Indo Global Journal of Pharmaceutical Sciences, 2022; 12: 228-236

INDO GLOBAL JOURNAL OF PHARMACEUTICAL SCIENCES
ISSN 2249- 1023

Charota (*Cassia tora*) Gum: A Potential Element as Suspending Agent, An Investigation of Suitability for Development of Paracetamol Suspension

Khomendra Kumar Sarwa[1*], Prabhat Kumar Vishwakarma [2], Vijendra Kumar Suryawanshi[3], Dhaneshwar Uraon[1], Malti Sao[4]

[1]*Department of Pharmacy, Government Girls Polytechnic Raipur, Chhattisgarh, India*

[2]*Department of Pharmacy, Guru Ghasidas University, Bilaspur, Chhattisgarh India*

[3]*MJ College, Kohka-Junwani Road, Bhilai, Durg, Chhattisgarh, India*

[4]*Shri Shankaracharya College of Pharmaceutical Sciences, Bhilai, Durg, Chhattisgarh, India*

Address for Correspondence: Khomendra Kumar Sarwa, khomendra.sarwa@gmail.com

Received: 29.10.2021
Accepted: 21.01.2022
Published: 20.08.2022
Keywords
Cassia tora, Suspension, Charota, Natural gum, Sedimentation volume.

ABSTRACT: **Background**: Charota (*Cassia tora*) gum is well reported as an additive for food product and generally recognized as safe" (GRAS). It is obtained from the seed of the herbaceous plants of the *Caesalpiniaceae* family. The plant's seed contains gluco-mannose polysaccharides, which swell in water and form a colloidal dispersion with increasing viscosity. This property of the gum was explored to use as a suspending agent for the preparation of paracetamol suspension. **Result**: In the present investigation, charota gum was extracted from the plant and used as a suspending agent in a range of 2-4% w/v in preparation of paracetamol suspension (5% w/v). The investigation has been performed compared with gum acacia, tragacanth, and gelatin at a similar range of 2-4% w/v. The parameters like sedimentation profile, rheological studies, redispersibility, pH, and dissolution rate were determined to evaluate suspending ability of *Cassia tora* gum. **Conclusion**: A comparative data with other gum reported a higher viscosity and lowest zeta potential for the suspension prepared with Charota gum. At different concentrations, it showed better suspending ability and redispersibility compare, and it was stable throughout the storage period of 6 weeks. The study's data conclude that charota gum produced flocculated suspension, redispersed in the least no of shakes post sedimentation.

Cite this article as: Sarwa, K.K.; Vishwakarma, P.K.; Suryawanshi, V.K.; Uraon, D.; Sao, M. Charota (*Cassia tora*) Gum: A Potential Element as Suspending Agent, An Investigation of Suitability For Development of Paracetamol Suspension. Indo Global J. Pharm. Sci., 2022; 12: 228-236. **DOI**: http://doi.org/10.35652/IGJPS.2022.12029

INTRODUCTION

In the last few decades, the scientific and industrial community shows huge attention toward excipient from natural sources. Its non-toxic, cost-effectiveness, and vast availability are significant advantages over synthetic chemical materials. A higher level of safety regulation and complexity on approval of synthetic products promotes the application of the natural product as additives. Furthermore, laboratory tailoring permits modifying the properties for suitable applicability in the drug delivery system[1].

Gums are considered to be pathological products formed following injury to the plant or owing to unfavorable conditions. Acacia, tragacanth, and guar gum are examples of gums. Gums on hydrolysis yield a mixture of sugars and uronic acids. Gums readily dissolve in water. Gums contain hydrophilic molecules, which can combine with water to form viscous solutions or gels. Gums and mucilage are applied in the paper, textile, petroleum, and pharmaceutical industries for many purposes like a binding agent and thickening agent. In the pharmaceutical formulation, the gum is reported for applicability as a disintegrating, emulsifying, gelling, and suspending agent, etc[2].

Cassia tora (Charota) gum was obtained from the seeds of *Cassia tora* Linn belonging to the family of Caesalpiniaceae, native to Southeast Asia, Northern Australia, Africa, and Latin

America. Charota is the regional name of *Cassia tora* in central India. In central India, Charota is found as a secondary forest in the rainy session starting from July to December. *Cassia tora* is also known as sickle senna due to the morphological similarities with senna. The seed of charota resembles a coffee seed, therefore also known as wild coffee in India. Some other vernacular name is Foetida cassia, Ktanta, and chakaramarda in Indian languages[3]. *Cassia tora* regarded as safe for human consumption and used in the food industry for many years. The Ministry of health and welfare, Japan, European agencies like the commission Directive and Council Directive are government agencies that have been approved charota for use[4].

The pharmaceutical suspension is a biphasic colloidal formulation of insoluble drugs in a manufacturing vehicle. Generally, aqueous, organic, and oil vehicles are used to prepare suspension as manufacturing vehicles, essentially adding the suspending agent. The most used suspending agents are origin from a natural source. The suspension contains two phases one disperse phase (generally active pharmaceutical ingredient) and another continuous phase (manufacturing vehicle). The internal phase commonly presents solid-state and disperse uniformly throughout the vehicle (continuous phase) used to manufacture biphasic dosage form. The internal stress of the biphasic colloidal system makes suspension thermodynamically unstable and form flocculated or deflocculated suspension. Thus, it is necessary to include a suspending agent in suspension to reduce internal stress and sedimentation rate by increasing viscosity. One or more suspending agents are used to suspend insoluble particles (disperse phase) in manufacturing vehicles (continuous phase). The suspending agent also improves the redispersibility of suspension[5].

Many natural, semisynthetic, and synthetic compounds are applied as pharmaceutical suspending agents. The natural suspending agents are acacia, gelatine, tragacanth, sodium alginate, and carboxymethylcellulose[6]. The natural gums are chemically heteropolysaccharides of galactose and mannose, commonly known as galactomannans, which are commercially used as a thickening or gelling agent[7]. In the *Cassia tora* gum, mannose, galactose, and glucose were identified as major polysaccharides with approximately 75%, 15%, and 7% availability, respectively, confirmed by the HPLC study. The polysaccharide of *Cassia tora* also has a 1,4-beta-D-mannopyranose unit with 1,6 linked alpha-D-galactopyranose[8]. Thus, we hypothesized that the above property of *Cassia tora* gum is appropriate for suspending agents. Therefore, the current investigation is designed to evaluate the suitability of *Cassia tora* gum as a suspending agent for pharmaceutical formulation. The comparative studies were performed among *Cassia tora* gum and other naturally occurring suspending agents like gum acacia, tragacanth, and gelatine.

MATERIALS & METHODS

Drugs and Chemicals

Paracetamol was collected as a gift sample from PelTech Mumbai, India. Acacia, gelatine, tragacanth, and other chemical were purchased from Loba, Mumbai. *Cassia tora* seeds were collected from a secondary forest area of the Durg district of Chhattisgarh (India), and their gum was extracted in a laboratory. A detailed procedure was given in the next section.

Isolation of *Cassia tora* gum

Cassia tora seeds were collected from a secondary forest area of the Durg district of Chhattisgarh (India). Fully matured ripe pods and seeds were removed by physical means and subjected to cleaning. The only endosperm was taken, which contains mainly polysaccharides. Endosperm was defatted by using petroleum ether. Seeds of *Cassia tora* were dried in a shaded place, and then the size was reduced through a grinder and sieved. Powdered seeds were extracted in 500 ml of distilled water in a 1000 ml beaker, then heated and stirred continuously at 60 ^{0}C for approximately 1 h. The concentrated solution was obtained and subjected to cloth filtration through a muslin cloth. The solution was cooled at 4–6 ^{0}C. The resultant gum was precipitated by adding ethyl alcohol and then filtration through a muslin cloth. Collected gum was rewashed with ethyl alcohol and further dried at room temperature. The hard gum was stored in a desiccator for further use[9].

Formulation of suspension

The suspension was prepared with natural gums as a suspending agent at an investigating concentration of 2 to 4 % w/v. The paracetamol concentration was taken as a constant value (5% w/v) in every formulation (Table I). A total of 200ml formulation was prepared once a time. Propylparaben and methylparaben were used as a preservative at the concentration of 0.2% (w/v) and 0.02% (w/v), respectively. Propylene glycol and glycerine were added as a wetting agent at a 5% (w/v) concentration in all formulations.

Initially, natural investigational gum was dispersed in hot water at 70^{0}C and kept for 12 hours to allow proper swelling and dispersion. Paracetamol was wetted with glycerine and propylene glycol and dispersed in a gum solution with continued stirring with a mechanical stirrer (Remi, India) at 100 rpm for 30 minutes. As per general laboratory practice, the final product was transferred to the graduated glass cylinder and made up the final volume.

Evaluation of suspending properties

Sedimentation volume

An Anderson pipette was used to determine sedimentation volume at room temperature without any particular arrangement. A standard laboratory practice was strictly followed during the experiment. Each suspension was shaken to ensure uniform dispersion before the sedimentation study. The study was performed for 1 hour at a 5-minutes interval. The sedimentation value is calculated by dividing the ultimate volume of the sediment by the initial volume obtained in the Anderson pipette. The data were presented in percentage form. The data was reported as dividing the sediment's ultimate volume by the initial suspension volume multiplied by 100.

Rheological Study

Viscosity*:* Brookfield Synchroelectric Viscometer with spindle number 4 with gear speed 20 resolution per minute. The rate of shear calculates rheological behavior. Studies were performed at room temperature. The rate of shear v/s shearing stress was plotted to obtain a rheogram. Both up curve and down curve reading was taken.

Apparent viscosity*:* A 10 ml pipette was filled with resuspended suspension and placed in a vertical position with the help of the stand. Time was recorded for the complete drain of the formulation. The Apparent viscosity was expressed as the ratio of the suspension volume and the time required draining in seconds.

Resuspendibility

The resuspendibility of suspensions was evaluated qualitatively using an Anderson pipette. About 50 ml of test suspension was kept in Anderson pipette and left for 30 minutes for complete sedimentation.

The test was performed by shaking the cylinder using a laboratory-made 180º movable shaker. Recorded the numbers of movements required to convert the sediment to disperse suspension uniformly. The method essentially consisted of holding the sample tube straight in the upright position in the jaw of the instrument. The instrument provides uniform rotation to all samples. The number of shakes required for the complete elimination of sediment from the bottom was recorded.

The pH of the suspensions

A digital pH meter (Systronics, India) was used to determine the pH of each investigating formulation without any pretreatment.

Zeta Potential Determination

Malvern Zetasizer (MLA 500962, U.K.) was occupied with a computerized inspection system used for the purpose. All the measurements were performed at 27°C at an angle of 90° between laser and detector without any prior treatment[11]. Determination was based on Dynamic light scattering methodology.

In vitro dissolution study

In vitro dissolution studies of prepared suspensions were performed using United States Pharmacopeia (USP) dissolution apparatus (Electrolab, India) using paddle-type basket assembly. Tests were performed in 0.1 hydrochloric acids at a physiological temperature of 37±1◦C. A paddle rotation speed was set at 25 rotations per minute. An investigation suspension sample of about 10 ml was carefully introduced into the bottom of the vessel. About 5 ml of Dissolution media was withdrawn at the 5-minute interval by an automated sampler system. An equal quantity of fresh media was added immediately to the apparatus as a replacement. The dissolution study was performed for a total duration of 30-minute. The U.V. spectrophotometer was adopted to determine drug content in the collected sample at absorbance maxima at 430 nm.

Stability Studies

The stability of suspension prepared with *Cassia tora* gum was evaluated by measuring parameters; sedimentation volume, viscosity, flow measurement, redispersibility, pH, and dissolution studies for up to 6 weeks. Before measuring any parameters, suspensions were redispersed by shaking.

RESULTS AND DISCUSSION

A heat roasting process is typical to remove endosperm from the seed: husk and germ and brittle so easily removed by heat processing. The endosperm, which is encapsulated inside the seed, was obtained intact. *Cassia tora* seeds are brown, while gum was off-white to cream color with a fruity smell and neutral taste. Polysaccharide content was 78%, and the percentage yield of the gum was 11.8% using ethyl alcohol as precipitating solvent. The quantity of suspending agents in pharmaceutical suspension was not exceeded more than 4% of the total volume of manufacturing vehicles[14]. In the present investigation, 2-4% w/v was selected for the study; the concentration of other natural gum was also taken in this range for drawing a comparative conclusion.

The sedimentation volume of all experimentally prepared suspensions is reported in **Table 1** and presented in **Figure1**. In the initial 5 minutes of the study, the sedimentation volume of the suspension prepared with charota gum 2%, 3%, and 4% was 99, 98, and 95, respectively. This value was significantly higher than other prepared formulations. The sedimentation volume of acacia gum suspension at 2%, 3%, and 4% was 80, 85, and 85, respectively. The tested suspension prepared with gelatine produced only 55, 78, and 80 sedimentation volumes at 2%, 3%, and 4% respective concentrations of suspending agent. The apparent viscosity and flow rate of the suspension prepared with natural gums at different concentrations are shown in **Table 2**. The viscosity of suspension prepared with charota gum at 2%. 3% and 4% were found 2.23±0.02, 2.31±0.09, and 2.55±0.08 poise, respectively. The viscosity of suspension prepared with charota gum was higher than other tested suspensions. The order of viscosity of the suspensions formulation with natural gums was *Cassia tora*>*tragacanth*>*acacia* > gelatine.

The flow rate of suspension prepared with charota gum at 2%. 3% and 4% was found 0.990±0.07, 0.71±0.09 and 0.53±0.08 ml/sec, respectively. The order of flow rate of different suspension formulations was *Cassia tora*<tragacanth< acacia< gelatine. The well-accepted inverse proportional relationship between viscosity and flow rate was observed in the present study. In dispersibility study, visual, physical appearance tests and conventional shaking methods were performed. The result was tabulated in **Table 2**, which revealed that suspension prepared with *Cassia tora* and gelatine had better redispersibility than suspension prepared with acacia and tragacanth. The formulation was prepared with *Cassia tora* gum and gelatine redispersed in three shakes. About 8-10 times shaking was required to redispersed the suspension prepared with acacia gum, while other formulations were redispersed in only five shakes.

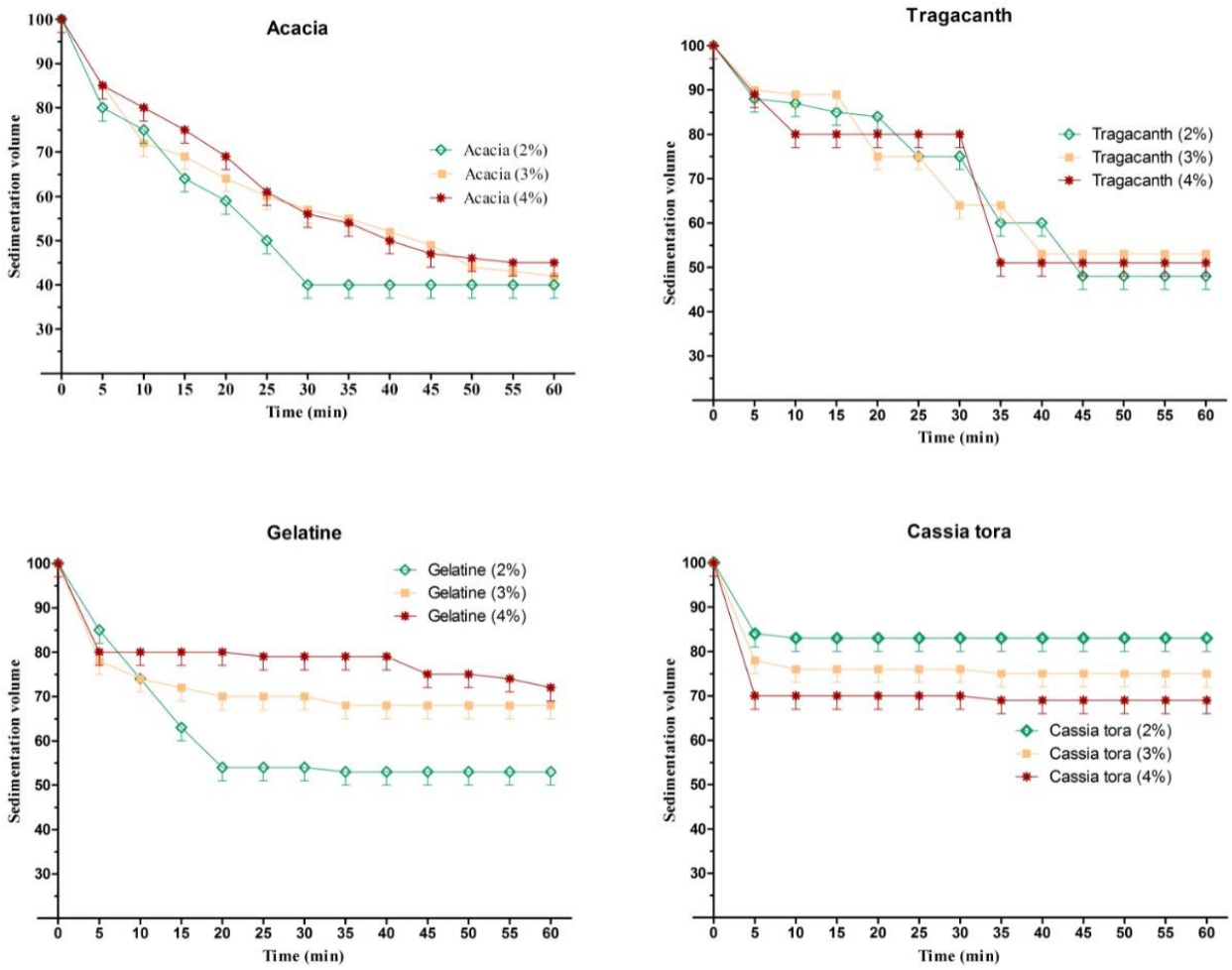

Figure 1 Sedimentation behavior of suspension prepared with natural gms. A faster constant sedimentation volume was found with charota gum. The sedimentation behavior of suspension prepared with tragacanth was complex. The suspension prepared with acacia needed a longer time for attending constant sedimentation volume. The sedimentation behavior of suspension prepared with gelatine was similar to cassia tora with lower sedimentation volume.

Table 1: Sedimentation volume of prepared suspensions

SN	Suspending Agent	% Used	Time in minute												
			0	5	10	15	20	25	30	35	40	45	50	55	60
1	Acacia	2	100	80	75	64	59	50	40	40	40	40	40	40	40
		3	100	85	72	69	64	60	57	55	52	49	44	43	42
		4	100	85	80	75	69	61	56	54	50	47	46	45	45
2	Tragacanth	2	100	88	87	85	84	75	75	60	60	48	48	48	48
		3	100	90	89	89	75	75	64	64	53	53	53	53	53
		4	100	89	80	80	80	80	80	51	51	51	51	51	51
3	Gelatine	2	100	55	55	55	54	54	54	53	53	53	53	53	53

		3	100	78	74	72	70	70	70	68	68	68	68	68
		4	100	80	80	80	80	79	79	79	79	75	75	74	72
4	*Cassia tora*	2	100	99	98	98	98	98	98	98	98	98	98	98	98
		3	100	98	96	96	96	96	96	95	95	95	95	95	95
		4	100	95	95	95	95	95	94	94	94	94	94	94	94

Table 2: Rheology, pH, zeta potential, and dissolution studies of prepared suspensions

S. N.	Suspending Agent	Percentage Used	Flow rate ml/Sec	Viscosity Poise	Redispersibility/ No of shake	pH	Zeta Potential	Percent drug dissolved within 30 min
1	Acacia	2	1.40±0.01	0.80±0.04	+/8	4.52±0.04	38.3	95.12±1.01
		3	1.19±0.04	0.90±0.06	+/9	4.61±0.07	35.1	93.56±1.05
		4	1.01±0.03	1.10±0.03	+/10	4.67±0.03	33.8	89.70±1.42
2	Tragacanth	2	1.17±0.06	1.23±0..08	+/5	4.10±0.09	22.2	96.90±1.91
		3	1.00±0.08	1.38±0.01	+/6	4.23±0.01	23.5	95.33±1.17
		4	0.86±.05	1.57±0.04	+/7	4.40±0.05	23.1	90.72±1.16
3	Gelatine	2	1.65±0.09	0.13±0.07	+/3	4.71±0.04	25.2	97.48±1.29
		3	1.42±0.06	0.14±0.06	+/3	4.78±0.06	24.6	96.64±1.38
		4	1.35±0.02	0.15±0.0	+/3	4.82±0.02	24.0	95..31±1.55
4	*Cassia tora*	2	0.90±0.07	2.23±0.02	+/3	6.0±0.03	18.2	97.81±1.80
		3	0.71±0.09	2.31±0.03	+/3	6.2±0.07	18.9	91.98±1.60
		4	0.53±0.08	2.55±0.08	+/5	6.3±0.01	19.8	82.92±1.72
All values represented as mean ± standard deviation, *n=3*								

Table 3a: Stability Studies of suspensions prepared with *Cassia tora*.(Sedimentation and Dissolution studies).

S.N	*Cassia tora* gum(%)	Sedimentation Volume						Percentage drug dissolved after storage					
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
1	2	98	98	99	97	97	99	97.81 ±1.17	97.74 ±1.22	97.70 ±1.19	97.67 ±1.17	97.64 ±1.27	97.60 ±1.08
2	3	96	96	95	96	95	95	91.98 ±1.32	91.85 ±1.37	91.80 ±1.44	91.77 ±1.40	91.69 ±1.24	91.62 ±1.21
3	4	94	94	94	93	94	93	92.82 ±1.36	82.89 ±1.27	82.83 ±1.29	81.80 ±1.05	81.71 ±1.11	80.60 ±1.18
All values represented as mean ± standard deviation, *n=3*													

Table 3b: Stability Studies of suspensions prepared with *Cassia tora* (Flow and Viscosity studies).

S.N	*Cassia tora* gum(%)	Apparent Viscosity						Viscosity Poise					
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
1	2	0.90 ±0.01	0.90 ±0.05	0.91 ±0.06	0.90 ±0.03	0.89 ±0.02	0.89 ±0.03	2.23 ±0.25	2.24 ±0.13	2.22 ±0.13	2.23 ±0.11	2.24 ±0.12	2.24 ±0.13
2	3	0.71 ±0.02	0.71 ±0.01	0.72 ±0.07	0.73 ±0.02	0.71 ±0.04	0.74 ±0.01	2.41 ±0.21	2.42 ±0.16	2.43 ±0.14	2.42 ±0.15	2.44 ±0.13	2.45 ±0.16
3	4	0.53 ±0.06	0.50 ±0.04	0.44 ±0.03	0.41 ±0.04	0.37 ±0.07	0.35 ±0.07	2.55 ±0.19	2.64 ±0.18	2.66 ±0.19	2.69 ±0.16	2.69 ±0.17	2.70 ±0.13
All values represented as mean ± standard deviation, *n=3*													

Table 3c: Stability Studies of suspensions prepared with *Cassia tora* (Redispersibility and pH studies).

S.N	*Cassia tora* gum(%)	Redispersibility/No of the shake						pH					
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
1	2	3	3	3	3	3	3	6.00 ±0.23	6.02 ±0.20	6.01 ±0.16	6.06 ±0.17	6.07 ±0.13	6.04 ±0.23
2	3	3	3	3	3	3	3	6.22 ±0.32	6.27 ±0.29	6.2 3±0.15	6.31 ±0.13	6.25 ±0.15	6.31 ±0.25
3	4	5	5	5	7	7	8	6.32 ±0.25	6.47 ±0.17	6.57 ±0.21	6.69 ±0.19	6.78 ±0.18	6.90 ±0.11
All values represented as mean ± standard deviation, n=3													

The result of the dissolution study is shown in **Table 2**. The dissolution of prepared paracetamol suspension was ranged from 82.0% to 98.0%. The entire formulation meets the USP specification, a value of not less than 80% within 20 minutes dissolve[19]. The pH value of the suspension prepared with *Cassia tora* gum was higher as compared to other formulations. The pH value of suspension prepared with *Cassia tora* gum was 6.0 to 6.3, while the pH of the formulation containing acacia, tragacanth, and gelatine was 4.10 to 4.82. The summary of results is tabulated in **Table 2**. The pH value of different concentrations (2%, 3%, and 4%) of *Cassia tora* suspension was 6.5, 6.6, and 6.7, respectively.

The highest zeta potential was found for suspension prepared with acacia gum in a range between -33.8 to -38.3 mv. The lowest zeta potential recorded for suspension prepared with charota gum and their range was -18.2 to -19.8 mv. Similarly, the zeta potential range of the suspension prepared with tragacanth and gelatine was -22.2 to -23.1 mv and -24.0 to -25.2 mv, respectively. The stability of suspension prepared with *Cassia tora* gum was evaluated by measuring parameters like sedimentation volume, viscosity, flow measurement, redispersibility, pH, and dissolution studies for up to 6 weeks. The results are shown in **Table 3a, 3b, 3c**. Formulations were not shown any significant changes in sedimentation volume and dissolution profile and passed the dissolution test within acceptable limits. The pH of the suspension prepared with *Cassia tora* was stable during storage. The pH changes in the samples were found to be insignificant. These results showed that the pH should be maintained close to the initial value during the stability study.

Natural polymers are commonly used excipients in colloidal formulations like emulsion and suspension[12]. The color and morphological characteristics of the collected seed were found similar to the information provided by Chhattisgarh Medicinal Plant Board. The good polysaccharide content of about 78% was found with an 11.8% yield. The previous report also supports the finding of the study. *Cassia tora* mainly contains rhamnose, fructose, arabinose, and xylose which constituted about 88.1% of total sugar content. Out of this pectin polysaccharide and hemicellulose is a main water-soluble fraction[13]. *Cassia tora* gum is soluble in both hot and cold water. At low concentration, it hydrated quickly to give viscous solutions and showed better viscosity than other polysaccharide solutions. This property makes it an effective suspending agent for a poorly water-soluble drug like

paracetamol. The viscosity of the suspension might be increased due to the formation of inter and intramolecular ester cross-links between pectin polysaccharides and other polymers. *Cassia tora* also has a large quantity of free carboxylic acid [13]. The previous report may support the hypothesis that *Cassia tora* gum swells in water and form a viscous colloid by making a gel-like structure in which dispersed drug particles are either entrapped or encapsulated. (, Hallagan)

The pattern of the sedimentation of suspension prepared with acacia and *Cassia tora* was quite similar with different sedimentation volumes. The sedimentation behavior of suspension prepared with tragacanth was quite complex, initial fast sedimentation was observed then a constant value was achieved. A suspension prepared with tragacanth could not produce a specific pattern of settlement of particles. The sedimentation volume of *Cassia tora* gum was higher than other tested natural gums. The order of results was *Cassia tora*> gelatine>tragacanth> acacia gum.

The relationship between flow rate and viscosity was found inversely proportional in all the prepared formulations. A suspension prepared with *Cassia tora* shows pseudoplastic rheological behavior. Viscosity decreases with an increase in shear rate, and this property is essential in suspension.

The fewer shakes required for the susceptibility of the suspension prepared with *Cassia tora* gum indicates its efficacy as a suspending agent. Redispersibilty in *Cassia tora* containing suspension showed that it can form the floccules and stabilize the paracetamol particles by increasing the viscosity of the suspension confirmed by previous reports[15,16]. The results conclude that suspension prepared with *Cassia tora* gum at low concentration (2%) exhibits a similar efficacy to that of other natural gums. No significant changes were observed for suspensions prepared with 2 and 3% of *Cassia tora* gum, but suspension prepared with 4% of *Cassia tora* showed a viscosity rise with a decreased flow rate. We hypothesized that the behavior exhibited by *Cassia tora* gum might be due to gelling effect, which is supported by increased numbers of shaking required for redispersibility. *Cassia tora* gum solutions are expected to non-newtonian pseudoplastic flow and initial viscosity is resbuilt immediately. This property helps with the pourability of colloidal pharmaceutical formulation[17]. The gel strength of *Cassia tora* is about 80 gm^{-10} that is sufficient for dispersion of poorly water-soluble drugs like paracetamol. *Cassia tora* gum posses non-ionic clonogenicity[18].

The release rate decreased with an increasing amount of suspending agent probably might be due to flakes formation or gelling effect in the system, which is evidenced by the high number of shaking required for detachment of the sediment. The relationship between the quantities of charota gum used with dissolution was found inverse. The faster dissolution rate was recorded with the low viscous formulation and vice versa, and viscosity directly increases with the concentration of the suspending agent. This effect is probably due to the formation of the tightly bound layer surrounding the drug particles.

The pH of all the prepared suspensions was below 7. The interesting noticeable point is that suspension prepared with charota gum was slightly acidic compared to the higher than other prepared suspensions with acacia, gelatine, and tragacanth. Suspension prepared with charota gum was found better because the slightly acidic nature of oral formulation is suitable for palatability, consumer acceptance, and long-term stability[20]. The order of zeta potential amplitude of the tested suspension formulation prepared with a different suspending agent was acacia>tragacanth>gelatine> *Cassia tora*. The lowest zeta potential was recorded for suspending agent *Cassia tora* possibly indicated floccules development|[10]. The flocculation is probably responsible for significant sedimentation volume gain by *Cassia tora* gum compared to another experimental suspending agent. The investigators aim to check out the suitability of charota gum as a suspending agent, therefore not maintain a constant level of pH and viscosity throughout investigating formulations.

The nature of cassia gum is non-ionic probably would be helpful for the long-term stability of prepared suspension[21]. No significant variation was found in the test parameters for prepared suspension with charota gum in a 6 weeks storage period. The suspending agent is added in the formulation to suspend the drug particles and to alter the sedimentation behavior of dispersed particles. The sedimentation behavior is changed by increasing the apparent viscosity of the continuous phase and thereby slowing down settling following Stokes Law[22]. *Cassia tora* is probably altering the sedimentation by increasing viscosity, flake formation, and gelling effect. *Cassia tora* meets the properties of ideal suspending agents; it has high viscosity at negligible shear, free-flowing during agitation, pouring, and spreadability.

The pharmaceutical investigator is always trying to find an alternative to a synthetic compound due to regularity guidelines. The specially focused area is a natural product because of safety reliability with traditional consumption of stabilized natural source than synthetic compound. Charota gum is one of them which has a lot of potential applicability in the field of pharmaceuticals. The present work is limited but the potential of *Cassia tora* is unlimited if explore in the medicinal field as an active pharmaceutical agent as well as an adjuvant.

CONCLUSION

The applicability of *charota* gum in a food product is well reported as a thickening agent, emulsification, foam stabilizer, moisture retention, and texture improvement. The suspension prepared with *Cassia tora* gum achieved desired flow properties and redispersibility for paracetamol at low concentration, which was stable throughout the storage period of 6 weeks under normal storage conditions. The prepared formulation is easily dispersed without lump formation with rapid polymer hydration. Therefore, *Cassia tora* may be used as a suitable suspending agent for pharmaceutical formulations. Safety data is also well reported for *Cassia tora* gum to reveal its applicability in a pharmaceutical formulation. The applicability may be extended to evaluate its suitability as a gelling agent, flocculating agent, and other similar pharmaceutical applications. Lots of investigations have been done concerning the safety of *Cassia tora* and are considered safe for human use also.

ACKNOWLEDGMENT
Not declared.

CONFLICT OF INTEREST
The authors declare that they have no known competing financial interests or personal relationships that could appear to influence the work reported in this paper.

DATA AVAILABILITY
Not declared.

AUTHOR'S CONTRIBUTION
All the authors have contributed substantially in the work, read the final version of the manuscript and approved the same.

ETHICS STATEMENT
The authors have taken all the necessary permissions as per ethical guidelines wherever applicable. The authors will be responsible for all the technical content mentioned in the manuscript. Journal and Publisher will not be responsible for any copyright infringement and plagiarism issues.

FUNDING STATEMENT
Declared none.

ABBREVIATIONS
Not applicable

REFERENCES
1. Sarwa KK, Patel D, Rudrapal M, Bhattacharya S, Saraf S, Jain V, Joshi V, Pandey R, Vyas A (2021) Standardization and Quality Evaluation of Botanicals with Special Reference to Marker Components. In: Evidence Based Validation of Traditional Medicines. Springer, Singapore.
2. Singh S, Bothara SB (2014) Manilkara zapota (Linn.) Seeds: A Potential Source of Natural Gum. ISRN Pharm 2014:647174. doi:10.1155/2014/647174
3. Sarwa KK, Rudrapal M, Debnath M, Kumar A, Verma VK (2014) Phytochemical and Biological Potential of *Cassia tora* Linn. European J Med Plants 4(8):946–63.
4. Mahungu S, Meyland I (2008) *CASSIA GUM* Chemical and Technical Assessment. Published by Food and Agriculture Organization of The United Nations. Available Via http://www.fao.org/fileadmin/templates/agns/pdf/jecfa/cta/71/cassia-gum.pdf. Accessed 07 Jun 2021.
5. Morrison JT, Lugo RA, Thigpen JC, Brown SD (2013) Stability of extemporaneously prepared lansoprazole suspension at two temperatures. J Pediatr Pharmacol Ther JPPT Off J PPAG 18(2):122–127. doi:10.5863/1551-6776-18.2.122
6. Choudhary PD, Pawar H.A. (2014) Recently Investigated Natural Gums and Mucilages as Pharmaceutical Excipients: An Overview. J Pharm 2014:204849. doi:10.5863/1551-6776-18.2.122
7. Pawar H, Varkhade C, Jadhav P, Mehra K (2014) Development and evaluation of orodispersible tablets using a natural polysaccharide isolated from *Cassia tora* seeds. Integr Med Res 3(2):91–98.
8. Hallagan J.B., La Du BN, Pariza MW, Putnam JM, Borzelleca JF (1997) Assessment of cassia gum. Food Chem Toxicol an Int J Publ Br Ind Biol Res Assoc. 35(6):625–632.
9. Farooq U, Malviya R, Sharma PK (2014) Extraction and characterization of Artocarpus integer gum as a pharmaceutical excipient. Polim Med 44(2):69–74.
10. Tripathi DK (2015) Industrial Pharmacy: A Comprehensive Approach. Pharma Med Press, Hyderabad.
11. Sarwa K.K., Mazumder B, Suresh PK, Kaur CD (2016) Topical Analgesic Nanolipid Vesicles Formulation of Capsaicinoids Extract of Bhut Jolokia (Capsicum chinense Jacq): Pharmacodynamic Evaluation in Rat Models and Acceptability studies in Human Volunteers. Curr Drug Deliv 13(8):1325–1338.
12. Ko YG, Choi US (2012) Gelation of natural polymer dispersed suspensions under electric field. Soft Matter 8(2):253–259. doi: 10.1039/C1SM06400B.
13. Huang YL, Chow CJ, Tsai YH (2012) Composition, characteristics, and in-vitro physiological effects of the water-soluble polysaccharides from Cassia seed. Food Chem 134(4):1967–1972. doi:10.1016/j.foodchem.2012.03.127.
14. Moreton, R. C. (2010) Commonly used excipients in pharmaceutical suspensions. In: Pharmaceutical Suspensions: From Formulation Development to Manufacturing. Springer, New York.
15. Banerjee C, Ghosh S, Sen G, Mishra S, Shukla P, Bandopadhyay R (2014) Study of algal biomass harvesting through cationic cassia gum, a natural plant based biopolymer. Bioresour Technol 151:6–11. doi:10.1016/j.biortech.2013.10.035.
16. Salehizadeh H, Yan N, Farnood R (2018) Recent advances in polysaccharide bio-based flocculants. Biotechnol Adv 36(1):92–119. doi:10.1016/j.biotechadv.2017.10.002.
17. Miyoshi E, Nishinari K (1999) Non-Newtonian flow behaviour of gellan gum aqueous solutions. Colloid Polym Sci 277(8):727–34. doi:10.1007/s003960050446
18. Saha D, Bhattacharya S (2010) Hydrocolloids as thickening and gelling agents in food: a critical review. J Food Sci Technol 47(6):587–597. doi:10.1007/s13197-010-0162-6
19. Anand O, Yu LX, Conner DP, Davit B.M. (2011) Dissolution testing for generic drugs: an FDA perspective. AAPS J 13(3):328–35. doi:10.1208/s12248-011-9272-y
20. Večeř M, Pospíšil J (2012) Stability and Rheology of Aqueous Suspensions. Procedia Eng 42:1720–1725.

doi:10.1016/j.proeng.2012.07.564.

21. Yokosawa M M, Pandolfelli VC, Frollini E. (2002) Influence of pH and time on the stability of aqueous alumina suspensions containing sodium polyacrylates: A revisited process. J DISPER SCI TECH *23*(6):827–836. doi:10.1081/DIS-120015979.
22. Singh BP, Menchavez R, Takai C, Fuji M, Takahashi M (2005) Stability of dispersions of colloidal alumina particles in aqueous suspensions. J Colloid Interface Sci 291(1):181–186. doi:10.1016/j.jcis.2005.04.091.

Indo Global Journal of Pharmaceutical Sciences(ISSN 2249 1023; CODEN- IGJPAI; NLM ID: 101610675) indexed and abstracted in CrossRef (DOI Enabling), CNKI, EMBASE (Elsevier), National Library of Medicine (NLM) Catalog (NCBI), ResearchGate, Publons (Clarivate Analytics), CAS (ACS), Index Copernicus, Google Scholar and many more. For further details, visit http://iglobaljournal.com