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A Review On: Alginate Forming In-Situ Gel for Treating Peptic Ulcers and Reflux Disorders

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ABSTRACT:

The oral delivery of drugs with a narrow absorption window in the gastrointestinal tract (GIT) is often limited by poor bioavailability with conventional dosage forms due to incomplete drug release and short residence time at the site of absorption. In-situ gel provides the best way to overcome problems of immediate release and short gastrointestinal residence of liquids. The in situ gel dosage form is a liquid before administration and after it comes in contact with gastric contents due to one or more mechanisms gets converted to gel which floats on gastric contents. This achieves increased residence as well as sustained release. This approach is useful for systemic as well as local effect of drugs administered. In the presence of gastric acid, alginates precipitate, forming a gel. Alginate-based raft-forming formulations usually contain sodium or potassium bicarbonate; in the presence of gastric acid, the bicarbonate is converted to carbon dioxide which becomes entrapped within the gel precipitate, converting it into a foam which floats on the surface of the gastric contents, much like a raft on water. Alginate-based rafts can entrap carbon dioxide, as well as antacid components contained in some formulations, thus providing a relatively pH-neutral barrier, they also act as physical barrier to reduce the episode of reflux disorders. This review gives the information about alginate raft gel alone and/ or along with different type of antacids (H₂ receptors & proton pump inhibitors) can be efficiently used to treat peptic ulcers as well as reflux disorders.

KEY WORDS: oral, in-situ, alginate forming raft, pH-neutral barrier, reflux disorders

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INTRODUCTION:

In situ gel forming systems have been widely investigated as vehicles for sustained drug delivery. This interest has been sparked by the advantages shown by in situ forming polymeric delivery systems such as ease of administration and reduced frequency of administration, improved patient compliance and comfort¹. In situ gel formation occurs due to one or combination of different stimuli like pH change, temperature modulation and solvent exchange². Gastroretentive in situ gelling system helps to increase bioavailability of drug compared to conventional liquid dosage form. The gel formed from in situ gelling system, being lighter than gastric fluids, floats over the stomach contents or adhere to gastric mucosa due to presence of bioadhesive nature of polymer and produce gastric retention of dosage form and increase gastric residence time resulting in prolonged drug delivery in gastrointestinal tract.

Alginate-based raft-forming formulations have been marketed world-wide for over 30 years under various brand names, including Gaviscon. They are used for the symptomatic treatment of heartburn and oesophagitis, and appear to act by a

unique mechanism which differs from that of traditional antacids. In the presence of gastric acid, alginates precipitate, forming a gel.

Alginate-based raft-forming formulations usually contain sodium or potassium bicarbonate; in the presence of gastric acid, the bicarbonate is converted to carbon dioxide which becomes entrapped within the gel precipitate, converting it into a foam which floats on the surface of the gastric contents, much like a raft on water. Both *in vitro* and *in vivo* studies have demonstrated that alginate-based rafts can entrap carbon dioxide, as well as antacid components contained in some formulations, thus providing a relatively pH-neutral barrier. Several studies have demonstrated that the alginate raft can preferentially move into the oesophagus in place, or ahead, of acidic gastric contents during episodes of gastro-oesophageal reflux; some studies further suggest that the raft can act as a physical barrier to reduce reflux episodes. Although some alginate-based formulations also contain antacid components which can provide significant acid neutralization capacity.³

INTRODUCTION TO PEPTIC ULCER⁴

Peptic ulcer disease refers to painful sores or ulcers in the lining of the stomach or first part of the small intestine, called the duodenum. It is now found that an ulcer is the end result of an imbalance between digestive fluids in the stomach and duodenum. Most ulcers are caused by an infection with a type of bacteria called *Helicobacter pylori* (*H. pylori*).

Factors that can increase risk for ulcers include:

1. Use of painkillers called non-steroidal anti-inflammatory drugs (NSAIDs), such as aspirin, naproxen (Aleve, Anaprox, Naprosyn, and others), ibuprofen (Motrin, Advil, some types of Midol, and others), and many others available by prescription; even safety-coated aspirin and aspirin in powdered form can frequently cause ulcers
2. Excess acid production from gastrinomas, tumours of the acid producing cells of the stomach that increases acid output (seen in Zollinger-Ellison syndrome)
3. Excessive drinking of alcohol
4. Smoking or chewing tobacco
5. Serious illness
6. Radiation treatment to the area

Symptoms that are seen in peptic ulcers are as follows:

An ulcer may or may not have symptoms. When symptoms occur, they may include:

A burning pain in the middle or upper stomach between meals or at night

- Heartburn
- Bloating
- Nausea or vomiting

In severe cases, symptoms can include:

- Dark or black stool (due to bleeding)
- Vomiting blood (that can look like "coffee-grounds")
- Weight loss
- Severe pain in the mid to upper abdomen

An ulcer can be really serious in following ways:

Although ulcers often heal on their own, you shouldn't ignore their warning signs. If not properly treated, ulcers can lead to serious health problems, including Bleeding, Perforation (a hole through the wall of the stomach), Gastric outlet obstruction from swelling or scarring that blocks the passageway leading from the stomach to the small intestine

Taking NSAIDs can lead to an ulcer without any warning. The risk is especially concerning for the elderly and for those with a prior history of having peptic ulcer disease

People who are likely to get ulcers are those who are infected with *H. Pylori* bacteria, who take NSAIDs on regular basis like aspirin, ibuprofen, naproxen etc. , have family history of ulcers, who drink regularly, who are having other problems of lungs or liver or kidney , or mostly in people who are of age 50 years or more.

INTRODUCTION TO FLOATING ORAL IN SITU GELS^{6,7}

Oral in situ gel forming system also known as stomach specific or raft forming systems have provided a suitable way of providing the controlled drug delivery within stomach with enhanced gastro-retention. The tablet/capsule floating dosage forms are stable as compared to liquids but the problem with them is that they are needed to swallow as whole unit. In case of dosage adjustment these cannot be broken in halves as these are also designed for controlled release and floating ability also depends on dimensions of tablets. Elderly patients, children some adult persons and patient with certain conditions suffer from dysphasia, so it becomes difficult for them to swallow tablet/capsule dosage forms. Also in case of dosage adjustments these floating solid dosage forms are

needed to be available in different strengths. Where an environment specific gel forming solution, on conversion to gel, floats on the surface of the gastric fluids (due to less density than gastric contents). In this technique, a solution of low viscosity is used which on coming in contact with the gastric fluids, undergo change in polymeric conformation and a viscous gel of density lower than the gastric fluids is produced. This low density gel formation called as raft not only provide the much desired gastro retention to prolong the contact time, but also produce the continuous and slow drug release. Diagram shows floating in situ gel.



Figure 1 -Sequence of formation of in-situ gel²⁴

INTRODUCTION TO THE PROPERTIES AND MECHANISM OF ALGINATES³

Alginates are natural polysaccharide polymers isolated from brown seaweed (Phacophyceae), and can be classified as dietary fibre. Their ability to form viscous solutions and gels coupled with their safety, have led to a variety of uses in food, cosmetics and pharmaceutical products for over 100 years. Alginates are block co-polymers of L-guluronic and D-mannuronic acid residues connected by 1:4 glycosidic linkages. The relative proportions of D-mannuronic and L-guluronic acids are species-dependent and can be influenced by growth conditions. In the acid environment of the stomach, both alginate salts and alginic acids precipitate to form a low density, but viscous gel. The gel forms rapidly on exposure to gastric acid, occurring in vitro within seconds, and in vivo within a few minutes of dosing. The strength of the gel is dependent on factors intrinsic to, and extrinsic of the alginic acid. Molecular weight and the ratio of D-mannuronic and L-guluronic acid residues are intrinsic properties that influence raft strength. Generally, alginic acids with higher molecular weight and guluronic acid content form rafts with greater visco elastic strength. Extrinsic factors which influence raft strength include the presence or absence of specific cations. Calcium increases in vitro raft strength, while the addition of aluminium, a common component of many antacid formulations, reduces raft strength. The ability of calcium to

increase raft strength is attributed to its ability to cross-link alginic acid polymers, allowing the gel to form an structure which has great inherent strength. Generally alginate/antacids are formulated to include bicarbonate which acts as a gas generating system. The CO₂ bubbles which form in the presence of gastric acid become entrapped within the forming gel matrix, converting it to a foam and providing buoyancy which allows the gel to float on the surface of the gastric contents, much like a raft on water, as well as entrapping acid neutralizing capacity. Indeed, the floating alginate gel/foam is often described as a 'raft'. This formulation had efficacy in treating symptomatic refluxoesophagitis. The alginate raft appeared to provide sufficient viscosity to reduce reflux episodes, and the raft structure appeared to be retained within the stomach. Alginate-based antacids therefore provided the advantages of the rapid onset of relief provided by antacids together with a significantly longer duration of action.

Both in vitro and in vivo studies have demonstrated that alginate-based rafts can entrap carbon dioxide, as well as antacid components contained in some formulations, thus providing a relatively pH-neutral barrier. Several studies have demonstrated that the alginate raft can preferentially move into the oesophagus in place, or ahead, of acidic gastric contents during episodes of gastro-oesophageal reflux; some studies further suggest that the raft can act as a physical barrier to reduce reflux episodes. Although some alginate-based formulations also contain antacid components which can provide significant acid neutralization capacity, the efficacy of these formulations to reduce heartburn symptoms does not appear to be totally dependent on the neutralization of bulk gastric contents.

DIFFERENT APPROACHES FOR IN SITU GELLING SYSTEM:

There are different mechanisms used for triggering the in situ gel formation: physical changes in biomaterials (e.g., Diffusion of solvent and swelling), chemical reactions (e.g., enzymatic, chemical and photo-initiated polymerization) and Physiological stimuli (e.g., temperature and pH).

IN SITU FORMATION BASED ON PHYSICAL MECHANISM:

SWELLING AND DIFFUSION: Swelling of polymer by absorption of water causes formation of gel. certain biodegradable lipid substance such as myverol (glycerol mono-oleate) forms in situ gel under such phenomenon¹⁰. Solution of polymer such as N – methyl pyrrolidone (NMP) involves diffusion of solvent from Polymer solution into surrounding tissue and results in precipitation or solidification of polymer matrix¹¹.

Table 1 Clinical Efficacy of Alginate-Based, Raft-Forming Formulations³

Patients		Study design				results
No. of patients	Entry criteria and diagnosis	Test agent	Treatment regimen	Design and duration		
Open and placebo controlled trials						
93 40M:53F	Hiatal hernia and endoscopic oesophagitis	Gaviscon powder ^b	Before meal and bedtime	Open study; 1month-1.5 years duration	All patients had at least partial symptomatic relief and 66% showed histologic improvements; NSA	
85 36M; 49F	Hiatal hernia and oesophagitis symptoms	Gaviscon Powder ^b	2 g mixed in water taken after meals and before bed	Open study; usage up to 48 months.	55 patients reported complete or near-complete symptomatic relief. NSA	
596 F	Symptomatic heartburn, dyspepsia, regurgitation, and/or dysphagia	Gaviscon Liquid,	20 mL q.d.s., after meals and at bedtime	Multisite, open-label, 2-week diary study.	Gaviscon provided effective relief of dyspepsia and heartburn in over 82% of patients. NSA	
1030	Symptomatic patients with clinically and endoscopically confirmed healed oesophagitis.	Gaviscon Suspension	1±4 doses daily for relief of reflux symptoms or epigastric pain	Multisite, open-label, 6-month study	883 patients with usable data, 76 . 2% remained healed after 6 months; 95% took < 2 sachets of Gaviscon per day	
38 12M; 26F	Hiatal hernia	Gastrocote	2 tablets after meals and at bedtime.	Open label study with assessment at 3 and 6 months	After 6 months treatment, 23 (62%) were symptom free, 19% had occasional symptoms and 19% failed to improve. NSA	
Comparison antacids, H2-blockers, proton pump inhibitors and prokinetics						
28 8M; 20F	Hiatal hernia with reflux symptoms	Gaviscon Tablets	2 tablets after meals and at bedtime.	DB, XO, RAN comparison to antacid and PLA; 2 weeks per leg	Gaviscon significantly relieved regurgitation and heartburn compared to antacid or placebo	
41 12M; 29F	Endoscopically confirmed oesophagitis	Gaviscon Antacid Tablets vs. antacid	2 tablets after meals and at bedtime.	DB, RAN, parallel design; 4 weeks duration; weekly physician assessment and patient diary	No difference between treatments for symptomatic relief; 75% of patients had complete healing of oesophageal erosions.	
20 9M; 11F	Long-standing GERD	Gaviscon Liquid vs. Algicon liquid	Algicon 10 mL or Gaviscon 20 mL after meals and at bedtime.	SB, RAN, XO; 2 weeks placebo washout between treatments.	Algicon but not Gaviscon reduced night-time heartburn; both treatments significantly reduced daytime heartburn, regurgitation and nausea.	
44 11M; 33F	Heartburn and epigastric pain with confirmed reflux.	Gaviscon Suspension vs. liquid antacid	10 mL Gaviscon or antacid gel after meals and at bedtime	Open label, RAN, XO design; 15 days treatments	Gaviscon rated as good to very good for heartburn relief by 84% of patients vs. 24% for antacid. 68% reported more relief with Gaviscon.	
16	Symptomatic	Gaviscon	2 tablets after meals	DB, RAN, XO; 3	No difference between	

	reflux with hiatal hernia	Tablets, vs. antacid	and at bedtime	weeks consecutive treatments.	treatments for endoscopic or symptomatic improvement. NSA
Studies in infants and children					
76 infants	Reflux confirmed by pH monitoring.	Gaviscon Suspension	1 or 2 mL/kg/day in divided doses after meals	Open-label, multicenter study of 4 weeks duration.	Both doses of Gaviscon significantly and equally reduced regurgitation and vomiting, were well tolerated and caused no adverse effects
49 children 34M; 15F	Reflux oesophagitis	Gaviscon Tablets, vs. famotidine	1 Gaviscon tablet after meals and before bed-time), or 1 mg/kg famotidine. Children aged 2±16 years,	RAN, parallel-design; 6 months duration	Famotidine superior to Gaviscon for symptomatic relief and healing of oesophagitis.
18 infants	Regurgitation and vomiting	Gaviscon powder	.±1 tsp with 120 mL feed.	Open label prospective trial	Resolved or reduced vomiting in all patients
20 infants	Episodic reflux, regurgitation, vomiting.	Gaviscon powder	2 g Gaviscon or placebo in 240 mL milk.	RAN, PLA; 8-day trial	Gaviscon significantly reduced reflux episodes, vomiting, and oesophageal acid exposure
90 infants	Reflux and vomiting	Al-free alginateh vs. PLA	Weight adjusted dose provided after meals in volume of 5±10 mL	14day treatment ; diary and medical assessment at day 7 & 14	Alginate superior to placebo for reducing the number and severity of vomiting episodes. Rated superior by both parents and physicians
Studies in pregnancy					
157 pregnant women	Heartburn and symptomatic reflux	Algicon liquid vs. antacid	10 mL Algicon or Mg trisilicate susp. After meals and before bed	RAN, parallel groups, open label, 2 weeks treatment.	Over 80% of subjects were in 3rd trimester. No difference in efficacy between treatments. NSA
50 pregnant women	Heartburn and symptomatic flux.	Gaviscon Suspension	20 mL after meals and before bed	Open trial; 1-month duration.	Gaviscon improved symptoms

IN SITU GELLING BASED ON CHEMICAL STIMULI:

IONIC CROSSLINKING: Certain ion sensitive polysaccharides such as carrageenan, Gellan gum(Gelrite®), Pectin, Sodium Alginate undergo phase transition in presence of various ions such as K^+ , Ca^{2+} , Mg^{2+} , Na^+ ¹². For e.g., alginic acid undergoes gelation in presence of divalent/polyvalent cations e.g. Ca^{2+} due to the interaction with guluronic acid block in alginate chains¹³.

ENZYMATIC CROSSLINKING: Certain natural enzymes which operate efficiently under physiologic conditions without need for potentially harmful chemicals such as monomers and initiators provides a convenient mechanism for controlling the rate of gel formation, which allows the mixtures to be injected before gel formation in situ.¹⁴

PHOTO-POLYMERISATION:

A solution of monomers such as acrylate or other polymerizable functional groups and initiator such as 2,2 dimethoxy-2-phenyl acetophenone, camphorquinone and ethyl eosin can be injected into a tissues site and the application of electromagnetic radiation used to form gel designed readily to be degraded by chemical or enzymatic processes or can be designed for long term persistence in vivo.¹⁵ Typically long wavelength ultraviolet and visible wavelengths are used.

IN SITU GEL FORMATION BASED ON PHYSIOLOGICAL STIMULI:

TEMPERATURE DEPENDANT IN SITU GELLING: These are liquid aqueous solutions before administration, but gel at body temperature. These hydrogels are liquid at room temperature (20°C -25°C) and undergo gelation when in contact with body fluids (35°C -37°C), due to an increase in temperature This approach exploits temperature-induced phase transition. Some polymers undergo abrupt changes in solubility in response to increase in environmental temperature (lower critical solution temperature, LCST)^{16 17}. Polymers such as Pluronics (poly (ethylene oxide)-poly(propylene oxide)-poly (ethylene oxide)(PEO-PPOPEO) Triblock)¹⁸, Polymer networks of poly(acrylic acid) (PAA) and polyacrylamide (PAAm) or poly(acrylamide-co-butyl methacrylate)¹⁹. Polymer solution is a free flowing liquid at ambient temperature and gels at body temperature²⁰. A positive temperature- sensitive hydrogel has an upper critical solution temperature (UCST), such hydrogel contracts upon cooling below the UCST. Polymer networks of poly (acrylic acid) (PAA) and polyacrylamide (PAAm) or poly (acryl amide-co-butyl methacrylate) have positive temperature dependence of swelling.¹⁹

pH DEPENDANT GELLING: Another formation of in situ gel is based on Change in pH. Certain polymers such as PAA (Carbopol®, carbomer) or its derivatives 21 Polyvinylacetal diethylaminoacetate (AEA) 22, Mixtures of poly (methacrylic acid) (PMA) and poly (ethylene glycol) (PEG)²³ shows change from sol to gel with change of pH. Swelling of hydrogel increases as the external pH increases in the case of weakly acidic (anionic) groups, but decreases if polymer contains weakly basic (cationic) groups.

Table No. 2: Polymers used in floating drug delivery system²⁴

Natural		Synthetic	
Na. alginate	Tara gum	HPMC K 4M	Polyvinyl ethers
Pectin	Moi gum	HPMC K 15M	Esters and halides
Tragacanth	Gum copal	HPMC K 100M	Polymethyl Methacrylic acis
Gelatin	Sesbenia gum	Carbopol	HPC
Carrageenan	Chitosan	Ethyl cellulose	HEC
Hibiscus rosasinesis	Gellangum	Methyl cellulose	
Okra gum	Xyloglucan	Sod. Carboxy methyl cellulose	
Guar gum	Carbopol	Polyvinyl alcohol	
Locust gum	Xanthangum	Polycarbonates	
Isapgulla (Psyllium)	Pluronic f-27	Polyalkylene glycols	

EVALUATION OF IN SITU GELLING SYSTEM CLARITY²⁵:

The clarity of formulated solutions can be determined by visual inspection under black and white background.

VISCOSITY:

The viscosity and rheological properties of the polymeric formulations, either in solution or in gel made with artificial tissue fluid (depending upon the route of administrations) were determined with different viscometer.

SOL-GEL TRANSITION TEMPERATURE AND GELLING TIME: For in situ gel forming systems, the sol-gel transition temperature and pH should be determined. Gelling time is the time required for first detection of gelation of in situ gelling system.

GEL-STRENGTH: A specified amount of gel is prepared in a beaker, from the sol form. This gel containing beaker is raised at a certain rate, so pushing a probe of rheometer slowly

through the gel. The changes in the load on the probe can be measured as a function of depth of immersion of the probe below the gel surface.

FOURIER TRANSFORM INFRA-RED SPECTROSCOPY AND THERMAL ANALYSIS: Fourier transform infra-red spectroscopy is performed to study compatibility of ingredients. Differential scanning calorimetry is used to observe if there are any changes in thermograms as compared with the pure ingredients used thus indicating the interactions.

IN-VITRO DRUG RELEASE STUDIES: The drug release studies are carried out by using the plastic dialysis cell. The cell is made up of two half cells, donor compartment and a receptor compartment. Both half cells are separated with the help of cellulose membrane. The sol form of the formulation is placed in the donor compartment. The assembled cell is then shaken horizontally in an incubator. The total volume of the receptor solution can be removed at intervals and replaced with the fresh media. This receptor solution is analyzed for the drug release using analytical technique.

FUTURE PROSPECTS WITH RESPECT TO HERBAL DRUGS²⁶:

Herbal drug delivery is the emerging field in the pharmacy. The use of FDDS for herbal medicament is the novel approach for the better delivery. The drug release profile has been a major focusing area for the pharmaceutical research scientists for the past two decades. The scientists are finding it a great opportunity to work on GI transit profiles. This has given rise to new products with substantial benefits to the patients. Now with the advent of FDDS the products have been designed which could release drug for upto 24 hrs. Some herbals that can be delivered as floating drug delivery systems:

BLACK MYROBALAN: The aqueous extract of black myrobalan (*Terminalia chebula* Retz) has been shown to have uniform antibacterial activity against ten clinical strains of *H. pylori*.

GINGER: Ginger root (*Zingiber officinale* Rosc.) has been used traditionally for the treatment of gastrointestinal ailments such as motion sickness, dyspepsia and hyperemesis gravidarum, and is also reported to have chemopreventative activity in animal models. The gingerols are a group of structurally related polyphenolic compounds isolated from ginger and known to be the active constituents.

TURMERIC: Curcumin, a polyphenolic chemical constituent derived from turmeric (*Curcuma longa* L.), has been shown to prevent gastric and colon cancers in rodents. Many mechanisms had been proposed for the chemopreventative effects, although the effect of curcumin on the growth of *H. pylori* has not been reported.

LICORICE: In a recent study at the Institute of Medical Microbiology and Virology, Germany, researchers found that licorice extract produced a potent effect against strains of *H. pylori* that are resistant against clarithromycin, one of the antibiotics typically used in the three antibiotic treatment regimens.

BERBERINE: Berberine is a plant alkaloid isolated from the roots and bark of several plants including golden seal, barberry, *Coptis chinensis* Franch. and Yerba mansa. Berberine-containing plants have been used medicinally in ayurvedic and Chinese medicine, and are known to have antimicrobial activity against a variety of organisms including bacteria, viruses, fungi, protozoans, helminths, and chlamydia. More recently, berberine had been demonstrated to be effective against *H. pylori*. All these herbal drugs can be prepared as gastroretentive drug delivery system.

RECENT ADVANCES:

S. Miyazaki et. al., Assessed formulations with in situ gelling properties for their potential for the oral delivery of cimetidine. The formulations were dilute solutions of: (a) enzyme-degraded xyloglucan, which form thermally reversible gels on warming to body temperature; (b) gellan gum and; (c) sodium alginate both containing complexed calcium ions that form gels when these ions are released in the acidic environment of the stomach. The in vitro release of cimetidine from gels of each of the compounds followed root-time kinetics over a period of 6 hr. Plasma levels of cimetidine after oral administration to rabbits were compared with those resulting from administration of a commercial cimetidine/alginate suspension with an identical drug loading.²⁷

Jadav SL et.al., Aqueous solution of nizatidine was made using sodium alginate, hydroxy propyl methyl cellulose n gas generation as well as calcium supplying agent calcium carbonate which form gel in acidic environment in stomach n remain sustained over there for 10hrs²⁸

Milad Jawad Hasan; et al, formulations were prepared of sodium alginate alone and in combination with HPMC as a floating polymers besides to sodium bicarbonates gas generating agents A stomach specific in-situ gel of Ranitidine hydrochloride could be prepared using floating mechanism to increase the residence time of the drug in stomach and thereby increase the absorption for 10h²⁹

Jayvadan K.Patel; et al, Alginate based floating in-situ gelling system of famotidine were prepared by dissolving varying concentration of alginate in deionized water containing

sodium citrate, to varying concentration of drug and calcium chloride was added and dissolved by stirring. Results of preliminary trials indicate that concentration of sodium alginate, calcium chloride and sodium citrate affected the characteristics of insitu gel. A 32 full factorial design was employed to study the effect of independent variable concentration of sodium alginate(X1) and calcium chloride(X2) on dependent variables, i.e viscosity, drug content, drug release at 4hr(Q50) and drug release at 8hrs (Q80). A sustained drug release was obtained for more than 8hrs. in-vivo testing of FIGF to albino Wistar rats demonstrating significant anti-ulcer effect of Famotidine.30

MARKETED PRODUCTS :

Liquid Gaviscon - Al-hydroxide (95mg), Mg carbonate (385mg)
Topalkan - Al-Mg antacid

Convicon - Ferrous sulphate⁸

CONCLUSION:

All the above review proves that In-situ drug delivery provides a great potential for development of liquid orals for their sustained drug release. This floating in-situ gel approach is also suitable for drugs having absorption window in stomach or drugs showing local effect in stomach. These types of drugs which are currently present in market as their solid dosage forms (tablets or capsules) will be available as their floating in-situ gel in near future.

And after such brief study we conclude that alginate raft forming gel can be efficiently used to treat peptic ulcers and various episodic reflux disorders.

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