ISSN: 0975-766X

Available Online through
www.ijptonline.com

Research Article

PRELIMINARY EVALUATION OF BINDING PROPERTIES OF RANDIA DUMETORUM FRUIT MUCILAGE

K.S Bodas[1*], V.V. Potnis[2], M. J. Patil[3], K. L. Satpute[4], N. S. Sheth[5]

[1]Sinhgad College of Pharmacy, Vadgoan (Bk.), Pune: 411041, India.
[2] Pad. Dr. D. Y. Patil Institute of Pharmaceutical Science and Research, Pimpri, Pune:411018, India.
[3] M.M. Colllege of Pharmacy, Kalewadi, Pune: 411017, India.
[4] Dayanand College of Pharmacy, Latur, Pune: 413531, India.
[5] Nulife Pharmaceuticals, MIDC, Pimpri, Pune 411018, India.
Email: *kaumudeebodas1982@yahoo.co.in*

Received on 25-05-2010 ***Accepted on 23-06-2010***

ABSTRACT:

The basic aim of present work was to extract the mucilage from *Randia dumetorum* fruit by using suitable method and to check its suitability for tablet binder. The mucilage was extracted from fruit powder by maceration technique using water and then precipitated with alcohol in 1:2 proportion (yield 8-9 % w/w). The physicochemical properties of mucilage like moisture content, solubility, density, viscosity, pH, surface tension, swelling index, water absorption capacity and microbial load were determined. The granules were prepared by Wet Granulation technique using Paracetamol as Model drug and mucilage as binder in concentrations 1-5 % w/w. Then tablets were punched by keeping pressure constant. The granules and tablets were evaluated as per official procedures. *In vitro* dissolution profiles of tablets were carried out in Phosphate Buffer pH 5.8. All parameters were compared with standards like acacia (1-5% w/w) and starch (6, 8, 10%w/w). The evaluation data suggested that tablets prepared with *Randia dumetorum* fruit mucilage as binder showed good results and comparable dissolution profile as that of standards. Also the results were complied with pharmacopoeial limits. Hence, the mucilage from *Randia dumetorum* fruit can act as suitable binder for conventional tablets instead of synthetic polymers.

Keywords: Randia dumetorum, mucilage, binder.

INTRODUCTION:

The pharmaceutical companies traditionally have regarded excipients as relatively marginal to main business of producing active ingredients. But now the dividing line between excipients and active ingredient is becoming blurred due to pressure of an evolving market and increase costs. Recent trends towards use of vegetable, ecofriendly and non-toxic products demands the replacement of synthetic additives with that from natural resources. The use of vegetable gums and mucilage, which are abundantly found in India, can provide one of the appropriate solutions to the current problems. These are important food hydrocolloids that exhibit excellent binding, suspending, emulsifying, thickening, water holding, stabilizing disintegrating properties. These could be utilized for large-scale production of pharmaceutical dosage form, by taking some effort on their research and development studies[1]. Also these natural products have certain advantages over synthetic products like non-toxicity, comparatively having low cost, freely available from natural resources, emollient and non-irritating nature[2]. Also there are several reports of successful use of natural polymers like Guar gum, Karaya gum, Locust bean gum and Carrageenan in pharmaceutical dosage forms[3]. The fruit of *Randia dumetorum* is credited with a number of medicinal properties like antheimintic, abortificient, expectorent, nervine calmative, antispasmodic, emetic, remedy for teething problems and insecticidal properties. It consist of outer hard pulp 50.6 %, inner seedy pulp 29.7 % and outer peel 19.7 %. The pulp contains moisture, proteins, sugars soluble carbohydrates (17.7, 6.7 %) and tannins. Presence of pectin, mucilage, tartaric acid was also reported[4]. Hence, in present work the attempts were made to isolate, evaluate physicochemical and binding properties of fruit mucilage of *Randia dumetorum.*

MATERIALS AND METHODS:

The fruits of *Randia dumetorum* were purchased from local market from Pune and authenticated from Botanical Survey of India, Pune. Model drug Paracetamol was purchased from Unilab Remedies, Gujarat. All other reagents and chemicals required for the study were of AR grade.

1) Isolation of mucilage:

The dried fruits of *R. dumetorum* were coarsely powdered and macerated in water for 24 h. It was then boiled for 1h and kept aside for 2h to release mucilage. Then it was filtered through muslin cloth to separate marc and extract was concentrated. For precipitation of mucilage acetone and alcohol (in 1:1 and 1:2 proportions) were tried. The precipitating solvent alcohol in 1:2 proportions gave satisfactory yield of mucilage than acetone so it was used as precipitating solvent throughout the work. The mucilage was separated and dried in vacuum oven at temperature below 50^0 powdered and passed through sieve number 80.The powdered mucilage was stored in desiccator until further use (Yield 8-9 %w/w)[5,6].

2) Evaluation of physicochemical and rheological properties of mucilage:

The mucilage was analyzed further for determination of bulk density, tapped density, flow properties, moisture content, swelling index, pH, density, surface tension, viscosity and microbial load as per official procedures mentioned in IP[7].

3) Preparation and evaluation of granules:

For granules preparation Paracetamol was used as Model Drug, Maize starch as disintegrant, Lactose and magnesium stearate was used as diluents and lubricant respectively. Binder used was mucilage isolated from *R. dumetorum*. Granules prepared by Wet granulation technique in various batches using different concentrations of binder i.e. 1 to 5 % w/w, 6, 8 and 10 % w/w (solution strength ranges from 2-20 % w/v) concentrations[7]. Binder solutions were prepared in water with mild heat treatment. The quantity of water used was just sufficient for granulation. Similar method was followed for preparation granules with acacia (1-5%w/w) and starch (6, 8, 10 %w/w) which were used as standard binders. The composition of tablets has been shown in table 1 and 2 where binder concentration was gradually increased and concentration of lactose decreased proportionally.

Then granules were evaluated for percentage fines, angle of repose, bulk densities and tapped densities, Carr's index and Hausner's ratio [8,9,10,11].

Table1:Composition Of Paracetamol Tablets Prepared With Acacia And *R. Dumetorum* Mucilage.

Name of ingredient	Quantity (%w/w)									
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**
Paracetamol	77	77	77	77	77	77	77	77	77	77
Maize starch	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Lactose	q. s.	q. s.	q. s.	q. s.	q. s.	q. s.	q. s.	q. s.	q. s.	q. s.
Magnesium stearate	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
R. dumetorum mucilage	1	2	3	4	5	--	--	--	--	--
Acacia						1	2	3	4	5

q.s. denotes quantity sufficient.

Table 2: Composition Of Paracetamol Tablets Prepared With Starch And *R. Dumetorum* Mucilage.

Name of ingredient	Quantity (%w/w)					
	F11	**F12**	**F13**	**F14**	**F15**	**F16**
Paracetamol	77	77	77	77	77	77
Maize starch	10.0	10.0	10.0	10.0	10.0	10.0
Lactose	q. s.	q. s.	q. s.	q. s.	q. s.	q. s.
Magnesium stearate	1.5	1.5	1.5	1.5	1.5	1.5
R. dumetorum mucilage	6	8	10	--	--	--
Starch				6	8	10

q.s. denotes quantity sufficient.

4) Preparation and evaluation of tablets:

The granules were punched at constant pressure (7 tones) by using 8 station rotary press tablet punching machine (Cipla). The batch size was of 100 tablets. The tablets prepared with acacia, starch and *R. dumetorum* mucilage as binder were evaluated for hardness, weight variation, friability, and content uniformity as per methods specified in USP[12].

5) In vitro dissolution Profile:

The test was carried out using six stations USP XXVI Type II Paddle Dissolution Test Apparatus USP. The dissolution medium used was 900 ml of Phosphate buffer, having pH 5.8. The speed was 50 r.p.m. The temperature was maintained at $37^0 \pm 0.5^0$ throughout the test. The sampling time specified in USP was modified i.e. instead of withdrawing a single sample at 30 min interval, serial sampling was done at 10, 20, 30, 40 50, 60 minute intervals. This provided additional data about the dissolution profile. The samples were filtered and suitably diluted and assayed photo metrically at 244nm.Percentage drug dissolved in 30 min (as per USP requirement) was found out. The values of average percentage drug release at various time intervals were found out and plotted against time[12].

RESULT AND DISCUSSION:

The coarsely powdered fruits of *R. dumetorum* yielded 9 % w/w using alcohol as precipitating solvent. The buff coloured, odourless and tasteless powder was obtained. The mucilage was partially soluble in cold water but dissolve in worm water forming viscous solution but it was insoluble in ethanol, chloroform and ether. The moisture content was 10 % w/w. The extracted mucilage was checked for its flow properties, it showed angle of repose below 40^0, Carr's index between 5-15 % and Hausner's ratio below 1.2 indicating its excellent flow properties [9,10]. The swelling capacity of mucilage that was found to be 8 ml suggesting that *R. dumetorum* mucilage may show good disintegration and dissolution release profile. The pH 6.7 which was closer to neutral, so that it may be less irritating to GIT, hence can be utilized for making the uncoated tablets. Also when it is dispersed in liquid medium, an alkaline or acidic medium will not result, so that product instability due to effects on gastro intestinal absorption of active

drug could be avoided[13]. The microbial count it was found to be less than 100 CFU/gm. It was within acceptable limit hence can be suitable for internal administration. The results of various physicochemical, flow properties and microbial properties are shown in table 3.

Table 3: Physicochemical and Microbial Properties of *R. Dumetorum* Mucilage.

Sr. No.	Parameter	Values*
1.	Angle of repose (^{0})	31.22
2.	Bulk density (g/cm^3)	0.500
3.	Tapped density (g/cm^3)	0.555
4.	Hausner's ratio	1.11
5.	Carr's index (%)	9.90
6.	Moisture content (%w/w)	10
7.	Swelling capacity (ml)	8
8.	pH	6.7
9.	Microbial load (CFU/gm)	Less than 100 CFU/gm

* = Average of three values

The density was also checked for 0.5 to 10 % w/v of mucilage solution in distilled water. It was observed that as concentration of binder was increased there was increase in the densities of solution. With increase in density of solutions, denser solutions will form, which may lead to stronger attractive forces between particles, hence can form granules with satisfactory properties[9]. The results for densities have been displayed in table 4. The surface tension and viscosity of mucilage binders are important determinants of granulation phenomena such as adhesion, cohesion, wetting and spreading [14]. The mucilage of *R. dumetorum* exhibited definite surface tension lowering capacity as it was found to lie between 77.78 - 42.15 dynes/ cm as displayed in figure 1. There was sharp increase in viscosity of mucilage with increase in concentration and it revealed pseudo plastic behavior as viscosities were found

to be decreased with increase in rate of shear. Figure 2 shows **e**ffect of rate of shear on viscosity of mucilage solution. Also viscosities of *R. dumetorum* were measured for 7 days, and it was increased slightly after 24 hours and then was stable over this period. Thus there was no effect of aging on viscosity.

The lower viscosity and surface tension may cause better penetration and spreading of binder solution during granulation, hence produce more porous granules. Also, the interstices lined by mucilage films may create hydrophilic channels around hydrophobic drug particles so it may enhance the disintegration and dissolution of tablets[14].

The prepared granules were tested for various properties like flow properties, percentage of fines, bulk density, tapped density and were compared with properties of granules containing acacia and starch as binder. The results of granules characterization are displayed in table 5 and 6. It was observed that the percentage of fines decreased as concentration of binder used to prepare granules was increased. The percentages of fines were in acceptable limit i.e. below 20 % [12]. It was found that the percentage of fines of granules prepared with *R. dumetorum* mucilage was lower than that of acacia but slightly higher than starch. All the granules showed angle of repose below 40^0 this was the indication of good flow properties[9]. The granules prepared with mucilage of *R. dumetorum* were superior in flow properties as that had lesser angle of repose than that of acacia and starch. The bulk densities of all the prepared granules were found to decrease slightly by increase in concentration of binders. This result may be due to the formation of larger agglomerates and the decrease in fines in granules, as increased concentrations of binders provide more binding to granules. The Hausner's ratio was also found to be within acceptable limit, which was below 1.2. This means that granules had low interparticle friction and hence exhibited good flow properties. The compressibility index (Carr' index) between 5-15 % indicated that granules had excellent flow ability with good bridge strength and stability [10].

Table 4: Density of Binder Solution at Various Concentrations.

Sr. No.	Concentration % w/v	Density (gm/cc).
1	0.5	1.0118
2	1	1.0138
3	2	1.0149
4	3	1.0155
5	4	1.0332
6	5	1.0598
7	6	1.0864
8	8	1.1226
9	10	1.1773

Table 5: Characterisation of Granules Prepared Using Acacia and *R.Dumetorum* Mucilage as Binder*

Binder concentration % w/w	Binders used	Angle of repose (^{0})	Fines (%)	Bulk density (g/cm^3)	Tapped density (g/cm^3)	Hausner's ratio	Carr's index (%)
1	A	30.83	17.45	0.500	0.550	1.10	9.0
	R	29.3	19.2	0.500	0.555	1.11	9.91
2	A	29.93	16.62	0.495	0.534	1.088	7.3
	R	29.35	15.42	0.476	0.523	1.12	8.5
3	A	29.32	13.24	0.480	0.520	1.083	7.69
	R	28.73	10.91	0.465	0.510	1.070	7.5
4	A	28.61	9.32	0.476	0.512	1.075	7.03
	R	28.07	10.76	0.454	0.487	1.072	6.7
5	A	28.36	8.9	0.470	0.500	1.063	6.0
	R	28.07	9.83	0.448	0.476	1.061	5.8

Results are mean of three observations; A= Acacia and R= *R. dumetorum*

Table 6: Characterisation of Granules Prepared By Using Starch and *R. Dumetorum*.

Sr. No.	Parameter	Binder Concentration % w/w.					
		6		8		10	
		S	R	S	R	S	R
1.	Angle of repose (^{0})	32.00	30.83	31.6	29.56	28.73	27.61
2.	Fines(%)	8.93	9.65	8.90	8.96	8.41	8.72
3.	Bulk density (g/cm^3)	0.500	0.526	0.487	0.526	0.454	0.454
4.	Tapped density (g/cm^3)	0.540	0.571	0.526	0.571	0.487	0.480
5.	Hausner's ratio	1.081	1.080	1.080	1.080	1.074	1.050
6.	Carr's index (%)	7.4	7.88	7.4	7.88	6.7	5.41

Results are mean of three observations; S= Starch and R= *R. dumetorum*

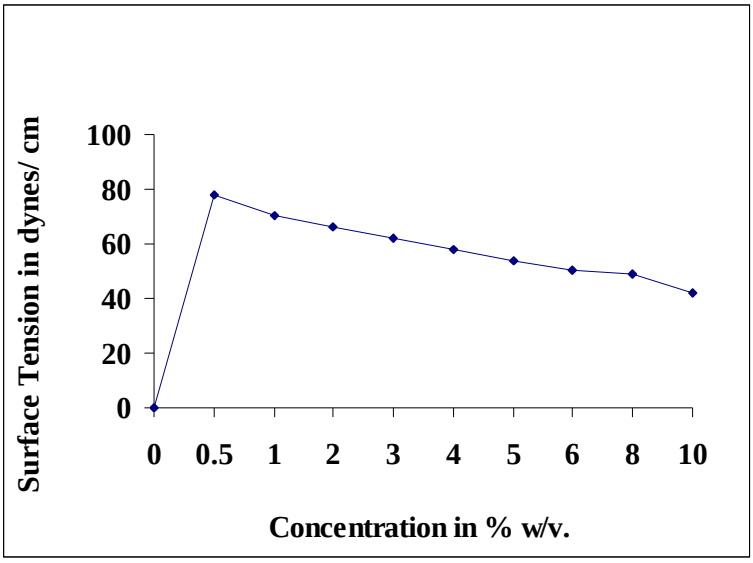

Fig. 1. Effect of concentration of *R. dumetorum* mucilage on surface tension.

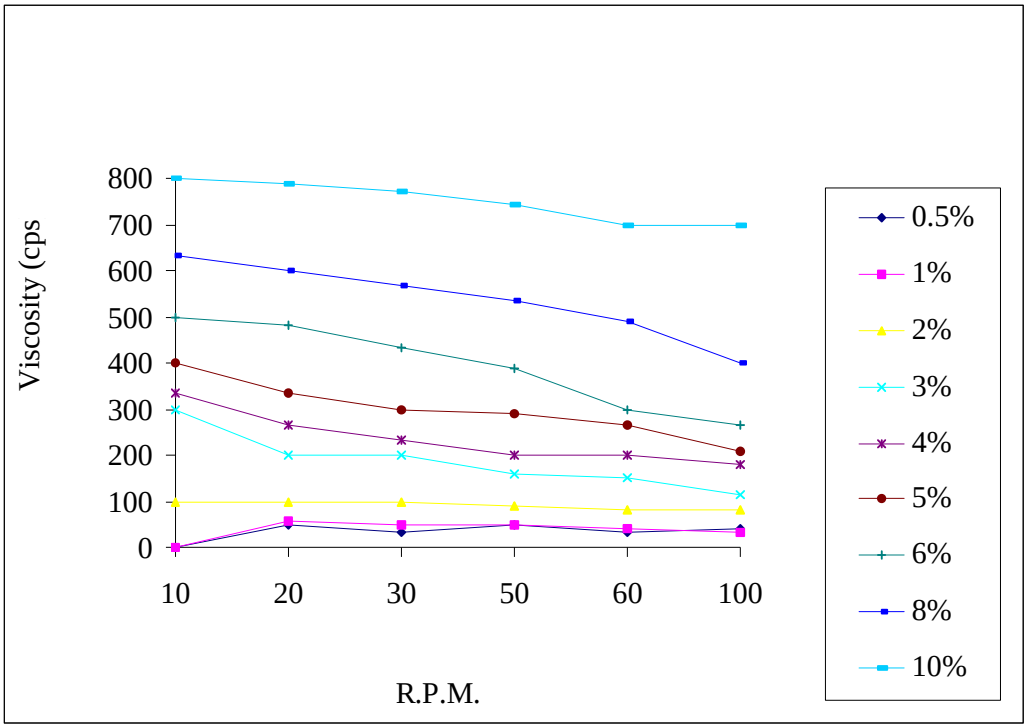

Fig. 2. Effect of rate of shear on viscosity of mucilage solution ranging from concentration 0.5 to 10 % w/v.

The tablets were prepared using mucilage of *R. dumetorum* at eight different concentrations of binder like 1 to 5 % w/w compared with acacia and 6,8,10 % w/w compared with starch. The tablets were evaluated for hardness, disintegration time, weight variation, friability, content uniformity and *in vitro* dissolution profile. The results for tablet characterization are shown in table 7 and 8. The hardness and disintegration time of tablets was increased with increase in concentration of binder used. All the values were within pharmacopoeial limits. The tablets prepared with *R. dumetorum* binder were superior in terms of disintegration time than acacia and starch. As concentration of binder was increased the friability values were decreased but they are within acceptable criteria, generally friability values, which are less than 0.8 to 1%, are acceptable[12]. All the tablets showed good uniformity of weight. Also all the tablets possessed good content uniformity and it was found to be within acceptable limit[9].

Table 7: Characterisation of Tablets Prepared By Using Acacia and *R.Dumetorum* Mucilage

Binder Conc. % w/w	Binders used	Hardness (kg/cm^2)	Friability (% w/w)	Disintegration time (min)	Content Uniformity (%)	Uniformity of weight (mg)
1	A	4.1	0.74	1min.10s	96.76	645.3
	R	3.9	0.79	1min.	97.23	647.8
2	A	4.3	0.70	4min.7s	97.38	646.9
	R	4.2	0.72	3min.45s	97.38	649.8
3	A	4.9	0.63	10min.	97.67	651.3
	R	4.5	0.64	8min.10s	97.84	653.4
4	A	6.0	0.57	14min	98.30	653.2
	R	5.5	0.60	12min	98.46	654.1
5	A	6.2	0.49	17min.21s	98.61	655.3
	R	5.9	0.51	15min	98.92	655.9

Results are mean of three observations; A= Acacia and R= *R. dumetorum*

Table 8: Characterisation of Tablets Prepared By Using Starch and *R.Dumetorum* Mucilage

Sr. No.	Parameter	Binder Concentration % w/w.					
		6		8		10	
		S	R	S	R	S	R
1.	Hardness (kg/cm^2)	7.0	6.0	7.5	6.3	8.0	6.7
2.	Friability (% w/w)	0.40	0.42	0.33	0.35	0.27	0.30
3.	Disintegration time (min)	16min. 46s	13min. 10s	24min. 47s	20min. 35s	27min. 30s	27min. 30s
4.	Content Uniformity (%)	97.84	99.07	98.92	99.38	99.53	99.69
5.	Uniformity of weight (mg)	653.4	654.1	654.3	656.1	656.1	656.9

Results are mean of three observations; S = Starch and R= *R. dumetorum*

In case of *In vitro* dissolution study, amount released at specific time was decreased with increase in binder concentration. *In vitro* dissolution profiles of Paracetamol tablets prepared with different binders

are represented in Figure 3 to 6. The tablets containing *R. dumetorum* mucilage showed superior results than acacia binder at concentration ranging from 1 to 5 % w/w. But at higher concentration (6, 8 and 10 % w/w) delayed release was observed in case of the mucilage from *R. dumetorum* than starch. The tablets prepared with 6 % mucilage of *R. dumetorum* showed release comparable with tablets prepared with 8 % of starch binder. The tablets prepared with mucilage of *R. dumetorum* at 1 to 3 %w/w concentration have passed the criteria prescribed in USP (uncoated tablets should release not less than 80 % within 30 min) [12]. Thus, all the tablets prepared with mucilage of *R. dumetorum* as binder passed all the criteria for conventional tablets and exhibited superior results than acacia containing tablets. Also at the end of 1 hour the release was 45.86 % for tablets containing 10 % w/w of *R. dumetorum* mucilage. It was the indication of drug release delaying ability of *R. dumetorum* mucilage.

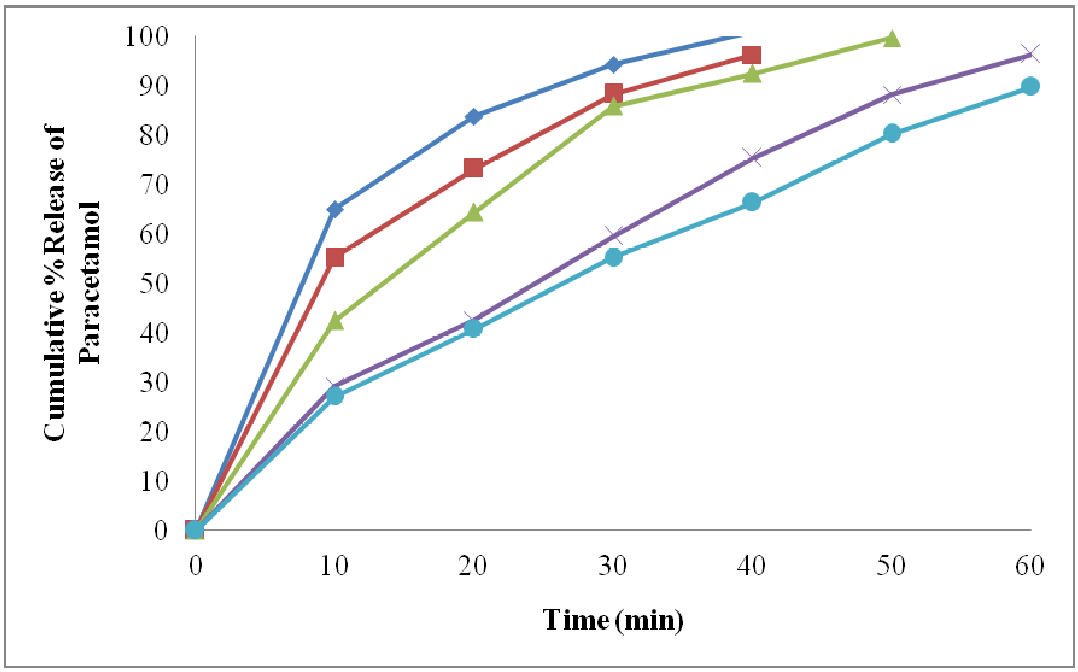

Fig.3. *In vitro* release profile of drug from tablets.
F1 containing 1 % (-♦-), F2 containing 2% (-■-), F3 containing 3% (-▲-), F4 containing 4 % (-×-) and F5 containing 5 % (-●-) *R. dumetorum* mucilage as binder.

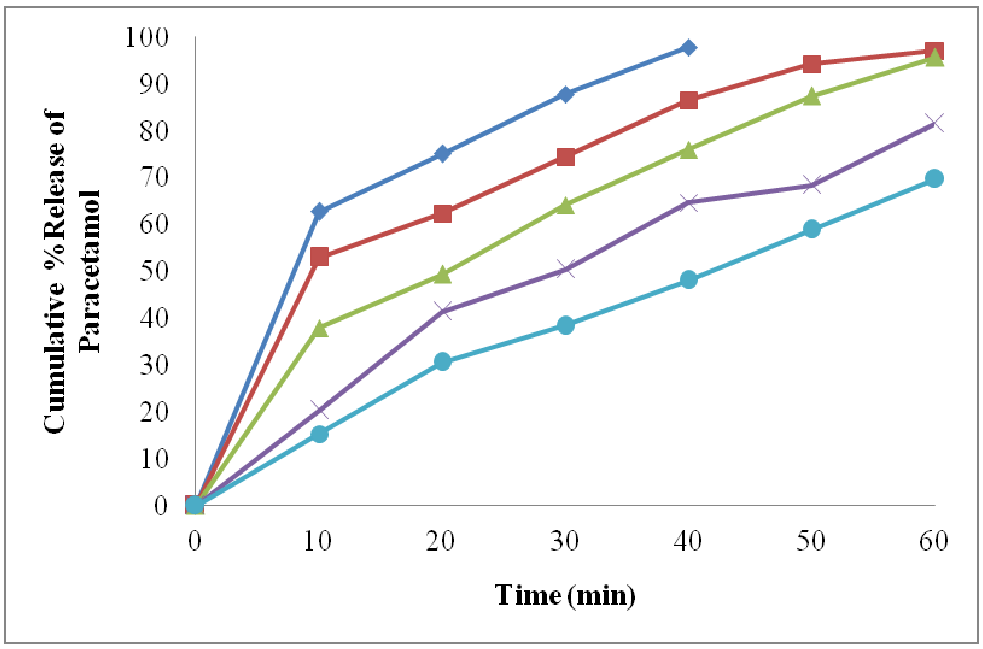

Fig.4. *In vitro* release profile of drug from tablets.
F6 containing 1 % (-♦-), F7 containing 2% (-■-), F8 containing 3% (-▲-), F9 containing 4 % (-×-) and F10 containing 5 % (-●-) acacia as binder.

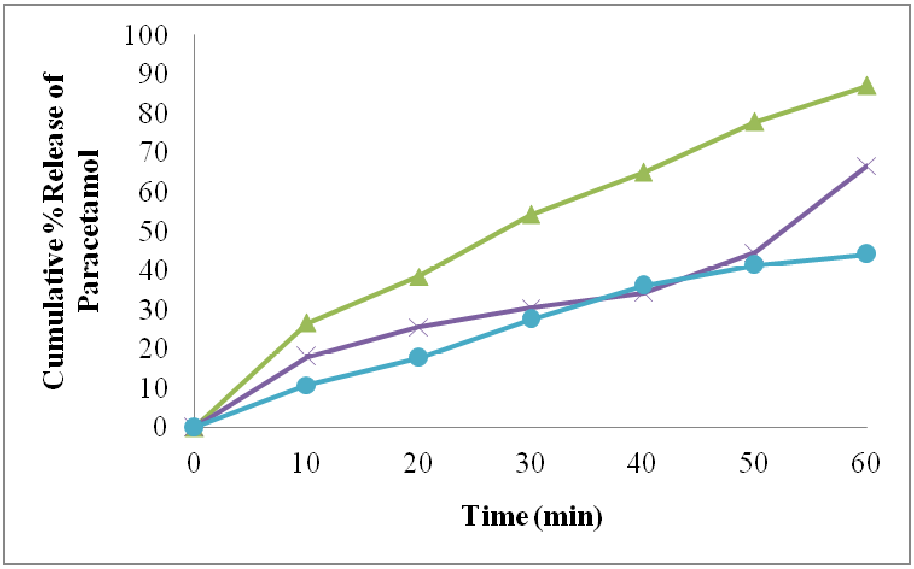

Fig.5. *In vitro* release profile of drug from tablet.
F11 containing 6% (-▲-), F12 containing 8 % (-×-) and F13 containing 10 % (-●-) *R. dumetorum* mucilage as binder.

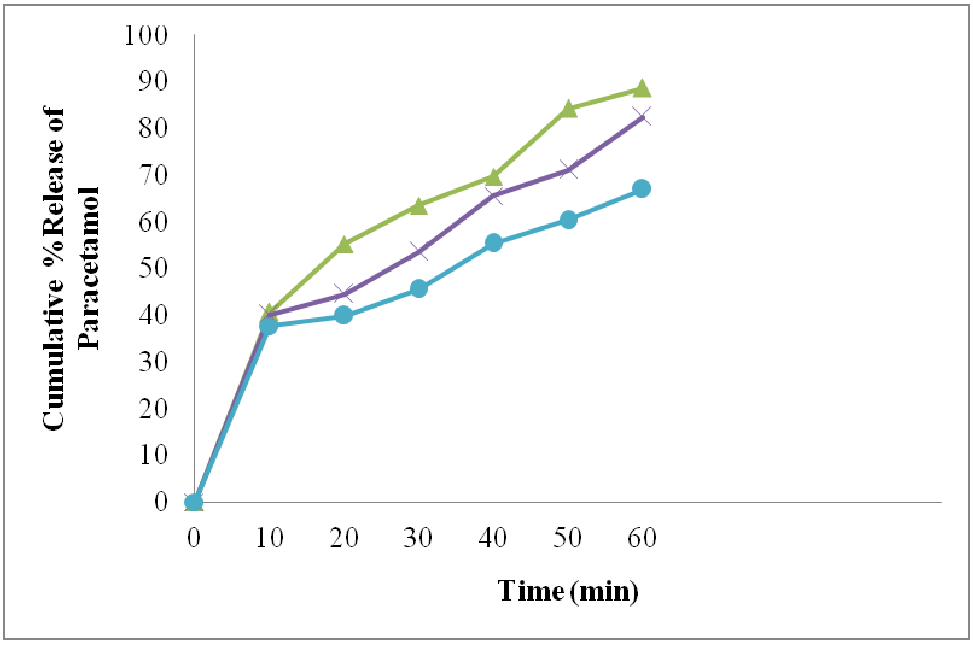

Fig.6. *In vitro* release profile of drug from tablets.
F14 containing 6% (-▲-), F15 containing 8 % (-×-) and F16 containing 10 % (-●-) Starch as binder.

CONCLUSION:

From present work it can be concluded that mucilage from *R. dumetorum* can serve as suitable binder in conventional tablet formulations and can be the better substitute for acacia. At the same time it can be evaluated further for its drug release modifying ability.

ACKNOWLEDGEMENTS:

The authors are thankful to Mr. R. D. Patankar and Dr. Atmaram Pawar for their assistance in research work.

REFERENCES:

1. Taylor, J. Current trends and challenges in the excipients market, Pharmaceutical Technology 2006; 1-4.
2. Kulkarni GT, Gowthamarajan K, Rao BG, Suresh B. Evaluation of binding properties of *Planto ovata* and *Trigonella foenum graecum* mucilages, Indian drugs 2002; 39: 422-25.
3. Sujja- Areevanth J, Munde DL, Cox PJ, Khan KL. Release characteristic of Diclofenac sodium from encapsulated natural gum matrix formulation. Int J Pharm 1996; 139:53-62.
4. Wealth of India- Raw materials, Vol. 8. New Delhi: Council of Scientific and Industrial Research; 2003. p. 360-64.
5. Pawar H, D'mello PM. Isolation of seed gum from *Cassia tora* and preliminary studies of its application as a binder for tablets. Indian Drugs 2004; 41 (8): 465-68.
6. Ghule BV, Darwhekar GD, Jain DK, Yeole PG. Evaluation of binding properties of *Eulophia campestris* wall mucilage. Indian Journal of Pharmaceutical Sciences 2006; 68: 566-69.
7. Indian Pharmacopoeia. vol. 2. New Delhi: Ministry of Health and Family Welfare, Govt. of India; 1996. A-100.
8. Gordon, R.E., Rashanke, T.W., Fonner, D.E., Anderson, N. R., Banker, G. S., In: Lachman, L., Lieberman, H.A., Schwartz, J.B., Editors. Pharmaceutical dosage forms: Tablets, Vol.2. New York: Marcel Decker; 1999. p. 245.
9. Banker, G.S., Neil ,R.A., In: Lachman, L., Lieberman, H.A., Joseph, L.K., Editors. The Theory and Practice of Industrial Pharmacy, 3rd Edn. Mumbai: Varghese Publishing House; 1987.p. 77, 295-318.
10. Aulton, M.E., Editors. In: Pharmaceutics: The Science of Dosage Form Design 2nd Edn. London: Churchill Livingstone; 1988, p. 133-35, 600.

11. Martin, A., Swarbrick, J., Cammarata,A. ,In: Micromertics- Physical Pharmacy: Physical Chemical principles in the Pharnaceutical Sciences, 3rd Edn. K. M. Mumbai: Varghese Company; 1991, p.492.
12. The United States Pharmacopoeia 27th Revision and The National Formulary 22nd Edn. The Official Compendia of Standards, Asian Edition. Rockville: The Board of Trustees; 2003. p. 16-9, 2303-04.
13. Iwuagwu MA, Onyekwell AO. Preliminary investigation into the use of Pieurotus tuber regium powder as a tablet disintegrant. Tropical Journal of Pharmaceutical Research 2002; 1: 9-37.
14. Adebayo AS, Itiola OA. Effect of Breadfruit and Cocoyam starch mucilage binders. Pharmaceutical Technology 2003; 78-90.

For correspondence*
Ms. K. S. Bodas,
Lecturer,
Sinhgad college of Pharmacy, Pune
Email: *kaumudeebodas1982@ yahoo.co.in*