

A REVIEW ON PHARMACEUTICAL IMPORTANT NATURAL EXCIPIENTS

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Abstract—The increasing demand for sustainable and biocompatible excipients in pharmaceutical formulations is driven by regulatory support and consumer preference for natural products. This review examines the pharmaceutical potential of selected natural excipients—neem gum (*Azadirachta indica*), guar gum (*Cyamopsis tetragonoloba*), gum ghatti (*Anogeissus latifolia*), khaya gum (*Khaya senegalensis*), tamarind seed gum (*Tamarindus indica*), and agar (from *Gelidium* and *Gracilaria* spp.). A comprehensive analysis of peer-reviewed literature was conducted to evaluate their physicochemical properties, extraction and purification techniques, and roles in various dosage forms.

Each excipient demonstrated multifunctional utility: neem gum exhibited gel-forming and controlled-release capabilities; guar gum showed mucoadhesive and sustained-release potential; gum ghatti functioned effectively as a thickening and emulsifying agent in colon-targeted formulations; khaya gum served as a binder and stabilizer in suspensions; tamarind seed gum provided excellent bio-adhesion and rapid disintegration in orally disintegrating tablets; and agar proved effective as a gelling agent in controlled-release systems.

Natural excipients offer advantages such as biodegradability, low toxicity, and cost-effectiveness. However, challenges like batch-to-batch variability, microbial contamination, and formulation stability must be addressed through further standardization and regulatory harmonization. This review highlights their promising role in developing eco-friendly, patient-compliant, and regulatory-aligned pharmaceutical formulations.

Index Terms—Natural Excipients, Pharmaceutical Excipients, Gum, Guar, Ghatti, Khaya Gum, Tamarind Seed Gum, Agar, Drug Delivery Systems, Biocompatibility, Plant-based Polymers, Binders, Disintegrants, Stabilizers, Gelling Agents, Mucoadhesive Agents, Controlled Release, Sustainable Formulations, Herbal Excipients, Excipient Purification.

INTRODUCTION

Pharmaceutical excipients play a crucial role in the formulation of drug products, serving as inert substances that facilitate the delivery of active pharmaceutical ingredients (APIs) to the body. Defined as inactive ingredients, excipients are integral in enhancing the stability, bioavailability, and overall efficacy of pharmaceutical formulations. They are classified based on their origin into three main categories: natural, semisynthetic, and synthetic excipients.

The choice of excipient significantly influences the physicochemical properties of pharmaceutical formulations, including their flowability, compressibility, and dissolution rates. For instance, disintegrants like croscarmellose sodium facilitate the breakup of tablets in the gastrointestinal tract, enhancing drug absorption. Binders, such as starch and gelatin, help in tablet formation, ensuring mechanical strength and integrity.

Excipients are crucial for stabilizing and delivering active pharmaceutical ingredients effectively. They enhance drug bioavailability, ensure proper dosage form structure, and improve patient compliance. By controlling drug release and protecting APIs from degradation, they ensure therapeutic efficacy. Careful selection of excipients ensures safety, stability, and overall product quality in formulations.

In conclusion, pharmaceutical excipients are indispensable components of drug formulations, impacting the performance, safety, and efficacy of therapeutic products. Understanding the various types of excipients and their functions is essential for pharmaceutical scientists and formulators aiming to develop effective and stable drug products.¹

Role of Excipients in Pharmaceutical Formulations

Excipients perform various critical roles in pharmaceutical preparations, ensuring the successful development and delivery of drug products:

- 1. Binders:** Binders are used to bind powders during the manufacturing of tablets, ensuring they hold together firmly. They help in forming cohesive and stable tablets that possess the necessary mechanical strength and uniformity. Examples include acacia gum, guar gum, and starch.²
- 2. Diluents:** When the active ingredient dosage is low, fillers or diluents are added to increase the bulk of the tablet or capsule, making it easier to manufacture and administer. Plant-derived substances such as microcrystalline cellulose and starch serve this purpose effectively, providing bulk while being safe and biocompatible.³
- 3. Disintegrants:** These excipients facilitate the breakdown of tablets once ingested, promoting the rapid release and absorption of the active pharmaceutical ingredient (API). By aiding disintegration in the gastrointestinal tract, they improve the bioavailability and therapeutic efficiency of the drug. Common plant-based disintegrants include starches like corn starch and mucilages like psyllium.⁴
- 4. Stabilizers and Coating Agents:** Plant polymers such as pectin and cellulose derivatives (e.g., Hydroxypropyl Methylcellulose) are used to stabilize drug formulations and extend their shelf life. They also act as coating agents, offering protective layers that can control the release rate of the API, improving the drug's performance and patient compliance.⁵

5. Viscosity Agents: Plant gums and mucilages, including xanthan gum and agar, are utilized to modify and control the viscosity of liquid formulations such as suspensions, emulsions, and gels.⁶

Types of Excipients:

Based on their origin:

1. Natural Excipients:

Natural excipients are derived from plant, animal, or mineral sources. They are widely used due to their biocompatibility, non-toxicity, and availability. These excipients serve as binders, disintegrants, thickeners, or stabilizers. Their variability in quality may require stringent quality control during formulation.⁷

Examples: Acacia gum, starch (corn, potato), alginates, pectin, and gelatin.

2. Semisynthetic Excipients:

Semisynthetic excipients are derived from natural sources but chemically modified to enhance their functional properties in pharmaceutical formulations. These modifications improve their stability, solubility, or compatibility with active pharmaceutical ingredients (APIs). They are widely used as binders, thickeners, and controlled-release agents.⁸

Examples: Hydroxypropyl methylcellulose (HPMC), ethylcellulose, and carboxymethyl cellulose (CMC).

3. Synthetic Excipients:

Synthetic excipients are chemically synthesized and designed to provide specific properties like enhanced stability, controlled drug release, and ease of manufacturing. These excipients are often used when natural or semisynthetic alternatives are not suitable. They are manufactured through controlled chemical processes, ensuring consistent quality and purity.⁹

Examples: Polyvinylpyrrolidone (PVP), polyethylene glycol (PEG), and synthetic polymers like carbomers and poloxamers.

Based on their application in formulation:

The below data provide detailed insights into the types of excipients used in pharmaceuticals, along with their specific roles and examples.

1. Binders:

Binders are used to provide cohesiveness to powdered materials during tablet formation, ensuring that tablets or granules maintain their shape and integrity during production, handling, and storage. Example: Plant gums (e.g., acacia, guar gum), cellulose derivatives.

2. Fillers (Diluents):

Fillers are added to increase the volume or weight of tablets and capsules when the dosage of the active ingredient is low. Examples: Lactose, microcrystalline cellulose, starch.

3. Disintegrants:

Disintegrants help tablets break down into smaller particles in the gastrointestinal tract to enhance drug absorption. Example: Starch, croscarmellose sodium, crospovidone.

4. Lubricants:

Lubricants are added to reduce friction during the tablet manufacturing process, preventing sticking to equipment. Example: Magnesium stearate, stearic acid, talc.

5. Coating Agents:

Coating agents protect the tablet's surface, control drug release, and enhance the tablet's appearance and stability. Example: Hydroxypropyl methylcellulose (HPMC), ethylcellulose, pectin.

6. Stabilizers and Preservatives:

These excipients help maintain the stability and shelf-life of the drug product by preventing degradation and microbial growth. Examples: Sorbic acid, benzalkonium chloride, ascorbic acid.

7. Viscosity Agents (Thickening Agents):

These are used to adjust and control the viscosity of liquid formulations, such as gels, suspensions, and emulsions. Example: Xanthan gum, agar, guar gum.

8. Flavoring and Sweetening Agents:

These excipients improve the taste of oral formulations, making them more palatable, especially for pediatric and geriatric patients. Examples: Sucrose, aspartame, menthol.¹⁰

Advantages of Natural Excipients

- **Biodegradable:** Naturally being polymers produced by all living organisms. They show no adverse effects on the climate or human beings.
- **Biocompatible and non-toxic:** Chemically, nearly all of these plant stuff are carbohydrates in nature and composed of repeating monosaccharide units. Hence, they're non-toxic.
- **Economic:** They're cheaper and their product cost is lower than synthetic material.
- **Safe and devoid of side effects:** They're from a natural source and hence, safe and without side goods.
- **Easy availability:** In multiple countries, they're produced due to their application in multiple industries.
- **Regulatory Acceptance:** Many natural excipients are already approved by regulatory agencies due to their historical use and safety profile.
- **Versatility:** Natural excipients serve multiple functions, such as binders, disintegrants thickeners, and stabilizers, making them highly versatile in formulations.
- **Cost-Effectiveness:** Natural excipients are often more economical to produce compared to synthetic alternatives.¹¹

Disadvantages of Natural excipients

- **Batch-to-Batch Variability:** Natural excipients can exhibit significant variability in composition and properties due to differences in source material, growing conditions, and processing methods.
- **Microbial Contamination:** Being derived from biological sources, natural excipients are prone to microbial growth, requiring careful sterilization and preservation.
- **Limited Functional Consistency:** Natural excipients may not always meet the stringent consistency and performance standards required for pharmaceutical formulations.
- **Hydrophilicity and Moisture Sensitivity:** Many natural excipients, such as gums and starches, are hydrophilic and absorb moisture from the environment, which can affect the stability of the formulation.
- **Complex Processing Requirements:** Extracting, purifying, and processing natural excipients to achieve pharmaceutical-grade quality can be time-consuming and costly.
- **Potential Allergenic Reactions:** Some natural excipients may cause allergic reactions in sensitive individuals, such as proteins (e.g., gelatin) or plant-derived materials.
- **Stability Issues:** Natural excipients may degrade or lose functionality over time due to exposure to heat, light, or moisture, leading to shorter shelf lives.
- **Limited Mechanical Strength:** In some cases, natural excipients may lack the mechanical strength required for specific applications, such as tablet compression.
- **Chemical Complexity:** The complex structure of natural excipients can make it difficult to modify or optimize their properties for specific pharmaceutical needs.¹²

Natural Excipients

Plants produce an enormous variety of natural products with largely different structures. These products are generally nominated as “secondary metabolites” in discrepancy to the “primary metabolites” which are essential for factory growth and development. Secondary metabolites were once regarded as “waste products” without physiological function for the plant. These secondary metabolites don't have any medicinal properties but they exhibit good pharmaceutical excipient properties.

Natural excipients are now being incorporated into novel drug delivery systems (NDDS) to serve multiple functions. They can directly or indirectly control the release and rate of drug delivery. Extensive research efforts have been dedicated to developing safe and effective drug delivery systems using natural excipients. This includes their isolation, purification, standardization, characterization, and various applications. The study aims to highlight the diverse applications of natural plant excipients of pharmaceutical importance in different types of formulations.

Natural excipients serve as gelling agents, thickeners, suspending agents, binders, diluents, lubricants, and disintegrants. The growing demand for sustainable and natural alternatives in the pharmaceutical industry has led to an increased focus on plant-based excipients due to their biocompatibility, low toxicity, and reduced environmental impact. Moreover, these excipients align with the trend toward green chemistry, offering a more sustainable approach to drug development. The study outlines the advancements in natural products and the assessment of naturally extracted plant excipients for formulation development. These excipients have a wide range of applications in formulation design.¹³

1. Neem Gum:

Neem gum as a pharmaceutical excipients can serve multiple functions, including acting as a binder, stabilizer, and thickening agent in tablet and capsule formulations. Its natural origin and biocompatibility enhance the safety profile of formulations, aligning with the growing trend towards natural and sustainable ingredients in drug development. Research indicates that neem gum can improve the bioavailability of active pharmaceutical ingredients (APIs) while maintaining stability in dosage forms. Additionally, its ability to form gels and films makes it suitable for use in topical preparations and controlled-release systems.¹⁴



Figure 1: Neem Gum

Pharmacognostic Properties of Neem Gum

1. Botanical Description

- **Scientific Name:** *Azadirachta indica*
- **Family:** Meliaceae
- **Common Names:** Neem, Indian Lilac
- **Habitat:** Predominantly found in tropical and subtropical regions, especially in India.

2. Physical Characteristics

- **Appearance:** The gum is typically a yellowish or brownish resinous substance.
- **Odor:** It has a characteristic odor.
- **Taste:** Bitter taste is often noted.
- **Solubility:** Soluble in water and various organic solvents, indicating its potential for multiple applications.¹⁵

Isolation and purification of Neem gum:

The neem gum was collected from the neem trees in October and November from the surrounding regions. The gum was collected from the neem trees by making incisions and leftovers for a few days to Produce the gum. The gum was collected and allowed to

dry at room temperature before being used. The dried gum was ground in a mortar and passed through sieve no. 60. In distilled water, neem gum (25g) was solubilized (250 ml) and to this solution, 20 ml of Acetone was added to precipitate gum. The precipitate of gum was dissolved in 50 ml of water and 20 ml of ethanol was added to Precipitate the gum again. It was separated by using a muslin cloth, air-dried, pulverized, and Kept in an airtight container. Purified neem gum of 18g was obtained out of 25 g of the original gum.¹⁶

2. Guar Gum:

Guar gum's multifunctional properties make it an invaluable excipient in pharmaceutical formulations. Its ability to enhance the stability, release, and bioavailability of drugs positions it as a key ingredient in various dosage forms. It can modify the release profile of active pharmaceutical ingredients (APIs), making it suitable for sustained-release formulations. Guar gum also exhibits mucoadhesive properties, allowing it to adhere to mucosal tissues and enhance the residence time of drug formulations.¹⁷



Figure 2: Guar Gum

Pharmacognostic Properties of Guar gum

1. Botanical Description

- **Scientific Name:** *Cyamopsis tetragonoloba*
- **Family:** Fabaceae
- **Common Names:** Guar or Guwar and Guwar beans
- **Habitat:** primarily grown in India and Pakistan.

2. Physical Characteristics

- **Appearance:** Typically appears as a free-flowing, white to off-white powder.
- **Odor:** odorless
- **Taste:** Tasteless
- **Solubility:** Guar gum is soluble in cold water, forming a viscous solution. It does not dissolve well in hot water.¹⁸

Isolation and Purification of Guar Gum

- 1. Seed Preparation:** Collect mature guar seeds from the guar plant and remove any foreign materials, dirt, or debris from the seeds by washing them with water.
- 2. Dehusking:** Use a mechanical device or manually dehusk the seeds to separate the seed coat from the endosperm. Gather the endosperm, which contains the guar gum.
- 3. Grinding:** Grind the dehusked endosperm into a fine powder using a grinder or mill. This increases the surface area for better extraction.
- 4. Extraction:** Combine the ground endosperm powder with distilled water in a suitable ratio (typically 1:10 w/v). Stir the mixture continuously for several hours (around 2-4 hours) to allow the guar gum to dissolve in water.
- 5. Filtration:** Filter the mixture using a muslin cloth or filter paper to remove undissolved material, obtaining a viscous guar gum solution.
- 6. Precipitation:** Add a precipitating agent like ethanol or isopropanol to the filtered solution. The usual ratio is 2-3 volumes of alcohol for every volume of gum solution. Stir the mixture to ensure even distribution of the alcohol and promote the precipitation of guar gum.
- 7. Washing:** Collect the precipitated guar gum by filtration. Wash the precipitate with cold ethanol or isopropanol to remove residual impurities and solvent.
- 8. Drying:** Spread the washed guar gum on a clean surface or use a drying oven at a low temperature (about 40-60°C) to remove moisture. Once completely dried, grind the guar gum again if necessary to achieve a uniform powder.¹⁹

2. Gum Ghatti

Gum Ghatti, a natural exudate from *Anogeissus latifolia* (family Combretaceae), is a versatile pharmaceutical excipient commonly found in India and Southeast Asia valued for its functional properties. It is a complex polysaccharide primarily composed of galactose, arabinose, mannose, and glucuronic acid. Available as pale yellow to brown granules or powder, it is partially soluble in water, forming a viscous colloidal solution. In pharmaceutical formulations, Gum Ghatti is utilized as an emulsifying agent to stabilize oil-water emulsions and as a thickener in suspensions. Its binding properties make it suitable for use in tablets and capsules, enhancing cohesion and stability. Additionally, it acts as a film-forming agent in coatings, providing a smooth finish and controlled release.²⁰



Figure 3: Gum Ghatti

Pharmacognostic Properties of Gum Ghatti :

1. Botanical description :

- **Scientific name:** *Anogeissus latifolia*
- **Family:** Combretaceae
- **Common Names:** Gum Ghatti, Indian Gum,
- **Habitat:** forests of India, particularly in dry, deciduous regions

2. Physical Characteristics:

- **Appearance:** Gum ghatti is an off-white to light brown powder or granule.
- **Odor:** It has a faint, characteristic odor.
- **Taste:** It has a bland taste, typically tasteless.
- **Solubility:** Insoluble in water but swells to form a viscous colloidal solution.²¹

Isolation and purification of Gum Ghatti

The typical extraction process can be outlined as follows:

- 1. Collection of Gum:** The gum is harvested from the *Anogeissus latifolia* tree, usually by tapping the bark. The gum exudates naturally from the tree in response to injuries to the bark. The collected gum is then cleaned to remove any contaminants such as bark pieces, dirt, or other impurities.
- 2. Purification:** The crude gum is dissolved in water, and the solution is filtered to remove insoluble particles. The gum solution may be subjected to precipitation using an alcohol (usually ethanol), followed by washing and drying to yield the purified gum.
- 3. Drying and Powdering:** The purified gum is dried under controlled conditions (e.g., in an oven or air-dried) to remove residual moisture, which may affect its quality and stability. After drying, the gum is finely powdered to facilitate incorporation into pharmaceutical formulations.²²

4. Khaya Gum

Khaya gum is a natural exudate obtained from the bark of *Khaya senegalensis* (family Meliaceae) a tree native to Africa. It is water-soluble and commonly used as a stabilizer, emulsifier, and thickening agent in pharmaceutical and food applications, and is a versatile pharmaceutical excipient. It is a complex polysaccharide that forms a viscous solution in water, making it useful as a thickening, suspending, and stabilizing agent in liquid formulations. Khaya gum is also employed as a binder in tablets, improving cohesion and mechanical strength, and as a disintegrant to facilitate tablet dissolution. Biodegradable, non-toxic, and cost-effective, it is an excellent alternative to synthetic gums, offering compatibility with various drugs and excipients. Its natural origin aligns with the growing demand for sustainable pharmaceutical ingredients.²³



Figure 4: Khaya Gum

Pharmacognostic Properties of Khaya gum

1. Botanical description:

- **Scientific Name:** *Khaya senegalensis*
- **Family:** Meliaceae
- **Common Name:** Khaya gum, African mahogany gum
- **Habitat:** Native to tropical Africa, found in savannas.²⁴

2. Physical Characteristics:

- **Appearance:** Khaya gum is a translucent, amber to light brown solid or granule.
- **Odor:** It has a mild, slightly woody odor.

- **Taste:** It is generally bland or slightly astringent.
- **Solubility:** Insoluble in water but swells and forms a gel-like solution when dispersed in hot water.²⁵

Isolation and purification of Khaya gum

- 1. Collection:** Collect gum exudate from the bark of *Khaya senegalensis* trees. This is done by making incisions in the bark and allowing the gum to exude naturally.
- 2. Initial Cleaning:** The collected gum is allowed to air dry and then manually cleaned to remove bark, dust, and other large impurities.
- 3. Dissolution in Water:** The cleaned gum is then dissolved in warm distilled water, which helps to remove water-soluble impurities.
- 4. Filtration:** The gum solution is filtered to remove insoluble impurities, debris, and other solid particles. Filtration can be done through muslin cloth, filter paper, or using a vacuum filter if available.
- 5. Precipitation:** To purify the gum further, the solution is treated with ethanol or acetone. This step causes the gum to precipitate out of the solution, leaving many impurities dissolved in the solvent.
- 6. Washing:** The precipitated gum is washed multiple times with ethanol to remove any remaining impurities and solvent residues.
- 7. Drying:** The purified gum is air-dried or oven-dried at low temperatures to avoid degradation. It is then ground into powder if required.
- 8. Storage:** The purified gum powder is stored in an airtight container to protect it from moisture and contamination. This process yields a cleaner, more standardized Khaya gum suitable for various applications in food, pharmaceuticals, or industrial uses.²⁶

5. Tamarind Seed Gum

Tamarind seed gum, derived from the seeds of *Tamarindus indica* (family Fabaceae), is a natural polysaccharide widely used as a pharmaceutical excipient. It consists of xyloglucan, which hydrates in water to form a highly viscous solution, making it an effective thickening, stabilizing, and gelling agent. Tamarind seed gum is utilized in controlled drug delivery systems, as a binder in tablets, and as a bioadhesive for mucosal applications. Its non-toxic, biodegradable, and biocompatible nature ensures safety and sustainability. Additionally, it enhances drug solubility and release profiles, making it a valuable ingredient in modern pharmaceutical formulations.²⁷



Figure 5: Tamarind Seed Gum

Pharmacognostic Properties of Tamarind seed gum:

1. Botanical description:

- **Scientific Name :** *Tamarindus indica*
- **Family:** Fabaceae
- **Common Name:** Tamarind seed gum, Tamarind gum
- **Habitat:** Native to tropical Africa but widely cultivated in tropical and subtropical regions worldwide, often found in dry woodlands.

2. Physical Characteristics

- **Appearance:** Tamarind seed gum is a white to light yellowish-brown powder.
- **Odor:** It has a mild, characteristic odor.
- **Taste:** It is generally bland and tasteless.
- **Solubility:** Partially soluble in cold water, but forms a viscous solution when dispersed in hot water.²⁸

Isolation and purification of Tamarind seed gum:

- 1. Seed Collection and Preparation:** Tamarind seeds are collected, cleaned, and then soaked in water to soften them, which makes it easier to remove the hard seed coat.
- 2. Dehulling:** The softened seeds are mechanically or manually dehulled to remove the outer seed coat, leaving the endosperm, which contains the gum.
- 3. Extraction:** The dehulled seeds are boiled in distilled water or hot water to extract the polysaccharides, forming a viscous solution. This helps to release the gum from the seed endosperm.
- 4. Filtration:** The extracted gum solution is filtered to remove insoluble residues, such as seed fragments or other impurities.
- 5. Precipitation:** The filtered solution is then treated with a non-solvent, typically ethanol or isopropanol, which precipitates the gum. This step separates the polysaccharide from water and other soluble impurities.
- 6. Washing:** The precipitated gum is washed several times with ethanol to further purify and remove any residual impurities or solvents.
- 7. Drying:** The purified gum is dried at a controlled temperature to avoid degradation. It can be air-dried or dried in an oven at a low temperature.
- 8. Grinding and Storage:** The dried gum is ground into a fine powder and stored in airtight containers to prevent moisture absorption. This process yields purified tamarind seed gum, suitable for applications in food, pharmaceuticals, and industrial uses.²⁹

6. Agar

A natural polysaccharide derived from red algae (*Gelidium and Gracilaria spp.*), is widely used as a pharmaceutical excipient due to its gelling, thickening, and stabilizing properties. It is primarily employed in the preparation of gels, suspensions, and controlled-release drug delivery systems. Agar serves as a binder in tablet formulations, enhancing cohesion, and is also used in microbiological media as a solidifying agent. Its ability to form gels at low concentrations and its non-toxic, biocompatible nature make it an ideal excipient in pharmaceuticals. Agar's versatility and safety contribute to its widespread use in various dosage forms.³⁰



Figure 6: Agar-Agar

Pharmacognostic Properties of Agar:

1. Botanical description:

- **Scientific Name:** *Gelidium spp. And Gracilaria spp.*
- **Family:** Gelidiaceae (Red algae)
- **Common Name:** Agar
- **Habitat:** Marine environments, particularly in shallow coastal waters.

2. Physical Characteristics:

- **Appearance:** Translucent, either in thin strips or powdered form.
- **Odor:** Odorless.
- **Taste:** Tasteless.
- **Solubility:** Insoluble in cold water but dissolves in hot water to form a gel.³¹

Isolation and purification of Agar:

1. **Collection:** Harvest red algae (*Gelidium or Gracilaria spp.*) from marine environments.
2. **Washing:** Thoroughly wash the algae to remove sand, salt, and impurities.
3. **Boiling:** Boil the algae in water or an alkaline solution to extract the agar.
4. **Filtration:** Filter the hot solution to remove residual algae and debris.
5. **Cooling:** Cool the filtered solution, allowing the agar to gel.
6. **Freezing and Thawing:** Freeze and thaw the gel to remove impurities and concentrate the agar.
7. **Drying:** Dry the purified agar gel in thin layers under controlled conditions.
8. **Powdering:** Grind the dried agar into powder or cut it into strips for commercial use.³²

CONCLUSION:

This review highlights the use of natural excipients in pharmaceutical formulations, and their multifunctionality, biocompatibility, and cost-effectiveness by serving as binders, disintegrants, stabilizers, thickeners, and more. Natural excipients like neem gum, guar gum, gum ghatti, khaya gum, tamarind seed gum, and agar demonstrate their versatility in enhancing drug delivery. Each excipient contributes uniquely to formulation designs, such as Neem gum's gel-forming ability for controlled release, Guar gum's application in sustained-release systems, Gum Ghatti in colon targeting drug delivery, Khaya gum in flocculation of suspension, Tamarind gum and Agar as super disintegrating agents.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this review article.

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