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Research Article

A NOVEL BINDING AGENT FOR PHARMACEUTICAL FORMULATION FROM *CASSIA ROXBURGHII* SEEDS

***KUNDLIK GIRHEPUNJE [1], ARULKUMARAN[2], RANJU PAL [1], NITIN MASKI [2] AND N THIRUMOORTHY[2].**

[1]Shri Leuva Patel Trust Pharmacy Mahila College, Amreli (Gujrat)
[2]KMCH College of Pharmacy, Coimbatore-641 035 (Tamilnadu).
*For Correspondence - kundlik@gmail.com

ABSTRACT

Various Plant gums like gelatin, acacia, alginic acid, guar gum etc have been used as binder in pharmaceutical formulations. But still finding novel binder are useful in the pharmaceutical industry for manufacture of tablets and capsules. The *Cassia roxburghii* seed gum was found for its binding property. The isolated gum was evaluated for its binding property like % of fine, stability and viscosity. The adhesive and cohesive property in tablet like hardness, friability, disintegration time and dissolution rate were evaluated on paracetamol tablets. All evaluation were compared with widely used standard sodium carboxy methyl cellulose and gelatin. The gum is prepared from seeds of *Cassia roxburghii* and the prepared gum was evaluated in different concentration like 1%, 1.5% and 2% which compared with the same concentration of sodium CMC and gelatin. The *Cassia roxburghii* seed gum was found to be more viscous than sodium CMC and gelatin. which also produce less fine. Only the marginal difference was found in the hardness of tablet when compared with standard sodium CMC and gelatin. It also showed linearity between concentration and hardness. Increased concentration of *Cassia roxburghii* seed gum from 2 to 6% increased the disintegration and dissolution time. *Cassia roxburghii* gum produce tablet with better mechanical property longer disintegration and dissolution time than those containing sodium CMC and gelatin. This suggest that *Cassia roxburghii* gum could be useful binding agent especially when high mechanical strength and slower release concern.

Keywords: *Cassia roxburghii*, Binder, Tablet, Sodium CMC, gelatin, Drug release, Stability.

INTRODUCTION

Plant gums and mucilages have been widely used in various industries like paper, textile, food, pharmaceuticals, ink, cosmetics and petroleum due to their abundance in nature and low cost. They are frequently used in pharmaceuticals as thickening, binding, emulsifying, suspending, gelling and stabilizing agents and also used as coating materials in microencapsulation. As binders they impart adhesive qualities to the powder material by formulation of granules of the desired size, hardness, strength, friability and compressibility. Various plant gums, which have been used as binders include, gelatin, acacia, tragacanth, alginic acid its salts and guar gums. In view of importance of binders in pharmaceutical industry for the manufacture of tablets and capsules in a improved manner so investigation on ***C. roxburghii*** seed gum was undertaken to evaluate its binding properties through assessment of various parameters essential for pharmaceutical formulation[1-3].

Cassia roxburghii Linn. (Family: Fabaceae/ Leguminosae) commonly known as Ceylon senna, red cassia. It is a fairly large "shower" tree with feather like pinnately compound leaves and twigs covered with a dense carpet of fine, soft hair. Seeds are medium in size and consist of about 50% endosperm which are responsible for yielding water soluble gum. The gum is galactomannan composed of D-galactose and D-mannose in the ratio of 1:4 having the main chain of 1→ 4 linked β-D-mannopyranose units and single D-galactopyranose stubs are attached to mannan chain through α-(1→ 6) linkage at the

average of every 4 mannose units. The gum has been reported to be having useful viscosity and interaction properties with microbial xanthum gum. According to the result of Sarode and Malhotra on the toxicity of the gum, oral dose in the range of 10mg to 4640mg/kg body weight of albino rats, the gum showed no mortality in 7 days[1,4-5].

MATERIAL AND METHODES

Chemicals

Paracetamol was obtained as a gift sample from Universal Medicament Pvt. Ltd. Nagpur. All other ingredient and solvent used were of analytical grade.

Experimental

Viscosity was determined by Brookfield viscometer. Tablets were prepared using multipunch tablet machine, friability and hardness of tablet were determined by Friability Tester (Roche Friabilator, Bombay) and Hardness Tester (Campbell electronics, Bombay). Tablets disintegration test machine (Tab machine, Bombay) was used for disintegration time studies. A Tablet dissolution test machine (Tab machine, Bombay) was used for dissolution studies.

Isolation of seed gum

The seeds of *C. Roxburghii* were broken by mechanical force followed by powdering in a grinder. The seed powder was soaked in sufficient water, kept over boiling water bath for 30 min. with occasional stirring, left overnight and strained through muslin cloth. The clear solution was processed for the extraction of gum and the total yield was obtained 21%. One batches of 1.0, 1.5 and 2.0% gum solutions of *C. roxburghii* were prepared by making slurry of weighed amount of gum powder with minimum amount of water using mortar and pestle. The slurry was transferred to beaker using required amount of warm water for desired concentration and stirred vigorously for 15 min. Another batch of sodium CMC and gelatin solutions were prepared in same concentration and all batches were preserved with 0.18% (w/v) methyl paraben and 0.2% (w/v) propyl paraben[1,7-8]. The viscosity were examined by using brookfield viscometer for 16 days and results are tabulated in Table 1.

Preparation of tablets

Paracetamol 250 mg tablets were prepared by conventional wet granulation technique. Paracetamol was mixed with starch, lactose and granulated with aqueous solution of binders like 2, 4 and 6% of *C. roxburghii* gum and passed through sieve no 20 . The granules obtained were dried for half an hours at 60°C. The resulting dried granules were again passed through sieve No. 24 and dried at 60°C. To each batch 0.1% w/w magnesium stearate and 0.1% w/w of talc were added. The tablets were punched in multipunch tablet compression machine. Another two batches of paracetamol tablet were prepared by the same method by replacing *C. roxburghii* with sodium CMC and gelatin[9-10].

Evaluation of binding properties of seed gum

All prepared tablets containing *C. roxburghii* gum, sodium CMC and gelatin were evaluated for uniformity of weight using electronic weighing balance. Friability was determined using Roche friabilator at the speed of 25 rpm, the % weight loss was determined and the results were compared with IP standards. Hardness was measured using hardness tester (Cambell electronic, Bombay). Disintegration test by using disintegration test machine (Tab machine,

Bombay) were performed by the IP standard and the results are tabulated in Table 2.

***In vitro* Drug release study**

In vitro drug release was studied using USP Dissolution apparatus, with 900 ml of dissolution medium having pH 7.4 which maintained at 37 ± 1^0 for 2 hr. at 50 rpm, 5 ml sample was withdrawn after regular time interval and was replaced by an equal volume of fresh dissolution medium of same pH, collected sample were analysed spectrophotometrically at 243 nm, cumulative percentage of drug release was calculated and the study was performed in triplicate[11-12]. The results are tabulated in Table 2.

Accelerated stability studies

Stability study was carried out by gradually increasing temperature and relative humidity on optimized formulation, by keeping at $0\text{-}4^0$ (in refrigerator), room temperature (28^0), and at 45^0, in air tight high density polyethylene bottle for three month, at RH 75±5%. Physical evaluation and *in vitro* drug release was carried out after every 1 month.

RESULT AND DISCUSSION

A comparative viscosity study of 1.0, 1.5 and 2.0% gum solution of *C. roxburghii*, sodium CMC and gelatin was carried out after preserving with preservatives and results are tabulated in Table 1. The 1.0, 1.5 and 2.0% solution of *C. roxburghii* gum showed a higher viscosity than sodium CMC and gelatin solution. On keeping these solution for 16 days, 1.0, 1.5 and 2% *C. roxburghii* gum solution showed least decrease in viscosity up to 24.33%, 19.09% and 13.60%, sodium CMC solution 12.98%, 20.17% and 22.82% where as in gelatin 37.15%, 40.65% and 40.50% was found respectively. *C. roxburghii* gum solution retained viscosity up to 75.67%, 80.91% and 86.40%, sodium CMC solution retained 87.02%, 79.83% and 77.18% and gelatin retained 62.85%, 59.35% and 59.50% for 1.0, 1.5 and 2% respectively, from the result it showed that the decrease in viscosity was more in gelatin and nearer to sodium CMC which showed more viscosity power like sodium CMC on keeping for 16 days.

During evaluating the binding properties of *C. roxburghii* seed gum regarding formulation of tablets and its comparison with sodium CMC, encouraging results were obtained. The 2.0% binder concentration of *C. roxburghii* gum showed lower percentage fine (5.29) than gelatin (6.85) and sodium CMC (6.46). 2% *C. roxburghii* gum showed higher hardness of 5.57 kg/cm^2 than sodium CMC 5.32 kg/cm^2 and gelatin 4.92 kg/cm^2. As regard to the disintegration time of the tablets, it was 13.36 min. for 2% *C. roxburghii* gum whereas for gelatin 10.55 min. and for sodium CMC it was 10.46 min. The % friability of 2% *C. roxburghii* gum showed lowest % friability (0.77) as compared to 2% sodium CMC (0.81) and gelatin (0.97).

As the concentration of *C. roxburghii* gum increased from 2 to 6% the friability was decreased from 0.77 to 0.60%, whereas for sodium CMC 0.81 to 0.69% and for gelatin it was 0.97 to 0.74% . Hardness was increased for *C. roxburghii* from 5.44 to 5.8 kg/cm^2, sodium CMC 5.32 to 5.72 kg/cm^2 and for gelatin 4.92 to 5.6 kg/cm^2. Disintegration time for *C. roxburghii* increased from 13.36 to.17.34 min. whereas for sodium CMC 10.46 to 16.58 min. and gelatin 10.55 to 15.01 min.

TABLE 1. Viscosity Behavior of *C. roxburghii* seed gum, gelatin and sodium cmc gums at different time intervals

Viscosity (cP) with preservative, all gums were preserved with 0.18% w/v of methyl paraben and 0.02% w/v propyl paraben.

No. of day	***C. roxburghii* seed gum**			**Gelatin**			**Sodium CMC**		
	1%	1.5%	2%	1%	1.5%	2%	1%	1.5%	2%
1	908	1220	1875	950	1070	1185	724	1115	1450
2	865	1168	1807	700	980	1050	722	1064	1390
4	605	1102	1775	660	736	846	710	1007	1386
8	775	1070	1702	615	700	780	685	987	1298
12	707	1003	1687	605	680	755	668	917	1257
16	687	987	1620	597	635	705	630	890	1119

Table 2. Studies on binding properties of *c. roxburghii* seed gum, gelatin and sodium cmc

Binding agent	**Conc. of binder % (w/w)**	**Avg. wt. of tablets (Mean± S.D)**	**% Fines**	**Hardness (kg/cm^2)**	**%Friability**	**Disintegration time (min)**	**Dissolution (% C. R.)**
C. roxburghii gum	2	0.297 ±0.0148	5.29	5.44±0.109	0.77±0.02	13.36±0.577	91.66±1.215
Gelatin	2	0.303 ±0.0150	6.85	4.92±0.067	0.97±0.110	10.55±0.360	96.85±0.842
Sodium CMC	2	0.305 ±0.0152	6.46	5.32±0.218	0.81±0.03	10.46±0.606	95.53±0.665
C. roxburghii gum	4	0.308 ±0.0154	4.83	5.55±0.147	0.68±0.01	15.56±0.750	78.58±1.103
Gelatin	4	0.304 ±0.0150	5.91	5.08±0.086	0.82±0.026	13.38±0.175	83.92±0.582
Sodium CMC	4	0.306 ±0.0153	5.10	5.62±0.165	0.71±0.02	14.52±0.612	81.16±2.394
C. roxburghii gum	6	0.296 ±0.0148	3.78	5.8±0.12	0.6±0.03	17.34±0.209	62.76±0.770
Gelatin	6	0.297 ±0.0148	5.02	5.6±0.102	0.74±0.030	15.01±0.407	75.03±1.150
Sodium CMC	6	0.298 ±0.0149	4.68	5.72±0.156	0.69±0.04	16.58±0.369	70.98±1.128

Dissolution was performed at 7.4 pH for 2 hr.
S.D.: standard deviation (n=3)
C.R.: cumulative release

It has been observed that an increase in the concentration of *C. roxburghii* from 2 to 6% effectively increase the binding characteristic of the tablets. All the formulation showed decrease in the friability and increase in the hardness and disintegration time by increasing concentration, which indicated that the binding capacity of the tablet is directly proportional to the concentration of *C. roxburghii* gum.

Release profile of paracetamol tablet (at pH 7.4) using various concentration of *C. roxburghii* gum, gelatin and sodium CMC gum shown in fig.1 and fig.2. *C. roxburghii* gum have less percentage release as compared to gelatin and sodium CMC. As increases the concentration from 2 to 6% the drug release rate was decreased. *C. roxburghii* gum show less drug release rate because of more binding property. This may be due to the reason that the gums in higher concentration in tablets might have produced dense matrix around the drug particles, providing more barrier for them to escape and dissolve[13].

Stability studies reveled that there was no significant change in friability, hardness, disintegration time and dissolution rate profile of all formulation. Thus, formulation was stable at 0-45^{0}C temperature.

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