IJPSR (2019), Volume 10, Issue 8 **(Research Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 07 December 2018; received in revised form, 14 March 2019; accepted, 01 April 2019; published 01 August 2019

DESIGN AND *IN-VITRO* EVALUATION OF ANTI-AMOEBIC TABLETS ON COLON DRUG DELIVERY SYSTEM

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Keywords:

Amoebiasis, Metronidazole, Chitosan, Pectin, PVP K-30, Carbopol 934P, Compression coated tablets, Colon drug delivery system

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ABSTRACT: The present study aims to formulate colon targeted drug delivery of Metronidazole compression coated tablets by using different ratios of chitosan and pectin. Carbopol 934P coating is given for compression coated tablets which makes them able to release the drug at the pH of the colonic fluid. Core tablets of Metronidazole (400 mg) were prepared by using swellable and pH dependent polymers like chitosan and pectin in which PVP-K30 is used as a binder. Drug release profile was evaluated in simulated gastric fluid, intestinal fluid, and simulated colonic fluid. The results of drug release studies performed according to the USP paddle method by using 0.1N HCl for 2 h, pH 7.4 phosphate buffer for 3 h and pH 6.8 phosphate buffer up to 24 h without using rat caecal content. Compression coated tablets containing chitosan as polymer released 95-99% of Metronidazole in a simulated colonic fluid, whereas tablets containing pectin as polymer released 94-99% of Metronidazole. The stability study for prepared tablets at 40 °C / 75% relative humidity for 6 weeks showed no significant change in physical appearance, drug content uniformity and *in-vitro* drug release pattern. From the result, it can be concluded that formulation F1 (Chitosan compression coated tablets) and formulation F4 (Pectin compression coated tablets) were suitable for colonic drug delivery as drug release is maximum while compared to other formulations.

INTRODUCTION: There has been an enhanced demand for more patient-friendly and compliant dosage forms. As a result, the demand for developing new technologies has been increasing annually. Since the development cost of a new drug molecule is very high, efforts are now made by pharmaceutical companies to focus on the development of new drug dosage forms for existing drugs with improved safety and efficacy together with reduced dosing frequency, and the production of more cost-effective dosage form [1].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.10(8).3920-27

The article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.10(8).3920-27

Colon-specific drug delivery has gained increased importance not just for the delivery of drugs in the treatment associated with the colon, but also as a potential site for the systemic delivery of therapeutic peptide and proteins. To achieve successful colon targeted drug delivery, a drug needs to be protected from degradation, release and absorption in the upper portion of the GI tract and then to be ensured abrupt or controlled release in the proximal colon [2].

Various drug delivery systems have been designed that deliver the drug quantitatively to the colon and then trigger the release of the drug. Different types of polymers which can be used in the formulation of colon targeted drug delivery systems such as chitosan, pectin, chondroitin sulphate, cyclodextrins, dextran, guar gum, inulin, amylose

and locust bean gum [3]. Targeted drug delivery into the colon is highly desirable for local treatment of a variety of bowel diseases such as ulcerative colitis, Crohn's disease, amoebiasis, colonic cancer, local treatment of colonic pathologies, and systemic delivery of protein and peptide drugs. The primary conventional approaches used to obtain colon-specific delivery mostly based on pro-drugs, pH and time-dependent systems or microflora activated systems which achieved limited success. As recent approaches used to target the therapeutic agents specifically to the colon such as pulsincap system, port system**,** pressure-controlled colon delivery capsules (PCDCs), CODES, osmotically controlled colon targeted drug delivery (OROC-AT), colonic drug delivery system based on pectin and galactomannan coating, multiparticulate system based drug delivery, azo-hydrogels, nanoparticles [4].

Amoebiasis (also known as amoebic dysentery) is an infection of large intestine caused by a protozoan parasite, *Entamoeba histolytica* leading to the death of 40-100 thousands of people, which makes amoebiasis second only to malaria as a cause of death resulting from the protozoan parasite (World Health Organization, 1997). The disease can be acute or chronic showing the various degree of illness. The trophozoites of *Entamoeba histolytica* can invade the colonic epithelium, causing amoebic colitis. The most preferred choice of drugs for intestinal amoebiasis is Metronidazole and Tinidazole. Therapeutic agents are classified as luminal, systemic, or mixed anti-amoebic drugs based on the site where it is effective. The mechanism of action includes, the active group of a drug can serve as an electron acceptor, forming reduced cytotoxic compounds that bind to proteins and DNA, resulting in cell death [5, 6]. Chemically, Metronidazole is, 1-(β-Hydroxy Ethyl) -2-Methyl-5-Nitroimidazole, which inhibits nucleic acid synthesis. It had especially high activity *in-vitro* and *in-vivo* against the anaerobic protozoa against *T. vaginalis* and *E. histolytica* [7].

The aim of the present study is to formulate colon targeted drug delivery of Metronidazole compression coated tablets by using different ratios of chitosan and pectin. Carbopol 934P coating is given for compression coated tablets which makes them able to release the drug at the pH of the colonic fluid. A combined mechanism of release is seen, which combines specific biodegradability of polymer and pH. Dependent drug release from the compression coated tablet.

MATERIALS AND METHODS:

Materials: Metronidazole was gifted from Abbott India Pvt. Ltd., Goa. Chitosan and carbopol 934P procured from Ozone international, Mumbai. Pectin was procured from Sisco Research Laboratories Pvt. Ltd., Mumbai. PVP K-30 procured from Qualikems Fine Chemicals Pvt. Ltd., Gujarat. Whereas microcrystalline cellulose procured from Loba Chemical Pvt. Ltd., talc procured from Nice Chemicals Pvt. Ltd. Cochin and magnesium stearate procured from NR Chemicals, Mumbai. Methanol, hydrochloric acid, potassium dihydrogen phosphate, sodium hydroxide procured from S.D. Fine Chem. Ltd.

Methods:

Preparation of Metronidazole Core Tablets: Six compression coated tablet formulations each containing 200 mg of Metronidazole and weighing 400mg tablets were prepared by direct compression techniques using chitosan and pectin matrices. Metronidazole, polymers (Chitosan and Pectin), PVP-K30 (as a binder), and microcrystalline cellulose were triturated well and sieved through sieve no. 60 and mixed thoroughly by using mortar and pestle. To the above powder mass lubricants (Talc and magnesium stearate) were added and mixed thoroughly. The powder is evaluated for pre-compression parameters. The powder was then compressed using a 10 mm flat-faced punch using a Rimek tablet punching machine. The total weight of the tablet was maintained at 400 mg. The composition of various formulations is shown in **Table 1**.

Preparation of Metronidazole Compression Coated Tablets: The different ratios of chitosan and pectin core tablets of Metronidazole were compression coated by using one coat formulation. The compression coat formulations were prepared using carbopol 934P and chitosan **Table 2**. Initially, 40% of coat weight was placed in a 12.4 mm die cavity of a Rimek tablet punching machine followed by carefully centering the core tablet and addition of reminder of coat weight. The coating material was compressed around the core tablet with high compression force.

TABLE 1: COMPOSITION OF COLON TARGETED CORE TABLETS OF METRONIDAZOLE

S. no.	Ingredients (mg/tablet)	Formulation code					
		F1	F2	F3	F4	F5	F6
1	Metronidazole	200	200	200	200	200	200
2	Chitosan	50	75	100	-	-	-
3	Pectin	-	-	-	100	125	150
4	Pvp-K30 (As binder)	10	10	10	10	10	10
5	Microcrystalline cellulose	131	106	81	81	56	31
6	Magnesium stearate	4	4	4	4	4	4
7	Talc	5	5	5	5	5	5
	Total	400	400	400	400	400	400

* Quantity in mg for one tablet.

TABLE 2: COMPOSITION OF CARBOPOL 934P COAT FORMULATION OF METRONIDAZOLE

Ingredients (mg/tablet)	Weight in mg
Chitosan	20
Carbopol 934P	160
Pvp-K30(As binder)	10
Magnesium stearate	6
Talc	4
Total	200

* Quantity in mg for one tablet.

Evaluation of Tablets:

Uniformity of Thickness: [8] Three tablets were picked from each formulation randomly, and thickness was measured individually. The mean values were calculated. It is expressed in mm. The tablet thickness was measured using -Dial-Caliper (Mitutoyo, Japan).

Hardness Test: [8] Hardness indicates the ability of a tablet to withstand mechanical shocks while packaging, handling, and transportation. The hardness of the tablets was determined using Monsanto hardness tester. It is expressed in kg/cm^2. Three tablets were randomly picked and analyzed for hardness. The mean values were calculated.

Friability Test: [8] It is the phenomenon whereby tablet surfaces are damaged and show evidence of lamination or breakage when subjected to mechanical shock or attrition. The friability of tablets was determined using Roche Friabilator. It is expressed in percentage (%). Ten tablets were initially weighed ($W_{initial}$) and transferred into friabilator. The friabilator was operated at 25 rpm and run up to 100 revolutions. The tablets were weighed again (W_{final}). The % friability was then calculated. % Friability of tablets less than 1% are considered acceptable.

Weight Variation Test: [8] Twenty tablets were selected randomly from each batch and weighed. Calculating the average weight and comparing the individual tablet weight to the average.

Drug Content Uniformity: [9] Twenty tablets of each formulation were weighed and powdered. The quantity of powder equivalent to 50 mg of Metronidazole was transferred into a 100 ml volumetric flask and extracted with a 0.1N hydrochloric acid solution, filtered and kept a side for 2 h. Dilute 10 ml of the resulting solution to 250 ml with 0.1N HCl and the absorbance of the resulting solution at the maximum at 279 nm using a Shimadzu UV-Visible spectrophotometer.

***In-vitro* Disintegration Time:** [10, 11] The process of breakdown of a tablet into smaller particles is called as disintegration. The *in-vitro* disintegration time of a tablet was determined using the disintegration test apparatus as per I.P. specifications. Place one tablet in each of the 6 tubes of the basket. Add a disc to each tube and run the apparatus using pH 6.8 (simulated intestinal fluid) maintained at 37 ° ± 2 °C as the immersion liquid. The assembly should be raised and lowered between 30 cycles per minute in the pH 6.8 maintained at 37 ° ± 2 °C. The time in sec or min took for complete disintegration of the tablet with no palpable mass remaining in the apparatus was measured and recorded. Enteric coated tablets pass the test if each of the six tablets disintegrates in not more than 60 min in the simulated intestinal fluid.

***In-vitro* Dissolution Studies:** [12] The compression coated tablets of Metronidazole to remain intact in the physiological environment of the stomach and small intestine was assessed by conducting *in-vitro* drug release studies. Drug release studies were carried out using a USP Type II test apparatus (Paddle Type). (Apparatus Type II, 100 rpm, 37 ± 1 °C) for 2 h in 0.1 N HCl (900 ml) as the average

gastric emptying time is about 2 h. Then the dissolution medium was replaced with pH-7.4 phosphate buffer (900 ml) and tested for drug release for 3 h as the average small intestinal transit time is about 3 h. After 5 h, the dissolution medium was replaced with pH 6.8 phosphate buffer (900 ml) and tested for drug release up to 24 h. At the end of each period, 10 ml of the samples were taken. From which 1 ml is diluted to 10 ml with respective dissolution medium and analyzed for Metronidazole content. A 10 ml volume of fresh and filtered respective dissolution medium was added to make the volume after each sample withdrawal. *In-vitro* dissolution studies are done without using rat caecal content.

Curve Fitting Analysis: [13] The mechanism of drug release was studied by fitting the dissolution data in different models.

1. Zero-order equation.
2. First order equation.
3. Higuchi model equation
4. Korsmeyer Peppas equation

Drug Release Kinetics: To study the release kinetics, data obtained from in vitro drug release studies were plotted in various kinetic models: zero order (Equation 1) as cumulative amount of drug released *vs.* time, first order (Equation 2) as log cumulative percentage of drug remaining *vs.* time, and Higuchi's model (Equation 3) as cumulative percentage of drug released *vs.* square root of time.

$$C + K_0 t \quad \ldots..1$$

Where K_0 is the zero-order rate constant expressed in units of concentration/ time, and t is the time in h. A graph of concentration *vs.* time would yield a straight line with a slope equal to K_0 and intercept the origin of the axes.

$$LogC + LogC_o - kt/2.303 \quad \ldots..2$$

Where C_0 is the initial concentration of the drug, k is the first order constant, and t is the time. (Bourne 1963)

$$Q + K t_{1/2} \quad \ldots..3$$

Where K is the constant reflecting the design variables of the system and t is the time in h. Hence, the drug release rate is proportional to the reciprocal of the square root of time.

Mechanism of Drug Release: To evaluate the mechanism of drug release from matrix tablet, data for the first 60% of drug release were plotted in Korsmeyer *et al.*, equation (Equation 4) as log cumulative percentage of drug released *vs.* log time, and the exponent n was calculated through the slope of the straight line.

$$Mt/M8 = K t^n \quad \ldots..4$$

Where Mt/M8 is the fractional solute release, t is the release time, K is a kinetic constant characteristic of the drug/polymer system, and n is an exponent that characterizes the mechanism of release of tracers.

Stability Studies: [1] Stability of a drug has been defined as the ability of a particular formulation, in a specific container, to remain within its physical, chemical, therapeutic and toxicological specifications. In the present study, Stability studies were carried out at 40°C / 75% RH for a specific period up to 6 weeks for the best formulations.

RESULTS AND DISCUSSION:

Preparation of Standard Calibration Curve of Metronidazole: The standard calibration curve of Metronidazole was obtained by plotting Absorbance *vs.* Concentration. The standard calibration curve shows the slope of 0.025, 0.037, 0.047 and correlation coefficient of 0.999. The curve was found to be linear in the concentration range of 1-20 µg/ml (Beer's range) at 277 nm. Compressed coated tablets of Metronidazole were prepared by using a direct compression method.

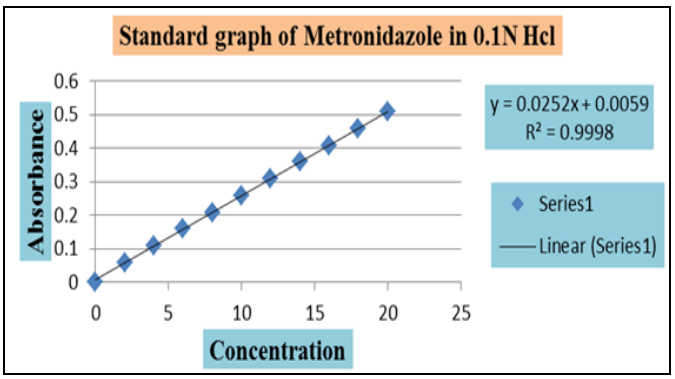

FIG. 1: STANDARD CALIBRATION CURVE OF METRONIDAZOLE IN 0.1 N HCl, PHOSPHATE BUFFER

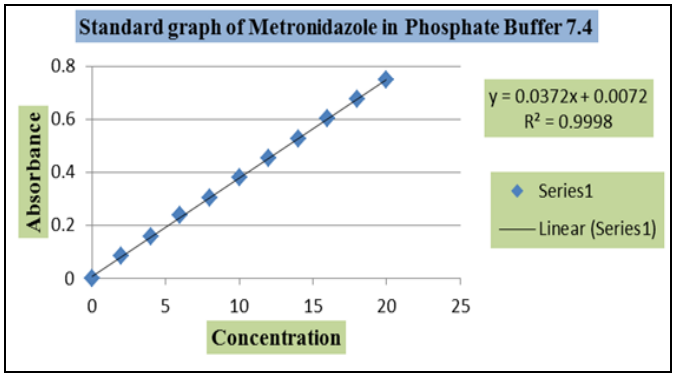

FIG. 2: STANDARD CALIBRATION CURVE OF METRONIDAZOLE IN PHOSPHATE BUFFER 7.4

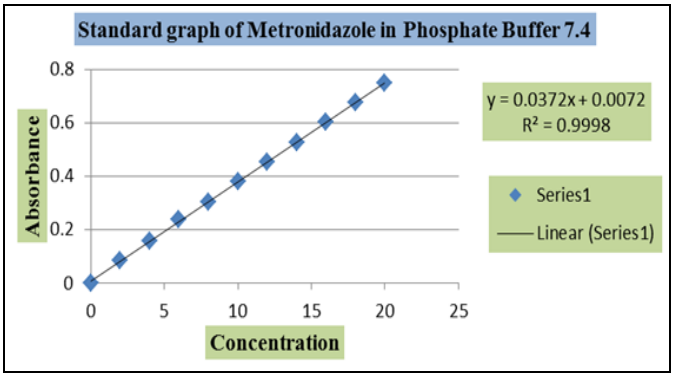

FIG. 3: STANDARD CALIBRATION CURVE OF METRONIDAZOLE IN PHOSPHATE BUFFER 6.8

Before compression, the powder blends were subjected to pre-compression evaluation parameters to determine the flow properties and the compressibility. The results of the pre-compression evaluation are as given below. The values of angle of repose were found to be in the range of 25^0.8' to 29º.9'. All formulations showed the angle of repose within 30º, which indicates a good flow property of the powder. The loose bulk density and tapped bulk density for all the formulations varied from 0.46 gm/cm^3 to 0.52 gm/cm^3 and 0.50 gm/cm^3 to 0.60 gm/cm^3 respectively. The values of Hausner's ratio were found to be in the range of 1.13 to 1.18. This percent compressibility of powder mix was determined by Carr's compressibility index which lied within the range of 11.5 to 15.78. Tablets are subjected to punching and evaluated for post-compression parameters. Tablets were obtained of uniform weight due to uniform die fill, with acceptable weight variation as per pharmacopoeial specification. Its weight varied between 396.0 to 404.0 mg. The drug content uniformity was found in the range of 98.10% and 98.77%. (Acceptable limit) and the hardness of the tablet was found between 5.2 to 6.2 kg/cm^2; The tablet thickness was found to be around 3.0 to 4.1 mm, friability of tablet was found below 1% indicating good mechanical resistance. All formulations showed disintegration time of less than 45 min. Among the two polymers used, pectin (Formulation F4) showed less disintegrating time.

TABLE 3: EVALUATION OF PRE-COMPRESSION PARAMETERS

Formulation code	Angle of repose (θ)	Bulk density (gm/cm^3)	Tapped density (gm/cm^3)	Hausner's ratio	% Compressibility index
F1	29°.9'	0.51	0.60	1.17	15.0
F2	28°.9'	0.48	0.56	1.16	14.2
F3	28°.1'	0.46	0.52	1.13	11.5
F4	29°.6'	0.48	0.57	1.18	15.78
F5	26°.7'	0.50	0.58	1.16	13.79
F6	25°.8'	0.52	0.60	1.15	13.33

TABLE 4: EVALUATION OF POST-COMPRESSION PARAMETERS

Formulation code	Thickness (mm)	Hardness (kg/cm^2)	Weight variation (mg)	Friability (%)	Disintegration time (min)	Drug content uniformity (%)
F1	3.1	5.4	397	0.39	27	98.36
F2	3.1	6.1	396	0.37	35	98.67
F3	3.0	5.5	401	0.38	41	99.26
F4	4.0	5.2	398	0.56	27	98.10
F5	4.1	5.4	403	0.52	32	98.39
F6	4.0	5.5	404	0.48	46	98.77

***In-vitro* Dissolution Studies:** All the formulations were subjected for the *in-vitro* dissolution studies using Tablet Dissolution Apparatus USP Type II (Paddle type). The samples were withdrawn at different time intervals and analyzed at 277 nm. Cumulative drug release was calculated by the mean amount of Metronidazole present in the respective tablet. The results obtained in the *in-vitro* drug release for the formulations F1 to F6 are tabulated.

TABLE 5: *IN-VITRO* DISSOLUTION STUDIES OF METRONIDAZOLE

Time (h)	pH 1.2HCl, 900 ml, USP-II (Paddle) Apparatus 1000 rpm, 37 ± 0.5 °C					
	% Cumulative Drug Release					
	F1	F2	F3	F4	F5	F6
1	6.12	3.96	2.88	4.32	3.24	2.16
2	12.24	9.72	7.56	8.64	7.92	5.76
	pH 7.4 Phosphate buffer, 900 ml, USP-II (Paddle) Apparatus 100 rpm, 37 ± 0.5 °C					
3	12.64	11.88	10.44	10.44	9.94	6.79
4	16.74	15.30	13.95	14.08	13.86	11.88
5	20.43	18.36	18.00	16.74	17.23	13.59
	pH 6.8 Phosphate buffer, 900 ml, USP-II (Paddle) Apparatus 100 rpm, 37 ± 0.5 °C					
6	22.59	21.60	20.65	18.36	18.09	15.88
7	27.54	26.50	23.71	21.82	21.60	17.77
8	29.83	28.89	27.94	25.33	25.65	20.65
9	34.83	33.39	30.10	27.18	23.53	23.13
10	38.47	37.03	33.30	30.33	31.18	28.53
11	43.33	39.33	36.94	37.71	35.59	30.82
12	48.91	43.42	39.15	40.18	38.07	33.12
13	55.80	48.15	42.48	45.85	40.00	37.53
14	59.53	51.48	46.53	48.42	41.35	40.59
15	62.68	57.60	48.24	54.76	44.77	43.42
24	98.77	96.31	95.26	99.72	96.51	94.97

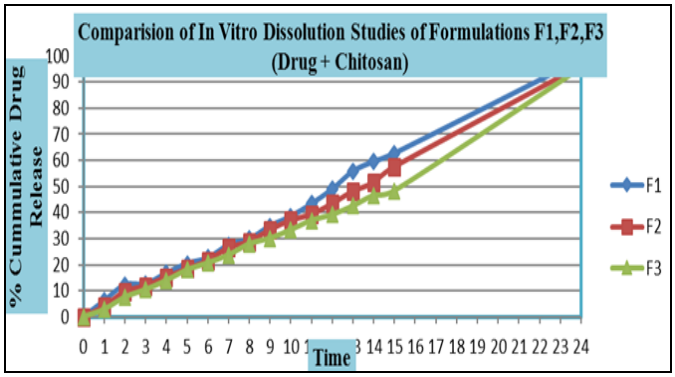

FIG. 4: *IN-VITRO* DISSOLUTION PROFILE OF THE FORMULATIONS F1, F2, F3, IN 0.1N HCl, pH. 7.4 PHOSPHATE BUFFER, PH. 6.8 PHOSPHATE BUFFER

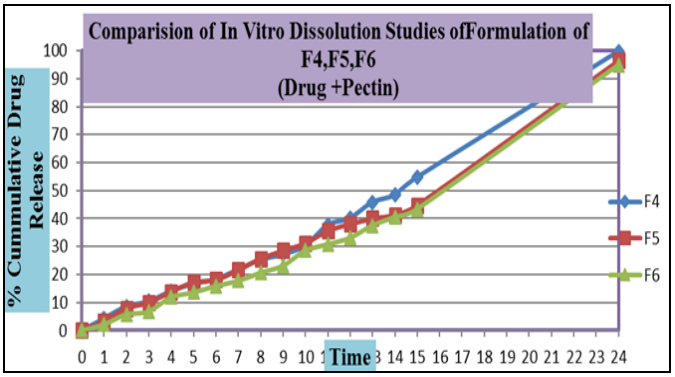

FIG. 5: *IN-VITRO* DISSOLUTION PROFILE OF THE FORMULATIONS F4, F5, F6 IN 0.1N HCl, pH. 7.4 PHOSPHATE BUFFER. PH. 6.8 PHOSPHATE BUFFER

The plots of cumulative % drug release *vs.* time are shown in **Fig. 4** and **5**. The dissolution rate was found to decrease linearly with increasing concentration of polymer. Formulations F1, F2 and F3 containing drug plus chitosan polymer with carbopol 934P coating have recorded drug release 98.77%, 96.31%, and 95.26% respectively, at the end of 24 h.

Formulations F4, F5, F6 containing drug plus pectin polymer with carbopol 934P coating have recorded drug release 99.72%, 96.51%, and 94.97% respectively, at the end of 24 h. In all the formulations the drug release was near to 100% within 24 h. The relative efficiency of different ratios of polymers to improve the dissolution rate of tablets was in order, chitosan: F1>F2>F3 and Pectin: F4>F5>F6

Drug Release Kinetics: The zero-order rate describes the systems where the drug release rate is independent of its concentration. The first order describes the release from systems where the release rate is concentration dependent. Higuchi's model describes the release of drugs from an insoluble matrix as a square root of a time-dependent process based on Fickian diffusion.

The release constant was calculated from the slope of the appropriate plots, and the regression coefficient (r^2) was determined. The values of different models for all formulations are calculated. The dissolution data were fitted to Zero Order, First Order, Higuchi Model, and Korsmeyer-Peppas model to analyze the drug mechanism. The correlation coefficient for (r^2) Zero Order ranges was found to be 0.9513 to 0.9946; First Order

ranges from 0.7102 to 0.8015, Higuchi model ranges from 0.7787 to 0.888, and that of Korsmeyer-Peppas model ranges from 0.8849 to 0.9715 **Fig. 6** and **7**.

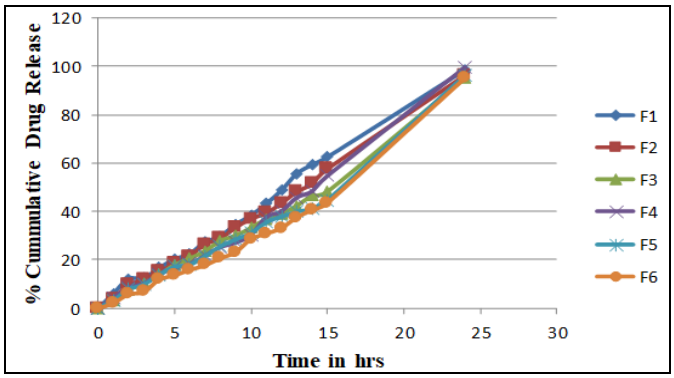

FIG. 6: ZERO ORDER PLOTS OF METRONIDAZOLE FROM FORMULATION F1 TO F6

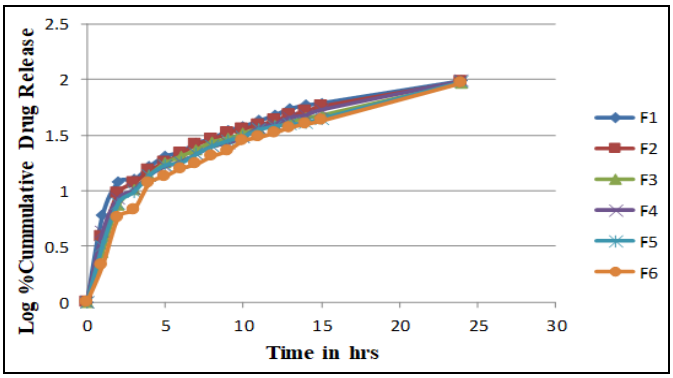

FIG. 7: FIRST ORDER PLOTS OF METRONIDAZOLE FROM FORMULATION F1 TO F6

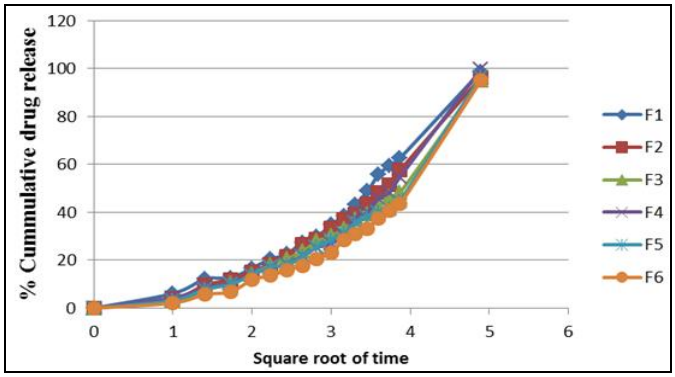

FIG. 8: HIGUCHI ORDER PLOTS OF METRONIDAZOLE FROM FORMULATION F1 TO F6

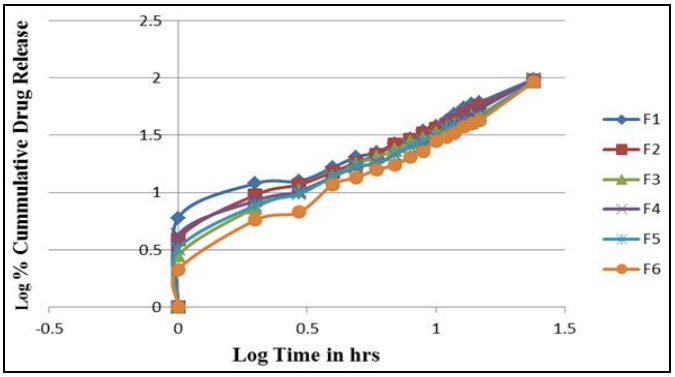

FIG. 9: KORSMEYER- PEPPAS ORDER PLOTS OF METRONIDAZOLE FROM FORMULATION F1 TO F6

Stability Studies: The formulations F1 and F4 were selected for stability studies by their high cumulative % drug release. The stability studies were carried out at 40°C / 75% RH for all the selected formulations up to 6 weeks. For two week time interval, the tablets were analyzed for drug content uniformity, hardness, *in-vitro* disintegration time, friability and *in-vitro* drug release up to 6 weeks. These formulations showed not much variation in any parameter. From these results, it was concluded that Formulations F1 and F4 are stable and retained their original properties.

CONCLUSION: In the present study, an attempt was made to design colon targeted compression coated tablets of Metronidazole for treatment of amoebiasis. The main interest in such dosage form was to target the drug to the colon by ensuring a minimal amount of drug release in the physiological environment of the upper GI tract. Colon targeted compression coated tablets of Metronidazole were prepared by direct compression method.

From the result, it can be concluded that the prepared Metronidazole colon targeted compression coated tablets have the ability to control drug release over prolonged periods. It has observed that Formulation F1 (chitosan compression coated tablets) and Formulation F4 (pectin compression coated tablets) were suitable for colonic drug delivery as drug release is maximum while compared to other formulations.

The *in-vitro* drug release studies revealed that level of the polymer in the compression coated tablets played an important role in the modulation of drug release. Metronidazole is an ideal drug for formulation as colon-specific drug delivery. There is a need to investigate some indigenously available retardant materials to make a concept of colon drug delivery system more viable for the industry in a more economical way.

ACKNOWLEDGEMENT: The authors are thankful to the School of Pharmacy OPJS University for providing excellent facilities to carry

out the work. And also thanks to M/S Abbott India Pvt. Ltd., Goa for providing gift sample of Metronidazole.

CONFLICT OF INTEREST: Nil

REFERENCES:

1. Kolte BP: Colon targeted drug delivery system – A novel perspective. Asian Journal of Biomedical and Pharmaceutical Sciences 2012; 2(14): 1-10.
2. Dhyani A and Juyal D: Colon targeted drug delivery systems: A review of primary and novel approaches. International Journal of Pharmaceutical Science and Research July 2016; 1(5): 40-47.
3. Rajpurohit H, Sharma P, Sharma S and Bhandari A: Polymers for colon targeted drug delivery targeting. Indian J Pharm Sci 2010; 72(6): 689-96.
4. Agarwala VK, Guptab A, Chaturvedia S and Khana F: Polysaccharide: Carrier in colon targeted drug delivery system. MIT International Journal of Pharmaceutical Sciences 2016; 2(2): 1-9
5. Krishnaiah YSR, Reddy PRB, Satyanarayana V and Karthikeyan RS: Studies on the development of oral colon targeted drug delivery systems for Metronidazole in the treatment of amoebiasis. International Journal of Pharmaceutics 2002; 236: 43-55.
6. Kluwer W, Williams L and Wilkins: Illustrated reviews, pharmacology, Edition 4th, 2009: 417-20.
7. Kapoor D, Rajora A and Saini V: Formulation development and dissolution enhancement of compeba-400 (Metronidazole-400) tablet Asian Journal of Biomedical and Pharmaceutical Sci 2011; 1(2): 25-31.
8. Lachman L, Liebermann HA, and Kiang JL: Theory and practice of industrial pharmacy. Varghese publishing house, Edition 4th, 2013.
9. Kumar MP, Ishaq BM, Reddy JRK, Kumar RP, Badrinath A, and Chetty CM: Formulation and evaluation of colon specific matrix and coated tablets of Metronidazole. International Research Journal of Pharmacy 2011; 2(9): 194-99.
10. Patel BD, Patel DV, Chavda JR, Dabhi MR and Manek RA: Development and evaluation of pectin-based colon targeted herbal drug delivery system. African Journal of Pharmacy and Pharmacology 2012; 6(25): 1815-20,
11. Shabbeer S and Madhuri IS: Formulation and development of Mesalamine sustained release guar gum matrix for colon-specific drug delivery. International Journal of Pharmaceutical Research and Development (IJPRD) 2012; 4(02): 180-85.
12. Mehta TJ, Rajput SS, Patel MR, Patel KR, Patel NM and Mothila M: Formulation, development and optimization of Metronidazole compression coated tablets. Scholars Research Library, Der Pharmacia Lettre 2011; 3(5): 94-103.
13. Patel JK, Patel NV and Shah SH: Formulation and in-vitro evaluation of mesalamine matrix tablets using chitosan for colonic drug delivery. Journal of Pharmacy Research 2009; 2(8): 1319-23.

How to cite this article:
Rajkumar M, Iqbal MM, Fatima N, Tadmale T and Saraswat R: Design and *in-vitro* evaluation of anti-amoebic tablets on colon drug delivery system. Int J Pharm Sci & Res 2019; 10(8): 3920-27. doi: 10.13040/IJPSR.0975-8232.10(8).3920-27.