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Evaluation of the suspending properties of *Leucaena Latisiliqua* seed gum

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ABSTRACT

The purpose of the study is to select a new cheap, effective alternative natural suspending agent for pharmaceutical suspensions. Comparative study between the Leucaena Latisiliqua seed gum and known gums like Tragacanth, Acacia were done. Leucaena Latisiliqua seed was boiled and the seed gum was extracted with acetone, dried and powdered. Then its phytochemical investigation, swelling index was determined. Different type of zinc oxide suspensions using Leucaena Latisiliqua seed gum, Tragacanth, Acacia were prepared and effect of type and concentration of suspending agent on sedimentation volume, viscosity and particle size were studied. The phytochemical test showed the presence of less common sugar. The zinc oxide suspension prepared in batches containing Leucaena gum, compound tragacanth, acacia and the result showed that sedimentation volume, viscosity, and the particle size were found directly proportional to the concentration of suspending agent and inversely proportional to the flow rate. The suspending ability of the suspending agents were in the order of Leucaena Latisiliqua gum > Compound Tragacanth >Acacia. From the results, it was concluded that the gum of Leucaena Latisiliqua can be employed as stabilizer and thickener of choice when high viscosity is desired.

Key words: Leucaena Latisiliqua seed, Mimosaceae, Zinc oxide, Binding agent, Suspending agent.

INTRODUCTION

Modern technology has provided the pharmaceutical scientist with a variety of suspending materials for formulating and developing superior suspension. Among these suspending agents hydrocolloids play important role by increasing the viscosity of water. They bind with the water molecules or trap the water molecule between their intertwined macromolecules chain and limit

the mobility of water. Suspending agents are used to prevent the sedimentation by affecting the rheological behaviour of a suspension. Ideal suspending agents might have viscosity at low shear, Its viscosity should not be altered by temperature or on aging, should be able to tolerate electrolytes and applicable over a wide pH range, compatible with other formulation excipients and should be nontoxic. Suspending agent 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 [1-3]. Seed gums are important agrochemical used in various industries worldwide. The growing industrial utility of these gums in the field of paper, textile, petroleum recovery and pharmaceutical industries has resulted in an impetus in India for intensified research on new sources of gums and their modified products [4-7] ˙The suspending agent was obtained from the Leucaena Latisiliqua seed from the family of Mimosaceae. Leucaena Latisiliqua requires warm temperature (25-30ºC day temperature) for optimum growth. At higher altitudes and at elevated tropical growth is reduced. Freshly harvested Leucaena often has a high degree of hard seed due to impermeable waxy coat. Scarification to break the seed involves treatment with hot water, mechanical scarification for practical alternative [8].Zinc oxide is an astringent and topical protectant used for making the suspension. Zinc oxide is insoluble in water, alcohol and only soluble in alkali acids. So zinc oxide is used to be given as suspension in oral route [9]. In the present study the evaluations of a natural suspending agent and comparison with other suspending agents are also done. These observations prompted us to make suspension of zinc oxide with Leucaena Latisiliqua seed gum and compared with Tragacanth and Acacia.

MATERIALS AND METHODS

Zinc oxide, suspending agent isolated from Leucaena Latisiliqua seed, Tragacanth, Acacia, Benzoic acid, Glycerine, Chloroform water for vehicle. These materials have attracted due to their novel properties as they are derived from plants. Hence they are biocompatible, biodegradable and cheap.

Extraction of Suspending Agent

Dried pods of Leucaena Latisiliqua were collected from the Erode of Namakkal district of Tamil Nadu. Seeds were segregated from pods. Then seeds are soaked in 200ml of warm water to isolate the brown mucilaginous covering. Seeds were swelled to detach suspending material from the kernel and the tegmen. The mucilaginous portion was pricked manually and crushed in mortar followed by boiling in water for an hour. This is then filtered through a muslin cloth and extract was collected in a beaker. Thrice volume of acetone was added and stirred. Then the purified product was dried in a vaccum dryer and powered and passed through sieve no. 74 and kept for further studies.

Phytochemical Screening

The powdered extract were subjected to various chemical test and it shows the presence of less common sugar and absence of carbohydrates, steroids, glycosides, tannins, alkaloids, flavanoids, proteins and amino acids [10].

Determination of Swelling Index

The natural suspending agent 1gm was taken in china dish. 10ml of water was added and mixture was shaken, weighed and allowed to stand for 1 hour. After 1 hour remaining water was discarded and weight increased by swelling of suspending agent was rated. Swelling index was calculated by the following formula [11].

$$\text{Swelling index\%} = (W_2 - W_1 \div W_1)$$

W_1- weight of china dish and natural suspending agent before swelling
W_2 – weight of china dish and natural suspending agent after swelling

Preparation of Zinc Oxide Suspension

Compound tragacanth powder 0.5gm and 20gm of zinc oxide were triturated together with 20ml of glycerine to form a smooth paste. Benzoic acid (0.1gm) was added. 50ml of chloroform water was added gradually. The mixture was transferred into 100ml amber container, made up to volume with distilled water and then shaken vigorously for 2 minutes (thus making 0.5% w/v of the gum in the preparation. The procedure was repeated using 1, 1.5, 2 w/v of compound tragacanth powder. The above procedure was repeated with Acacia and Leucaena Latisiliqua also (Table 1).A different concentration of 0.2gm, 0.4gm, 0.6gm, 0.8gm of each suspending agents (Leucaena Latisiliqua seed, Tragacanth, Acacia) were taken for measuring the flow rate and viscosity of the suspension.

Table 1: Formula for different batches of zinc oxide suspension

Content	**Formulation**		
Suspending agent	**Leucaena Latisiliqua**	**Tragacanth**	**Acacia**
	0.5gm, 1gm, 1.5gm, 2gm	0.5gm,1gm, 1.5gm, 2gm	0.5gm,1gm,1.5gm, 2gm
Zinc oxide	20gm	20gm	20gm
Glycerine	20ml	20ml	20ml
Benzoic acid	100mg	100mg	100mg
Water	Up to 100ml	Up to 100ml	Up to 100ml

Determination of Sedimentation Volume

Each suspension of 50ml was stored in a 50ml measuring cylinder for 6 days at 35ºC. Observations were made every 24 hours for 6 days. The sedimentation volume, F (%) was calculated using the equation [12]

$$F = 100\ V_u / V_0$$

Where V_u is the ultimate volume of sedimentation and V_0 is the original volume of the suspension

Measurement of Viscosity

The 0.5 %w/v, 1.5 % w/v, 2 % w/v solution of natural suspending agent was prepared and it was taken in Oswald viscometer to analysis the viscous nature of isolated natural suspending agent.

$$\upsilon_1 = \upsilon_2 \times (d_1t_1 / d_2t_2)$$

υ_2= viscosity of water, d1& d2 = density of water and sample, t_1 & t_2 = time of flow of water and sample in seconds

Determination of Flow Rate

The time required for the each suspension sample to flow through a 10ml pipette was determined and the apparent viscosity was calculated by equation.

Flow rate = $\upsilon\alpha$ = volume of pipette (ml)/Flow time (s)

Particle Size Analysis

After shaking, 10ml of each sample was separately transferred into 200ml cylinder. Distilled water 150ml was added and mixed, 10ml aliquot was removed at a distance of 10 cm below the surface of the mixture and at 15, 30, 60 minutes. This was transferred into evaporating dish and dried in an oven at 105ºC and the residue was weighed. The particle diameter was calculated using stokes equation.

$$\mathbf{d = 18h\eta /(\rho_s - \rho_0) gt}$$

Where h is the distance of fall of the particle (cm), t is the time (s), η is the viscosity of the dispersion medium (poise), $\rho_s - \rho_0$ is the density gradient between the dispersed particles and the liquid (g cm^{-3}) and g is the gravitational constant (cms^{-2}).

RESULT AND DISCUSSION

The effect of type and concentration of suspending agents on sedimentation volume, flow rate, viscosity and particle size are as shown in Table 2 & Figs 1-4. Phytochemical tests carried out on Leucaena Latisiliqua gum confirmed the absence of alkaloids, anthraquinones and carbohydrates in accordance with the belief that gums do not contain carbohydrates. Zinc oxide suspension formulations were prepared in different batches containing Leucaena gum, compound tragacanth, acacia (concentration range of 0.5 – 2 % w/v at 0.5 intervals each). The preparations were assessed based on their sedimentation volume, viscosity and particle size analysis. The results showed that sedimentation volume, viscosity and particle size were found to be directly proportional to the concentration of the suspending agents. The reverse was in the case for the flow rate. Inverse proportionality was observed between the storage time on one hand and sedimentation volume on the other. Swelling index was calculated and found to be 45.45% for Leucaena Latisiliqua gum. All the formulations were observed to the Stokes law when subjected to particle size analysis. The suspending ability of the suspending agents were in the order of Leucaena gum > compound tragacanth > acacia. Thus Leucaena gum appears to exhibit the best suspend ability of all the materials investigated. Infact 2 % w/v of this gum produced suspension of optimal properties which compared favourably with the suspension containing 1 % w/v compound tragacanth, a traditional suspending agent. In view of these properties, Leucaena gum can be employed as stabilizer and thickener of choice when high viscosity is desired especially in cosmetic, pharmaceutical and food industries.

Table II: Determination of sedimentation volume

Suspending Agent	Concentration	Sedimentation time (day)						Sedimentation volume V= Vu / Vo					
Leucaena Latisiliqua	0.5% 1 % 1.5 % 2 %	91 97 100 100	86 96 100 100	81 94 99 100	72 94 97 94	70 92 95 94	68 90 95 93	0.91 0.97 1 1	0.86 0.96 1 1	0.81 0.94 0.99 1	0.72 0.94 0.97 0.94	0.70 0.92 0.95 0.94	0.68 0.90 0.95 0.93
Tragacanth	0.5% 1 % 1.5 % 2 %	59 66 61 60	58 66 60 60	58 65 60 59	57 65 60 58	56 64 59 58	55 62 59 58	0.59 0.66 0.61 0.60	0.58 0.66 0.60 0.60	0.58 0.65 0.60 0.59	0.57 0.65 0.65 0.58	0.56 0.64 0.59 0.58	0.55 0.62 0.59 0.58
Acacia	0.5% 1 % 1.5 % 2 %	30 34 39 45	27 32 35 41	24 32 34 39	24 30 32 39	20 28 30 36	19 28 28 33	0.30 0.34 0.39 0.45	0.27 0.32 0.35 0.41	0.24 0.32 0.34 0.39	0.24 0.30 0.32 0.39	0.20 0.28 0.30 0.36	0.19 0.28 0.28 0.33

Fig.1. Evaluation of Sedimentation Volume for different suspending agents added Zinc oxide suspension

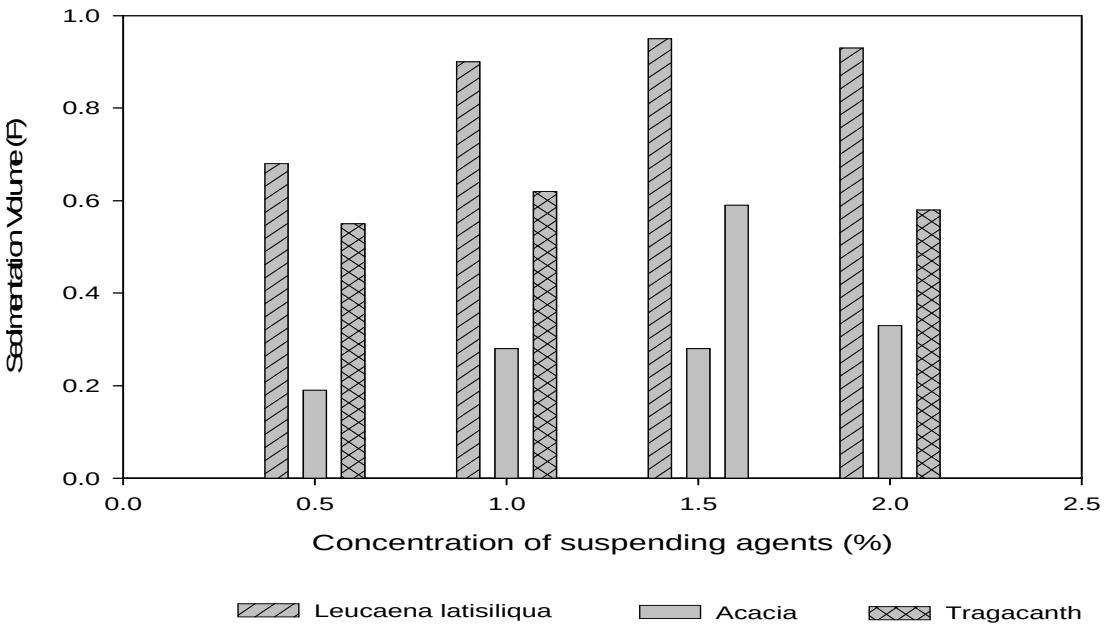


Fig II.Effects of concentration of suspending agents on viscosity of zinc oxide suspension

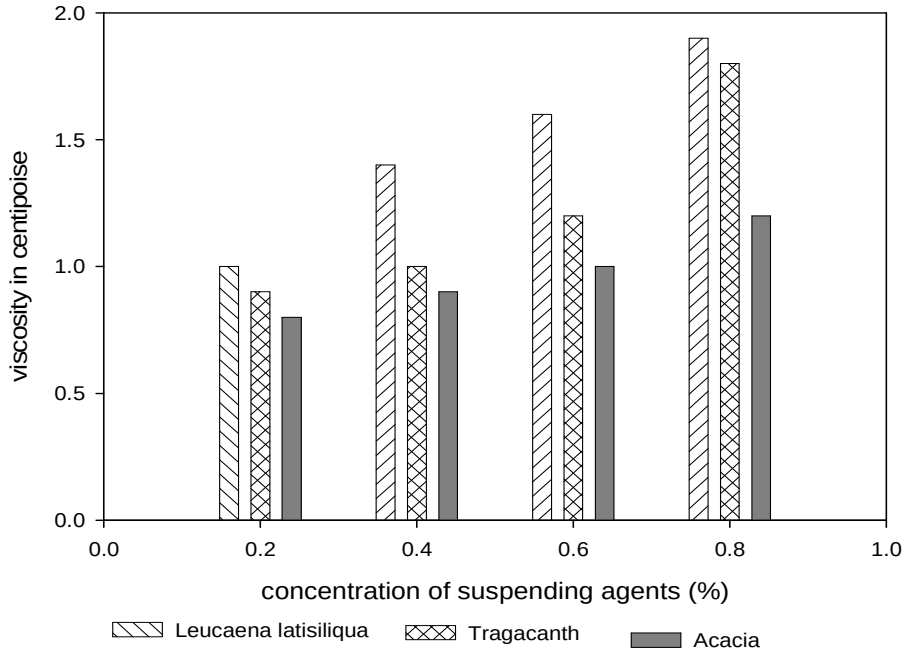


Fig III - Effect of concentration of suspending agent on flow rate of zinc oxide suspension.

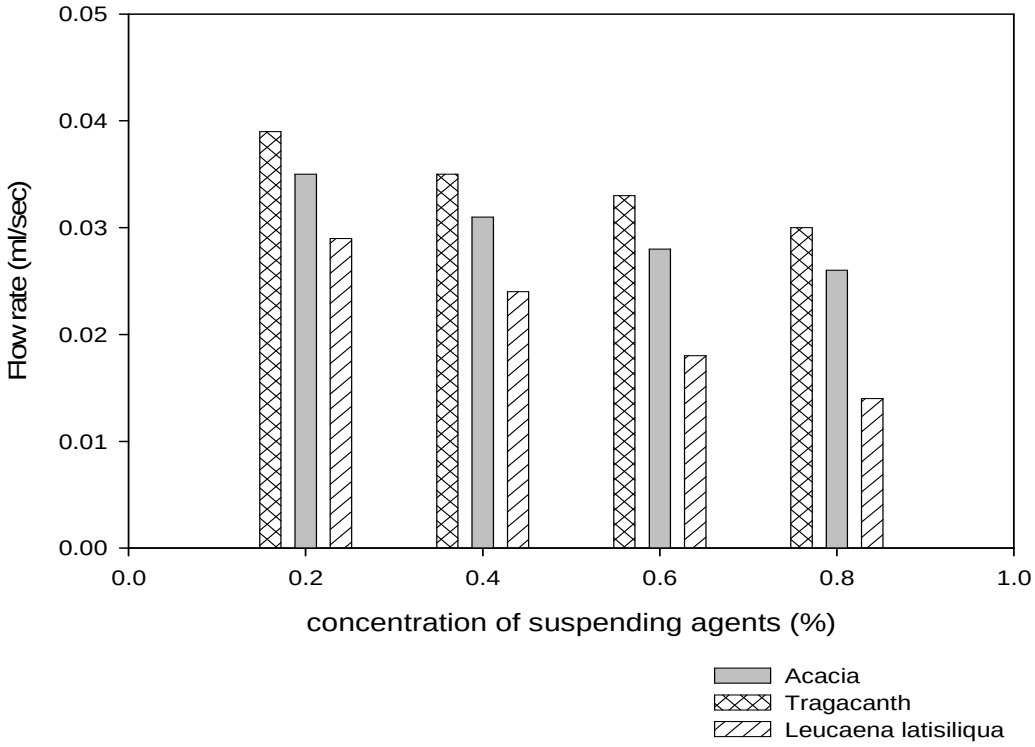
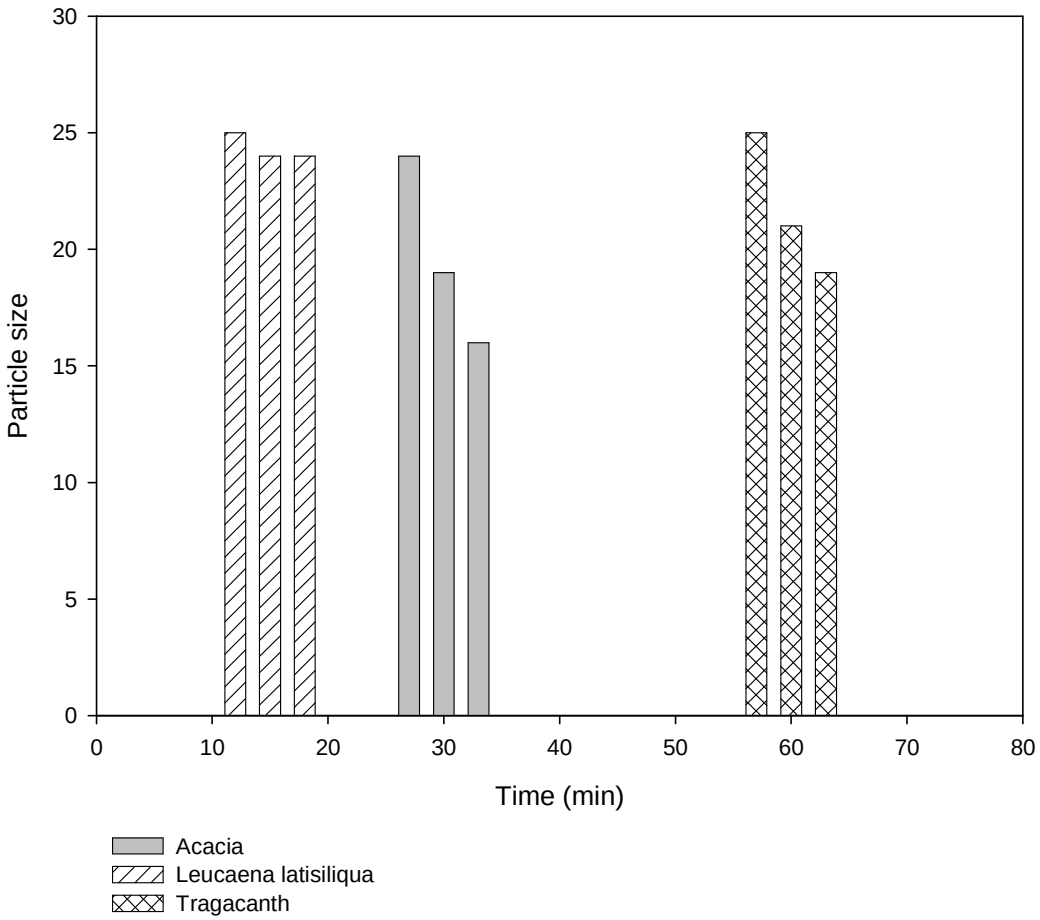


Fig IV. Particle size Analysis of prepared suspensions



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