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EVALUATION OF *ACACIA AURICULIFORMIS* MUCILAGE AS TABLET BINDER

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ABSTRACT

Background: Gums and mucilages have been used as binding agent due to its non toxicity, low cost, emollient, and non irritating agent. The *Acacia auriculiformis Linn* fruits, family, *Leguminaceae*, mucilage is used as gum for pasting sheets of paper and card board. **Aim:** The present study is an attempt to investigate the efficacy of *A. auriculiformis* fruit mucilage as tablet binder. **Methods:** The mucilage was screened phytochemically for detection of mucilage and physiochemical characteristics of mucilage were studied. The heavy metal study in soil, study of toxicity, gum-experimental tablet excipients interactions using Fourier transform infrared spectroscopy and Differential Scanning Colorimetry ensured its safe use as a tablet binder. Tablets were manufactured using Paracetamol as model drug and granules were prepared by wet granulation method with different concentration (6, 8, 10, 12 and 14% w/v) of mucilage as tablet binding agent. The prepared granules were evaluated for percentage of fines and flow properties. A comparison was made against the tablets prepared with 10 % w/v poly vinyl pyrrolidone paste as standard binder, based on studying the standard parameters like hardness, thickness, friability, weight variation, disintegration time and *in vitro* dissolution. **Results:** The tablets had good tablet physiochemical properties and the drug release was more than 99 % within 1.8 h. *A. auriculiformis* at 10 % w/v was found to be effective as tablet binder. All the formulations were subjected to stability studies and showed stable with respect to tablet parameters.

Conclusion: Thus *A. auriculiformis* gum will be a non-toxic, biodegradable, economic and easily available option as tablet binder.

KEYWORDS: *A. auriculiformis*, mucilage, tablet binder, hardness, Pharmaceutical excipient.

INTRODUCTION

Excipients are the additives used to convert active pharmaceutical ingredients into pharmaceutical dosage form suitable for administration to patients[1]. In the modern era mucilage widely used in pharmaceutical industries as tablet binders, emulgents and thickeners in cosmetics and suspensions as film-forming agents and traditional colloids[2,3]. Binders are pharmaceutical excipient that are commonly employed in tablet formulation to impact cohesion on the powder mix and hence improves on the flow properties on the granules[4]. Natural gums are either water soluble or absorb water to form a viscous solution. Natural gums are economic, easily available and found useful as tablet binder[5]. *A. auriculiformis* is a large shrub or medium-sized, evergreen tree, usually 8-20 m tall, on good sites up to 35 m. Bark grey or brown, longitudinally fissured. Leaves (phyllodes) 8-20 cm long, glabrous and curved, with 3 prominent nerves (four in *A. mangium*). Flowers bisexual, creamy yellow, scented, in up to 8.5 cm long spikes. Fruits are flat, dehiscent, somewhat woody pod, 6.5 cm long, 1.5 cm wide, strongly curved and with undulate margins. Seeds are shiny black or brown, encircled by a long, red or yellow funicle. There is 55,000-75,000 seeds/kg[6-9]. To the best of our knowledge, no significant work has been reported on systematic and scientific study of *A. auriculiformis* gum as tablet binder.

MATERIAL AND METHODS

Paracetamol was procured as gift sample from Cipla Pharma Ltd., Mumbai, India. Chemicals used for tablet manufacturing are polyvinyl pyrrolidone (PVP), lactose monohydrate, starch, talc and obtained from E. Merck (India) Ltd., Mumbai, India. All other chemicals were used of analytical grade and procured from authorized supplier.

Heavy metal study in soil

The heavy metal study in soil from where plant collected was studied to assure the absence of heavy metal in soil, as presence of heavy metal in soil may lead to presence of heavy metal in plant extract, which may cause toxicity in living body. The heavy metal study was done as per the standard procedure of limit test for lead and arsenic[10].

Collection, authentication and extraction of mucilage from *A. auriculiformis*

The plant material *A. auriculiformis* fruits were collected from local area of Koraput in the month of June. The plant was identified and authenticated by the Biju Pattnayak Medicinal Plants Garden and Research Centre, Dr. M.S. Swami Nathan Research Foundation, Jeypore, Koraput (Dt), Odisha (Letter no. MJ14/DBT/235, dt. 19.01.2014). The fruits were soaked in distilled water, shaken for 8 to 10 h and filtered. The filtrate was gently heated in heating mantle at 45ºC to get a concentrated viscous solution. The aqueous viscous solution was treated with absolute alcohol (95% ethanol) in the ratio 1:2 with continuous stirring[11,12]. The coagulated mucilage which formed as a white mass was filtered in muslin cloth, transferred to an evaporating disc and treated successively with ethanol. The coagulated mucilage mass was dried in hot air oven at 40-50°C for 2 to 3 h. The dried product was grinded, powdered and passed through sieve (Sieve no 120) and the obtained dried mucilage powder was stored in an air tight container for further study.

Phytochemical Analysis

For the detection of the presence of carbohydrates and reducing sugars the standard tests Molisch's test for carbohydrate [13,14] and reduction of Fehling's solution for reducing sugars[15] were done. In short, in Molisch's test, the gum was treated with α-naphthol and concentrated sulphuric acid, which gave violet ring at the junction of two layers. In case of the detection of reducing sugars to the *A. auriculiformis*fruit mucilage, equal quantity of Fehling's solution [15]. The presence of tannin was tested upon treating the gum with ferric chloride solution. There was no black precipitation for tannin with ferric chloride solution. The presence of mucilage was tested by treating the mucilage with ruthenium red solution and Banzidine solution[12,13], formation of pink colour with Ruthenium red and blue colour with Benzidine solution indicate the presence of mucilage. To know whether the *A. auriculiformis* mucilage contains the enzymes, it was treated with few drops of hydrogen peroxide, no blue color formation indicate the absence of enzymes. The phytochemical properties such as presence of protein, flavanoids, sterols, alkaloids, saponins, glycoside, resin, phenol and terpenoids were determined[15,16].

Microbial content determination

About 1 g of *A. auriculiformis* mucilage was dissolved in 9 ml of sterile distilled water. Serial dilutions were made and viability assessed using pour plate method. For detection of fungal growth in sample, sodouraud dextrose agar medium was used. The plates were incubated at

27°C for 72 h.[15,16] Casein digest agar medium was used. The plates were incubated at 37°C for 24 h [17].

Acute toxicity study

The method was performed according to the OECD test guide line for testing of chemical TG423. The study protocol was approved by the Institutional Animal Ethics Committee (Regd. No. JCP / 07 / 60 / IAEC / 0013). To study the toxic effect (if any) of *A. auriculiformis* mucilage, the toxicity study was conducted on 12 male Swiss Albino mice with an average weight of 20-25 g. The animals were housed in polypropylene cages at 25±2°C/ 60% relative humidity in normal day and night photo cycle. The animals were fastened for 12 h before oral administration of the mucilage solution but allowed access to water *ad libitum*. The animals were given 5 ml of mucilage orally and were monitored for 24 h [18,19]. The animals are then had free access to basal diet and continued administration of 5ml mucilage orally daily for 7 days and were observed for one month.

Physicochemical properties of dried mucilage

The physicochemical properties such as color, odour, taste, solubility, pH, melting point, particle size distribution by optical microscopy, flow properties (Angle of repose and Carr's index), specific gravity and viscosity of dried mucilage were determined at 20ºC. The viscosity of the expressed mucilage was done by Brooke field viscometer [20] (Brook Field Engineering Labs. Inc. USA). The moisture content, loss on drying, total ash content, acid insoluble ash, water soluble ash and foreign organic matter were determined according to Ayurvedic Pharmacopoeia of India[21].

Drug excipient compatibility studies

Fourier Transform Infrared Spectroscopy (FTIR) study

To study the gum and experimental tablet excipient interaction[22], the pure gum, the tablet excipients without gum, the pure drug Paracetamol and a mixture of the gum and experimental tablet excipients were mixed separately with IR grade KBR in the ration 100: 1. The well ground and mixed powdered samples were compressed into pellets by applying 5.5 metric tons of pressure in a hydraulic press and pellets were scanned over a wave number of 4000 to 400 cm^{-1} in a FTIR instrument (840, Shimadzu, Japan).

Differential Scanning Colorimetric (DSC) study

DSC was performed on a Shimadzu DSC-60 (Shimadzu, Japan). A 1:1 ratio of drug and excipient was weighed into aluminum crucible and sample was analyzed by heating at a scanning rate of 100°C/min over a temperature range 200-3000°C under a nitrogen flow of 40ml/min. Reproducibility was checked by running the sample in triplicate[23].

Tablet formulation development and preparation of granules

Various tablet formulations (F1 to F5) were done by wet granulation technique using Paracetamol I.P. as model drug and different concentrations (6, 8, 10, 12 and 2% w/v) of *A. auriculiformis* mucilage. Formulation F6 was formulated by using poly vinyl pyrrolidone paste (10% w/v) as standard binder. Then drying was done in hot air oven at 45°C for 30 min and air dried granules were kept for two days. Again granules were sieved through sieve no.16. Lactose was used as diluents[24-27].

Evaluation of granules

The prepared granules were then evaluated for percentage of fines, particles size by optical microscopy and flow properties by measurement of angle of repose.[27-29]. The bulk and tapped densities of the granules were then assessed in accordance with the USP XXV tapped volume meter apparatus. The compressibility index of the granules was determined by Carr's compressibility index[28,29].

Compression of granules into Tablets

The granules were then mixed with extragranular excipients like starch (5% w/w) used as disintegrant, magnesium stearate (1% w/w) used as lubricant, talc (1% w/w) was used as glidants and flow promoters [24]. The lubricated granules were compressed into tablet using 8 mm biconcave punch with 10 station single punch (Cad Mack Ltd. Mumbai, India) tablet punching machine and average weight of each tablet was kept 200 mg.

Quality control test on the tablets

Hardness

Hardness study was conducted by following the guidelines of the USP-NF, 2002[30]. Six tablets were taken and hardness of each tablet of each batch was measured by Monsanto type Hardness Tester (Campbell Electronics Company, Mumbai, India).

Thickness and Diameter

The study of the tablet thickness was conducted by the following USP guidelines (The USP-NF, 2002) [30]. For these fifteen tablets were taken for each batch and thickness were measured by using Digimatic caliper, Mitutoyo Corporation, Japan.

Friability

Friability testing (The USP-NF, 2002) was done by using 6 tablets for each batch by using Friability Test Apparatus (Campbell Electronics, Mumbai, India)[30].

Weight Variation

Weight variation study was conducted by following guidelines of USP. In short 20 tablets were taken and they were weighed together and individually in electronically digital balance. The individual weight variations were studied from the mean weight of each set. Four such sets were run [30].

Disintegration Test

Test for disintegration was done by taking 6 tablets in each batch by using USP tablet disintegration testing apparatus (Electro lab / ED – 2L, Mumbai, India) by controlling the temperature at 37±0.5°C by following USP guidelines [30].

Drug content

About 20 tablets were selected randomly from each formulation, weighed. The weighed tablets were powdered. The powder equivalent to 100 mg of Paracetamol was accurately weighed and dissolved in phosphate buffer pH 6.8. After suitable dilution, the solution was analyzed for drug content by using UV-Visible spectrophotometer (Shimadzu UV 1700, Japan) at 243 nm.

In vitro dissolution study

In vitro dissolution studies of Paracetamol sodium tablets were performed using USP XXIII eight station dissolution apparatus type II (Electrolab TDT-08L, Mumbai, India) at 50 rpm in phosphate buffer pH 6.8 (900ml) medium at the temperature 37 ± 0.5°C. At intervals of 15 minutes, 5ml of samples were withdrawn and filtered through Whatmann filter paper No.41. The withdrawn sample was replaced with fresh dissolution media. The samples were then analyzed after suitable dilution by UV-Visible spectrophotometer (Shimadzu UV 1700, Japan) at 243 nm [30].

Accelerated stability study

The stability of the best formulated tablet (Optimized) of *A. auriculiformis* mucilage was tested at various storage conditions *viz.*25°C/60% RH, 30°C/65% RH and 40°C/75% RH as per ICH guidelines and various physicochemical parameter (Appearance, percentage drug content and release profile) were monitored periodically for 3 months[31].

Statistical analysis

Statistical data analyses were performed using the mean, standard deviation, standard error of mean and one way ANOVA at 5 % level of significance $p < 0.05$[32,33].

RESULTS AND DISCUSSION

No such significant amount of heavy metals like lead and arsenic was found in the soil as shown in Table 1 [10], which assured absence of heavy metal in plant extracts, demonstrated preliminarily that plant extract could be non toxic for living body which was further confirmed by acute toxicity study. The mucilage of *A. auriculiformis* was successfully extracted by using ethanol (95%) and the yield was 38.51 %[11]. Table 1 shows the phytochemicals detected in *A. auriculiformis* fruit extract. Upon various chemical tests for carbohydrate, the gum showed the presence of carbohydrate in it. Formation of yellow colour precipitate on reduction of Fehling's solution indicates that the gum contains reducing sugar. The presence of carbohydrate was further substantiated with the positive result (Formation of violet ring at the junction of α-naphthol in alcohol and concentrated sulfuric acid upon molisch's test [12]. Moreover, the gum was found to be devoid of tannin upon ferric chloride solution and mucilage upon ruthenium red solution and benzidine solution respectively. The mucilage also showed positive test for alkaloids, glycosides and flavonoids.

The result of microbial content (Table 2) showed that the microbial content of mucilage was within the microbial limit, which assured that the mucilage will not cause contamination with microbes in tablet formulations during storage condition [16]. Acute toxicity studies were conducted according to OECD guidelines no.423. The results shows that there is neither abnormal behavioral nor death which show no toxicity induced from *A. auriculiformis* mucilage [18]. Moreover, this fruit has been traditionally used by the native people without reporting any toxic manifestations. Thus it can be claimed that the gum is safe for use and in particular, the amount used here is very safe. The result of physicochemical properties of dried mucilage is given in Table 2. All physicochemical data were found within the standard limit as per the specification mentioned under standardization of herbal drug in Ayurvedic

Pharmacopoeia [21]. The viscosity of the freshly expressed mucilage is found to be 158.2±0.42 (Table 2), which indicate that the mucilage is colloidal in nature following non-Newtonian bodies [23], which do not settle down quickly. Chemical-Chemical interactions are studied using sophisticated instrument like FTIR Spectroscope [22]. In the present study, interactions between the *A. auriculiformis* gum (natural gum), the other experimental tablet excipients and model drug Paracetamol have been studied using FTIR spectra (Fig 1D). Fig 1A depicts the FTIR spectrum of Acacia gum, Fig 1B shows the spectrum of the tablet excipients without the Acacia gum and Fig 1C shows the spectrum of model drug Paracetamol. The distinct peaks of Paracetamol in Fig IC (3255.95 cm^{-1}, 2538.41 cm^{-1}, 767.69 cm^{-1} and764.48 cm^{-1}) were retained in the spectrum of the physical mixture. The distinct peaks of excipient Fig 1B (2920.32 cm^{-1}, 2850.88 cm^{-1}, 2511.4 cm^{-1}, 1795-79 cm^{-1}, 1537.32 cm^{-1}, 1471.74 cm^{-1} and 1168.9 cm^{-1}) were retained in the spectrum of physical mixture. Similarly on peak to peak matching in the region of 1700-750 cm^{-1} of the spectrum of gum *A. auriculiformis* (Fig 1A and Fig 1D)[34,35]. It was concluded that there is no interaction between the drug, excipient and gum *A. auriculiformis*.

The thermograms (Fig 2) being obtained by Differential Scanning Colorimetric (DSC) study of drug and mucilage of *A. auriculiformis* shows that there is no change in melting point which confirms that there is neither change in crystallinty of the drug nor any interaction.

After studying the toxicity, possible chemical composition and chemical-chemical interaction, the gum was selected as tablet binder and tablets were formulated with various proportions (Table 3) of this gum. The standard poly vinyl pyrrolidone paste was also used as binder to another batch as standard control (F6).

The prepared granules were evaluated for percentage of fines, particles size by optical microscopy and flow properties by measurement of angle of repose and the result are given in Table 4. It was observed that percentages of fines were reduced as the concentration of mucilage of *A. auriculiformis* was increased. The percentage of fines was little higher in granules prepared using 6 % of mucilage as binder. The bulk density was found in the range of 0.43±0.35 to 0.51±0.82 g/cc. Bulk densities of the prepared granules were found to decrease slightly by increasing the concentration of mucilage. This result may be due to the formation of larger agglomerates and decrease in fines in the granules, as increasing mucilage of *A. auriculiformis* concentration. The granules of all tablet formulations had Hausner's ratio of 1.1304 or less indicating good flowability. The Carr's index was found between 5.554 to

11.54, demonstrating good flow property. The good flowability of the granules was also evidenced with angle of repose within range of 21.1±0.49 to 24.7±0.77º, which is below 30° indicating good flowability.

The diameter (7.91±0.05 to 7.98±0.11 mm) and thickness (3.85±0.09 3.91±0.08 mm) of all tablet formulations was almost same (Table 5). The hardness of all tablet formulation was ranges from 2.83±0.24 to 5.13±0.21 kg/cm^2. Hardness of tablet formulations increased with increase in concentration of mucilage. The tablets (F3) prepared with 6.0% w/v of *A. auriculiformis* mucilage showed the hardness (4.93±0.12 kg/cm^2) nearly equal to the hardness (5.13±0.21 kg/cm^2) of tablets (F6) prepared by using 10.0% w/v of poly vinyl pyrrolidone paste (Standard binder). All the batches of tablet exhibited equal uniformity in weight (200±0.73 to 201±0.76 mg). The friability of all tablet formulation was ranges from 0.73±0.11 to 0.89±0.18 %. All tablet formulations passed friability test as per Pharmacopoeial limits of USP-2002, as percentage loss on friability was less than 1%. Disintegration time of all tablet formulation was ranges from 12.4±0.19 to 16.5±0.14 min. Disintegration time of tablet formulations increased with increase in concentration of mucilage. The tablet formulation (F3) prepared with 10.0% w/v of *A. auriculiformis* mucilage showed the disintegration time (14.5±0.16 min) almost equal to the disintegration time (16.5±0.14 min) of tablets (F6) prepared by using 10.0% w/v of poly vinyl pyrrolidone paste (Standard binder). As per Pharmacopoeial limits of USP-2002, one conventional tablet should disintegrate within 15 min. Thus all the tablet formulations passed the disintegration test. All the batches of tablet exhibited good uniformity in drug content (98.1±0.58 to 99.1±0.7 %). The maximum drug content (99.1±0.7 %) was achieved with tablet formulation F3 using 10 % w/v of *A. auriculiformis* mucilage as tablet binder. *In vitro* dissolution study showed that drug released from the tablet formulations, prepared by using *A. auriculiformis* mucilage at five different concentrations was more than 90 % in 1.8 h (Fig 3). Except formulation F5 (92.42±0.9%), all tablet formulation showed better drug release profile (94.5±0.7 to 99.43±0.8 %) as evident from Table 5. The tablet formulation F3 released drug 99.43±0.8 % in 1.8 h. Thus it can be concluded that *A. auriculiformis* mucilage can be a suitable and cheaper option as a tablet excipient in particular, as a tablet binder.

The tablet formulation F3 containing 10 % w/v of *A. auriculiformis* mucilage was the optimized tablet formulation as it showed satisfactory hardness, disintegration time and drug

release profile (As per Pharmacopoeial limits of USP-2002) as compared with tablet formulation (F6) containing 10 % w/v poly vinyl pyrrolidone paste as standard binder

The stability study of optimized tablet formulation was carried out at 25°C/60% RH, 30°C/65% RH and 40°C/75% RH as per ICH guidelines. The tablets were found to be stable at such condition; other parameters were found to be unaffected and were under Pharmacopoeial limits of USP-2002.

Table 1: Heavy metal study in soil and preliminary phytochemicals investigation of *A. Auriculiformis*mucilage.

Active constituents	***A.auriculiformis* mucilage**	**Active constituents**	***A.auriculiformis* mucilage**
Lead	-	Alkaloids	+
Arsenic	-	Triterpenoids	-
Carbohydrates	+	Glycosides	+
Proteins	-	Fats & Oils	-
Tannins	-	Resins	-
saponins	-	Phenols	-
Sterols	-	Flavonoids	+

The + sign indicates present and – sign indicates absence.

Table 2: Microbial content test and physicochemical properties of *A. Auriculiformis* mucilage.

Parameters	***A.auriculiformis* mucilage**	**Parameters**	***A.auriculiformis* mucilage**
Bacteria	-	Viscosity (1.0% w/v) in cps (X±SD)	158.2±0.42
Fungi	-	Loss on drying (%) (X±SD)	5±0.166
Solubility	In water, ethanol, methanol, acetone and chloroform	Specific gravity (g/ml of 1.0% w/v) (X±SD)	0.889±0.139
Particle size (µm) (X±SD)	243.106±1.022	Moisture content (%) (X±SD)	7.045±0.166
Angle of repose (°) (X±SD)	44.29±0.064	Swelling index (%) (X±SD)	8.8±0.325
Carr's Index (%) (X±SD)	28.094±0.135	Total ash (%) (X±SD)	17.033±0.145
Foreign organic matter (%)	0.03	Acid insoluble ash (%) (X±SD)	13.56±0.563
pH (X±SD)	6.163±.188	Water soluble ash (%) (X±SD)	4.233±0.284

The - sign indicates absence. All values are represented as mean ± standard deviation (n = 3). Standard error of mean < 0.621.

Table 3: formulation design of paracetamol tablets using *A. Auriculiformis* mucilage as binder.

Sl. No.	Ingredients (mg)	Formulations					
		F_1	F_2	F_3	F_4	F_5	F_6
1	Paracetamol	100	100	100	100	100	100
2	Starch	20	20	20	20	20	20
3	Lactose	60	56	52	48	44	52
4	*A. auriculoformis*	12	16	20	24	28	_
5	PVP	_	_	_	_	_	20
6	Magnesium stearate	4	4	4	4	4	4
7	Talc	4	4	4	4	4	4
Total weight		200	200	200	200	200	200

Table 4: Characterization of granules prepared from *A. Auriculiformis* mucilage and poly vinyl pyrrolidone.

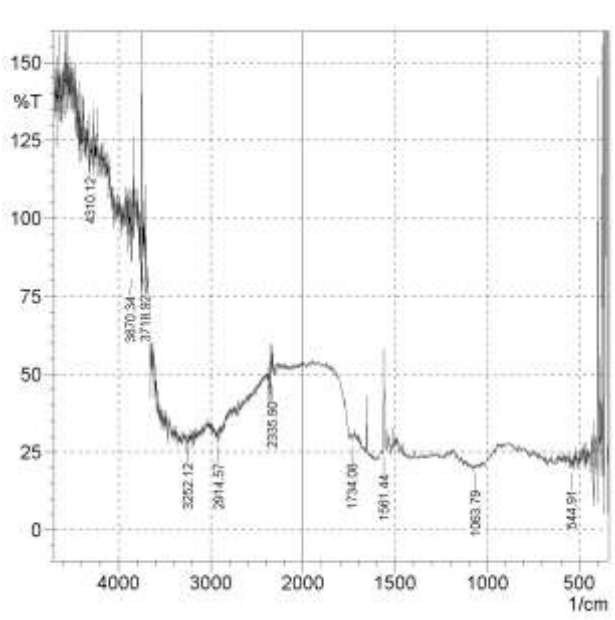
Parameters	Formulations					
	F1	F2	F3	F4	F5	F6
Percentage fines (%) (X±SD)	22.1±0.22	19.2±0.18	18.3±0.11	14.9±0.35	10.9±0.23	17.2±0.19
Granule size (mm) (X±SD)	0.33±0.55	0.41±0.89	0.38±0.67	0.41±0.77	0.38±0.86	0.42±0.88
Bulk density (g/cc) (X±SD)	0.43±0.35	0.46±0.47	0.47±0.55	0.51±0.82	0.47±0.44	0.49±0.73
Tapped density (g/cc) (X±SD)	0.48±0.22	0.52±0.81	0.52±0.72	0.54±0.92	0.55±0.44	0.57±0.65
Carr's Index (%)	11.54	9.896	10.487	8.190	10.487	5.554
Hausner's ratio	1.1304	1.1098	1.1236	1.0892	1.1236	1.0588
Angle of repose (°) (X±SD)	22.6±0.61	21.4±0.67	21.1±0.82	24.7±0.77	21.1±0.49	23.5±0.85
Flow comments	Good	Good	Good	Good	Good	Good
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	14.89043	5	2.978087	0.034199	0.049934	2.477169
Within Groups	3134.885	36	87.08015			
Total	3149.776	41				

The values are represented as mean ± standard deviation (n = 3). Standard error of mean < 0.531.

Table 5: Evaluation of various paracetamol tablet formulations.

Parameters	Formulations					
	F1	**F2**	**F3**	**F4**	**F5**	**F6**
Diameter(mm) (X±SD)(n=15)	7.98±0.07	7.93±0.08	7.94±0.03	7.91±0.05	7.97±0.12	7.98±0.11
Thickness (mm) (X±SD)(n=15)	3.98±0.07	3.85±0.09	3.91±0.08	3.89±0.06	3.86±0.04	3.88±0.09
Hardness (Kg/cm^2) (X±SD)(n=6)	2.83±0.24	3.83±0.24	4.93±0.12	4.67±0.11	4.67±0.23	5.13±0.21
Weight variation (mg) (X±SD)(n=20)	201±0.71	200±0.73	200±0.73	201±0.67	200±0.9	201±0.76
Friability (%) (X±SD)(n=6)	0.89±0.18	0.78±0.29	0.88±0.18	0.78±0.09	0.75±0.08	0.73±0.11
Disintegration time (min) (X±SD)(n=6)	12.4±0.19	13.6±0.28	14.5±0.16	15.4±0.26	16.2±0.30	16.5±0.14
Drug content (%) (X±SD)(n=3)	98.2±0.69	98.1±0.58	99.1±0.7	98.5±0.56	99.0±0.43	98.9±0.45
Cumulative % drug release (1.8 h study) (X±SD)(n=3)	94.6±0.96	95.6±1.1	99.43±0.8	94.5±0.7	95.9±0.6	95.6±1.0
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	12.22737	5	2.445473	0.000468	0.041672	2.437693
Within Groups	219700.2	42	5230.958			
Total	219712.5	47				

All values are represented as mean ± standard deviation. Standard error of mean < 0.635.



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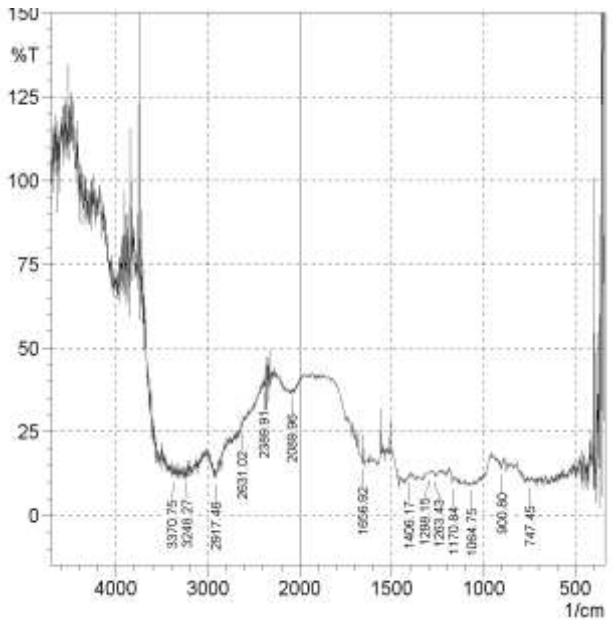

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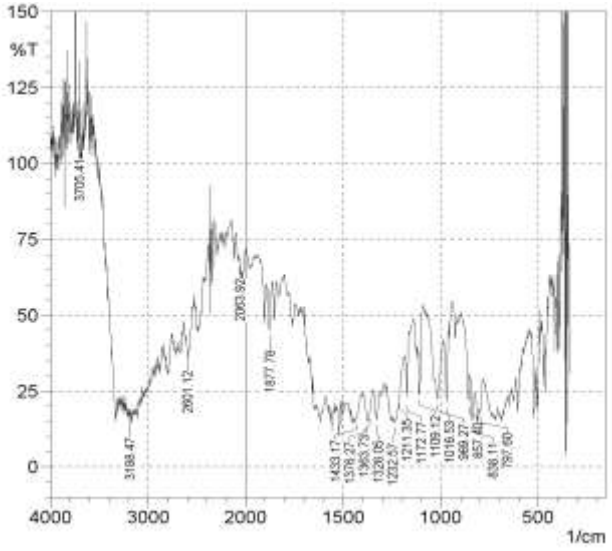

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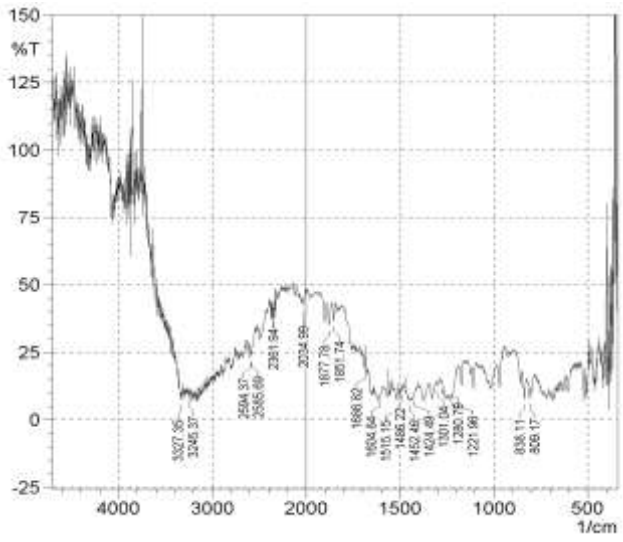

(D)

Figure 1: FTIR spectrum of (A) *A. auriculiformis* mucilage, (B) excipients without *A. auriculiformis* mucilage, (C) Paracetamol and (D) Tablets excipients, *A. auriculiformis* mucilage along with Paracetamol.

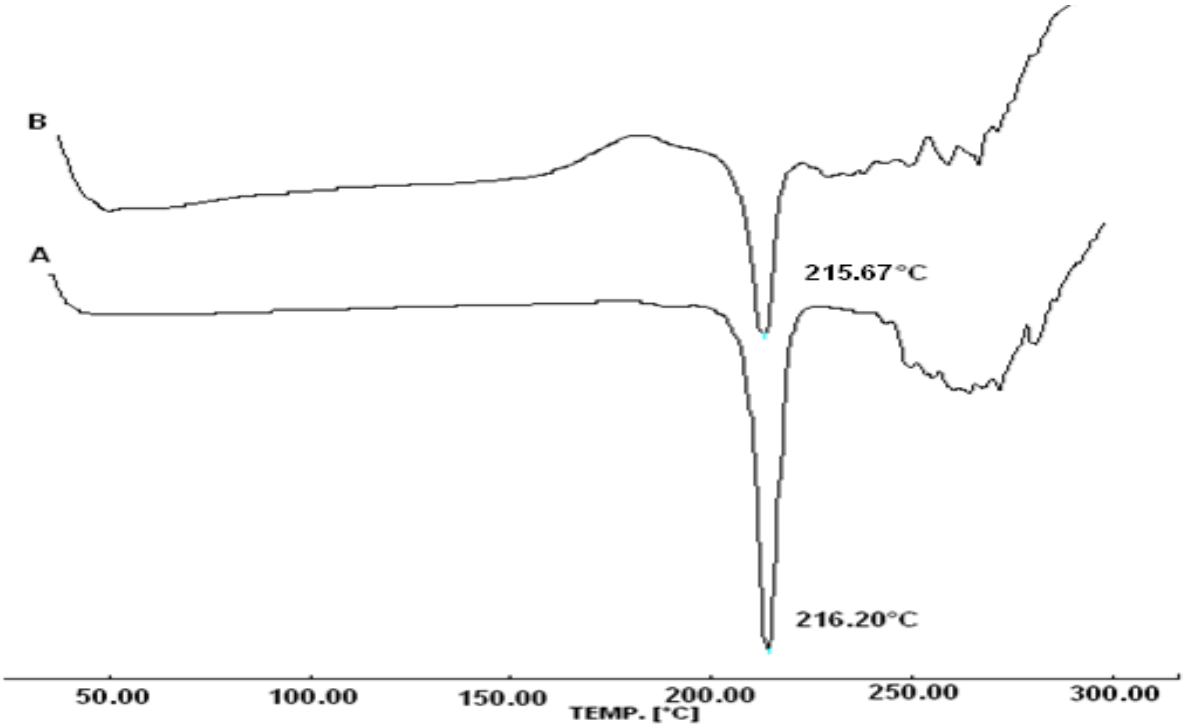

Figure 2: Differential Scanning Colorimetry of A) Pure drug Paracetamol and B) Drug with *A. auriculiformis* mucilage.

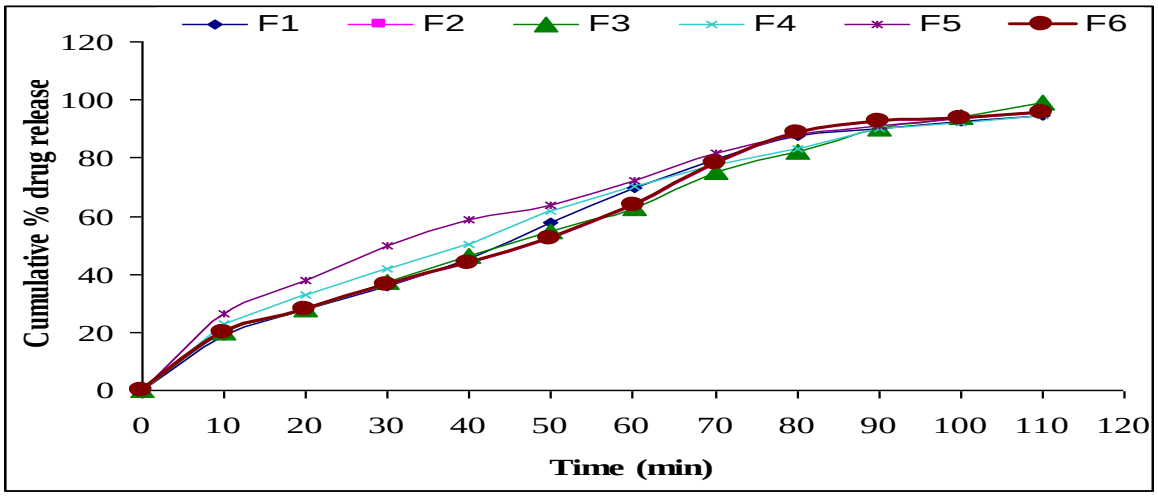

Figure 3: *In vitro* drug release profile of various Paracetamol tablets using *A. auriculiformis* mucilage and poly vinyl pyrrolidone.

CONCLUSION

From the above experimental study it has been found that the *A. auriculiformis* gum obtained from the fruit mucilage of the plant *A. auriculiformis* is having a potential binding effect. It is effective in a very low concentration (10 % w/v) as compared to that of the standard binder (Poly vinyl pyrrolidone paste – 10 % w/v) used. The FTIR Spectroscopic study and toxicity study in animals says that the gum is non toxic and safe to use internally. Moreover as this plant is widely distributed in nature, fruits are eaten by the local tribes, available chiefly in India and many other countries and easily available option without destroying the natural sources as compared to that of the other available natural option will be one of the suitable options to utilize as Pharmaceutical excipient as tablet binder.

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