International Journal of
Pharmaceutical Sciences and Nanotechnology (IJPSN)
http://www.ijpsnonline.com

REVIEWARTICLE

A Bird Eye View on Natural Gums and Mucilage used in Drug Delivery System

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How to cite this article: Gupta Manish Kumar, Suryawanshi Meghraj and Shrivastava Birendra, A Bird Eye View on Natural Gums and Mucilage used in Drug Delivery System, International Journal of Pharmaceutical Sciences and Nanotechnology. 2023, 16(1):6381-6391.

MSID: 3020

https://doi.org/10.37285/ijpsn.2023.16.1.10

ABSTRACT

Natural mucilage is utilized in drug delivery systems (DDS) to accomplish a variety of duties, including directly or indirectly regulating the rate and amount of drug release in specific circumstances. Gums are biomolecules composed of carbohydrates that may attract water and form gels. Proteins and minerals are typically found in the creation of the gums. Gums exist in a number of types, including mucilage gums, seed gums, exudate gums, and others. Plant gums are among the most important gums because of their bioavailability. Excipients are being used in unique dosage forms to fill specific tasks as a result of advances in drug delivery technology. In some cases, these additives have a direct or indirect effect on the amount and/or rate of drug release and absorption. Given the present trend toward the use of natural goods derived from plants, the substitution of synthetic additives with natural ones is important. The world is getting increasingly interested in natural drugs and excipients. Natural mucilage has advantages over synthetic mucilage because it is more easily available, less expensive, and chemically inert. They now compete with several polymeric materials for use as diverse drugs and have advanced from being an excipient to cutting-edge drug carriers. Extensive research has gone into the development of safe and effective natural-based mucilage particulate drug delivery systems. Natural gums and mucilage are examined, as well as their isolation, purification, standardization, and characterization properties, as well as their applications. This article provides an overview of natural excipients used in both traditional dosage forms and innovative drug delivery systems.

Keywords
Gum, Mucilage, Novel drug delivery system, Bioavailability, Non-toxic.

Introduction

Our health is vitally dependent on natural plants. The use of herbal products has significantly increased in recent years in both industrialized and Western nations. India is one of the nations with the widest variety of medical traditions in the world, and there, the use of medicinal plants is still revered as part of a long-standing tradition. Traditional medical systems

Abbreviations:PMMA: poly-methyl methacrylate, NMR: Nuclear Magnetic Resonance, FTIR: Fourier Transform Infrared Spectrometer TLC: Thin Layer Chromatography, HPLC: High-Performance Liquid Chromatography, OECD: Organization for Economic Co-operation and Development

including Ayurveda, Unani, and Siddha have been known to use medicinal herbs[1]. Excipients have traditionally served as an inert vehicle in drug formulations, providing the precise weight, consistency, and volume required for the proper administration of the active ingredient. However, in contemporary pharmaceutical dosage forms, they frequently serve multiple functions, such as modifying release, improving the stability and bioavailability of the active ingredient, enhancing patient acceptability, and ensuring ease of manufacture[2].

Due to their numerous pharmacological uses as diluents, binders, disintegrants in tablets, thickeners in oral liquids, protective colloids in suspensions, gelling agents in gels, and bases in suppositories, polymers produced from plants have attracted a lot of attention recently[3]. They are also utilized in the production of paper, paint, textiles, and cosmetics[4]. These natural gums and mucilage are chosen over synthetic ones because they are more readily available, less expensive, and biocompatible. Additionally, natural excipients are chosen over synthetic and semi-synthetic ones due to their non-toxicity, affordability, calming effect, availability, and non-irritating nature[5-8].

The field of drug delivery systems has advanced significantly due to the extensive use of different excipients, such as binders, thickening agents, sweeteners, and glidants, which can alter the physicochemical properties of the final formulation of the drug and adjust the pharmacodynamics and pharmacokinetic properties[9]. To advance polymer-based drug delivery systems and achieve targeted drug distribution, polymers are utilized as excipients[9-15]. Synthetic polymers offer great levels of mechanical, chemical, and physical stability, yet they can also be toxic to cells and incompatible with living things[14]. Povidone accumulates at the injection site during subcutaneous injection and causes granulomas in the limbs; animal studies have shown that carbomer-934P is toxic when consumed orally, and the resulting dust has also caused allergic reactions in the patient population. Synthetic polymers have disadvantages such as poor adaptation to the patient's body, high cost, and can also cause acute and chronic side effects. For instance, poly-(methyl methacrylate) (PMMA) can cause skin and Low biocompatibility, acidic product release during degradation that may trigger local and systemic responses and a quick loss of mechanical strength are further drawbacks of synthetic polymers employed in tissue engineering[16].

Natural polymers are now being used more often[17-19]. The pharmaceutical industry has seen a surge in the use of natural plant-derived polysaccharides as excipients, which can overcome formulation issues and reduce the negative effects of synthetic polymers[14-15]. Biopolymers are naturally occurring polysaccharides that are generated by the O-glycoside linkages that occur when monosaccharide residues are bound together[20]. Among these excipients are gums and mucilages. They can be customized for use in several drug delivery systems and are widely employed in the medical and cosmetic sectors[14].

These materials can be utilized in a variety of pharmacological forms, including implantable devices, suspensions, ophthalmic solutions, control release systems, film-coating agents, nanoparticles, etc. Polysaccharides are one of the many substances that make up gums and mucins. The retardant qualities release inhibitory properties that are transmitted to the dosage form by the resins and tannins in the gums. Gums can be found in a variety of plant parts. Some gums can be made by extracting them from plant leaves and bark or the seed epidermis[21]. Gums are pathological chemicals that result from harm to the plant or adverse conditions, such as rupturing the cell wall. Guar gum and acacia tragacanth are examples of gums; they are easily dissolved in water[22].

Mucilages are formed inside of cells and are organic byproducts of metabolism. They are difficult to dissolve in water. Mucilages are present in many different plant sections. Almost all plants and some microbes create mucilage, a thick, gooey substance. Both gums and mucilages are plant hydrocolloids, which gives them certain similarities. They also contain uronic acid and are made of transparent amorphous polymers and monosaccharide polymers. Hydrophilic molecules are found in gums and mucins, which can interact with water to produce viscous or gel-like solutions. Gums and mucilage provide several benefits for the pharmaceutical sector, including biodegradability, biocompatibility, nontoxicity, higher patient tolerance, fewer side effects, no allergic reactions in humans, no skin or eye irritation, and inexpensive production costs[23,24]. An overview of natural excipients utilized in both traditional dosage forms and novel drug delivery systems is provided in this article.

Gums and Mucilage

Gums are thought to be pathological byproducts that develop when a plant is injured or when unfavorable conditions, such as dryness, cause the disintegration of cell walls (extracellular formation: gummosis). Mucilage is often a physiological consequence of regular metabolism that is created within the cell (intracellular formation). Mucilage forms slimy masses, whereas gums easily dissolve in water. Both gums and mucilage are plant hydrocolloids that, when hydrolyzed, produce a combination of sugars and uronic acids[25]. Table 1 describes how gums and mucilage are categorized.

Table 1 Classification of Gums and Mucilage

Sr. No.	Class	Example
1	**Based on Source**	**Marine origin:** Agar, carrageenan, alginic acid, laminarin **Plant origin:** Gum Arabic, gum ghatti, gum karaya, tragacanth, khaya, and albizia gum, guar gum, locust bean gum, tara gum, starch, pectin, amylose, cellulose, **Animal origin:** Chitin, chitosan, hyaluronic acid **Microbial origin:** Xanthan, dextran, pullulan, zanflo, emulsan, lentinan, Kristin, etc.
2	**Based on Charge**	**Non-ionic seed gum:** Tamarind agar, locust bean, xanthan, arabinans, cellulose **Ionic seed gum:** Tragacanth, Arabic, karaya, gellan, agar, pectic acid, carrageenan

Chemical Character of Gums and Mucilages

Gums and mucilages are polysaccharides that hydrolyze into monosaccharides. Pentosan (for example, xylan) and hexose are two examples of hydrolysis products (e.g., starch and cellulose). Gums contain "polyuronides," or salts of potassium, calcium, and magnesium. Mucilages are complex polysaccharide-esterified sulfuric acid compounds. Gums and mucilages contain galactose and arabinose as sugars. Several chromatographic techniques are used to identify the sugar-forming units of a polysaccharide during hydrolysis. A polysaccharide's total carbohydrate content and monosaccharide content can both be calculated using the phenol-sulfuric acid method. The structural identification of gums and mucilages is also accomplished using mass spectrometry and NMR methods[26].

Gum and Mucilage Separation and Purification

Mucilage can be removed from plant parts using a variety of techniques, including heating, solvent precipitation, and extraction with microwave assistance. Solvent precipitation is the simplest technique. This procedure involves choosing the plant section that contains gum or mucilage, which is then dried, ground, and sieved. After being well dissolved in distilled water, this is stirred in and left to stand at room temperature for 6 to 8 hours. Centrifugation is used to obtain the supernatant. Following a water wash, the residue is added to the separated supernatant together with the washings. The precipitating solvent is chosen, and the supernatant is then continuously stirred with twice as much of the precipitating solvent. The precipitated material is washed with distilled water and dried at 50-60ºC under a vacuum. To extract pigments and chlorophyll, plant material must first be treated with petroleum ether and chloroform, followed by distillation [27,28].

Characterization of Gums and Mucilage

Table 2[29] summarizes preliminary confirmatory testing for dry gums and mucilage powders. Analytical methods can be categorized for characterization based on the type of information produced.

Structural: Sugars are present in polysaccharides like gums and mucilage. Therefore, chromatography (TLC/HPLC) can be used to validate the presence of various sugars, and FTIR, mass, and NMR spectroscopy can be used to clarify the structure.

Purity: Tests for alkaloids, glycosides, steroids, carbohydrates, flavonoids, terpenes, amino acids, saponins, oils and fats, tannins, and phenols are conducted to determine the purity of the chosen gum and mucilage.

Impurity Profile: Testing for inclusions can be done using the appropriate analytical techniques.

Physicochemical Properties: It is possible to assess properties such as color, flavor, shape, texture, and feel as well as solubility, pH, swelling index, loss on drying, hygroscopic nature, angle of repose, bulk and actual densities, porosity, and surface tension. Additionally, the microbial load and the presence of particular pathogens are assessed. Mucilage and gums have a high viscosity by nature. The rheological characteristics of excipients are crucial factors in determining their commercial application.

Toxicity: According to OECD guideline number 425 (Ashton et al., 1975), the acute toxicity of gums and mucilage is assessed using a fixed-dose approach[30].

Table 2 Preliminary confirmatory tests for dried gums and mucilage

Sr. No.	Test	Observation	Inferences
1	Molisch Test: 100 mg dried mucilage powder + Molisch reagent + conc. H_2SO_4 on the side of the test tube	Violet-green color observed	Carbohydrate present
2	Ruthenium test: Dried mucilage powder + Mounting on slide + Ruthenium red solution + Microscope	Pink color observed	Mucilage present
3	Iodine Test: 100 mg dried mucilage powder + 1ml 0.2 N iodine solution	No color observed	Polysaccharide present (Starch absent)

Some Recently Investigated Natural Gums and Mucilage

Gum of Albizia

Albizia gum is made from the tree *Albizia zygia* incised trunk (Family Leguminosae). It is made up mostly of D-galactose units that are β-1-6 linked and β-1-3 linked. As a potential alternative to gum Arabic as a natural emulsifier for food and medicines, albizia gum has been researched[31]. These gums were tested as fillers for compression-coated tablets, which the intestinal microbiota broke down and released the drug[32].

Locust Bean Gum

Carob gum, sometimes referred to as locust bean gum (LBG), is made from the refined endosperm of seeds from the *Ceratonia siliqua* carob tree (family: Leguminosae). The polymer needs heat to reach its full hydration, solubilization, and maximum viscosity[33]. It is neutral and very slightly soluble in cold water. D-galacto-Dmannoglycan, pentane, proteins, and cellulose are all components of the gum. Oral dispersible tablets containing locust bean gum were used to study the gum's super disintegrant properties, and they were compared to the industry standard super disintegrant croscarmellose sodium[34]. As a compressive coat that may be put over core tablets to operate as a suitable carrier for colonic drug administration since it can protect the core tablet, this gum has also been studied for its controlled delivery property[35]and as a prospective drug delivery vehicle for the colon[36].

Tara Gum

The *Caesalpinia Spinosa* seed endosperm is used to make Tara gum (family: Leguminosae or Fabaceae). The major component of the gum is galactomannans. Even at 1% concentration, Tara gums, which have a 3:1 mannose to galactose ratio, produce very viscous solutions[37]. Due to the gum's swelling, Tara gum cannot be used as a controlled-release carrier in the development of gastroretentive controlled-release tablets. Combining Tara gum with other ingredients lengthens the dosage form's floating period, demonstrating its effective gastroretentive properties[38]. Emulsion formulation also utilized Tara gum.

Almond Gum

The *Prunus amygdalus* tree provides almond gum (family: Rosaceae). The almond tree's wounds exude a water-soluble gum. Aldobionic acid, L-arabinose, L-galactose, D-mannose, and other sugars are found in gum. The many ingredients that make up almond gum has capabilities for emulsifying, thickening, suspending, adhering, glazing, and stabilizing. The ability of gum from almond trees to bond in tablet formulations has been investigated. When compared to synthetic gum concentration, the drug release increased with almond gum, and it was discovered that the release mechanism was non-Fickian diffusion. The manufacture of uncoated tablet dosage forms was found to benefit from the use of almond gum[39,40].

Hibiscus Mucilage

Hibiscus Rosa Sinensis leaves can be used to make mucilage (Family: Malvaceae). L-rhamnose, D-galactose, D-galacturonic acid, and D-glucuronic acid are all present in the mucilage of Hibiscus rosa-Sinensis[41]. Its mucilage has been used in the production of prolonged-release tablets, according to reports[42].

Gum Copal

Gum copal is a naturally occurring resin from the *Bursera bipinnata* plant (family: Burseraceae). Agatholic acid, agatholic ester, acetoxy agatholic acid, ciscommunic acid, transcommunic acid, polycommunic acid, sandaracopimaric acid, and agathic acid are all present in copal resin[42]. The effectiveness of copal gum as a matrix-forming substance for maintaining medication delivery has been examined. Copal resin was employed as a film-forming agent in a separate investigation. The swelling properties of the films were good. It was determined that it can be utilized as a coating material for colon-targeted medication delivery with sustained release. Gum copal was used to produce the film, and tests of its swelling were carried out in several phosphate buffers (pH 4.5, pH 6.0, and pH 7.4); considerable swelling was discovered at pH 7.4, allowing the colon to be targeted[43].

Moi Gum

The stem *Lannea coromandelica* leaves, stems, fruits, and bark are used to make moi gum (Family: Anacardiaceae). When this gum is new, it is a yellowish-white color, but as it dries, it turns dark. Gum ducts can be found in leaves, stems, and fruits, but they are most prevalent in the stem's bark[44]. Cluytyl ferulate is found in the roots, lanosterol in the heartwood, (+) dlepi-catechin and (-) leucocyanidin in the bark, ellagic acid in the flowers and leaves, and quercetin and quercetin-3 arabinoside in the leaves. Morin and isoquercetin can also be found in flowers. Beta-sitosterol, leucocyanidin, and leucodelphinidin are other substances found in leaves. As a microencapsulating agent and release rate regulator, moi gum has been studied. The process of solvent evaporation was used to create microspheres. Microspheres with a suitable size and morphology were created using moi gum. Comparing moi gum-based microspheres to guar gum-based microspheres, it was found that the moi gum-based microspheres demonstrated sustained release for longer than 10 hours

Phoenix Mucilage

The dried fruit of the *Phoenix dactylifera* is used to make Phoenix mucilage (family: Palmaceae). 44–88% of the fruit is made up of carbohydrates, which primarily consist of reducing sugars like fructose, sucrose, mannose, glucose, and maltose as well as trace amounts of polysaccharides including pectin (0.5-3.9%), starch, and cellulose. Date palm mucilage's binding abilities were satisfactorily assessed. It was discovered that phoenix mucilage-based tablets were less friable than those made of acacia and tragacanth. The binding ability improved as gum concentration rose, resulting in good consistency in weight and tablet hardness[45].

Bhara Gum

From the bark of *Terminalia bellerica*, bhara gum is a natural yellowish gum (Family: Combretaceae). Tannins, which mostly consist of ß-sitosterol, Gallic acid, ellagic acid, ethyl gallate, galloyl glucose, and chebulaginic acid, are the main chemical components. Bhara gum is used in a novel sustained-release microencapsulated medication delivery method that has been developed. Famotidine was used as the model drug in the ionic gelation procedure to form the microcapsules. The influence of various drugs on the drug release profile of bhara gum was evaluated and contrasted with guar gum. Famotidine was released slowly over 10 hours via microcapsules made with bhara gum[46].

Mimosa scabrella Gum

Gum is made from *Mimosa scabrella* seedlings (family: Mimosaceae). With a mannose: galactose ratio of 1.1:1, the gum is a highly hydrophilic galactomannan that contributes 20–30% of galactomannan (G). Studies on the controlled release matrix-forming ability of Mimosa scabrella gum have been conducted. In this investigation, it was found that drug release decreased as polymer concentration increased, while gum at a concentration of 25% by weight had an excessive sustained release effect. Diffusion and relaxation worked together to form the release mechanism[47,48].

Cocculus Mucilage

Leaves of the *Cocculus* hirsute are used to make mucilage (Family: Menispermaceae). Polysaccharides and a gelatinous substance are both present in mucin. To emollient and demulcent, leaves are applied topically. Human skin is not harmful[49]. Researchers looked at this mucilage's ability to gel. This was a study of comparison. For the creation of the gel, flurbiprofen was employed as a model medication. The anti-inflammatory properties of commercial flurbiprofen gel and gel made from Cocculus hirsute leaf powder were compared. The amount of drug released from the test gel preparation and its anti-inflammatory activity was found to be greater than those of the commercial gel[50].

Grewia Gum

A polymer called Grewia gum is produced from the inner bark of the edible plant *Grewia Mollis* (family: Tiliaceae). The gum's primary monosaccharide components are glucose and rhamnose, and its primary sugar acid is galacturonic[51]. The ability of this gum to build matrixes was also the subject of research. In this work, direct compression was used to compress and analyze tablets with various Grewia gum concentrations. The release of cimetidine from tablets can be regulated by Grewia gum for up to 12 hours, according to in vitro drug release tests. Growinguia gum and HPMC worked in concert to delay the release of cimetidine from tablets and to have film-forming properties[52].

Cordia Mucilage

The fresh fruits of the *Cordia obliqua* tree provide Cordia mucilage (family: Boraginaceae). Raw gum can be used to treat gonorrhea, while Cordia mucilage can be used as an expectorant and as a lung disease treatment. Studies on the binding and emulsifying abilities of Cordia mucilage have been conducted[53].

Ocimum Mucilage

The seeds of the plant *Ocimum americanum*, also known as *Ocimum canum*, are used to make occimum mucilage (family: Lamiaceae). Xylose, arabinose, rhamnose, and galacturonic acids are present in mucin[54]. It was discovered that the mucilage had a dissolving quality. Ocimum mucilage-based tablet formulations had a faster rate of disintegration than those made with starch as a disintegrant[55].

Konjac Glucomannan

Konjac tubers of the *Amorphophallus konjac* plant are used to make konjac glucomannan (family: Araceae). D-glucose and D-mannose are present in konjac glucomannan at a 1:1.6 ratio[56]. For its ability to gel, konjac glucomannan has been the subject of studies[57].

Recent Applications of Gums and Mucilage in Nano-Based Medicine

Table 3 also shows the thematic classification of some applications of natural gums and mucilages in the field of nanoscience and nanotechnologies.

Challenges and Future Scope

Although mucilages and gums come from nature, their availability varies according to the temperature and period. Following processing, extraction and purification are important steps[58]. Morphological traits (such as seed coat), physical injury to seeds, and inappropriate removal of mucilages and gums may also have an impact on the growth and productivity of mucilages and gums, posing a substantial barrier to prices and the possibility of mass production. Mucilages and gums have an equilibrium moisture content of around 10%, therefore it is likely that microbiological pathogens will be present during any stage of processing. Another important process is storage; studies have shown that storage circumstances affect the quality of the mucilage and gum[59]. Of course, it is essential to more fully investigate restriction factors in light of the various therapeutic applications for mucilages and gums, and research must be done to examine the range of mucilages and gums in comparison to conventional encapsulation materials in terms of cost, usability, functionality, and scalability. Metallic nanoparticles derived from plants are anticipated to influence disease diagnostics and treatment with minimal adverse effects[60]. Additionally, plants have a comprehensive viewpoint on the manufacture of metallic nanoparticles used in consumer products and healthcare.

Table 3 Applications of gums and mucilage in nanomedicine

Sr. No.	Genus and Used Form	Application	Results	Reference
1	Basil Seed Mucilage	Antimicrobial	MgO nanoparticles and Ziziphora clinopodioides essential oil can be found in basil seed mucilage-chitosan films, which can be employed to increase the duration of storage for food products	(Allafchian et al., 2020)[46]
2	Quince Seed Mucilage	Cell culture scaffolds	Maximizing adhesion and proliferation of epithelial Vero cells requires the use of electrospun quince seed mucilage in conjunction with polycaprolactone-based scaffolds with 3D topologies and 75-150 nm mean fiber diameters.	(Shahbazi et al., 2019)[47]
3	Quince Seed Mucilage	Structural improvement and antibacterial	Titanium dioxide (TiO_2) and silicon oxide (SiO_2) nanoparticles added to quince seed mucilage significantly enhanced the antibacterial and physicomechanical characteristics of the made films.	(Devanesan et al., 2020)[48]
4	Asafoetida gum	Cell toxicity and Antimicrobial	Asafoetida was used to create silver nanoparticles, which were successful in preventing the growth of cancer cells (MCF-7). Significant antibacterial and antifungal action were also shown by them.	(Jalili et al., 2019)[49]
5	*Alyssum homolocarpum* seed gum	Synthesis of magnetite nanoparticles and antibacterial	The effective synthesis and coating of magnetic nanocomposite (Fe_3O_4 NPs) using the seed gum of Alyssum homo-locarpum. Excellent antibacterial activity is displayed by the synthesized nanocomposite against both Gram-positive and Gram-negative bacteria.	(Kanikireddy et al., 2020)[50]
6	Guar gum	Biosynthesis of Nanocomposites and the agricultural industry	New (Carboxymethyl cellulose) CMC-guar gum silver nanocomposites (CG-Ag0NC) are created. Antimicrobial results showed that the CG-Ag0NC performed better. Strawberry shelf life was extended by the development of CG-Ag0NC.	(Samrot et al., 2020)[51]

Contd…

Sr. No.	Genus and Used Form	Application	Results	Reference
7	*Azadirachta indica* gum	Nano-carrier	Although gum made from Azadirachta indica has strong antioxidant and anticancer properties, it lacked antibacterial activity. The recovered polysaccharide underwent further carboxymethylation to create a nano-carrier for the anticancer medication curcumin. The MCF-7 cancer cell line was discovered to be sensitive to the nano-carriers.	(Khan et al., 2017)[52]
8	Guar gum	Water purification	The biocomposite of guar gum and nano-zinc oxide (GG/ZnO) was employed as an adsorbent for improved removal of Cr(VI) from an aqueous solution.	(Raeisi et al., 2019)[53]
9	Persian gum	Food industry	Persian gum was used to manufacture the fish oil-garlic essential oil nanocapsules. The produced nanocapsules have good physicochemical characteristics, indicating good stability.	(Saravanan et al., 2012)[54]
10	Gum kondagogu	Removal of various toxic metal ions	Nanoparticles of magnetic iron oxide modified with gum kondagogu (GK) (MNP). The following metal cations' removal efficiencies from the GK-MNP were quantified in the following order: Cd^{2+} is followed by Cu^{2+}, Cu^{2+}, Pb^{2+}, Ni^{2+}, Zn^{2+}, and Hg^{2+}.	(Joseph et al., 2013)[55]

Table 4 Some of the most important botanical sources of mucilage and their pharmaceutical applications

Sr. No.	Genus and Used Form	Structure	Pharmaceutical Application	Reference
1	Mimosa mucilage	D-xylose, D-glucuronic acid	↓Release of drug from tablets In vitro release→↑mucilage ↓Release of drug ↑Mucilage in tablets ↑Percent swelling ↓Percent erosion of tablets	(Choudhary and Pawar, 2014)[56]
2	Hibiscus rosa-Sinensis	L-rhamnose, D-galactose, D-galacturonic acid, D-glucuronic acid	Sustained release Binding agent Release-retarding agent	(Beikzadeh et al., 2020)[57]
3	Asario Mucilage	----------	Suspending agent Emulsifying agent	(Pawar et al., 2015)[58]
4	Fenugreek Mucilage	Mannose, Galactose, Xylose	Better release retardant	(Mazhar et al., 2018)[59]
5	Aloe Mucilage	Arabinan, Arabinorhamnogalacta, Galactan,Galactogalacturan, Glucogalactomannan,Galactoglucoarabinomannan,Glucuronic acid,Polysaccharides	A controlled delivery system	(Kothawade et al., 2010)[60]

Contd…

Sr. No.	Genus and Used Form	Structure	Pharmaceutical Application	Reference
6	Phoenix Mucilage	Carbohydrates 44–88%, Fructose, Sucrose, Mannose, Glucose, Maltose, Pectin (0.5–3.9%), Starch, Cellulose	Binding properties	(Krishna et al., 2011)[61]
7	Cassia tora Mucilage	Cinnamaldehyde, Tannins, Mannitol, Coumarins, Essential oils, (aldehydes, eugenol, pinene), Sugars, Resins	Binding Property ↓Hardness ↓Disintegration Suspending agent	(Keshani-Dokht et al., 2018)[62]
8	Dendrophthoe Mucilage	----------	Binder	(Haruna et al., 2016)[63]
9	Cocculus Mucilage	Polysaccharides, Gelatinous type of material	Gelling property Anti-inflammatory	(Jani et al., 2009)[64]
10	Cordia Mucilage	----------	Binding agent Emulsifying	(Amiri et al., 2021)[65]
11	Ocimum Mucilage	Xylose, Arabinose, Rhamnose, Galacturonic acids	Disintegrating property	(Amiri et al., 2021)[65]

Conclusion

Because natural gums are affordable, easily accessible, nontoxic, capable of chemical modification, potentially biodegradable, and, with a few exceptions, also biocompatible, they are an appealing choice for medicinal applications. Polysaccharides are the focus of the majority of research on natural polymers used in drug delivery systems. Natural gums can be altered to developed products specifically designed for drug delivery systems, competing with the synthetic excipients that are currently on the market. Newer gums, some of which have extraordinary properties, have been used in addition to the classic gums, which are still in use. There is a lot of room for study on newer plant-based gums and mucins, which may one day be used as a unique natural polymer for the formation of various drug delivery systems in the pharmaceutical industry.

Conflict of Interest

No conflict of interest

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