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A Review: Floating Tablets Using Natural Polymers

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Abstract : *The Oral drug delivery remains the most commonly used method of drug delivery. Various components play a crucial role in medication delivery system design. Polymers have evolved alongside the medication delivery mechanism The macromolecule compound known as a polymer is made up of many monomer units bound together by bonds.In the oral drug administration system, natural polymers are typically used as flavour masking, ratecontrolling, protecting, and stabilising agents.Polymers used in drug delivery systems might be natural or synthetic, depending on their origin.The article mentions natural polymers, including guar gum, chitosan, xanthan gum, Gellan gum, and sodium alginate.Polysaccharides, which are natural polymers, are biocompatible and asymptomatic. Natural polymers have many uses in the food and cosmetic industries, and their applications in pharmacy are greater than those of synthetic polymers.*

Keywords: Floating Drug Delivery Systems,Natural polymers,Site-specific.

I. INTRODUCTION

A polymer is a big molecule made up of repeating structural units, often known as a macromolecule. Covalent chemical bonds are usually used subunits.Natural polymers originate from plants, microorganisms, and animals and have high molecular weights. Natural polymers are commonly used rather than synthetic and semi-synthetic alternatives due to their low cost, availability, versatility, possibility for biodegradability, and compatibility with their natural origin.Natural polymers are widely used in the food, pharmaceutical, and cosmetics industries[1].The most practical and recommended method of delivering any medication Oral administration is a route for delivering drugs into systemic circulation. .The pharmaceutical industry has recently displayed a growing interest in oral controlled-release drug delivery as an approach to achieving better therapeutic benefits, including patience compliance, Ease of drug administration and formulation flexibility.Medications Exhibiting short half-lives and faster absorption through the gastrointestinal tract. rapidly Cleared through systemic circulation[2]. Floating systems, Commonly referred to as dynamically regulated systems possess low density formulations with sufficient buoyancy to flow within the gastric contents and retain their floating ability 38. Ranitidine hydrochloride floating matrix tablets on low density powder. Effect formulation and manufacturing variables affecting the drug release impacting gastric emptying rate for a longer period[3}. To achieve controlled drug release Drug formulation may be taken orally and is site-specific, it is preferable For delivering the drug to prolong the gastric residence duration. Extended stomach retention enhances tthe dissolution properties of drugs that have limited solubility in high pH environments, prolongs the time of drug release, decreases Drug loss and enhances bioavailability[4].

Floating System Floating drug delivery systems are distinguished bybulk density below that of gastric fluids, enabling them to Retain their floating ability within the stomach without altering gastric emptying rates For longer durations [5].

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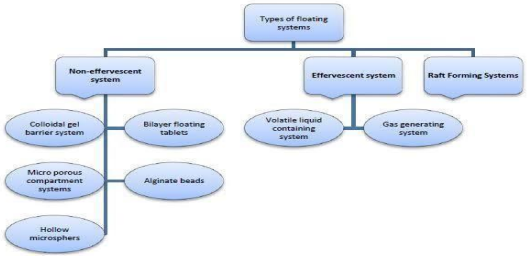


Fig 1: Classification of Floating System

Non-effervescent system : The non-effervescent FDDS relies on the polymer's swelling process or bioadhesion to the GI tract's mucosal layer. Gel-forming Highly swellable cellulosic hydrocolloids, polysaccharides, matrix-forming materials including Polycarbonate-based polymers, polyacrylate, polymethacrylate, and polystyrene, Along with bioadhesive polymers like chitosan and carbopol, Are extensively utilized excipients in noneffervescent FDDS[6].After swallowing, this type of system enlarges uncontrollably with gastric fluid, preventing it from exiting the stomach. These systems, known as "plug-type systems," tend to remain around the pyloric sphincter[7].

Colloidal Gel Barrier Mechanism : Gel-forming hydrocolloids help them stay buoyant Within the stomach, which improves Gastric retention time enhances the quantity of the drug at the absorption site. This technique uses a variety of gel-forming agents, including matrix-forming polymers like polystyrene and polycarbophil, as well as highly water-soluble cellulosic hydrocolloids like hydroxyethyl, hydroxypropyl, and hydroxypropyl methyl cellulose.

Bilayer floating tablet: Two layers of a bilayer tablet are used: one for immediate release, which releases the first dose into the system, and another for sustained release, which Takes up gastric fluid and forms a protective colloidal gel barrier covering its surface. The tablet's bulk density is less than unity, which keeps it Floating within the stomach.

Micro porous Compartment System: Encapsulated Drug-containing compartment located inside the microporous compartment, which features pores in both the Upper and lower walls. Because the outer walls of the drug-containing compartment are totally sealed, undissolved drug cannot come into direct touch with the stomach surface. The floating chamber's confined air encourages The system floats on the surface of gastric fluid.. The medicine dissolves when stomach Fluid passes through an aperture., facilitating absorption throughout the gut.

Effervescent system: Gas generating agents, including sodium bicarbonate, and other organic acids, such as citric and tartaric acid, included in the formulation, are applied in effervescent systems to release carbon dioxide gas, which lowers the system's density and causes to remain floating over the stomach fluid.Alternatively, a matrix containing a percentage of liquid can be incorporated to produce gas that evaporates at body temperature. Two types were further distinguished from these effervescent systems[8].

Volatile liquid containing systems: is possible to include an inflatable chamber filled with fluids to offer a drug delivery device with sustained gastric retention. This system contains liquids like cyclopentane and ether, which gasify at normal body temperature and lead the stomach to expand.The system is split into two halves. A medication is present in the first compartment and a volatile liquid in the second.

Gas generating systems : In essence, It contains effervescent substances Including Sodium bicarbonate along with citric and tartaric acids., Swelling polymers such as Methocel, and polysaccharides such as chitosan, Along with polymers that gasify at body temperature.Although the ethycellulose coating is insoluble, it floats because water may pass through it and release carbon dioxide.

Raft forming systems: The administration of acid-neutralizing agents and medications for gastrointestinal disorders and diseases has drawn considerable attention to raft-forming mechanisms. The creation From a cohesive gel that is viscous On entering the stomach fluids is the basic mechanism behind The formation of rafts. Each Component of the liquid swells to form a Uniform layer termed a raft.Typically, the system is made to be less thick and float atop the gastric fluid via the creation of alkaline bicarbonates or carbonates ,a gel-producing agent[9].

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II. THERAPEUTIC APPLICATIONS OF FLOATING DRUG DELIVERY

1. Sustained Drug Delivery

HBS-based formulations can be retained within the stomach for extended periods, allowing for long-term medication release.The Issue of limited Stomach retention period encountered Through oral controlled drug release Preparation consequently can be resolved by using these approaches. Such systems are can Remain buoyant in the gastric contents gastric contents Because their bulk density is lower than 1. Such systems are rather enormous in size, and It is not allowed to pass via the pyloric opening. Nicardipine Hydrochloride prolonged-release floating capsules were recently created and subjected to in vivo testing.The sustained release floating capsules' plasma concentration time curves revealed a longer administration period (16 hours) than those of the traditional MICARD capsules (8 hours) [10].

2. Site-Specific Drug Delivery : These systems are particularly beneficial for drugs like Furosemide along with riboflavin , which are specifically Absorbed within the stomach or the initial portion of the intestinal tract.The stomach absorbs furosemide the most, Followed by passage into the duodenum. As documented in the literature, a monolithic buoyant dosage Was formulated with an extended stomach residence duration, resulting in an improvement in bioavailability.For the local delivery of Misoprostol, a synthetic derivative of prostaglandin E1 that Is applied to prevent gastrointestinal ulcers brought on by NSAID use, a bilayer floating capsule was created[11].A bilayer-floating capsule was developed for the local distribution of misoprostol, a synthetic prostaglandin E1 analogue intended to treat gastrointestinal ulcers caused by NSAID use[12].

3. Absorption Enhancement :

Pharmaceuticals with Region-specific absorption in the upper gastrointestinal trac that have low bioavailability Can be formulated as floating drug delivery systems. to maximise absorption.When comparing Floating formulations commercially available LASIX tablets(33.4%)and enteric-coated LASIX-long dosage form (29.5%), a notable increase in bioavailability was possible (42.9%).

Floating Mechanism :

Floating-Based Drug Delivery Systems possess a Lower density compared with gastric fluids. to Maintain their floating ability in the stomach without altering gastric emptying rates For a long duration. The system Floats over gastric contents.The medication leaves the body gradually and at the intended pace. The stomach's residual system is emptied following the drug's release. This results in more consistent plasma drug concentrations. controlled and the GRT is raisedIf is on the upper In the upward direction, the object floats more easily. This system assists in FDDS optimisation Based on the longevity and stability of the upward forces generated For the purpose of avoid the negative effects of Unexpected changes in intra-gastric buoyant capacity 25. (Df – Ds) buoyant force minus opposing force where g is the acceleration caused by gravity, V is volume, Ds is object density, F is the Overall vertical force, and fluid density[13].

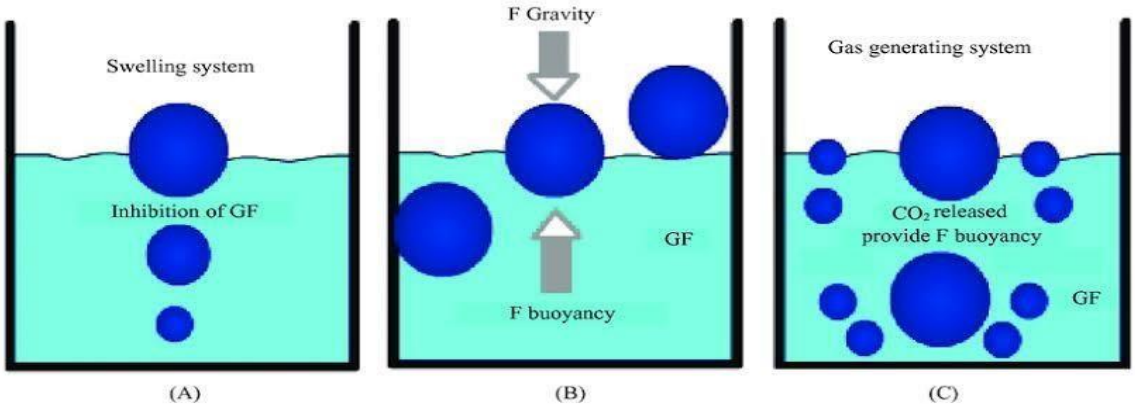


Fig 2: Mechanism Related to floating drug delivery systems

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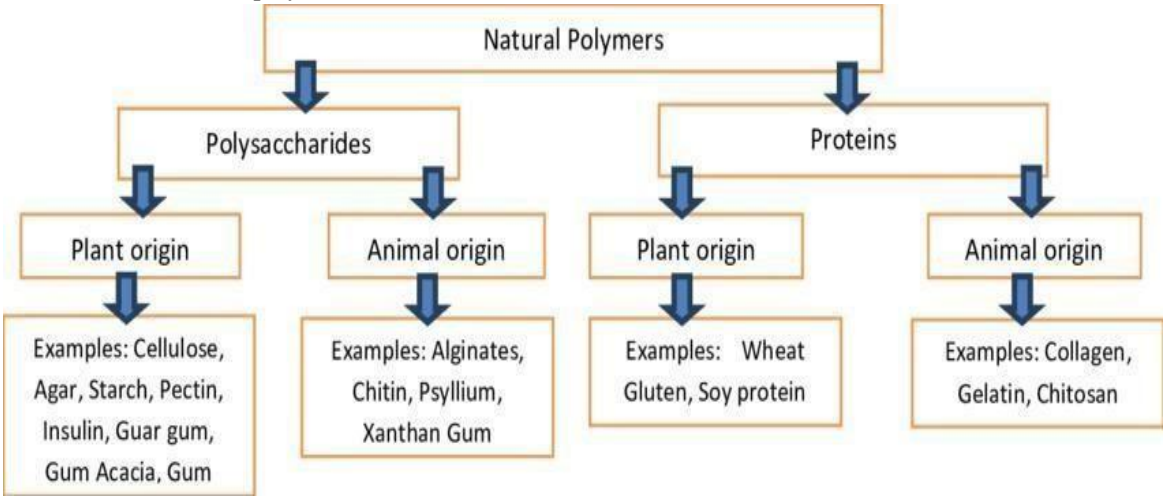
Role of Polymers in Floating Drug Release Systems :

Polymers are used in floating systems to target medicine delivery at Within the stomach, a particular area of the gastrointestinal tract. The floating drug delivery system makes use of both natural and manmade polymers. Natural polymers such as gellan gum, xanthan gum, guar gum, chitosan, and sodium alginate are utilised in floating systems[14].

Natural Polymers :

Natural gums are hydrophilic carbohydrate polymers with a large molecular weight that are derived from plants. In most instances, they remain insoluble in organic Solvents including ether and hydrocarbons. Gums can dissolve in water, absorb it, and then expand up or disperse to form a jelly-like viscous solution in cold water[15].Numerous advantageous characteristics Monosaccharide-based polymers exhibit high stability., nontoxicity, hydrophilicity, biodegradability, Gel-forming capacity, and simplicity in chemical modification. It contains a great deal of variation Within the structure composition of plant polysaccharides, and these variations are linked to both distinct plant species and the specific parts of the plant from which they arise, such as leaves, seeds, roots, and tubers[16].

Classification of Natural polymers:



Advantages Of Natural Polymer :

Biodegradable: Naturally occurring, biodegradable materials are created by all living things

Non-toxic and biocompatible : All of these plant components are essentially sugar polysaccharides that are repeated.

Low cost : cheaper to employ than organic resources. When comparing the production cost to synthetic material, it is lower. In several other developing nations, including India are reliant on agriculture, and a significant amount of money is invested in it.

Eco-friendly processing methods : The pharmaceutical industry uses a wide variety of natural chemicals derived from various plant sources, which are collected in vast quantities because the production processes are straightforward.

Local accessibility, particularly in developing nations : The government of India and other developing nations is pushing the development of plants as medicinal excipients and is providing facilities for large-scale manufacturing of products like mucilage and gum, which have numerous industrial uses.

They are more well-liked by the public and have greater patient tolerance : Natural materials are less likely to have side effects and negative impacts than manufactured ones[17] .

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THE NATURAL POLYMERS AND SOURCES LISTEN FLOTING BASED GASTRORETENTIVE DRUG DELIVERY SYSTEM :

Natural polymer	Source
Guar gum	Endosperm of the seed of *Cyamopsistetragonolobs*
Pectin	Citrus peel, apple pomace, sugar beet pulp etc.
Chitosan	Shell of marine invertebrate's
Xanthum gum	Fermentation of glucose by xanthomonascampestris
Psyllium husk starch	Seed coat of plant ago ovate storage polysaccharides in plants
Gellan gum	*Pseudomonas elodea*
Alginates	*Laminaeiahyperboria, Ascophyllumnodosum*

The following list of typical natural polymers is utilised in floating tablets :

1.GUAR GUM :

Guar is another name for cluster beans. Cyamopsis tetragonolobus (Family Leguminosae) seeds are the natural source of guar gum, a non-ionic polysaccharide.In the drug industry In Solid dosage formulations,guar gum serves as a binder. disintegrant as well as a polymer in the medication delivery system that floats[18,19]. It is a powder that is yellowish yellow in colour and tasteless. It dissolves well in water but becomes insoluble in organic solvents. Guar gum has a higher viscosity and is utilised as a disintegrant and binder in the pharmaceutical industry to manufacture solid dosage forms for floating drug delivery systems[20]. The oral controlled release tablet's effectiveness was developed using gum or modified gum[21].

Recent research has shown that guar gum functions as a flexible carrier for oral extended release drug delivery, supporting the theory that it was once employed as a hydrophilic matrix to build oral controlled release dosage forms[22]. Accelerated stability experiments and in-vitro dissolution testing reveal no changes in the formulation.In organic solvents, it is mostly insoluble. It works well with tragacanth and most other plant hydrocolloids, but not with acetone, ethanol (95%), tannins, strong acids, or alkalis[23]. They found that guar gum's viscolysing property influences the drug release profile and that it is incorporated to preserve the device's integrity[24].When Guar gum acts as hydrated and swells in cold water, viscous colloidal dispersions or sols are created.

Guar Gum Properties:

It exhibits insolubility in most organic solvents but dissolves in heated and cold water. Strong hydrogen bonds can be formed using it .

Its film-forming, stabilising, emulsion, and thickening qualities are outstanding.

It is very good at managing the water phase to control rheology.

Temperature, pH, the presence of salts, and other solids all affect how viscous guar gum Is[25,26].

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Fig3:Guar gum in powder form

Benefits of Guar Gum :

To extend The period of the drug's gastrointestinal residence time and boost its bioavailability, Srivastava et al. Created floating matrix tablets of atenolol utilising polymers including sodium carboxymethylcellulose, guar gum, and hydroxypropyl methylcellulose (K4M, K15M). The volume and pattern of drug release from the formulation have been Identified as significantly influenced by polymer swelling.

Guar gum represents utilised as a disintegration agent and binder in solid dosage forms in pharmaceuticals[27,28].

2. PECTIN

Pectin is a cheap, harmless polysaccharide that can be found in apple pomace and citrus peels. Because pectin tends to gel when esterified, it is a crucial drug carrier in the creation of gastro retentive controlled release formulations based on the source and the extraction method[29]. Pectin is a complex polymer consisting of 1-4 links of D-galactouronic acid [30].Pectin can be Present in various of foods, including carrot, papaya, orange, lemon, sunflower, and mango.In acidic media, it is more stable. Pectin and gelatin together may be utilised as an encapsulating agent to enable continuous release, according to one study. The use of pectin in conjunction with hydroxypropyl methyl cellulose and hydroxyethyl cellulose for colon drug delivery was assessed by Rao et al. The results indicated that naproxen was delivered to colon using pectin and hydroxyl ethyl cellulose basecoat. The coating was achieved by ethyl cellulose and cellulose acetyl phthalte[31]. are linear polysaccharides that aren't starchy and are Present in the walls of plant cells that are growing and dividing[32].

Pectin's properties :

Pectins have been used for many years in food due to their usefulness

It represents a powder that is either light brown, light grey, yellowish, or white.

Pectin is an emulsifier, thickening, stabiliser and gelling agent[33].

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. Fig4: Powdered Pectin Form

Pectin's advantages :

Pectin was initially discovered in isolation in the 1820s, and the first liquid pectin extract was produced commercially in Germany in 1908. Pectin is commonly found in plant tissues where it functions in conjunction with cellulose.

It dissolves Within water, although is Does not dissolve In various organic solvents 95% of ethanol.

It has been demonstrated that pectin gel beads are a useful medium for regulating a drug's release inside the gastrointestinal tract[34].

3.CHITOSAN :

Chitin undergoes alkaline deacetylation to yield chitosan, a naturally occurring and adaptable polymer. Chitosan, the product of deacetylated chitin, is a more beneficial and bioactive polymer.Due to the abundance of reactive amino side groups, it may undergo chemical changes. For the creation of traditional delivery systems, chitosan is a promising option because of these qualities[35]. The natural polymer chitosan is made from chitin, which is extracted from the shells of crustaceans, by alkaline deacetylation. Shrimp, lobster, krill and crab shell wastes are the sources of chitin[36]. is a strong contender for the creation of innovative and traditional gastrointestinal medications as well as gene drug delivery systems.It is essential for the administration of Medications that are particular Within the stomach, intestines, and colon[37].

Chitosan's properties :

Natural polymer, safe and non-toxic, biodegradable to normal body components, haemostatic, bacteriostatic, fungistatic, and spermicidal properties anticholesteremic, anticancerogen.

Chitosan is insoluble under neutral and basic pH conditions values because it is characterized by a Polymeric weak base with a high molecular weight having a pKa value of the D-glucosamine residue of roughly 6.2-7.0.

Is insoluble in alkaline and neutral pH solutions. The medication released at a slower pace when the thickness of the chitosan membrane increased [38].

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Fig5: Chitosan in powder form.

Chitosan has several advantages :

Chitosan-laminated preparations and granules may prove useful in the development of medication delivery methods that mitigate the impact of gastrointestinal transit time.

Ibrahim El-Gibaly used the ionic interaction of chitosan with a negatively charged surfactant, such as sodium dioctyl sulfosuccinate, to create unique floating chitosan microcapsules of melatonin.

The ratio of drug to polymer and the concentration of chitosan had a noteworthy impact on drug entrapment in microcapsules[39].

4. XANTHAN GUM :

A aerobic fermentation using a pure culture of a the carbohydrate using the bacterium Xanthomonas campestris yields xanthan, an extracellular hetero-polysaccharide A well-known biopolymer is xanthan. It is an anionic polymer, the main structure of which is determined by the type of bacteria and the conditions of fermentation. A naturally occurring, biosynthetic, and edible gum made of glucose, mannose, and glucuronic acid, Xanthan gum acts as extracellular polysaccharide that is utilised To increase viscosity and stabiliser In various meals[40]. Xanthan is utilised in food goods, cosmetics, topical medications, and oral medicinal formulations and preparations because it is non-irritating and nontoxic. When Administered in tablet form excipient, Xanthan gum acts as a helpful pharmaceutical excipient that has been classified as generally recognised as safe (GRAS). Rasul et al. Used microcrystalline cellulose as a diluent to manufacture a sustained release tablet of metoprolol tartrate by direct compression technique, using xanthan and tragacanth gum in varying amounts. The longer the medicine stays in the body, the more gum there is[41].

Xanthan Gum Properties :

Arising from the polyelectrolyte structure From the xanthan molecule, xanthan is extremely soluble in both hot and cold water.

Xanthan gum is mostly used to control viscosity and is thought to be non-gelling

It hydrates quickly in cold water without clumping, resulting in a consistent viscosity that promotes use as an emulsifier, foaming agent, thickener, and stabiliser.

The viscosity of xanthan solutions is high even at low concentrations[42].

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Fig6.Xanthan gum in powder form

Xanthan Gum's advantages :

There is limited information available on its use for sustained drug release. It is utilised as a tablet excipient to change the speed at which the drug releases.

Drug release according to zero-order release kinetics is one of xanthan's possible benefits; nonetheless, Drug delivery is primarily based on the medium's pH and ion concentration.

A few pills with citric acid and xanthan gum demonstrated buoyancy for longer than twenty four hours[43].

5. GELLAN GUM

Polysaccharides derived from a cultivated solution of Pseudomonas species Constitute the major portion of gellan gum. After drying, 85.0–108.0% of the gum is gellan gum. A pure culture of the microorganism Sphingomonas elodea synthesizes gellan gum as a fermentation by product. An aerobic, well-characterized, gram-negative, non-pathogenic bacterium serves as the production medium[44]. gum, which is marketed under the names Gelrite and Phytagel. When both mono- and divalent ions are present, it has the capacity to gel[45]. They discovered that this approach eliminated H. Pylori from the gastrointestinal tract more successfully than acetohydroxamic acid suspension and was feasible for producing stiff gels in the stomach. Similar to this, they also created gellan gum-based floating beads that were ionotropically gelled to contain clarithromycin. Results indicate that gellan floating beads may be beneficial and successful in the local administration of clarithromycin against H. Pylori in the stomach[46,47].

Gellan Gum's properties :

Both a high and a low acyl content version is offered. This gum has good film formation high clarity, process flexibility, stability, high gel strength, and thermally reversible gel properties. It also has superb flavour release.

Gellan gum is an off-white powder that dissolves in water

Its molecular weight is around 70,000 daltons, with 95% of it being over 500,000 daltons.

When positively charged ions, or cations, are introduced, it gels.

Sodium, potassium, magnesium, and/or calcium salt addition. Its melting point can also be adjusted to be higher or lower than 100° C.

Gellan gum forms viscous solutions in cold distilled water after dispersing and hydrating readily in both hot and cold deionised water.

It is chemically inert to the majority of additives used in biological growth media[48].

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Fig7: Gellan Gum powder

Gellan Gum Advantages:

Gellan gum, also marketed as Phytagel or Gelrite.It can form gels with both monovalent and divalent ions.
In the presence of both mono- and divalent ions, it can gel.
Multiple researchers have analyzed this gum as a possible carrier for various floating dosage forms[49].

6. PSYLLIUM HUSK :

Psyllium husk extracted from Plantago ovata seed coverings that have been dried. Plantago ovata (Plantaginaceae) seed and husk are collectively referred to as psyllium. Psyllium is frequently used as a dietary supplement containing fibre to relieve constipation.A floating bioadhesive drug delivery method was created by Belgamwar et al. Utilising innovative effervescent agents, based on similar principles. It was tried to optimise a sustained release profile using a variety of release delaying polymers, such as psyllium husk[50].

Psyllium Husk Properties:

Psyllium's strong capacity to form a gel within water qualifies it as a viscous fibre. This Ability arises from its function as the P's endosperm.
Ovate seed, where its purpose is to contain onto water to Prevent the seed from dehydration.
Its powder is light to medium buff in colour, with a faint pinkish undertone and a faint, distinct smell.
Mucilage occasionally contains single and 2-to 4-compound starch granules, each of which is spheroidal, Plano to angular convex, and ranges in diameter from 2 to 10µm[51].



Fig8: physillum husk powder

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Advantages of Psyllium Husk :

Additionally, psyllium husk contains release-delaying qualities. The features that have been examined above indicate that psyllium husk is probably going to be a good option for a gastroretentive medication delivery system.

The application of this polymer for extended dosage form retention in the stomach has also drawn the attention of numerous researchers.

Using different ratios of psyllium husk, HPMC K100M, and crospovidone, Chavanpatil et al.

Created sustained release floating tablets of ofloxacin[52].

FDDS Limitation

In order for these systems to function well and distribute drugs, there must be a lot of fluid in the stomach—a high coat of fluid.

Drugs with GIT solubility or stability issues should not be taken.

Additionally undesirable and inappropriate are medications that irritate the stomach mucosa.It is recommended to administer the drug formulation alongside a full 200-250 ml glass of water.

The usual dose forms of pharmaceuticals, which are absorbed across the gastrointestinal tract, are not much improved by these systems.

Floating Tablet Challenges using Natural Polymers :

1.Quality and Consistency of Polymers:

Natural polymers with biological origins, like guar gum, xanthan gum, pectin, alginate, and chitosan, exhibit variations in their quality and consistency. This may affect the stability, drug release profile, and buoyancy of the tablet.

2.Duration of Buoyancy :

It is difficult to ensure buoyancy for several hours at a time. When used with natural polymers, gas-generating agents like sodium bicarbonate may not always give prolonged floating ability because of premature release or insufficient gas retention

3.Controlled Drug Release: The uncontrollably swollen and gel-forming nature of natural polymers makes it difficult to achieve the intended medication release profile. It is important to balance the polymer's abilities to control medication release and float since polymers can degrade too quickly or over-hydrate.

4.Stability Issues:

Natural polymers can deteriorate over time, particularly in storage situations with fluctuating humidity and temperature. Degradation of the tablets can lead to a decrease in their mechanical strength, which can impact their buoyancy and drug release properties.

5.Manufacturing and Scale-Up:

Increasing manufacturing volume while preserving performance attributes might be difficult because to the variety in natural polymer properties. In big batches, it might be challenging to achieve consistent mixing, compaction, and repeatability.

6.Patient Adherence :

The increased polymer content necessary for buoyancy causes floating pills to have a greater physical size, which can have an impact on patient compliance, particularly for patients who have trouble swallowing large tablets[53,54].

II. CONCLUSION

The FDDS provides a further benefit for medications undergoing absorption mostly the gastric and upper intestinal regions, Upper gastrointestinal regions.Floating pills have developed into highly effective way to increase a drug's bioavailability, give it a sustained release, and prevent many of its side effects.It has been demonstrated that floating tablets are a viable treatment for stomach retention. These systems offer a unique benefit for Drugs that are mainly absorbed from the higher gastrointestinal tract. Thus, There exists a lot of room for future improvement in our Knowledge of the physiochemical and pharmacological aspects of drug research, In addition to formulation development, to design the best floating drug delivery system possible.

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Numerous researchers have effectively employed natural polymers In a range of floating medication delivery technology techniques. With a broad range of desirable properties for the efficient delivery of therapeutic medicines, these polymers have emerged as promising and useful agents.Drugs can be incorporated into natural polymers To develop a variety of shaped and sized dosage forms that Deliver the drug over long duration . With a broad range of desirable properties for the efficient delivery of therapeutic medicines, these polymers have emerged as promising and useful agents.Drugs can be incorporated into natural polymers To develop a variety of shaped and sized dosage forms that Deliver the drug over a prolonged duration of time. Drug manufacturing relies heavily on the choice of polymer because polymers are essential to drug delivery. This is Essential to polymer's toxicity, medication compatibility, and degradation pattern before choosing one. After reading this review, we can conclude that natural polymers are a good replacement for synthetic polymers and that they can help reduce many of the negative consequences of synthetic polymers.

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