

## Evaluation of *Delonix regia* Seed Gum as Suspending Agent in Paracetamol Suspensions

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**Abstract:** The purpose of this study is to search for a cheap and effective natural excipient that can be used as an effective alternative for the formulation of pharmaceutical suspensions. In this research work *Delonix regia* seed gum (DRG) was isolated and evaluated as a suspending agent in pharmaceutical oral suspensions using Paracetamol as model drug. Paracetamol suspensions were prepared with different concentrations (0.5%, 1% and 1.5 % w/v) of each suspending agents such as *Delonix regia* seed gum, compound tragacanth powder and acacia powder. Their sedimentation volume, flow rate, redispersibility, and viscosity were compared.

The suspending ability of the suspendants were in the order of *Delonix regia* seed gum > Compound Tragacanth powder > Gum Acacia. While an inverse relationship was observed between redispersibility and concentration of suspending agents and were in order of *Delonix regia* seed gum > Compound Tragacanth powder > Gum Acacia. Thus *Delonix regia* seed gum was found to have a promising potential for its use as a suspending agent in a concentration range of 1-1.5% w/v.

**Keywords:** *Delonix regia* seed gum (DRG), Sedimentation volume, Redispersibility.

### INTRODUCTION

Gums have been widely used as tablet binders, emulgents and thickeners in cosmetics and suspensions, as film-forming agents and transitional colloids<sup>1</sup>. Hydrophilic colloids such as xanthan gum, acacia and the cellulose derivatives have been used as suspending agents and, like surfactants, can produce a deflocculated system when used in low concentrations. Acacia or gum Arabic is mainly used in oral and topical pharmaceutical formulations as a suspending and emulsifying agent<sup>2</sup>. Mucilages isolated from *Cassia tora* seeds<sup>3</sup>, *cassia roxburghii* seeds<sup>4</sup>, *Trigonella foenum-graceum* seeds<sup>5</sup>, *Albizia zygia* gum<sup>6</sup>, *Hibiscus esculentus* fruits<sup>7</sup>, etc have been studied as suspending agents in pharmaceutical suspensions. The plant *Delonix regia* (family: Leguminosae, sub family: Fabaceae) some time known as royal Poinciana, may flower plant or Flamboyant, many branched, broad, spreading, flat crowned deciduous tree and well known for its brilliant display of red-orange bloom, literally covering the tree from May to June<sup>8</sup>. Traditionally *Delonix regia* plant is used as anthelmintic, antimicrobial, anticancer, antirheumatic, antimalarial, antioxidant, hepatoprotective activity, antiulcer effect and anti-diabetic activity<sup>9</sup>. Studies have been conducted to isolate *Delonix regia* seed gum and evaluate it as a binder in paracetamol tablets<sup>10, 11</sup> matrix forming polymer in sustained release tablets<sup>12</sup>. Suspension is thermodynamically unstable, thus, making it necessary to include, a stabilizer or suspending agent which reduces the rate of settling and permits easy redispersion of any settled particulate matter both by protective colloidal action and by increasing the consistency of the suspending medium<sup>13</sup>. The present study

focuses on the use of *Delonix regia* seed gum as suspending agent, compared with compound tragacanth powder and acacia powder as a suspending agent.

## MATERIALS AND METHODS

Dried seed pods of *Delonix regia* were collected from the local area of Baramati, Maharashtra and authenticated from Botanical Survey of India, Pune. Tragacanth and Acacia (Loba Chemie, Mumbai). Paracetamol, starch, sucrose, Saccharin sodium, compound tatrazine solution, orange syrup and chloroform water were sourced locally and were of AR grade.

### Isolation of Seed Gum:

Dried pods were imbibed in the water for an overnight and then dried in sunlight to separate the seeds from the pods. The seeds (500g) were boiled in the distilled water using pressure cooker for 1 h. Seed coat was then removed by hand. The gum part (endosperm) was separated from the dicotyledons. The endosperm was dried in an oven at 45°C for 12 h and then was grounded in the multimill. The resulting powder was passed through 60 # sieve. The isolated seed gum was purified by suspending it (100 gm) in water (1 L) at 70 °C for 2 h. The suspension was squeezed using several folds of muslin cloth to separate the marc from the filtrate. The filtered sample was precipitated in absolute ethanol, dried at 50 °C for 12 h in an oven, and milled. The powder was passed through 80 # sieve.

### Physicochemical Characterization of *Delonix regia* Seed Gum:

#### P<sup>H</sup> Determination<sup>14</sup>

This was done by shaking 1 % w/v dispersion of seed gum in water for 5 min and the P<sup>H</sup> was determined using P<sup>H</sup> meter (Systronic P<sup>H</sup> system 361).

#### Viscosity<sup>15</sup>

Viscosities of aqueous solution of different concentrations (0.5, 1 and 1.5 % w/v) of isolated seed gum were determined using Brookfield viscometer (Brookfield CAP 1000 + viscometer).

### Preparation of Paracetamol Suspensions:

2.4 % w/v Paracetamol suspensions were prepared using *Delonix regia* seed gum, and various conventional suspending agents (compound tragacanth powder and gum acacia) at concentrations of 0.5, 1 and 1.5 % w/v. Mucilages of the gums were prepared by hydration using part of the vehicle. The required quantity of Paracetamol was triturated with suspending agents and orange syrup until homogenous slurry was obtained. Compositions of formulations are shown in Table 1. Saccharine sodium, benzoic acid solution and chloroform water (double strength) were added and mixed well. The mixture was transferred into a 100 ml amber bottle, made up to volume with distilled water and then shaken vigorously for 2 min. All the suspensions were deflocculated.

### Evaluation of Suspension<sup>15-19</sup>:

#### Sedimentation Volume:

Sedimentation volume (F) was measured by carefully introducing the suspension in a measuring cylinder of 100ml and observing the rate of sedimentation every 24 h for 7 days. F was then calculated using the following equation:  $F = (H_u/H_o)$

Where (H<sub>u</sub>) - ultimate volume of the sediment as a suspension settles

(H<sub>o</sub>) - Initial height of the total suspension.

### Viscosity Determination:

The viscosity of suspensions was measured at 25°C using Brookfield viscometer, model (Cap 1000+visco) at 900 revolutions per minute. All determinations were made in at least triplicate and the results obtained are expressed as the mean values.

### Redispersibility

Fixed volume of each suspension (50 ml) was kept in calibrated tubes which were stored at room temperature for various time intervals (1wk, 2wk...7 wk). At regular interval of 1 wk, one tube was removed and shaken vigorously to redistribute the sediment. The time required to redistribute the sediment was measured.

### Flow Rate

The time required for each suspension sample to flow through a 10 ml pipette was determined and the apparent viscosity (ha in mls-1) was calculated using the equation:

Flow rate = ha = Volume of pipette (ml) / Flow time (s)

### Particle size Analysis

The particle sizes of the formulated suspensions were measured using microscope (Motic Microscope). Drops of suspensions were separately put on slides and placed on the stage of the microscope. The objects were viewed at X100 magnification and 500 particles were measured, from which the mean particle sizes were later computed.

## RESULTS AND DISCUSSION

The yield of isolated gum from *Delonix regia* seeds was 25 % w/w. The gum obtained was subjected to evaluation of P<sup>H</sup> and viscosity. P<sup>H</sup> of 1 % w/v dispersion of seed gum was 6.92. Viscosities of aqueous solution of different concentrations (0.5, 1 and 1.5 % w/v) of isolated seed gum were 63.06, 130.11 and 191.51 cp respectively. A direct relationship was observed between the concentration of DRG and viscosity.

To evaluate DRG as a suspending agent, it was used in a concentration of 0.5%, 1% and 1.5% w/v. For these studies suspensions were prepared containing paracetamol as a model drug with different concentrations of DRG (Table: 1). Comparisons were drawn with similar concentrations of compound tragacanth powder and acacia powder as a conventional suspending agents (0.5%, 1% and 1.5% w/v). The suspensions were evaluated for various parameters such as viscosity, flow rate (Table: 3), sedimentation volume (Figure: 1, 2, 3 and 4), redispersibility (Table: 4) and particle size.

The results showed that sedimentation volume and viscosity were found to be directly proportional to the concentration of the suspending agents. Viscosity of suspension containing low concentration of the DRG was low and so the rate of sedimentation was faster. The suspending ability of the suspendants were in the order of *Delonix regia* seed gum > Compound Tragacanth powder > Gum Acacia. Sedimentation volume for the suspensions containing concentration of DRG 1% and 1.5 %w/v was 0.72 and 0.8 respectively at the end of 24Hr, indicated reasonably good suspendability and redispersibility of DRG (Figure: 4). Here *Delonix regia* seed gum showed its superior suspending property over compound tragacanth powder and gum acacia. The flow rates were inversely proportional to the viscosity of the suspension and were in order of Gum Acacia > Compound Tragacanth powder > *Delonix regia* seed gum.

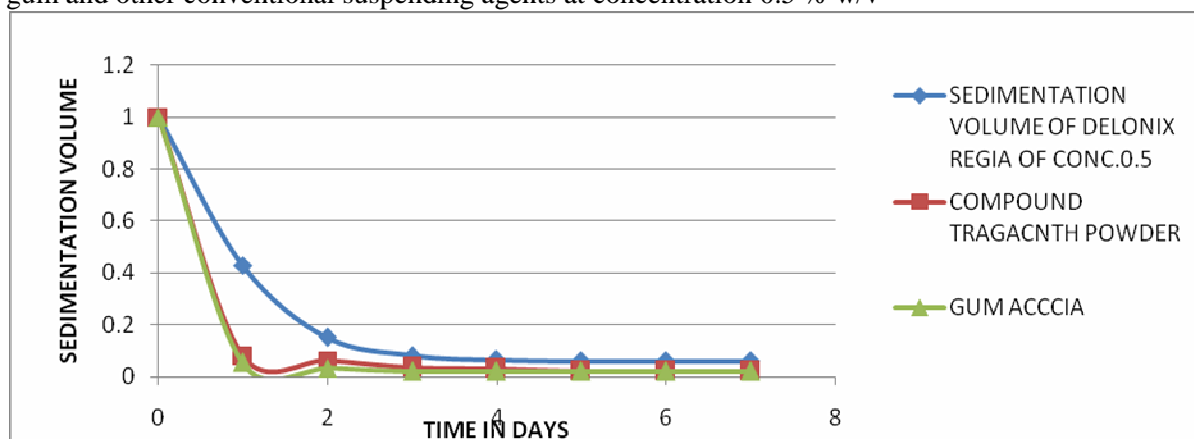
Since the suspension produces sediment on storage it must be readily dispersible so as to ensure the uniformity of the dose. An inverse relationship was observed between redispersibility and concentration of suspending agents and were in order of *Delonix regia* seed gum > Compound Tragacanth powder > Gum Acacia. Mean particle size were between 3.5 – 5.5 μ.

**Table 1:** Formulation of Paracetamol Suspensions.

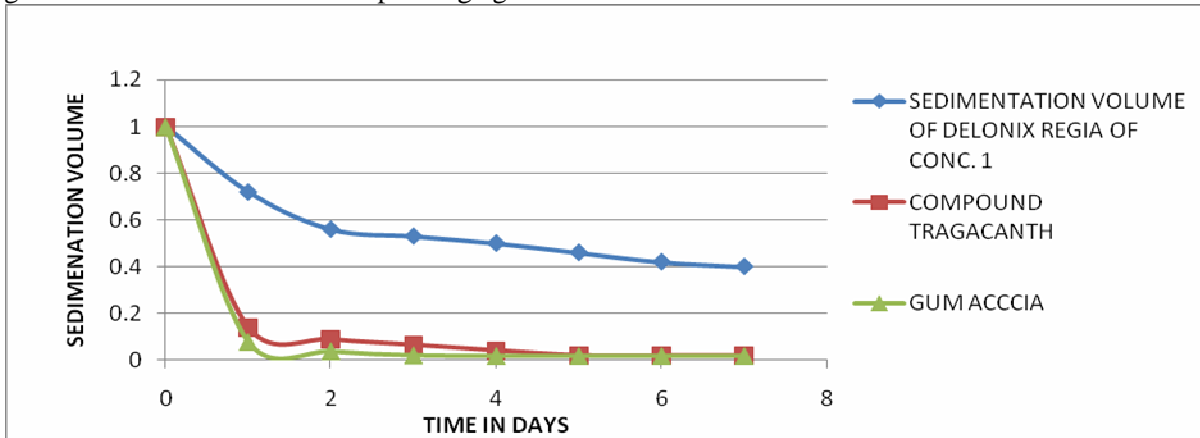
| Ingredients (g)            | F1   | F2   | F3   | F4   | F5   | F6   | F7   | F8   | F9   |
|----------------------------|------|------|------|------|------|------|------|------|------|
| Paracetamol                | 2.4  | 2.4  | 2.4  | 2.4  | 2.4  | 2.4  | 2.4  | 2.4  | 2.4  |
| Compound tragacanth powder | 0.5  | 1    | 1.5  | -    | -    | -    | -    | -    | -    |
| Accacia powder             | -    | -    | -    | 0.5  | 1    | 1.5  | -    | -    | -    |
| <i>Delonix regia</i> gum   | -    | -    | -    | -    | -    | -    | 0.5  | 1    | 1.5  |
| Saccharine sodium          | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Orange syrup (ml)          | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   | 30   |
| Benzoic acid solution(ml)  | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Chloroform water(ml)       | 50   | 50   | 50   | 50   | 50   | 50   | 50   | 50   | 50   |
| Distilled water Q.S to ml  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  | 100  |

**Table 2:** Physicochemical characterization of *Delonix regia* seed gum.

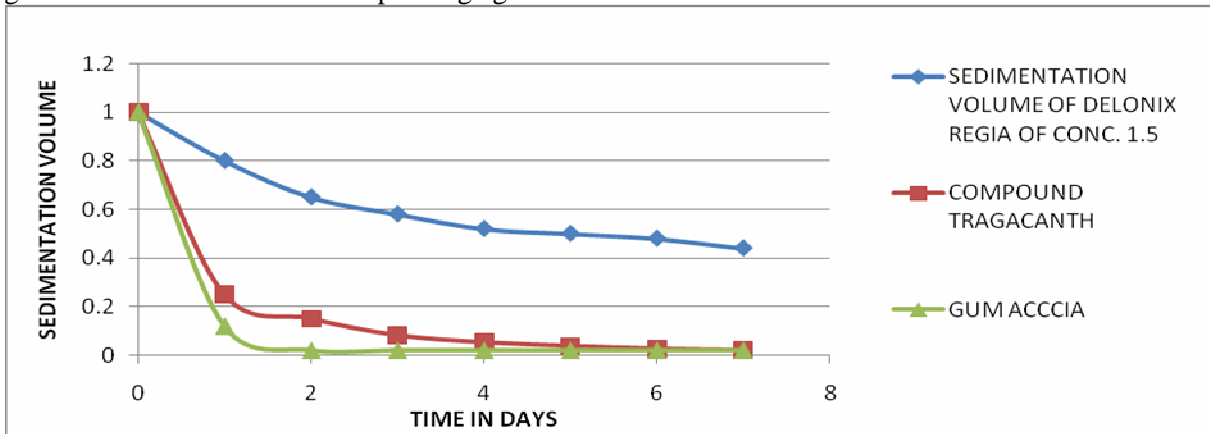
| Parameters  | Observation |
|---|-------------|
| P <sup>H</sup> (1 % W/V)                          | 6.92        |
| Viscosity of – 0.5 % w/v solution (cp)<br>(n = 3) | 63.06± 1.11 |
| 1 % w/v solution (cp)                             | 130.11±2.15 |
| 1.5% w/v solution (cp)                            | 191.51±1.42 |

**Figure 1:** The comparative sedimentation volume (F) profile for suspensions containing *Delonix regia* seed gum and other conventional suspending agents at concentration 0.5 % w/v

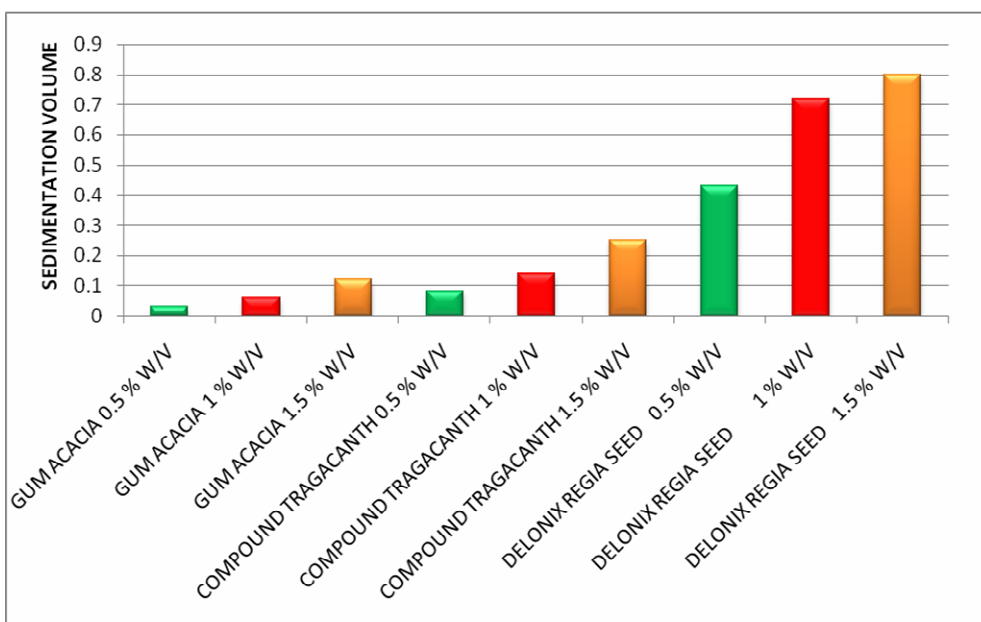
**Figure 2:** The comparative sedimentation volume (F) profile for suspensions containing *Delonix regia* seed gum and other conventional suspending agents at concentration 1% w/v



**Figure 3:** The comparative sedimentation volume (F) profile for suspensions containing *Delonix regia* seed gum and other conventional suspending agents at concentration 1.5 % w/v



**Figure 4:** Comparative sedimentation volume profile for suspension containing *Delonix regia* seed gum and other conventional suspending agents after 24 HRS.



**Table 3: Evaluation of suspensions for viscosity and flow rate.**

| Formulation | Viscosity (cp)<br>(n=3) | Flow rate (m/s <sup>-1</sup> ) |
|-------------|-------------------------|--------------------------------|
| F1          | 22.2±0.89               | 2.45                           |
| F2          | 46.61±1.38              | 2.08                           |
| F3          | 66.12±0.98              | 1.62                           |
| F4          | 15.16±2.3               | 2.51                           |
| F5          | 25.66±1.41              | 2.33                           |
| F6          | 43.58±1.36              | 2.11                           |
| F7          | 71.08±1.2               | 1.45                           |
| F8          | 138.13±0.95             | 1.12                           |
| F9          | 201.18±1.15             | 0.91                           |

**Table 4: Redispersibility values for different formulations.**

| Formulation | Time required to redistribute suspension (sec) |      |      |      |      |      |      |
|-------------|--|------|------|------|------|------|------|
|             | 1 WK   | 2 WK | 3 WK | 4 WK | 5 WK | 6 WK | 7 WK |
| F1          | 6  | 10   | 10   | 18   | 29   | 29   | 37   |
| F2          | 4  | 10   | 10   | 15   | 22   | 25   | 30   |
| F3          | 4  | 10   | 10   | 15   | 22   | 25   | 27   |
| F4          | 8  | 15   | 15   | 23   | 32   | 36   | 42   |
| F5          | 8  | 12   | 15   | 23   | 30   | 33   | 33   |
| F6          | 8  | 12   | 12   | 17   | 24   | 31   | 31   |
| F7          | 4  | 9    | 10   | 12   | 20   | 25   | 30   |
| F8          | 4  | 7    | 10   | 12   | 18   | 21   | 21   |
| F9          | 3  | 7    | 8    | 8    | 15   | 15   | 18   |

## CONCLUSION

After evaluating the viscosity of different concentrations of isolated DRG, a direct relationship was observed between the concentration of DRG and viscosity. From all evaluated parameters it was observed that, *Delonix regia* seed gum has a promising potential for its use as a suspending agent in a concentration range of 1-1.5% w/v as compared to compound tragacanth powder and acacia powder. *Delonix regia* seed gum could be employed as stabilizer and thickener of choice in pharmaceutical suspension preparation, cosmetic, pharmaceutical and food industries.

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