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Research Article

FORMULATION & CHARACTERIZATION OF TAMARIND GUM BASED COLON TARGETED MATRIX TABLETS

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ABSTRACT

Ornidazole (ORN), a nitroimidazole derivative is used in the treatment of bacterial vaginosis, amoebiasis, and infections due to anaerobic bacteria. These drugs are highly soluble in acidic media and precipitates in alkaline media thereby losing its solubility. The site of absorption of Ornidazole is in the whole GI tract and has a long half life of 13 hr. Hence we attempted to develop colon targeted matrix tablet of Ornidazole using natural polymers like tamarind gum, pectin and locust bean gum as a carrier in various concentrations (3%, 4% and 5%). The physicochemical compatibility of the drug and the polymers was studied by infrared spectroscopy and differential scanning calorimetry. The results suggested no physicochemical incompatibility between the drug and the polymers. The matrix tablets were prepared by wet granulation method and all the formulations (F1 to F9) were evaluated for pharmacopoeial requirements such as hardness, friability, thickness, weight variation etc. In- Vitro drug release study was performed in 1.2 Ph for 2 hrs, for next 3 hrs in 7.4 ph and rest of the time was followed by 6.8 ph in phosphate buffer. In-Vitro drug release study of tamarind gum based formulation (F1) revealed that tablets formulated with natural polysaccharides i.e. Tamarind gum have enough potential to target the drug in the colon due to its ph sensitive characterization. The mechanism of drug release was found to be non-fickian diffusion.

Key Words: Ornidazole, Tamarind gum, Matrix tablet, Colon targeted drug delivery.

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INTRODUCTION

Oral route of drug delivery system is one of the most convenient areas of delivering a drug with the ease of administration, cost-effectiveness, high patient compliance, optimum drug delivery, flexibility in designing the formulation and least sterility constraints (Konar *et al.*, 2013). Targeted drug delivery, sometimes called smart drug delivery, is a method of delivering pharmaceutical active constituents to achieve the therapeutic effect in a patient such a manner that increases the concentration of the medication in some parts of the body relative to others. The goal of a targeted drug delivery system is to prolong, localize, target and have protected drug interaction with the diseased tissue. The conventional drug delivery system is the absorption of the drug across biological membrane, whereas the targeted release system is when the drug is release in the dosages form. The advantages to the

targeted release system is the reduction in the frequency of the dosages taken by the patient, having a more uniform effect of drug, reduction of side effects, and reduced fluctuation in circulating drug levels. The disadvantage of the system is high cost which makes productivity more difficult and the reduced ability to adjust the dosages (Radhika *et al*., 2011). Colon specific drug delivery systems have achieved an attention for the treatment of several colonic diseases such as ameobaisis, Crohn's disease, ulcerative colitis and irritable bowel syndrome. The successful targeted delivery of drug to the colon via the gastrointestinal tract (GIT) requires the protection of a drug from degradation and release in the stomach and small intestine and then ensures abrupt or controlled release in the proximal colon (Katta *et al.*, 2017). Various approaches were adopted for the purpose of targeting drug to the colonic region are namely prodrug approach, pH dependent approach, time dependent approach, micro flora system (Agarwal *et al.*, 2013).

Linear polysaccharides remains unchangeable in GIT but the pH and the bacteria of human colon degrades them and thus make them potentially useful in colon targeted drug delivery system (Patel *et al.*, 2012). Tamarind gum is natural polysaccharide which contain oil, protein, no fiber carbohydrate etc..This natural polymer is insoluble in ethanol, methanol, acetone, ether, cold water, and also in organic solvents, but it yields a highly viscous colloidal solution or a viscous gel at temperatures above 85°C is completely dissolved in hot water. It is a pH dependent polymer which is been activated in similar pH environment and also act as an antimicrobial, antiprotozoal agent (Kar *et al*., 2018).

Ornidazole, a 5-nitroimidazole derivative which is used in the treatment of susceptible protozoan infections and anaerobic bacterial infections. It is readily absorbed after oral administration having biological half life about 11-13 hrs and bioavailability approaches 90%. It is oxidized by the liver to a hydroxyl ethyl metabolite and excreted in urine. Owing its similar chemical properties, Ornidazole shares the same mechanism of action and spectrum of microbiological activity as other nitro-imidazole agents against anaerobes and protozoa. Nitro-imidazole are thought to produce their bactericidal activity in four phases such as a. Entry into bacterial cell. b.Nitro group reduction. c. Action of cytotoxic by products. d. Production of inactive end products. Bactericidal activity to be dependent on the formation of redox intermediate metabolite in the bacterium. This toxic metabolite may interact primarily with DNA, RNA or intercellular proteins; however, its main effects are DNA strand breakage, inhibited repair and ultimately disrupted transcription and cell death (Singh *et al.*, 2003). Ornidazole having anti-protozoal and anti bacterial properties against anaerobic bacteria, so as a drug of choice to develop a matrix tablet to minimize the influence of the stomach emptying time on drug release and ensure that the tablet could invade in the colonic region for treatment of some colonic diseases.

The major obstacle with this kind of drug delivery via oral route is the absorption and degradation of the drug in the upper part of the gastrointestinal tract (GIT), which can be overcome for successful colonic drug delivery by implementing pH specific drug delivery system using pH dependent polymer.

MATERIALS AND METHOD

Materials

Ornidazole was purchased from local market. Locust bean gum, Pectin, Talc and Magnesium stearate were purchased from Loba Chemie Pvt Ltd. Polyvinyl pyrrolidone (PVP K30) was purchased from Central drug house. All other chemicals and reagents used in study were of analytical grade.

Preparation of Calibration Curve for Ornidazole

The calibration curve of Ornidazole was prepared in different buffer solution at different pH like 0.1N HCl at pH- 1.2, phosphate buffer at pH 7.4 and 6.8 (Roy *et al.*, 2011)

Drug –Polymer Interaction Study

IR spectra were recorded using an FTIR spectrophotometer by the KBR pellet method in the wavelength region between 4000-400cm^{-1}.The spectra obtained for Ornidazole and physical mixtures of Ornidazole with Tamarind and other polymers were compared to check compatibility of drug with polymers. The resultant spectra were compared for any possible changes in the peaks of the spectra (Navneet *et al*., 2011)

DSC Study

The DSC thermogram was recorded for Ornidazole and physical mixtures of with Ornidazole with Tamarind and other polymers were compared to check compatibility of drug with polymers (Roy *et al.*, 2011).

Extraction Process of gum from Tamarind Seed

The crushed seeds of *Tamarindus indica* were soaked in water for 24hrs, boiled for 2 hrs, and kept aside for again 24 hrs for release of gum into water. The soaked seeds were taken and squeezed in a muslin bag to remove marc from the filtrate. Then, to the filtrate, equal quantity of absolute ethyl alcohol was added to precipitate the gum. The gum was separated by filtration. The separated gum was continued until the material was free of gum. The separated gum was dried in hot air oven at temperature 40°C. The dried gum was powdered and stored in airtight containers at room temperature (Kar *et al.*, 2018).

Method of preparation of colon targeted matrix tablet containing Ornidazole

The sustained release matrix tablets of Ornidazole were prepared by the wet granulation method. The required quantity of drug, polymer along with other excipients given in table 1 were weighed properly and mixed thoroughly and passed through sieve no. 20#.. Then the wet mass was formed by adding the required quantity of binder solution. After that the wet mass was passing through the sieve no. 18# and dried for 15-20 minutes at 60^0C. Finally the sustained release tablets of Ornidazole were prepared by compressing the dried granules by Rotary Die tablet press using 9 mm round and flat punches (Roy *et al.*, 2011; Monjula *et al*., 2016).

Pre-compression parameter

After preparation of Ornidazole granules by incorporating different polymers the micromeritic properties like bulk density, tapped density, angle of repose, carr's index, hausner ratio etc. were studied (Monjula *et al*., 2016; Navneet *et al*., 2011)

Post-compression parameter

After preparation of Ornidazole matrix tablets by wet granulation technique, the post compression parameters like diameter, hardness, thickness, friability, weight variation, disintegration time, SEM, in vitro dissolution study were performed (Roy *et al.*, 2011; Monjula *et al*., 2016).

Drug content uniformity

Three tablets were finely powdered; quantity equivalent to 100 mg of Ornidazole taken and dissolved properly with 6.8 pH phosphate buffer solution in to a 100 ml of volumetric flask & made up to volume and mixed thoroughly. A aliquot sample (1ml) was withdrawn and diluted with 100 ml phosphate buffer solution and measured the absorbance at the 312 nm using a UV-visible spectrophotometer (1700 Shimadzu, japan). The linearity equation obtained from calibration curve was used for estimation of Ornidazole in the tablets formulations (Roy *et al.*, 2011).

***In-vitro*Drug Release Studies**

The matrix tablets containing 800 mg of Ornidazole were tested in Simulated Gastric Fluid (SGF) at pH 1.2, simulated small Intestinal Fluid (SSIF) at pH 6.8 and simulated ceccal fluid for their dissolution rates using USP dissolution test apparatus – type II (Tab machine dissolution tester Model No. DRS-14) which was performed at 37±0.10C on 100 rpm in 900 ml (three different medium). The prepared tablets were tested for drug release for 2 hr in 1.2 pH/0.1N HCL (900 ml) as the average gastric emptying time is about 2 hr. Then the dissolution medium was replaced with 6.8 pH phosphate buffer (900 ml) for next 3 hr as average intestinal transit time is about 3 hr. Then again the dissolution medium was replaced with 7.4 pH phosphate buffer (900 ml) for rest of the hours until the tablets dissolved completely. Samples withdrawn at various time intervals were analyzed by UV spectrophotometer at their respected wavelength. The % drug release and % Cumulative drug release at different time intervals was calculated (Roy *et al.*, 2011; Navneet *et al*., 2011)

.

RESULTS AND DISCUSSION

Preparation of calibration curve

The λ_{max} was found at 277nm in 0.1 N HCl (pH 1.2), at 320nm in phosphate buffer (pH 6.8), and at 320nm in phosphate buffer (pH 7.4), The standard calibration curve for Ornidazole with regression value of 0.997, 0.998 and 0.999 are shown in Fig. 2 respectively. The relation between drug concentration and absorbance is linear and the curve obeys Beer-lamberts law within the concentration range of 5 to 25 µg/ml of Ornidazole.

Drug Polymer Interaction Studies

The FT-IR spectra analysis of Ornidazole and Tamarind gum separately shown in Fig. 3 and a comparison study of drug and polymer physical mixture shown in Fig. 4 revealed no considerable changes in IR peaks of Ornidazole, indicating absence of interaction between drug and polymer used.

Differential Scanning Calorimetry Thermogram

The DSC thermogram analysis of Ornidazole and Tamarind gum separately shown in Fig. 5 and a comparison study of drug and polymer physical mixture was shown in Fig. 6 which concluded that there was no appreciable interaction or change in melting point between drug and polymers that supports the IR spectroscopy results.

Surface Topography (SEM)

Scanning electron microscopy was used to observe the surface morphology of matrix tablet of Ornidazole before and after dissolution study described by Fig. 7 & 8 respectively.

Micromeritic Properties

The obtained micromeritic properties are given in Table no.2. The Angle of repose of all formulations was within the range of 30˚ which indicates good flow properties for the granules. The tapped density values ranged between 0.510 ±0.08 to 0.590 ±0.04g/ cm^3 and the bulk density values ranged between 0.425 ±0.03 to 0.516 ±0.07 g/ cm^3. Carr's index values were found to be in the range of 14.09 ±0.86 to 17.69 ±1.95 % and Hausner's ratio ranges from 1.16 ±0.01 to1.21 ±0.09 %. These findings concluded that the powder mixture of all

formulations of Ornidazole exhibited good flow properties.

Physico-Chemical Properties of Matrix Tablets of Ornidazole

The tablet hardness, thickness, weight variations, and friability for each formulation are presented in Table 3. In determinations of tablet weights, all formulations weights were found to be within pharmacopoeia limits. A plain punch with the same radius each time was used for all formulations in tablet pressing. Friability value of all formulations and commercial tablets less than 1% indicates that tablet surfaces are strong enough to withstand mechanical shock or attrition during storage and transportation and until they are consumed. The average percentage deviation of all tablet formulations was found to be within the above limit, as per official pharmacopeia requirements. The manufactured tablets showed low weight variations a high degree of drug content uniformity.

***In- Vitro* Drug Release Studies**

The *in vitro* dissolution studies of the prepared colon targeted matrix tablets was carried out using USP type II apparatus (Dolphin, Mumbai, India) at 100 rpm for all the formulations in 0.1 N HCl for 2 hours, phosphate buffer pH 7.4 for 3 hours and phosphate buffer pH 6.8 with 4% rat ceacal content for 8 hours. The drug release at different time intervals was measured using an UV visible spectrophotometer (1700, Shimadzu, Japan).

The dissolution rate was subjected to various mathematical models like zero order given in Table 4, first order given in Table 5, Higuchi model given in Table 6 and Krosmeyer-Peppas model given in Table 7 and to elucidate the kinetics behavior and mechanism of drug release from the different formulations, data obtained from the release studies were fitted to various models shown in Fig. 9 to Fig. 12.

The comparative evaluation of *in vitro* dissolution qualities of various formulations was done by contrasting the values of regression coefficient given in table 7. After evaluating all of the data, it has been concluded that all the formulations has been followed by zero order kinetics as depicted from the regression values ranging from 0.902 to 0.959, as its value near to '1'.

The rate of drug release kinetics and numerical data of F1 formulation fitted into Korsmeyer - peppas model where the value of 'n' reaches above '1'. So, the mechanism of drug release was by Non fickian mechanism and followed by Super case-II transport.

Table 1. Formulation table of colon targeted Ornidazole matrix tablet

Formulation Code	Drug (mg)	Locust bean gum (mg)	Tamarind gum (mg)	Pectin (mg)	Lactose	PVP K30	Talc	Magnesium Stearate	Total
F1	500	--	3%	--	q.s	5%	1%	2%	800
F2	500	--	4%	--	q.s	5%	1%	2%	800
F3	500	--	5%	--	q.s	5%	1%	2%	800
F4	500	3%	--	--	q.s	5%	1%	2%	800
F5	500	4%	--	--	q.s	5%	1%	2%	800
F6	500	5%	--	--	q.s	5%	1%	2%	800
F7	500	--	--	3%	q.s	5%	1%	2%	800
F8	500	--	--	4%	q.s	5%	1%	2%	800
F9	500	--	--	5%	q.s	5%	1%	2%	800

Table 2. Pre compression evaluation study

Formulation Code	Angle of Repose	Bulk Density	Tapped Density	Carr's Index	Hauner's Ratio
F1	24.03 ± 0.78	0.425 ±0.03	0.512 ±0.017	16.99 ±2.25	1.20 ±0.03
F2	26.61 ± 0.98	0.467 ±0.1	0.551 ±0.1	15.24 ±1.68	1.17 ±0.02
F3	28.24 ± 0.86	0.438 ±0.06	0.510 ±0.08	14.11 ±0.88	1.16 ±0.01
F4	29.55 ± 1.09	0.495 ±0.09	0.590 ±0.04	16.10 ±1.15	1.19 ±0.01
F5	30.59 ± 1.19	0.437 ±0.02	0.530 ±0.015	17.54 ±0.83	1.21 ±0.009
F6	30.18 ± 1.36	0.460 ±0.05	0.553 ±0.03	16.81 ±0.64	1.20 ±0.007
F7	26.13 ± 1.06	0.516 ±0.07	0.610 ±0.06	15.40 ±0.87	1.18 ±0.05
F8	30.67 ± 1.43	0.432 ±0.01	0.525 ±0.02	17.71 ±1.97	1.21 ±0.09
F9	26.35 ± 1.23	0.450 ±0.06	0.532 ±0.05	15.41 ±0.89	1.18 ±0.024

Values are represented as mean ± SD (n=3)

Table 3. Physicochemical properties of matrix tablets of Ornidazole

Formulation Code	Thickness (mm)	Hardness (kg/cm2)	Friability (%)	Weight variation	Drug content (%)	Disintegration time(hrs)
F1	0.574±0.054	6.73 ± 0.16	0.45 ±0.01	.800 ± .13	99.79± 0.36	2.5
F2	0.596±0.070	6.79 ± 0.28	0.35 ±0.07	.797 ± .22	99.96 ±0.23	2.6
F3	0.579±0.83	6.79 ± 0.20	0.39 ±0.08	.798 ± .22	99.95 ±0.51	2.45
F4	0.592±0.53	6.77 ± 0.28	0.43 ±0.02	.800 ± .51	99.74 ±0.56	2
F5	0.563±0.44	6.85 ± 0.28	0.32 ±0.09	.800 ± .32	98.87± .382	3
F6	0.582±0.13	6.77 ± 0.16	0.39 ±0.03	.784 ± .37	99.34±0.12	3.5
F7	0.582±0.044	6.74 ± 0.17	0.44 ±0.02	.798 ±0.1	99.67 ±0.31	2.5
F8	0.576±0.070	6.83 ±0.28	0.35 ±0.08	.795 ± 0.55	99.02 ±0.14	2.4
F9	0.581±0.10	6.81 ± 0.33	0.37 ±0.01	.789 ± 0.23	99.97 ±.332	2.3

Values are represented as mean ± SD (n=3)

Table 4. Drug release Data to be fitted in Zero order model

		Cumulative % drug release								
Sl no	**Time [hr]**	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**
1	0	0	0	0	0	0	0	0	0	0
2	1	1.12	1.12	1.46	0.77	2.57	0.53	1.78	1.43	0.38
3	2	1.68	1.68	2.77	1.75	3.15	0.85	1.99	1.99	1.12
4	3	2.08	1.84	3.75	3.74	3.57	1.54	2.84	2.74	2.16
5	4	9.58	3.74	5.94	5.24	8.54	3.54	7.84	5.74	3.05
6	5	22.74	11	14.84	16.74	19.54	17.94	13.84	11.74	4.75
7	6	28.64	19.47	25.94	38.54	31.85	26.94	23.84	26.84	13.28
8	7	42.54	32.54	33.84	46.75	35.88	35.94	35.92	34.99	24.57
9	8	55.85	45.84	43.84	60.54	52.64	52	43.94	52.84	35.83
10	9	67.29	60.84	59.74	72.84	62.84	64	61.84	66.46	47.4
11	10	72.84	72.84	72.98	85.74	75.84	67.54	75.98	80.48	58.43
12	11	88.41	85.74	82.74	92.74	87	78.64	84.22	87.84	69.77
13	12	98.67	91.84	87	93.74	95.41	86.84	95.67	94.84	81.08
14	13	98.96	99.21	94.71	97.54	97.52	92.64	97.52	97.05	93.61

Table 5. Drug release Data to be fitted in First order model

	Log % of drug remain to release								
Time [hrs]	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**
0	2	2	2	2	2	2	2	2	2
1	1.995	1.995	1.993	1.996	1.988	1.997	1.992	1.993	1.998
2	1.992	1.992	1.987	1.992	1.986	1.996	1.991	1.991	1.995
3	1.987	1.991	1.983	1.983	1.984	1.993	1.987	1.987	1.99
4	1.956	1.983	1.973	1.976	1.961	1.984	1.964	1.974	1.986
5	1.887	1.949	1.93	1.92	1.905	1.914	1.935	1.945	1.978
6	1.853	1.905	1.869	1.788	1.833	1.863	1.881	1.864	1.938
7	1.759	1.829	1.82	1.726	1.806	1.806	1.806	1.812	1.877
8	1.644	1.733	1.749	1.596	1.675	1.681	1.748	1.673	1.807
9	1.514	1.592	1.604	1.433	1.57	1.414	1.581	1.525	1.72
10	1.433	1.433	1.431	1.154	1.383	1.511	1.38	1.29	1.618
11	1.064	1.154	1.237	0.86	1.113	1.329	1.198	1.084	1.48
12	0.123	0.911	1.113	0.796	0.661	1.119	0.636	0.712	1.276
13	0.017	0.102	0.723	0.39	0.394	0.866	0.394	0.469	0.805

Table 6. Drug release Data to be fitted in Higuchi model

	Cumulative % drug release								
Sqrt of time	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**
0	0	0	0	0	0	0	0	0	0
1	1.12	1.12	1.46	0.77	2.57	0.53	1.78	1.43	0.38
1.414	1.68	1.68	2.77	1.75	3.15	0.85	1.99	1.99	1.12
1.732	2.08	1.84	3.75	3.74	3.57	1.54	2.84	2.74	2.16
2	9.58	3.74	5.94	5.24	8.54	3.54	7.84	5.74	3.05
2.236	22.74	11	14.84	16.74	19.54	17.94	13.84	11.74	4.75
2.449	28.64	19.47	25.94	38.54	31.85	26.94	23.84	26.84	13.28
2.645	42.54	32.54	33.84	46.75	35.88	35.94	35.92	34.99	24.57
2.828	55.85	45.84	43.84	60.54	52.64	52	43.94	52.84	35.83
3	67.29	60.84	59.74	72.84	62.84	74	61.84	66.46	47.4
3.162	72.84	72.84	72.98	85.74	75.84	67.54	75.98	80.48	58.43
3.316	88.41	85.74	82.74	92.74	87	78.64	84.22	87.84	69.77
3.464	98.67	91.84	87	93.74	95.41	86.84	95.67	94.84	81.08
3.605	98.96	99.21	94.71	97.54	97.52	92.64	97.52	97.05	93.61

Table 6. Drug release Data to be fitted in Krosmeyer-Peppas model

	Log cumulative % of drug release								
Log Time	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**
-	-	-	-	-	-	-	-	-	-
0	0.049	0.049	0.164	0.113	0.409	0.275	0.25	0.155	0.42
0.301	0.225	0.225	0.442	0.243	0.498	0.07	0.298	0.298	0.049
0.477	0.318	0.264	0.574	0.572	0.552	0.187	0.453	0.437	0.334
0.602	0.981	0.572	0.773	0.719	0.931	0.549	0.894	0.758	0.484
0.698	1.356	1.041	1.171	1.223	1.29	1.253	1.141	1.069	0.676
0.778	1.456	1.289	1.413	1.585	1.503	1.43	1.377	1.428	1.123
0.845	1.628	1.512	1.529	1.669	1.554	1.555	1.556	1.543	1.39
0.903	1.747	1.661	1.641	1.782	1.721	1.716	1.642	1.722	1.554
0.954	1.827	1.784	1.776	1.862	1.798	1.806	1.791	1.822	1.675
1	1.862	1.862	1.863	1.933	1.879	1.829	1.88	1.905	1.766
1.041	1.946	1.933	1.917	1.967	1.939	1.895	1.925	1.943	1.843
1.079	1.994	1.963	1.939	1.971	1.979	1.938	1.98	1.976	1.908
1.113	1.995	1.996	1.976	1.989	1.989	1.966	1.989	1.986	1.971

Table 7. *In Vitro* Release Kinetic Parameters for Ornidazole Matrix Tablet

	Zero Order Model		**First-Order Model**		**Higuchi Model**		**Korsmeyer-Peppas Model**	
Formulations	r^2	k_0	r^2	k_1	r^2	k_h	r^2	K_{kp}
F1	0.959	8.873	0.715	-0.135	0.803	32.83	0.940	2.077
F2	0.927	8.668	0.672	-0.117	0.745	31.43	0.922	2.110
F3	0.945	8.220	0.811	-0.086	0.774	30.12	0.956	1.863
F4	0.952	8.196	0.779	-0.110	0.804	34.06	0.959	2.170
F5	0.955	8.625	0.849	-0.118	0.794	31.82	0.927	1.723
F6	0.948	9.145	0.854	-0.082	0.784	30.67	0.940	2.391
F7	0.939	8.626	0.805	-0.110	0.765	31.50	0.936	1.898
F8	0.937	8.881	0.755	-0.109	0.768	32.54	0.935	1.994
F9	0.902	7.566	0.725	-0.071	0.706	27.07	0.964	2.349

Fig 1. Structure of Tamarind gum (Kar *et al.*, 2018, Patil VS, 2008)

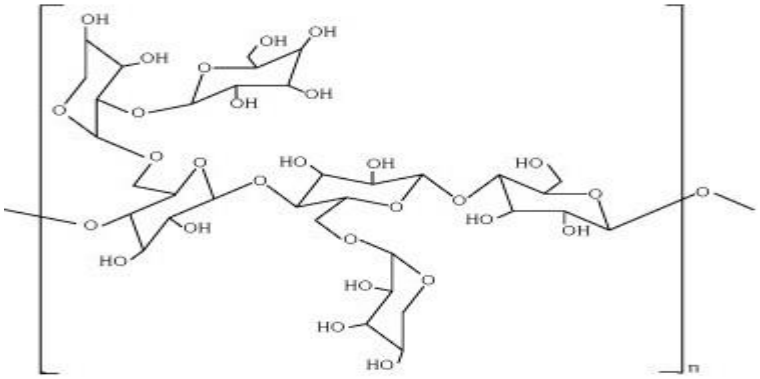
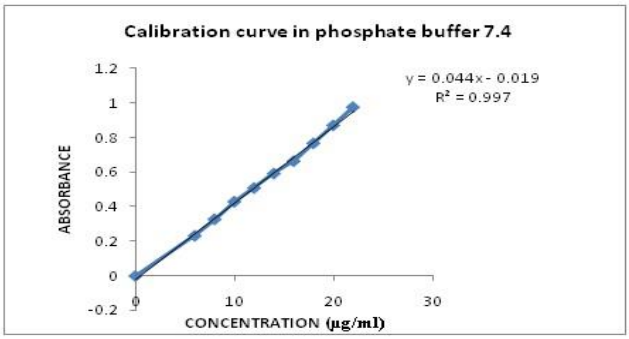
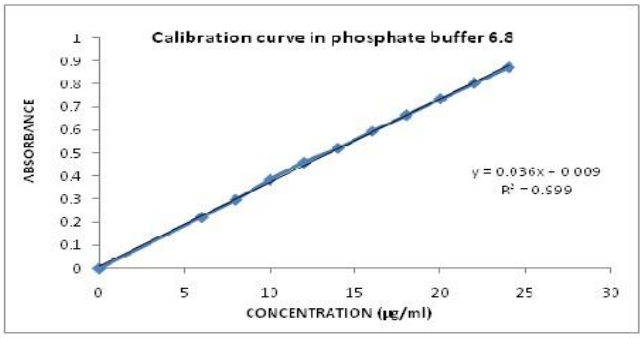


Fig 2. Calibration Curve of Ornidazole in different buffer solution





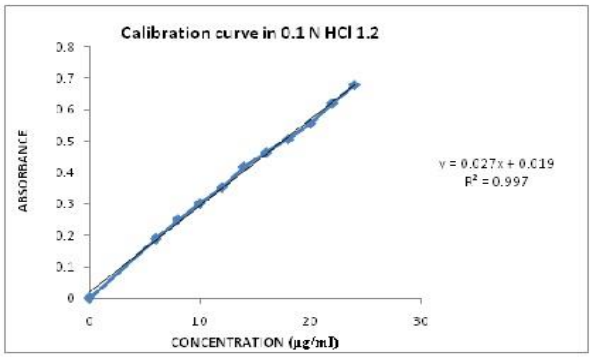
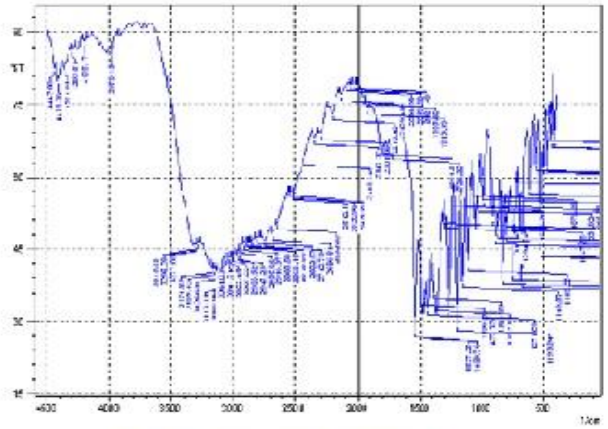
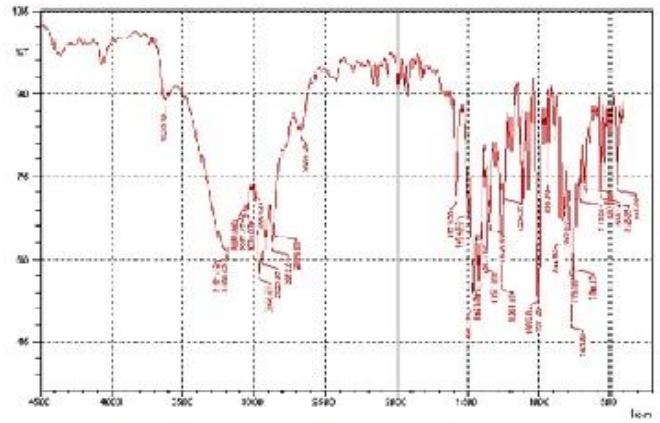


Fig 3. FTIR Spectra of pure drug and tamarind gum



FTIR Spectra of Ornidazole



FTIR Spectra of Tamarind Gum

Fig 4. Comparison study of FTIR Spectra of drug and Polymer mixture

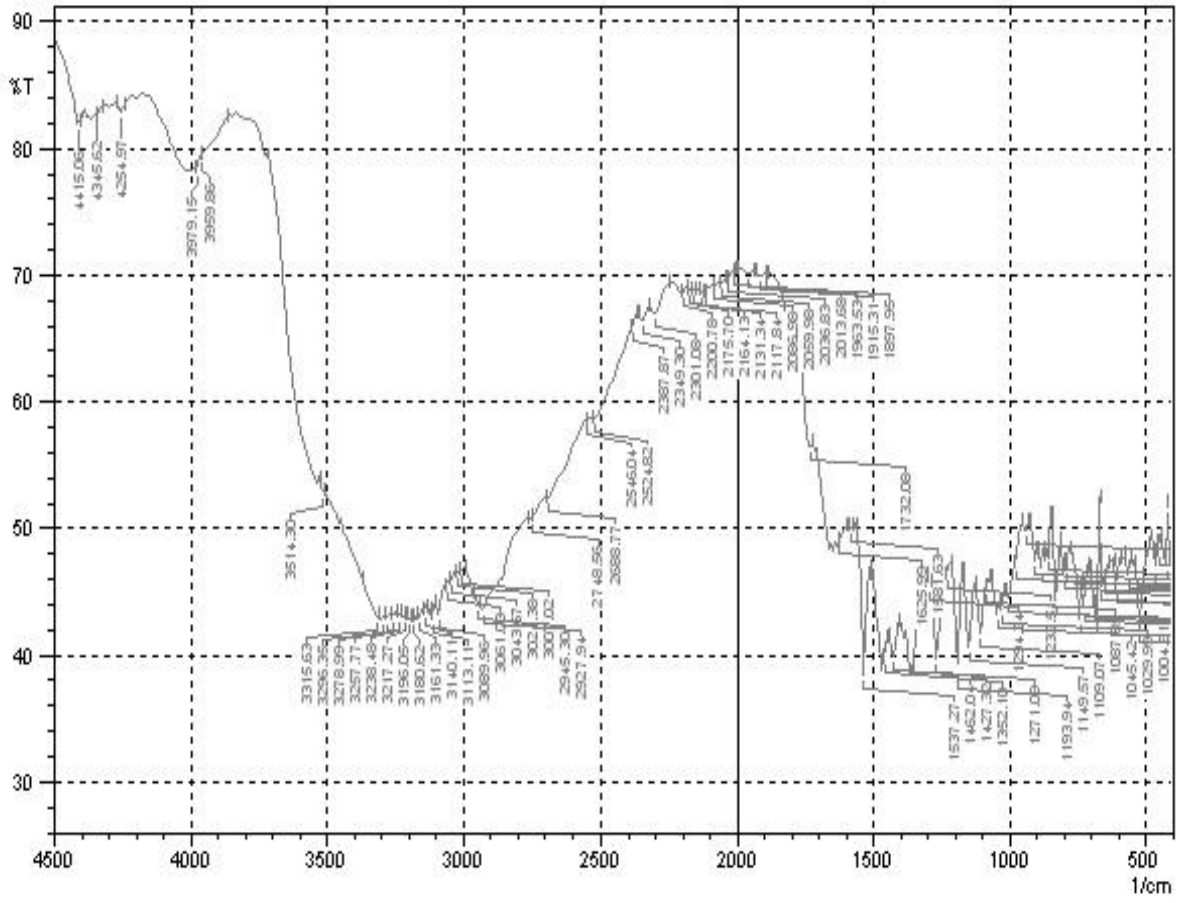
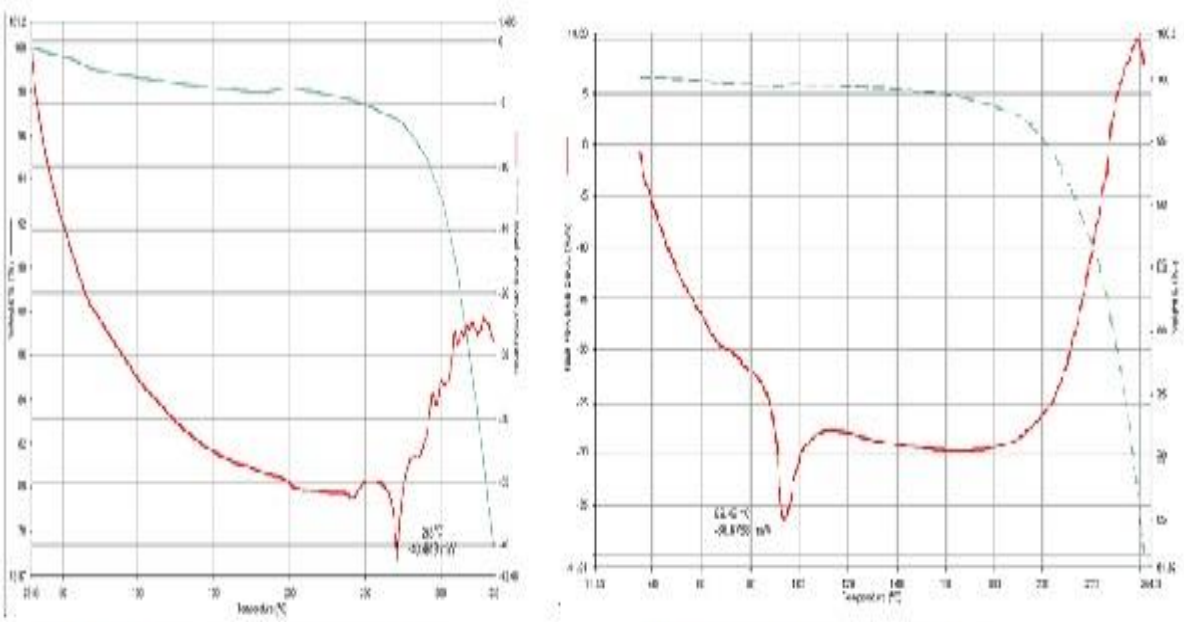


Fig 5. DSC Thermograms of pure drug and Polymers respectivel



DSC Thermogram of Tamarind Gum **DSC Thermogram of Ornidazole**

Fig 6. Comparison study of DSC thermogram of drug and polymer physical mixture

Fig 7. SEM of Ornidazole Matrix Tablet at 30X, 50X, 75X, 100X before Dissolution

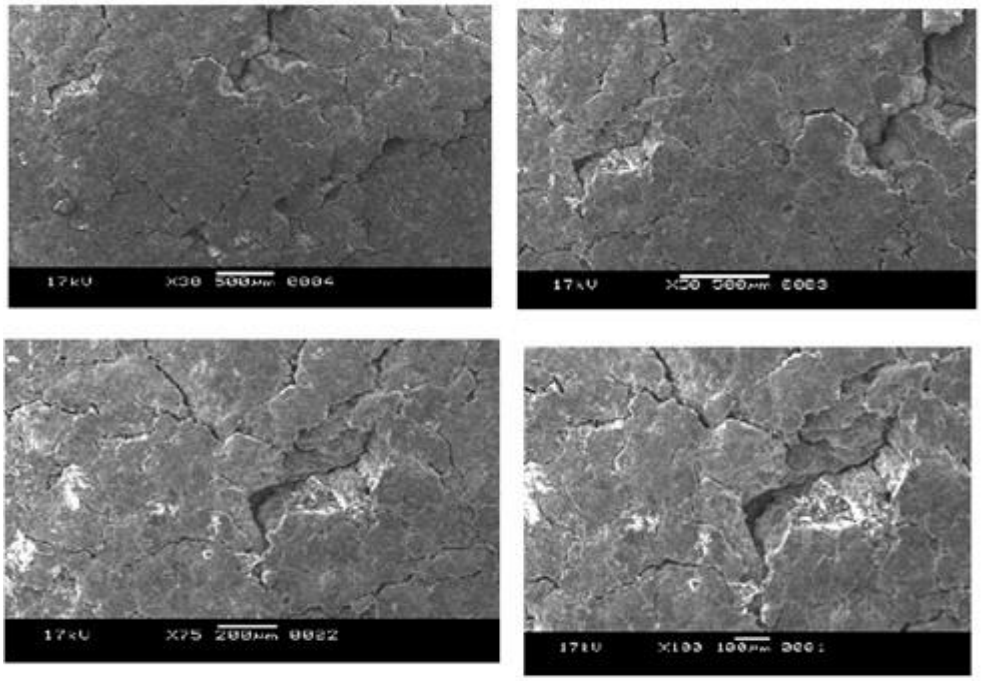


Fig 8. SEM of Ornidazole Matrix Tablet at 30X, 50X, 75X, 100X After Dissolution

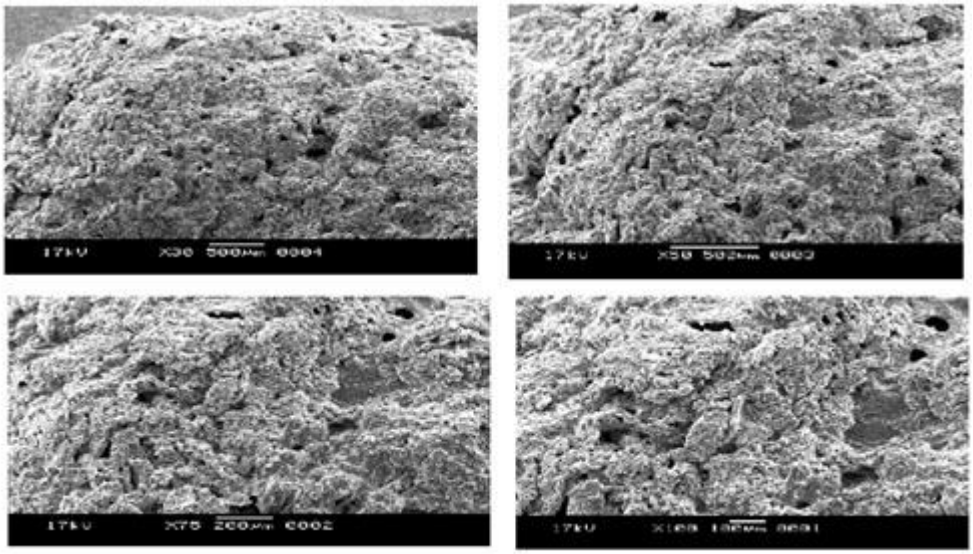


Fig 9. Comparative zero order kinetics of different colon targeted matrix formulations

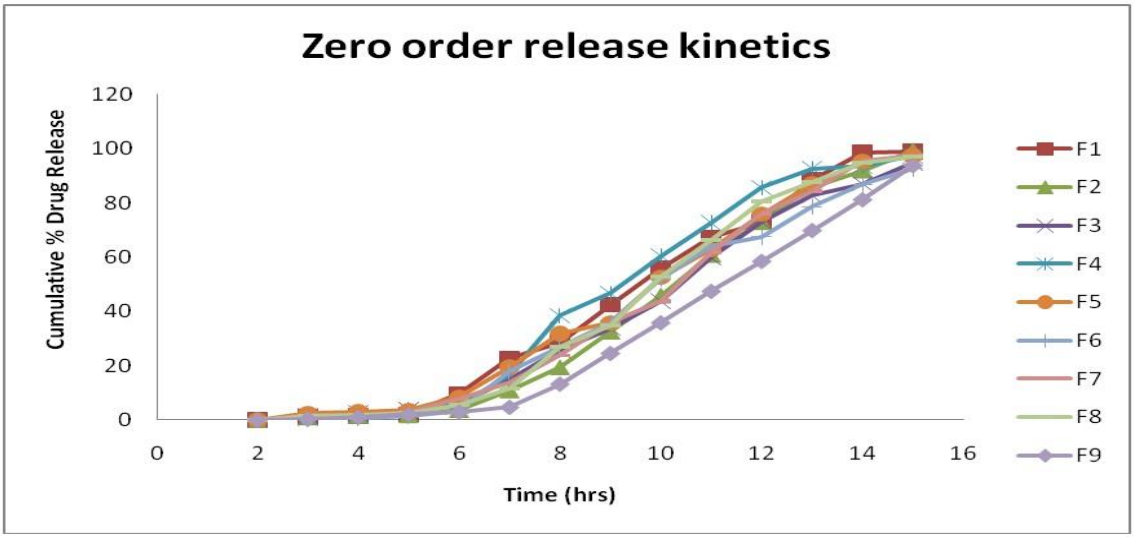


Fig 10. Comparative first order kinetics of different colon targeted matrix formulations

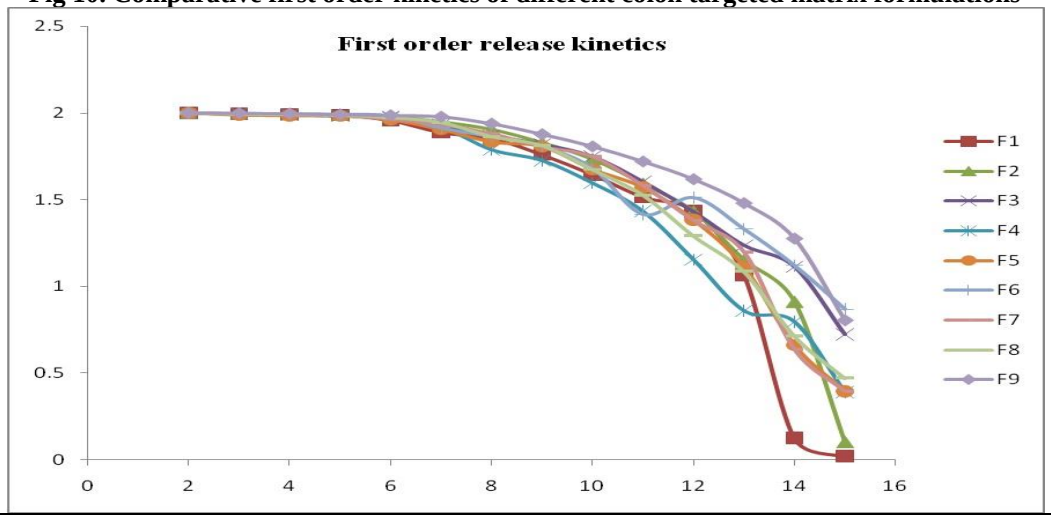


Fig 11. Comparative higuchi kinetics of different colon targeted matrix formulations

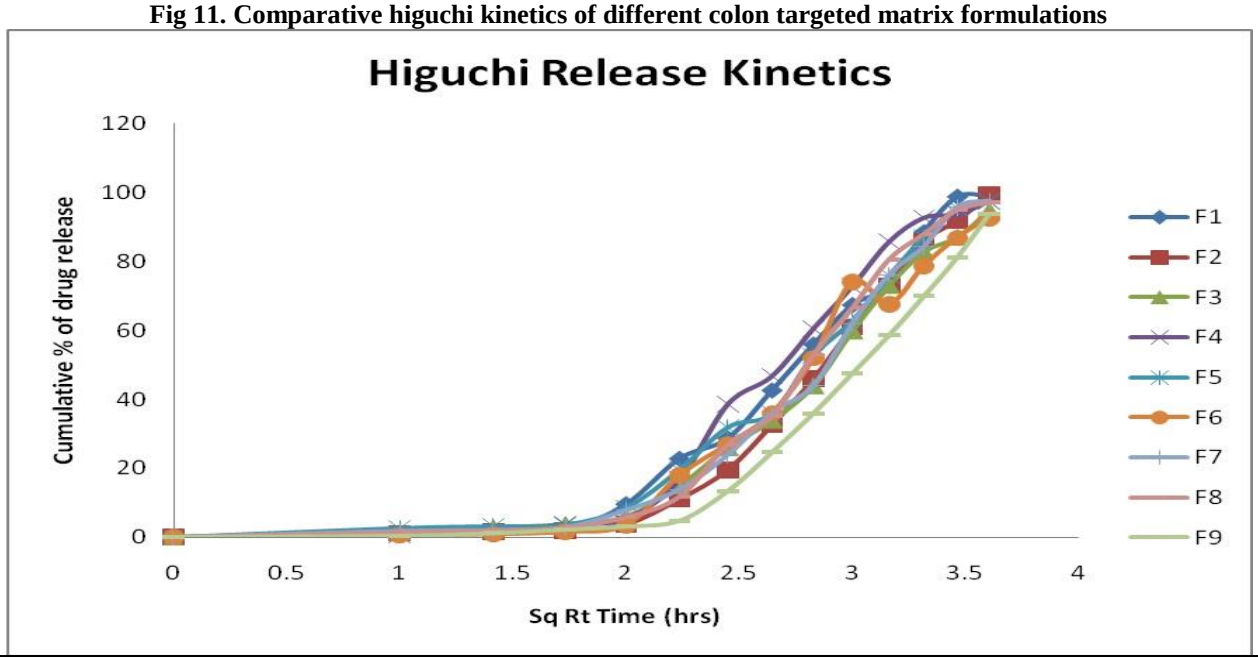
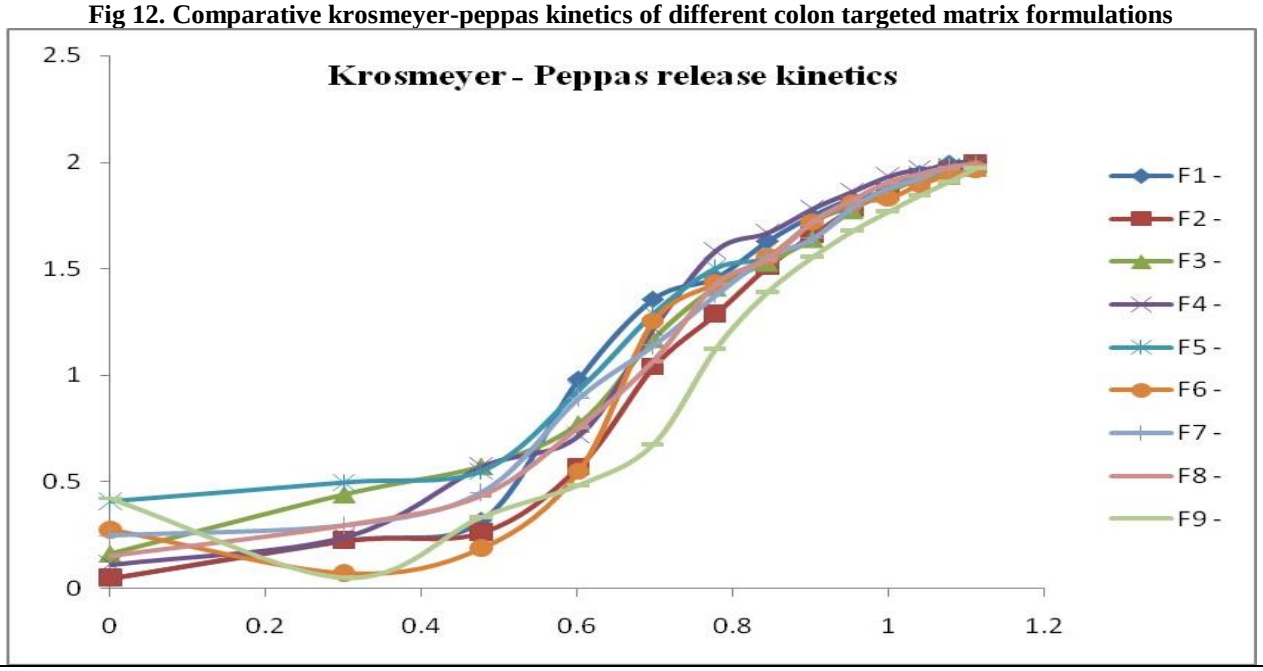


Fig 12. Comparative krosmeyer-peppas kinetics of different colon targeted matrix formulations



CONCLUSION

In the present study to formulate, developed and *in-vitro* characterization of natural polymer based Ornidazole matrix tablets were prepared for colon specific drug delivery which showed the sustained release of the drug in colonic region. Natural polysaccharides i.e. Tamarind gum have enough potential to target the drug release in to the colonic region due to its pH sensitive characterization. Previous workers reported their weakness in pausing the drug release in upper GIT region and avoiding the burst release effect. From that point of view, use of tamarind gum as a polymer was more potential to achieve desired release profile. When the natural polymer (tamarind gum) shows the sustained release effect with zero order kinetics which helps in increasing the drug release in colonic region and decrease the release in upper GIT. This is because the high cross linking, low swelling and probably due to the same reason macromolecules (Enzyme) fails to penetrate the matrix layer as well as polymer network and cleave then release the drug. The matrix tablet of Ornidazole and Tamarind gum remain

intact in the physiological environment of stomach and small intestine but degrade in colon by pH degradation. The *in-vitro* drug release studies indicated that optimized formulation was a promising system to provide targeting of ornidazole to the colon. The release pattern of the above formulation was best fitted to Korsmeyer-Peppas model and Zero order model and the mechanism of drug release was followed Non-fickian (Super case-II) transport mechanism.

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