	References
Gelling Agents	Provide texture, chewiness, and structural matrix	Gelatin, Pectin, Agar, Carrageenan	[30]
Sweeteners	Improve taste, mask bitterness, and provide energy	Sucrose, Glucose syrup, Sorbitol, Stevia	[31]
Humectants	Retain moisture and prevent hardening	Glycerin, Sorbitol, Propylene glycol	[30]
Flavoring Agents	Enhance palatability and acceptability	Natural fruit flavors, Mint, Citrus oils	[31]
Coloring Agents	Improve visual appeal	Natural colors (beetroot, turmeric), FD&C dyes	[32]
Acidulants	Impart tartness and stabilize pH	Citric acid, Malic acid, Tartaric acid	[32]
Preservatives	Prevent microbial growth and spoilage	Potassium sorbate, Sodium benzoate	[32]
Emulsifiers	Aid in mixing oil-based actives uniformly	Lecithin, Polysorbate 80	[32]
Coating Agents	Prevent sticking and improve handling	Carnauba wax, Vegetable oil, Beeswax	[32]
Active Ingredients	Deliver therapeutic effects (vitamins, minerals)	Vitamin C, D, Zinc, Herbal extracts	[32]

**Future Perspectives**

The future of pharmaceutical gummies holds significant promise in improving disease management, particularly in enhancing patient adherence and therapeutic outcomes. Ongoing research is expected to focus on the development of improved formulations with enhanced bioavailability, stability, and efficacy of active compounds. Combination therapies that incorporate multiple therapeutic agents or integrate conventional medications into gummy dosage forms may offer synergistic benefits. The growing trend

toward personalized medicine also paves the way for individualized gummy formulations based on genetic predispositions, dietary habits, and lifestyle factors. The identification and inclusion of novel natural ingredients with proven therapeutic properties, such as plant-based bioactives, is another key area of exploration. Advancements in drug delivery systems, including technologies like nanoencapsulation, liposomes, and mucoadhesive polymers, are anticipated to significantly enhance absorption and therapeutic efficacy. Furthermore, conducting large-scale clinical trials is essential to establish the safety, tolerability, and clinical effectiveness of these formulations. From a regulatory perspective, there is a pressing need to develop standardized guidelines to ensure the quality, safety, and labeling of gummies. The integration of digital health tools, such as mobile apps and wearable technologies, can facilitate real-time monitoring of blood glucose levels, gummy intake tracking, and personalized feedback. Additionally, promoting patient education regarding proper use, realistic expectations, and lifestyle modification remains vital for maximizing clinical benefit. Functional jellies for gut health and metabolic support are under exploration.[33]. Future research may focus on smart jellies responsive to physiological stimuli, nano particle-incorporated jellies for targeted delivery, and personalized medicine formulations [34]. Advances in polymer technology and nanotechnology are expected to expand the applications of jelly dosage forms.[35].Finally, cost-effectiveness analyses comparing pharmaceutical gummies with traditional therapies will be critical in evaluating their long-term value and accessibility in healthcare systems.

**Limitations**

Despite many benefits, jelly dosage forms face some challenges, likewise moisture sensitivity, shorter shelf life due to temperature sensitivity, dose uniformity not uniform due to dispersion issues, especially for poorly soluble drugs, and inconsistent manual dosing by patients. Jellies have limited drug compatibility issues, like hydrolysis and oxidation in an aqueous environment or may react with gelling agents. Its restricted dose delivery makes it suitable primarily for low to moderate dosages. Jellies have high water content, making them prone to microbial contamination and requiring preservatives. Less shelf life due to high water content can support microbial growth. Stability Issues in sensitive APIs may degrade in moist environments storage and packaging requirements like air-tight, moisture-resistant packaging. Absorption variability also occur with poorly permeable drugs, and shows delayed absorption from jelly matrices [36]. Less portable than tablets, larger unit doses may be needed for high-potency drugs [37].

**CONCLUSION**

Jelly dosage forms offer promising advantages in drug delivery by enhancing patient compliance and providing versatile administration routes. Ongoing research is expected to overcome current limitations and expand its applications in the pharmaceutical industry.

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