Formulation and Evaluation of Miglitol Sustained Release Matrix Tablets Using Moringa Oleifera Gum

Kamma Jitendranath Chowdary[1], M Pradeep Kumar*[2]

[1]M.Pharm Student, Department of Pharmaceutics, Vasavi Institute of Pharmaceutical Sciences, Andhra Pradesh, India
[2]Professor, Department of Pharmaceutics, Vasavi Institute of Pharmaceutical Sciences, Andhra Pradesh, India

A B S T R A C T

Our aim with this study was to develop and evaluate a sustained-release matrix tablet formulation for Miglitol, and to assess its effectiveness. The pre-formulation studies were carried out and the results were found to be favorable. The appropriate excipients were selected for formulation development. In accordance with the flow characteristics of the API, the experiment was carried out utilizing simultaneously dry and wet granulation procedures. Wet granulation was used to enhance the formulation in order to increase the flow quality of the tablets and turned out to be effective. During the formula's development, the beginning evaluations which included the bulk density, tapped density, Carr's index, Hausner's ratio, and angle of repose were reviewed for granules and hardness, friability, weight fluctuation, and thickness. In-vitro dissolution trials on Miglitol sustained release matrix tablets exhibited drug release in the range of 22.15% to 98.65% at the end of the 10th hour. In view of extended drug release, formulation F9 was picked as the most effective formulation. All hardness, friability, weight fluctuation, thickness, assay, drug content, and dissolution properties of the finished goods were examined. The kinetic release technique proved that the drug is released by zero-order kinetics (R^2 value of 0.9491), and the Korsmeyer equations provided a value that was close to one and indicated that the drug had been released by zero-order kinetics (R^2= 0.8449). Three months of testing for stability at 45°C/75% RH. Stability samples were examined at both the beginning and after three months. The resulting results were assessed in relation to the predefined requirements. All of the results have been deemed effective.

Keywords: Miglitol, assay, drug content, Korsmeyer equations, Carr's index

A R T I C L E   I N F O

Citation: *M Pradeep Kumar, et al. Formulation and Evaluation of Miglitol Sustained Release Matrix Tablets Using Moringa Oleifera Gum. Int. J. Med. Pharm. Res., 2023, 11(1):43-48.*

Contents

1. Introduction

Multiple significant aspects influence the layout of sustained-release systems for delivery. Some of these include the drug's method of administration, the form of delivery system, the medical condition being treated by patient, the duration of treatment, and the drug's qualities.

Each of these factors is interconnected, which limits the options regarding the mode of distribution, the structure of the distribution system, and the total duration of treatment. For developing a sustained release dosage form, pharmacological characteristics, particularly physicochemical and physiological features, are critical.

Miglitol

Description: Miglitol is an oral alpha-glucosidase inhibitor used to improve glycemic control by delaying the digestion of carbohydrates.

Chemical name: $C_8H_{17}NO_5$

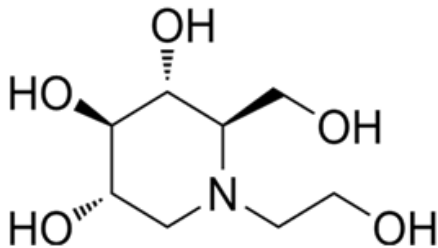**Molecular weight:** 207.224

Structure formula:

Figure 1: Structure of Miglitol

Solubility: It is soluble in water, alcohol, and Other Organic Solvents.

Appearance: white, crystalline powder

IUPAC: (2R,3R,4R,5S)-1-(2-hydroxyethyl)-2-(hydroxymethyl) piperidine-3,4,5-triol

Pharmacodynamics:

Miglitol, an oral alpha-glucosidase inhibitor, is a desoxynojirimycin derivative that delays the digestion of ingested carbohydrates, thereby resulting in a smaller rise in blood glucose concentration following meals. As a consequence of plasma glucose reduction, miglitol reduce levels of glycosylated hemoglobin in patients with Type II (non-insulin-dependent) diabetes mellitus. Systemic nonenzymatic protein glycosylation, as reflected by levels of glycosylated hemoglobin, is a function of average blood glucose concentration over time. Because its mechanism of action is different, the effect of miglitol to enhance glycemic control is additive to that of sulfonylureas when used in combination. In addition, miglitol diminishes the insulintropic &weight-increasing effects of sulfonylureas. Miglitol has minor inhibitory activity against lactase and consequently, at the recommended doses, would not be expected to induce lactose intolerance.

Pharmacokinetics:

Absorption:

Absorption of miglitol is saturable at high doses with 25 mg being completely absorbed while a 100-mg dose is only 50-70% absorbed. No evidence exists to show that systemic absorption of miglitol adds to its therapeutic effect.

Half-life:

The elimination half-life of miglitol from plasma is approximately 2 hours.

Metabolism:

Miglitol is not metabolized in man or in any animal species studied

Protein binding: The protein binding of miglitol is negligible (<4.0%).

Route of elimination:

Miglitol is not metabolized in man or in any animal species studied. It is eliminated by renal excretion as an unchanged drug

2. Methodology

Organoleptic characters:

The pre-formulation studies such as the color, odor, and taste can be done visually.

Solubility studies:

The solubility studies are done by using various solvents such as ethanol, methanol, acetone, and other organic solvents.

Drug and excipient compatibility studies:

The drug and excipient compatibility studies are done by FTIR Studies using KBr pellet method. First the 1 gm of the drug powder is taken under kept for the FTIR studies. The 1gm of drug and polymer taken and kept under FTIR studies the peaks which are came for drug product the nearer to the drug the polymer peaks will come. If they are not coming the drug and excipients are in compatible with each other.

Preparation of Standard Solution:

Miglitol (10 mg) was dissolved in pH 7.5 P.B in a 10 ml volumetric flask and diluted quantitatively with pH 7.5 P.B to obtain a solution having a known concentration of 1000 μg/ml.

Procedure:

The standard solution of miglitol was subsequently diluted with pH 7.5 phosphate Buffer to obtain a series of dilutions containing 1, 2,3,4,5 μg of miglitol per ml of solution. The absorbance of these substances was measured in Analytical Technologies Limited, UV-Visible Spectrophotometer at 229 nm using pH 7.5 P.B as blank. The concentration of miglitol and the corresponding absorbances are presented. The absorbances were plotted against the concentration of miglitol.

Construction of calibration curve in 7.5 buffer:

To take 10mg of Miglitol active substance it is going to disperse in 10ml of 7.5 buffer in a volumetric flask which is 1000ppm. From 1000ppm to take 1 ml and it is dispersed in 10ml of volumetric flask it is 100ppm. Take 1 ml and make up to 10 ml in a volumetric flask it is 10ppm.To check absorbance at 10ppm if the absorbance is high undergo serial dilutions like 1,2,3,4,5, ml and check the absorbance at 229 nm by using U.V visible spectroscopy.

Construction of calibration curve in methanol:

To take 10mg of Miglitol active substance it is going to disperse in 10ml of Methanol in volumetric it is 1000ppm. From 1000ppm to take 1 ml and it is dispersing in 10ml of volumetric flask it is 100ppm. From that take 1 ml and make up to 10 ml in a volumetric flask it is 10ppm.To check absorbance at 10ppm if the absorbance is high undergoing serial dilutions like 1,2,3,4,5, ml and check the absorbance at 315nm by using U.V visible spectroscopy.

Precompression parameters:

Bulk Density

The pre-formulation studies such as the bulk density. The bulk density is defined as a certain amount powder taken into the measuring cylinder. The Bulk density is the ratio of the weight of a powder to the volume it occupies.

It is expressed as gm/ml.

$$\text{Bulk density} = W / V_O$$

Where,

W = weight of the powder

VO = initial volume

Tapped Density

The tap density is defined as the amount of powder will take in the measuring cylinder the measuring cylinder is closed with lid. The tap density apparatus under kept and set for 500 tapings. The powder particles will settle down in the measuring cylinder the powder will decrease. The process is continued for the both consecutive readings were equal.

$$\text{Tapped density} = W / V_F$$

Where,

W = weight of the powder

VF = final volume

Angle of Repose

The angle of repose is defined as the maximum angle possible between the surface of a pile of the powder and the horizontal plane. For determining of the angle of repose the funnel method is used. The certain amount of powder taken in to the glass funnel by closing the funnel orifice. The glass funnel is fixed at 2cm from horizontal plan. The finally the closed orifice will open the powder flows through the funnel and farm a pile. The height of the pile is noted. A Circumference was drawn with a pencil on a graph paper and the radius of base of a pile was measured at 5 different points and average was taken for calculation.

$$\theta = \tan^{-1} h/r$$

Where h = height of pile.

r = radius of the base of the pile.

θ = angle of repose.

Angle of repose below 25 indicates an excellent powder flow.
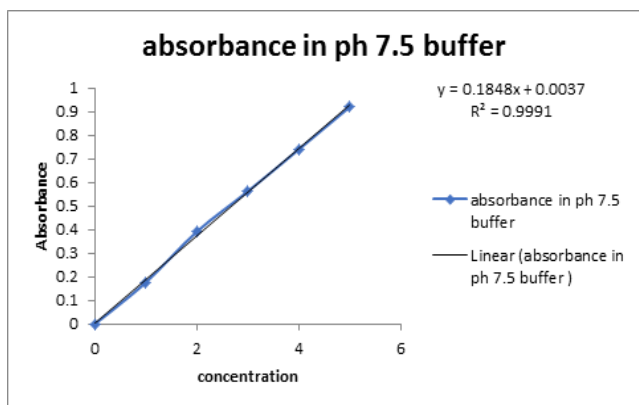
3. Results and discussion

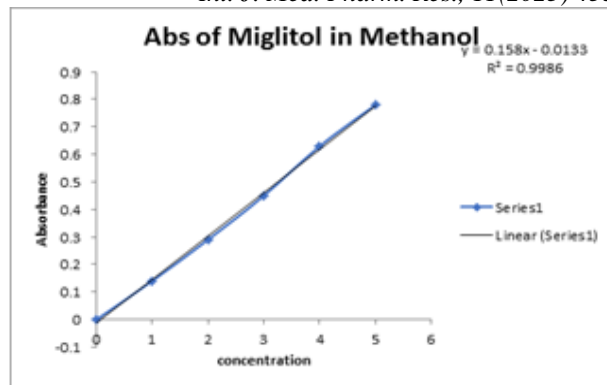Fig.No:2 showing picture of the calibration plot in 7.5 buffer
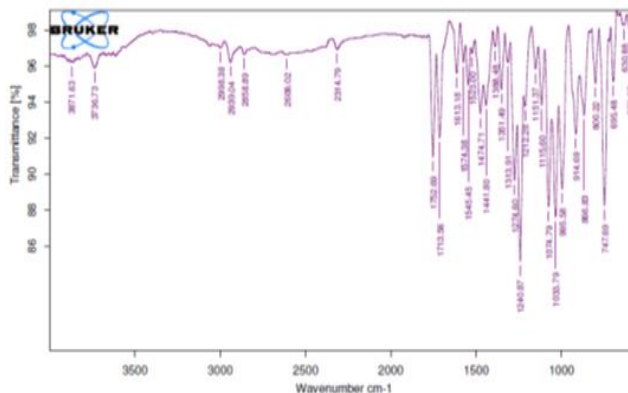

Fig.No: 3 showing calibration plot in methanol

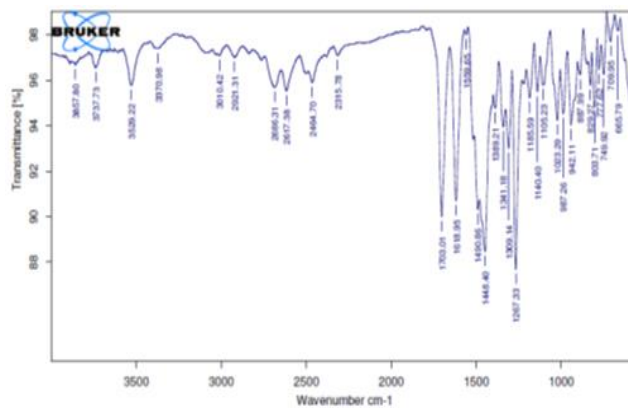Fig.No: 4 pure spectra of the Miglitol

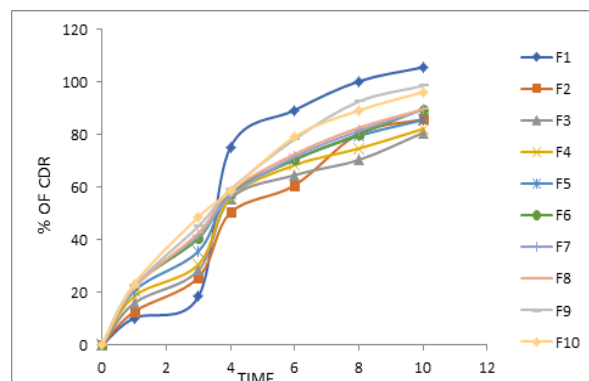Fig. No: 5 The fig shows the FTIR spectra of the drug and polymer blend

Fig. No 6: showing picture of in vitro drug release studies comparative graph

Table. No 1: showing values of the pre compression parameters

Formulation	Angle of repose (θ)	Bulk density (gm/ml)	Tapped density (gm/ml)	Carr's index (%)	Hausner's ratio
F1	25.38±0.13	0.40±0.02	0.50±0.02	20±0.13	1.25±0.01
F2	22.52±0.28	0.44 ±0.02	0.56±0.04	20±0.04	1.27±0.01
F3	27.19±0.19	0.44±0.00	0.54±0.01	18.61±0.11	1.22±0.02
F4	28.51±0.16	0.45±0.01	0.55±0.01	18.33±0.15	1.22±0.01
F5	23.60±0.21	0.41±0.01	0.50±0.00	18±0.05	1.21±0.02
F6	24.38±0.13	0.38±0.02	0.48±0.02	20.83±0.13	1.26±0.01
F7	23.52±0.28	0.39 ±0.02	0.47±0.04	17.02±0.04	1.20±0.01
F8	24.19±0.19	0.39±0.00	0.45±0.01	13.33±0.11	1.15±0.02
F9	22.51±0.16	0.40±0.01	0.44±0.01	9.09±0.15	1.1±0.01
F10	23.60±0.21	0.40±0.01	0.46±0.00	13.04±0.05	1.15±0.02

Table.no 2: showing in—vitro drug release studies

Time in hrs	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
0	0	0	0	0	0	0	0	0	0	0
1	10.23	12.65	15.89	18.56	20.56	22.32	22.52	21.65	22.15	23.21
3	18.35	25.65	28.36	30.56	35.62	40.53	41.53	42.62	45.15	48.65
4	75.35	50.36	55.68	56.12	57.65	57.65	56.72	58.56	59.12	58.52
6	89.35	60.78	64.65	68.42	70.56	70.55	71.62	72.62	78.32	79.22
8	100.33	80.41	70.42	74.74	79.56	80.18	81.43	82.65	92.63	89.23
10	105.65	85.96	80.75	82.23	85.65	89.83	89.53	89.65	98.65	96.23

Table. No3: Formulation table of Miglitol

| Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Miglitol	50	50	50	50	50	50	50	50	50	50
Moringa Oleifera gum	5	-	5	10	-	10	20	-	20	20
Stearic acid	-	5	5	-	10	10	-	20	20	10
Cross povidone	5	5	5	10	10	10	10	10	10	10
Microcrystalline Cellulose	236	236	231	226	226	216	216	216	196	206
Talc	2	2	2	2	2	2	2	2	2	2
Magnesium stearate	2	2	2	2	2	2	2	2	2	2
Purified Water (ml)	Q.s	Q.s	Q.s	Q.s	Q.s	Q.s	Q.s	Q.s	Q.s	Q.s
Total weight	300	300	300	300	300	300	300	300	300	300

Q.s*- Quantity Sufficient
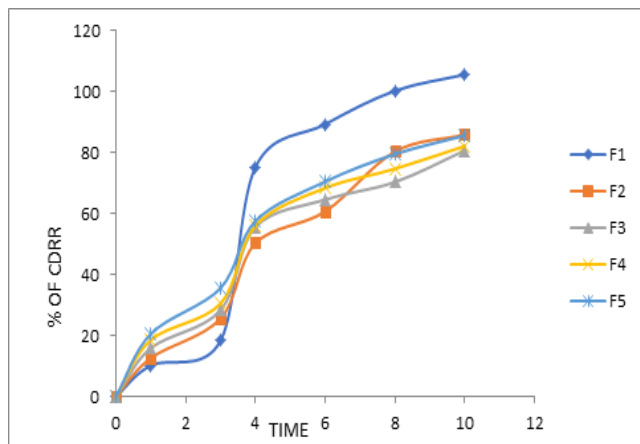
Fig.no 7: Picture showing all Comparative drug release profile F1-F5
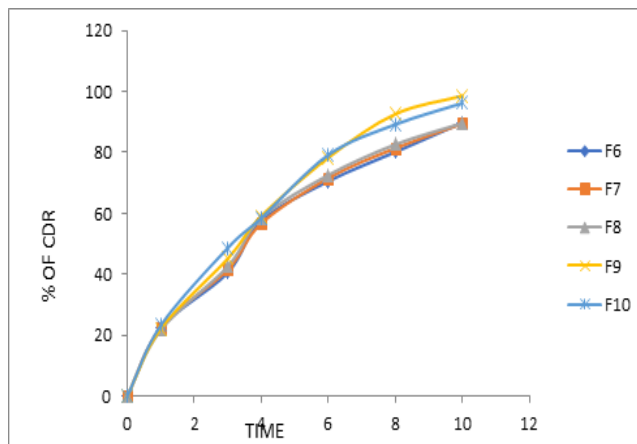

Fig.no 8: Picture showing all Comparative drug release profile for F6-F10 Kinetic profile data
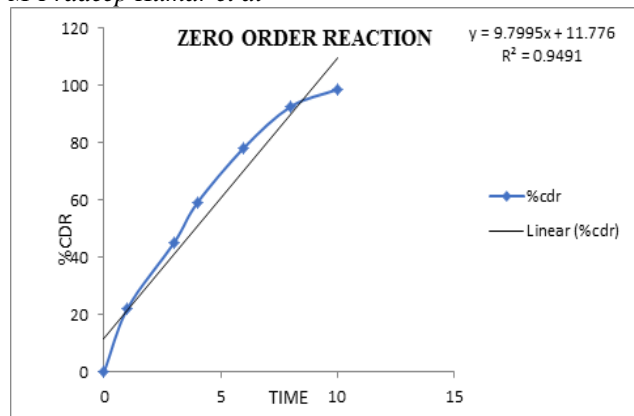
Fig.no: 9 showing picture of zero order reaction

4. Conclusion

Formulation and evaluation of the sustained release tablets of the Miglitol. The before going to formulate the tablets the pre formulation studies are carried out such as FTIR, calibration, organoleptic characters. The formulation is developed by using different types of the super disintegrates such as the crospovidone and moringa gum in different trails. The pre compression parameters such as angle of repose, bulk density, true density, and compressibility index, are found to be within the limits. The oral sustained release tablets of miglitol tablets are prepared by wet granulation method. The talc used as glidant and Mg. stearate used as lubricant, mcc used as filler. The after development of oral sustained release tablets are undergo for evaluation parameters. Such as weight variation, thickness, friability, drug content, and In vitro dissolution studies. They all are found in within range of limits. The in vitro drug release studies carried out by USP-II apparatus. The buffer medium 7.5pH. The optimized formulation under go for stability studies for 3 months. In stability studies the drug content and drug release studies carried out. These no degradation takes place in the drug content and drug release studies.

5. References

[1] Chien Y. W. Novel Drug Delivery System 1992; 2: 139 – 140.

[2] Altaf AS, Friend DR, MASRx and COSRx Sustained-Release Technology in Rathbone MJ, Hadgraft J, Robert MS, Modified Release Drug Delivery Technology, Marcell Dekker Inc., New York, 2003.

[3] Gwen MJ and Joseph RR, In Banker GS and Rhodes CT, Eds., Modern Pharmaceutics, 3rdEdn , Vol. 72, Marcel Dekker Inc. New York, 1996, 575.

[4] Salsa T, Veiga F And Pina M.E, Drug Develop. Ind. Pharm., 1997, 23, 931.

[5] Jantez GM, Robinson JR. Sustained and controlled release drug delivery systems. In:

[6] Banker GS, Rhodes CT, editors. Modern pharmaceutics. 3rd edition. New York: marceldekkerinc; 1996.

[7] Popli H, shrma SN. Trends in oral sustained – release formulations-I The eastern pharmacist1989; 32: p. 99-103.

[8] Remington. The Science and Practice of pharmacy, 20th Edition, vol. I: 903-913

[9] Brahmankar D. M. and Jaiswal S.B. in "Biopharmaceutics and Pharmacokinetics", "A

[10] Treatise," Vallabh Prakashan, 1st Edition, 1995: 347- 352.

[11] Lee V. H., Robinson J. R. Sustained and Controlled Release Drug Delivery System, Marcel Dekker, New York: 71-121,138-171.

[12] Brannon-Peppas, L. Med. Plast. &Biomater, Volume 199, Issue 6: 34-46

[13] Liberman H. A. Pharmaceutical Dosage Form: Tablets, Vol. I, 2nd Edition: 136.

[14] Aulton M.E. Hand Book of pharmaceutics Edition. 2001: 291-295.

[15] Howard C. Ansel. Pharmaceutical Dosage Form and Drug Delivery Systems; 7th Edition:229-243.

[16] Jain N.K. Controlled and Novel Drug Delivery. CBS Publiser, new Delhi, 1-2, 2002: 676-698.

[17] SrilathaMalvey, NareshKshirasagar, YamsaniVamshi Vishnu and J Srikanth (2015) Formulation and Evaluation of Acyclovir Orodispersible Tablets Using Sublimation Method. J Gen Pract 2015, 3: 208

[18] Ramu Bandameedi and ShanmugaPandiyan Formulation and Evaluation of Floating Osmotic Tablets ofNizatidine. J App Pharm 2015, 8(1): 2-7.

[19] Mahipal Reddy Donthi, Narendar Reddy Dudhipala, Devendhar Reddy Komalla, Dinesh Suram and Nagaraju Banala Preparation and Evaluation of Fixed Combination of Ketoprofen Enteric Coated and Famotidine Floating MiniTablets by Single Unit Encapsulation System. J Bioequiv , 2015, e 7(6): 279-283.

[20] Mahipal Reddy Donthi, NarendharDudipala, Devendhar Reddy Komalla, Dinesh Suram, VinayThallapally and NagarajuBanala (2015).

[21] Design and Evaluation of Floating Multi Unit Mini Tablets (MUMTS) Muco Adhesive Drug Delivery System of Famotidine to Treat Upper Gastro Intestinal Ulcers. J Pharmacovigil 2015, 3:5.

[22] Kumar Sampath KP., Bhowmik D., Srivastava S., Sustained release drug delivery system potentials, International Journal of Pharmaceutics 2010, 2:751-754.

[23] Kahoka BS, Badhan AC, Mahajan HS. Mouth Dissolving Tablets: A Novel Drug Delivery System. Pharma Times 2003; 35: 7-14.

[24] Vanscoik KG. Solid pharmaceutical dosage in tablet triturates form and method of producing the same. US patent No. 5, 082, 667.

[25] Gupta GD, Patel P. Fast Dissolving Drug Delivery Systems; An update" pharmacy industry 2005-2007. Www. Pharmainfo.net.

[26] Makino T, Yamada M, Kikuta J, et al. US patent No. 5, 1998, 720&974.

[27] Heinemann H, Rothe W. Preparation of Porous Tablets. US patent No. US 3885026, 1975.

[28] Knitsch KW, et al., "Production of Porous Tablets. US patent No,US 4134943, 1979.

[29] J Sujja-Areevath, D L Munday, P J Cox, and K L Khan, "Release characteristics of diclofenac sodium from encapsulated natural gum matrix formulations", Int J Pharm. 139, 53-62 (1996).

[30] E R Gordon, T W Rosanka, O E Fonner, N R Anderson, and G S Banker. PharmaceuticalDosage Forms, Libermen HA, Lachman L, Schwartz, editors. (Marcel Dekker, New York, 2nd edition, 1990), pp. 83. 3.

[31] M R Shivalingam, K S G Arul Kumaran, Y V Kishore Reddy, D Jeslin, M Tejaswini, Ch. MadhusudhanaRao, and B SaiChaitanya, "Evaluation of binding properties of Moringaoleifera gum in the formulation of paracetamol Tablets", Drug Invention Today. 2010, 2, 69-71.

[32] Wealth of India - Raw Materials, Council of Scientific and Industrial Research. New Delhi: India, 1998: 429.

[33] D Panda, S Sl, S Swain, S K Kanungo, and R Gupta, "Preparation and evaluation of gels from gums of MoringaOleifera", Indian J Pharm Sci. 68, 777-780 (2006).

[34] M G Saralaya, P K Patel, M A Patel, S P Roy, and A N Patel, "Antidiarrheal Activity of Methanolic Extract of Moringaoleifera Lam Roots in Experimental Animal Models:, Int. J Pharm. Res. 2(3), 35-39 (2010).

[35] A Katdare, and M V Chaubal, Excipient Development for Pharmaceutical, Biotechnology & Drug Delivery Systems, (Informa Health, UK, 2006, pp- -. 109.

[36] www.drugbank.com

[37] www.pubmed.com