Modification of the Release Properties of Lornoxicam Gastroretentive Floating Tablets with the Naturally Occurring Okra Mucilage

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Abstract: The aim of the present investigation is to study the effect of Okra mucilage on the buoyancy and release properties of lornoxicam floating gastroretentive tablets. Lornoxicam floating tablet formulae were prepared using HPMC K100M and/or Alginate as floating, release controlling polymers at different drug polymer ratios. Okra mucilage was added to the proposed tablet formulae both as dry powder and as granulating aqueous solution. The prepared tablets were evaluated for weight uniformity, hardness, friability, drug content, swelling index, *in-vitro* buoyancy, and *in-vitro* drug release. Results showed that incorporation of Okra mucilage into a floating tablet matrix positively affected the swelling and buoyancy where the swelling index increased to reach 221, 193, and 224 % in comparison to 211, 182, and 208 % respectively, the floating lag-time was shortened to be 0.23 minutes while the total floating duration was extended to exceed 12 hours. The drug release was retarded to be 85.3, and 75.7 % in comparison to 97.7, and 93.4 % respectively after 12 hours without any effect on the drug release kinetics, where the release still follows zero order kinetics. The floating tablet matrix properties and drug release were affected with Okra mucilage ratio and also the incorporation method. Depending on these results, it can be concluded that the naturally occurring Okra mucilage is a promising additive to improve the floating and release properties of gastroretentive floating matrices.

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1. Introduction

Oral route has been the most convenient and commonly employed route of drug delivery due to ease of administration, high patient compliance, least sterility requirements and more flexibility in dosage form design so sustained- release oral drug delivery systems have recently received higher research attention. (1)

The advantages of sustained-release systems include simpler dosage regimens, better drug utilization and effectiveness, minimum drug accumulation with decreased side effects, minimum fluctuated plasma drug concentration with smoother therapeutic effect, and improved patient compliance through reducing the frequency of the dosing. (2) Several techniques are currently used to control the drug release into the gastrointestinal tract (GIT) and retain an effective plasma drug concentration for prolonged time. Gastroretentive drug delivery systems are those designed to be retained in the stomach for an extended time period to slowly release their drug content in a controlled manner to the upper part of the GIT (3, 4) with minimum variability in bioavailability as compared with some currently available immediate and modified release systems. (5) Drugs that have a narrow absorption window in the small intestinal region, to be dissolved in gastric pH, of low stability in intestinal pH, and/or act locally on GIT are of choice in gastric retention formulations. (6)

During the last few decades, the technology of designing new devices to be retained in the upper part of the GIT has showed a large advance result in developing a large variety of systems, including: sinking systems to be retained in the bottom of the stomach (7), floating systems that causes buoyancy in gastric fluid (8-10), mucoadhesive systems (11), expanding, or swelling systems which hinder emptying of the dosage forms through the pyloric sphincter of stomach (12), superporous hydrogel systems (13), magnetic systems. (14)

Various approaches have been applied to induce the floatation of the dosage form over the GIT fluid. (15) Gas-generating effervescent buoyant delivery systems depend on the reactions between alkali carbonate/bicarbonate and citric/tartaric acid incorporated within the formula composition to liberate CO_2, which gets entrapped within the gelled hydrocolloid layer of the delivery system thus reducing its density to remain buoyant over the chyme for an extended time period and release the drug slowly at a specified rate. (16–18)

Mucilages and gums are carbohydrate polymers obtained from woody and non-woody plant parts. (19) In modern pharmaceutics, more attention has been

given to their application as pharmaceutical excipients in conventional and novel dosage forms for their binding, thickening, stabilizing, humidifying, disintegrating and release controlling effects. (20, 21) Polymeric hydrogels including mucilages that hydrate and swell on contact with water (22) were studied for controlling release applications as drug retarding agents because they can control the drug release close to zero-order kinetics (23).

Okra, Abelmoschus esculentus, originally an Indian plant, is now grown in many other areas of the world including the Middle East, Africa and the southern states of the USA. Okra gum, obtained from the fruits, is a polysaccharide consisting of D-galactose, L-rhamnose and L-galacturonic acid. Mucilages and gums are water soluble polysaccharides found in a widespread number of plants. Okra gum produces high viscosity mucilage at low concentrations and this content differs according to the origin of the cultivated plant (24). Okra gum is used as a binder (25), disintegrant (26), and hydrophilic matrix in sustained tablets. (27)

Lornoxicam is an oxicam non-steroidal anti-inflammatory drug of potent anti-inflammatory and analgesic activities; it is widely prescribed to relief the symptomatic acute moderate to severe inflammatory pain in rheumatoid arthritis, osteoarthritis and dentistry. It is also recommended in orthopedic, gynecological, and abdominal surgery to relief pre and post-operative associated pain. It is practically insoluble in water and aqueous fluids (BCS class II drug) that affects its absorption from GIT and hence oral bioavailability. Lornoxicam has a short half-life (3-5 hours) and poor solubility in acidic conditions, so it is proposed to be an ideal model drug to be formulated as gastroretentive sustained release dosage form. (28)

In this work; the naturally occurring Okra mucilage was extracted and incorporated in the preparation of modified gastroretentive floating tablet matrices containing lornoxicam at different ratios. The effect of Okra mucilage on the floating and release properties of the drug from these formula matrices was studied.

2. Materials and Methods

2.1. Materials

Lornoxicam (gift from October Pharm. Company, Giza., Egypt.), Hydroxypropylmethyl cellulose (HPMC) K100M (Goodrich Chemical Co, Cleveland, Ohio, USA), sodium alginate (Hipure, Genzyme, England), Avicel (microcrystalline cellulose) PH 101 (FMC Biopolymer, Drammen, Norway), sodium bicarbonate, anhydrous citric acid, purified talc, and magnesium stearate (S.D. Fine Chem. Ltd. Boisar-India) All chemicals are of reagent grade and were used as obtained from the manufacturers without further purification.

2.2. Methods

2.2.1. Preparation of okra mucilage (29)

Three kg of fresh immature fruits of Abelmoschus esculentus were obtained from a local market. After removal of the seeds, the fresh immature fruits were sliced, homogenized with five times its weight of cold water containing 1% (w/v) sodium metabisulphate.

The crude mucilage was centrifuged at 4000 rpm for 15 min and the clear, viscous solution was decanted. The solution was heated at 70°C for 5 minutes to inactivate enzymes; the gum was precipitated from the supernatant with acetone after cooling. The precipitated gum was washed several times with acetone; the obtained cream colored product was dried under vacuum in a desiccator. A light brown colored powder was obtained after complete removal of moisture. The dried gum was pulverized using the end runner mill and screened through a 0.25 mm stainless steel sieve, and stored in a well closed amber colored bottle till ready for use. The yield of crude Abelmoschus esculentus mucilage was 14 g /kg immature fruits.

2.2.2. Preparation of tablet mixtures

According to the formula composition presented in Table 1, twelve lornoxicam floating tablet mixtures were prepared using the following techniques:

Direct compression

The drug was added to all formula components (excluding lubricants) in ascending order of their weights with continuous mixing for 10 minutes. Finally the lubricants magnesium stearate and talc were added and the mixing was continued for a further 5 minutes and this lubricated blend was directly compressed into tablets in 8-mm flat punch/die set using a manual single punch tableting machine (Manestry, Liverpool, UK) without granulation. The applied compression force was adjusted to obtain tablets with hardness in the range of 6 -7 kg/cm^2. A batch of 30 tablets was prepared.

Wet granulation:

The drug was mixed with all formula components (excluding Okra mucilage and lubricants) in ascending order of their weights for 10 minutes. Granulation was made with an aqueous solution of Okra mucilage prepared in concentrations according to the weights mentioned in formula composition. The granules were dried in conventional hot air oven at 45ºC. The dried granules were sized through 40/60 mesh and compressed into tablets after lubrication with magnesium stearate and purified talc on 8-mm flat punch/die set using a manual single punch tableting machine (Manestry, Liverpool, UK). The applied compression force was adjusted to obtain tablets with hardness in the range of 6 -7 kg/cm^2. A batch of 30 tablets was prepared.

2.2.3. Evaluation of the prepared tablet mixture

2.2.3.1. Pre-compression evaluation

The flow properties of the prepared formula mixtures were characterized in terms of angle of repose (θ), percentage of compressibility (Ci %) and the Hausner ratio. (30)

For the determination of the angle of repose, the fixed funnel method was applied. The formula mixture was allowed to freely flow through a funnel which was fixed at a position such that its lower tip was at 2.5 cm height above a horizontal plane till a pile is formed. The angle of repose was calculated using the following equation: $\theta = \tan^{-1}(2h/r)$, where h is the height of the pile and r is the radius of its base.

To calculate the Carr's index and Hausner ratio, five grams of each formula mixture were packed into a tarred graduated cylinder and the cylinder was dropped from a height of 1 inch onto a hard surface three times at 2 second intervals. The volume occupied was then recorded as the bulk volume (Vb). The cylinder was tapped till a constant volume and the obtained volume were recorded as the tapped volume (Vt). The process was repeated at least three times then bulk density (ρb), and tapped density (ρt) were calculated and the following equations were applied:

$$\text{Compressibility index, } Ci = (\rho t - \rho b)/\rho t \times 100$$

$$\text{Hausner ratio} = \rho t/\rho b.$$

2.2.3.2. Post-compression evaluation

Ten tablets sample of each formula was selected and subjected to the following evaluation tests:

Uniformity of thickness and diameter: The diameter and thickness were measured at two different positions and the average value with the standard deviation was then calculated.

Weight variation: Tablets were separately weighed and their average weight with the standard deviation was calculated.

Content uniformity (31): Tablets were separately crushed in a mortar and extracted with 100 ml of 0.1N HCl for 15 min and filtered through a cellulose acetate membrane filter (0.45 μm). The absorbance of the solution was then measured spectrophotometrically at λ_{max} 378 nm using a UV/Vis double beam spectrophotometer (Shimadzu, Tokyo, Japan) after suitable dilution and the drug content was calculated using K obtained from the slope of the calibration curve of the drug in 0.1N HCl.

Friability test: Ten tablets from each formula were accurately weighed, placed in the drum of friabilator and it was rotated at 25 r.p.m for a period of 4 minutes. Then, the tablets were wakened and reweighed. The percentage weight loss was calculated and taken as a measure of friability.

Hardness test: The average breaking strength (in Kg/cm^2) of ten tablets of each formula was determined by hardness tester.

Swelling studies (32): The swelling properties were studied by soaking the weighed tablets at 37±1ºC in 0.1N HCl (pH 1.2) in a glass beaker for eight hours without stirring. Tablets were withdrawn and re-weighed after blotting the surface water on tissue paper. All mass measurements were taken on a single pan balance (Mettler AE 240S, Switzerland), having an accuracy up to the fifth decimal. The ratio of water uptake was calculated as:

$$\text{Percentage swelling index} = (\text{Wet weight} - \text{Dry weight}) / (\text{Dry weight}) \times 100$$

In-vitro Buoyancy Studies: The method applied with Rosa *et al.* (33) for the determination of the in vitro buoyancy was adopted. The prepared lornoxicam tablets were placed in a 100 ml beaker containing 0.1N HCl and the time required for the tablet to rise to the surface and float was recorded as the floating lag-time. The duration of time the table constantly remained on the surface of the medium was also recorded as the total floating time.

In-vitro release studies (31): The drug release rate from the prepared tablets was carried out using the USP XXII dissolution testing apparatus II (Vision-G2 classic, Hanson, Chatsworth, USA) using 900 ml of 0.1N HCl (pH 1.2) as the dissolution medium, maintained at 37 ± 0.5 ºC and at 100 rpm. Aliquots of 10 ml were withdrawn at the specified predetermined time intervals of 0.5, 1.0, 1.5, 2.0, 3.0, 4.0, 6.0, 8.0, 10 and 12.0 hours with replacement. The absorbance of the drug was measured spectrophotometrically at 378 nm that was previously determined as the wavelength of the maximum absorption (λ_{max}) using a UV/Vis double beam spectrophotometer (Shimadzu, Tokyo, Japan), after filtration through a 0.45 μm membrane filter and the cumulative percentage of drug release was calculated using an equation obtained from a standard calibration curve. The mean of six determinations was considered.

Kinetic analysis of the release data: the cumulative amount of drug released at different time intervals were fitted to zero, first order kinetics, Higuchi and Koremeyer–Peppas models to characterize the mechanism of drug release using KinetDS 3.0 (Aleksander Mendyk, GNU GPLv3 license, 2007, Krakow, Poland) software.

Table 1: Composition of the prepared lornoxicam floating tablet formulae

Code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
D.P.R	1:1						1:2					
Lornoxicam	8	8	8	8	8	8	8	8	8	8	8	8
HPMC K100 M	10	-	5	5	-	2.5	20	-	10	10	-	5
Na-Alginate	-	10	5	-	5	2.5	-	20	10	-	10	5
Okra mucilage	-	-	-	5	5	5	-	-	-	10	10	10
Avicel PH 101	100	100	100	100	100	100	90	90	90	90	90	90
Na-bicarbonate	80	80	80	80	80	80	80	80	80	80	80	80
Citric aid	40	40	40	40	40	40	40	40	40	40	40	40
Talc	3	3	3	3	3	3	3	3	3	3	3	3
Mg-stearate	3	3	3	3	3	3	3	3	3	3	3	3

D.P.R.: Drug polymer ratio

3. Results and Discussion

3.1. Preparation of lornoxicam floating tablets

Twelve lornoxicam floating tablet formulae were prepared using HPMC K100M and/or Alginate as floating, release controlling polymers at different drug polymer ratios, and the effect of the addition of the naturally occurring Okra mucilage on the floating and release properties of the drug from these formulae was studied. In this work; Okra mucilage was added to the proposed tablet formulae both as dry powder and as granulating aqueous solution and the effect of the incorporation method on the floating and release properties of the drug from the prepared formulae was also studied. The gas generating Na-bicarbonate/citric acid mixture was added at a constant ratio to all prepared formulae.

3.2. Pre - compression evaluation

The flow properties of the prepared lornoxicam floating tablet formula mixtures were studied and the results are shown in Table 2. In this work; Angle of repose, compressibility index (Ci), and Hausner ratio were selected as the flow indicating parameters, they reflect the effect of bulk density, particle size, surface characters, and moisture content on the powder flow. According to literature good flow is described with an angle of repose close to 25 and Carrs' index values not exceed 20 -21% while Hausner ratio has to be close to unity. (34)

The angle of repose was in the range of 24.32 to 29.2 º, Carrs' index was found to be less than 13.32 % and Hausner ratio ranged from 1.03 to 1.32 % in all prepared tablet mixtures. These values indicate that the prepared mixtures exhibited good flow properties. These results can be attributed to the crystalline nature of the drug and high percentage of Avicel incorporated in all formula mixtures. Further investigation of the flow study results shows that granulated powder mixture ($F4_W$, 5_W, 6_W, 10_W, 11_W and 12_W) had better flow properties. Also it can be easily noted that Okra containing formula mixtures (F4, 5, 6, 10, 11, 1nd 12) showed better flow properties than the corresponding Okra free mixtures (F 1, 2, 3, 7, 8 and 9) prepared without granulation and this could be attributed to the granular nature of the prepared Okra mucilage.

3.3. Evaluation of the prepared floating tablets

Results of tablet evaluation are shown in Table 2. All prepared tablet formulations had an acceptable weight variation within the pharmacopeal limits (±7.5%) in the range of 242 to 246 mg with a low standard deviation. Lornoxicam content in the prepared tablet formulae ranged from 98.14 to 101.32 % which complies with the acceptable pharmacopeal limits (90.00 –110.00 %). Regarding tablet hardness and friability values that reflects the mechanical and breaking strength of the prepared tablets, results show that tablet hardness in all prepared formulations lies within 6 –7 Kg/cm^2 as we planned during tablet compression, the percentage of weight loss did not exceed 0.36% complies with friability pharmacopeal limits (less than 1%) indicating that all prepared lornoxicam floating tablets can withstand handling and shipping conditions. (35)

The hydrophilic characteristics of the prepared lornoxicam floating tablets were investigated by studying the selling index, floating lag-time, and total buoyancy. Results are summarized in Table 3. Swelling is a function of matrix hydrophillicity and ionization of functional groups within the hydrated polymer that directly controls the characteristics of the formed network structure, and the swelling index describes the water amount within the hydrated polymer (hydrogel) at equilibrium. (36, 37) All prepared tablet formulations showed good swelling in contact with water due to the high hydrophilic nature of the applied polymers, it can also be easily noted that the swelling of HPMC K 100M was superior (194 %) than alginate (163 %) and a combination of both polymers showed a marked increase in the swelling index (190 %). The swelling of the prepared formulations was affected by the amount of the applied polymer where the swelling index values increased with increasing drug polymer ratio to reach 211, 182, and 208 % in comparison to

194, 163, and 190% for formulations F1, 2, 3, 7, 8, and 9 respectively. The results also clearly showed that Okra mucilage positively affected the swelling properties of the prepared tablets where the swelling index ratio reached 210, 198, and 207, 221, 193, and 224 % for formulations F4, 5, 6, 10, 11, and 12 respectively. Similar results were observed by Senthil et al (38) and Ravi Kumar et al (39) who recorded the direct relationship between the swelling index and mucilage concentration during their studies on Okra mucilage. Further investigation of the results showed that the incorporation method of Okra mucilage also had a noticeable effect on the swelling properties of the prepared tablets, where swelling index values for the tablets prepared by wet granulation were decreased when compared with those directly compressed formulae of the same composition, where the swelling index value decreased to be 198, 178, 200, 214, 188, and 216 % in comparison to 210, 187, 207, 221, 193, and 224 % for formulations F4, 5, 6, 10, 11, and 12 respectively. This could be attributed to the decrease in the hydration power of the applied polymers which may be due to insufficient and/or inappropriate drying of the prepared granules.

On contact with acidic medium, the sodium bicarbonate particles present in the surface layer of the floating tablet starts to react and CO_2 bubbles start to appear on the outermost layer that propel the tablet toward the surface and causing the initial buoyancy. (40) The release medium penetrates the hydrophilic polymer within the floating tablet matrix causing swelling and gel formation which lead to tablet expansion, (41) that result in density reduction of dosage form that supports good buoyancy. (42)

Results in Table 3 show that all prepared lornoxicam floating tablets had an excellent floating lag-time with a maximum value of 0.58 minutes and this could be attributed to the highly hydrophilic nature of the tablet matrices and high swelling capacity. Excluding Okra based formulae, HPMC K 100M based formulations had a shorter floating-lag time (0.37 minutes) and longer floating duration (> 12 hours) and this could be explained by the capillary nature of the cellulose molecule that causes faster swelling and hence faster density reduction also highly swollen hydrophilic polymeric chains of cellulose that could retain the tablet integrity allowed the generated CO_2 to be entrapped within the formed matrix for longer duration. Increasing the drug/polymer ratio within the prepared formulae generally prolonged the floating lag-time as a longer time period was required to hydrate the polymeric chains and allowed the formation of the jellified floatable matrices.

The addition of Okra mucilage to the formulated floating mixtures positively affected the floating of tablets where the floating lag-time was shortened to be 0.23, 0.31, 0.37, 0.33, 0.40, and 0.46 minutes in comparison to 0.37, 0.44, 0.41, 0.49, 0.58, and 0.53 minutes in formulae F4, 5, 6, 10, 11, and 12 respectively and the total floating duration exceeded 12 hours in all formulations. This could be correlated to the very high swelling capacity of Okra mucilage, where it was observed that Okra mucilage and gum can be hydrated to over twenty times its original size. (43)

***In-vitro* release studies**

Percentage lornoxicam released from the prepared floating tablet formulations in 0.1N HCl was investigated and results were presented in Figures 1, 2. According to the drug dissolution profile; all prepared floating formulae retarded the drug release in a controlled manner where the tablet content of the drug was slowly released over twelve hours. The drug release behavior was dependent on the polymer type and the applied drug/polymer ratio; the percentage of drug release after 12 hours was 93.7, 98.4, 92.4, 84.8, 93.4, and 90.1 % from the prepared floating formulae F1, 2, 3, 7, 8, and 9 respectively. These results are in accordance with the hydrophilic nature and the swelling capacity of the tablet matrices, as previously mentioned HPMC K 100M based formulae were highly hydrated, expanded, and jellified. This hinders and hence prolongs the drug release from these matrices. The direct relationship between the swelling capacity and the polymer concentration explains the effect of the drug polymer ratio on lornoxicam release.

Okra mucilage incorporation within the formulated floating tablet mixtures significantly affected the drug release rate where the percentage of drug released after 12 hours was lowered to be 88.3, 93.8, 85.3, 79.8, 81.8, and 75.7 % from the Okra containing floating tablet formulae F4, 5, 6, 10, 11, and 12 respectively. This is mainly due to the positive effect of added Okra mucilage on the hydrophillicity, and swellability of the tablet matrices in these formulations.

As previously discussed, it was noticed that preparation of the tablet matrices by wet granulation retarded the hydration and swelling of the tablet and this led finally to the less retardation effect of these matrices on the lornoxicam release rateResults in Figure 2 show that; the percentage of lornoxicam released from the tablets prepared by wet granulation was 91.8, 95.2, 91.7, 83.6, 87.8, and 82.3 % in comparison to 88.3, 93.8, 85.3, 79.8, 81.8, and 75.7 % from the corresponding formulae prepared by direct compression F4, 5, 6, 10, 11, and 12 respectively.

The correlation coefficient (R^2) values of the release data to different kinetic models are presented in Table 4. The results show a higher correlation with zero order than first order, Koremeyer–Peppas, and Higuchi models that is close to unity indicating that the predominant drug release mechanism from all prepared gastroretentive floating tablets is controlled release.

Table 2: Physical characterization of the prepared lornoxicam floating tablet mixtures

Code	Angle of repose	Hausner Ratio	Carrs' Index	Average weight (mg)±S.D	Thickness (cm)	Content Uniformity (%)±S.D	Friability (%)	Hardness (kg/cm^2)
F1	28.72	1.24	12.14	244±0.137	0.26	99.91±1.120	0.32	6.6
F2	29.21	1.32	13.32	245±0.126	0.24	99.98±1.350	0.34	6.4
F3	28.92	1.26	12.62	246±0.201	0.26	99.87±1.540	0.33	6.5
$F4_D$	26.21	1.16	12.24	243±0.113	0.22	98.97±1.270	0.35	6.3
$F4_W$	25.22	1.12	11.74	244±0.241	0.22	99.15±1.221	0.28	6.8
$F5_D$	27.12	1.22	12.34	242±0.120	0.27	99.94±1.440	0.27	6.8
$F5_W$	26.21	1.14	11.71	245±0.252	0.25	98.44±1.333	0.23	6.9
$F6_D$	25.51	1.13	12.21	245±0.141	0.24	98.14±1.680	0.34	6.4
$F6_W$	24.71	1.09	11.82	246±0.160	0.22	98.69±1.452	0.27	6.8
F7	28.11	1.21	12.47	245±0.211	0.21	99.92±1.080	0.36	6.2
F8	28.79	1.31	12.99	245±0.207	0.25	101.08±1.32	0.29	6.6
F9	28.14	1.22	12.83	244±0.133	0.23	98.89±1.310	0.34	6.3
$F10_D$	26.32	1.14	12.11	243±0.121	0.26	99.11±1.331	0.33	6.7
$F10_W$	25.11	1.08	12.22	242±0.121	0.24	99.12±1.720	0.28	6.5
$F11_D$	26.35	1.05	12.17	243±0.213	0.23	98.22±1.550	0.34	6.4
$F11_W$	25.86	1.03	11.28	245±0.183	0.22	98.96±1.151	0.27	6.8
$F12_D$	25.44	1.11	12.14	246±0.111	0.25	101.32±1.261	0.33	6.5
$F12_W$	24.87	1.07	11.75	245±0.159	0.23	99.09±1.220	0.25	6.9

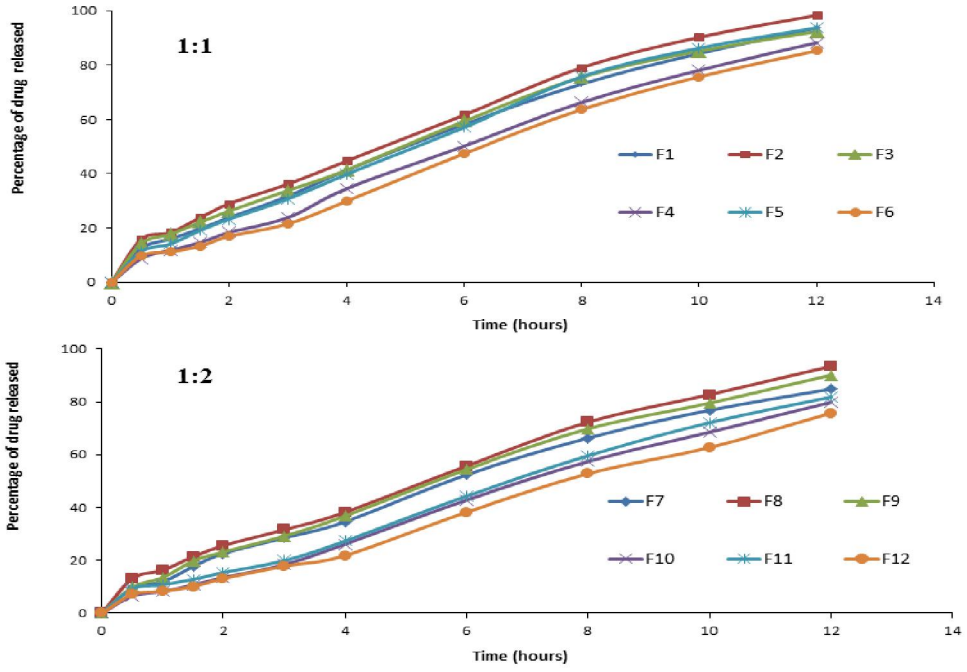


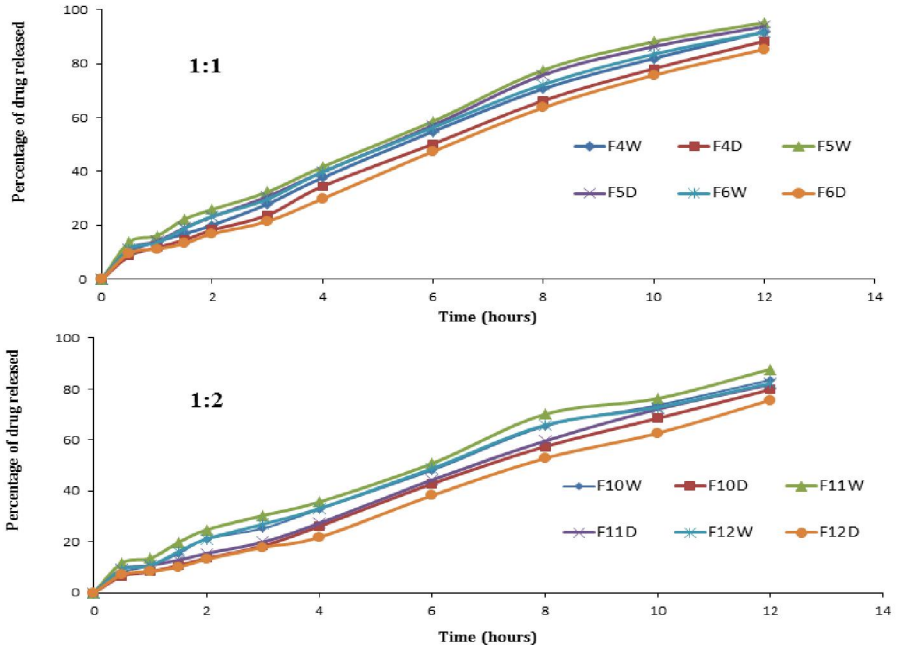
Figure 1: Dissolution profile of lornoxicam from the prepared floating tablets.

Table 3: Hydration properties of the prepared lornoxicam floating tablets

Code	Floating Lag time (min)	Floating Time (hr)	Swelling Index (%)
F1	0.37	> 12	194
F2	0.44	7- 8	163
F3	0.41	10 - 11	190
$F4_D$	0.23	>12	210
$F4_W$	0.27	>12	198
$F5_D$	0.31	>12	187
$F5_W$	0.33	> 12	178
$F6_D$	0.37	>12	207
$F6_W$	0.41	>12	200
F7	0.49	>12	211
F8	0.58	> 12	182
F9	0.53	>12	208
$F10_D$	0.33	>12	221
$F10_W$	0.38	>12	214
$F11_D$	0.40	>12	193
$F11_W$	0.44	>12	188
$F12_D$	0.46	>12	224
$F12_W$	0.49	>12	216

Table 4: Correlation coefficient of the release data to different kinetic models

Code	Correlation coefficient (R^2)			
	Zero	**First**	**Higuchi**	**Koremeyer – Peppas**
F1	0.9918	0.9100	0.8368	0.9832
F2	0.9904	0.9152	0.8909	0.9795
F3	0.9905	0.9172	0.8827	0.9821
$F4_D$	0.9906	0.9087	0.7785	0.9816
$F4_W$	0.9950	0.9163	0.7192	0.9799
$F5_D$	0.9897	0.9138	0.8490	0.9786
$F5_W$	0.9889	0.9041	0.7973	0.9841
$F6_D$	0.9917	0.9019	0.8119	0.9840
$F6_W$	0.9939	0.9408	0.7027	0.9540
F7	0.9905	0.8867	0.7994	0.9898
F8	0.9949	0.9925	0.8560	0.9817
F9	0.9927	0.8938	0.8061	0.9919
$F10_D$	0.9920	0.8871	0.7417	0.9912
$F10_W$	0.9959	0.9264	0.6171	0.9717
$F11_D$	0.9926	0.9072	0.8404	0.9817
$F11_W$	0.9935	0.9487	0.9615	0.9494
$F12_D$	0.9934	0.8998	0.7803	0.9835
$F12_W$	0.9939	0.9478	0.6340	0.9551



4. Figure 2: Effect of Okra incorporation method on lornoxicam dissolution profile from the prepared floating tablets.Conclusion

In this work; the effect of Okra mucilage on the floating and release properties of lornoxicam from HPMC K100M and/or Alginate tablet matrices was studied. The prepared modified tablet mixtures showed acceptable flow and compressibility results. The hydration properties of the prepared tablet matrices were significantly improved where the swelling and the total floating duration were increased while the floating lag-time was shortened. Incorporation of Okra mucilage into the prepared floating tablet matrices also significantly affected the drug release rate where the drug release was retarded and the kinetic analysis of the release data indicated a controlled release mechanism with zero order kinetics. Finally; it could be concluded that incorporation of Okra mucilage into gastroretentive floating tablet matrices has a noticeable effect on their release and floating properties and this effect is controlled by its ratio and also the incorporation method, so we can consider the naturally occurring Okra mucilage as a promising additive in the preparation of gastroretentive floating dosage forms.

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