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Evaluation of the suspending property of grewia gum in sulphadimidine suspension

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Abstract
The suspending property of grewia gum in sulphadimidine suspension was evaluated. The gum was extracted by maceration, filtration, precipitation and drying techniques. It was used at 0.3 to 1% w/v as a suspending agent for sulphadimidine. Sodiumcarboxymethylcellulose (SCMC) and tragacanth were used as basis for comparison. The suspending properties evaluated included the sedimentation rate, sedimentation volume, ease of redispersibility, apparent viscosity and degree of flocculation. Results obtained after 8 weeks of storage showed that the optimum suspending concentration for grewia gum in the drug was 1% w/v. The sedimentation rate, sedimentation volume and the viscosity of the suspension containing grewia gum were not superior to those made with SCMC. Significant ($P < 0.05$) difference in these properties was observed when compared with suspension containing tragacanth. The suspension containing grewia gum was moderately redispersed. The degree of flocculation decreased in the order SCMC>grewia>tragacanth. On the basis of these, grewia gum may find application as a suspending agent in sulphadimidine suspension.

Keywords: Grewia gum; Sulphadimidine; Suspension

INTRODUCTION

Because of the overdependence on imported pharmaceutical raw materials for most of our pharmaceutical products in Nigeria, there has been marked increase in the search for pharmaceutical excipients from our abundant potential raw materials yet untapped. This will help reduce the depletion of our foreign reserves and also the cost of production leading to affordability of raw materials for foods and pharmaceutical products. Shrubs or tree exudates may serve as a potential source of commercially useful gums and hydrocolloids that are employed in foods, pharmaceutical and cosmetics preparations. Gums such as acacia and tragacanth are plant exudates that are commonly used (Carter, 1987) these are now scarce and expensive. Plant gums are naturally occurring water soluble polymers widely found in nature. They are derived from plant exudates, seaweed extracts, seed extracts and fermentation processes of certain microorganism (Zatz *et al.*, 1988). They find application in pharmacy as viscosity-building agents, defflocculants and, sometimes, as emulsifying agents.

Grewia gum is a polysaccharide derived from the inner stem bark of the edible plant *Grewia mollis*, Juss (family Tiliaceae).

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The plant is a savannah shrub, which grows widely but is usually cultivated. Its local source is in the guinea savannah region of the middle belt of Nigeria where it is called *dargaza* in Hausa language. Indigenous people use the powdered inner stem back as thickening agent in local dishes (Okafor, 2001a; Audu-Peter, 2007).

Works have been done on the rheological, binding, sustained release and film forming properties of grewia gum (Okafor, 2001b; Okafor and Chukwu, 2003; Audu-Peter, 2007). The present study aimed at evaluating the suspending property of the gum in sulphadimidine suspension formulation. Similar suspensions made with tragacanth and sodium carboxymethyl cellulose (SCMC) were used as basis for comparison.

EXPERIMENTAL

Materials. The materials used included sodium metabisulphite, hydrochloric acid (Sigma-Aldrich, Germany), sodium benzoate, (BDH Chemical, England), sodium hydroxide (Avondale lab, England), 95% w/v Ethanol (Philip Harris, England), Sodium carboxymethylcellulose (SCMC) (Merck, Germany), tragacanth, sulphadimidine (M&B Chemicals, England) and grewia gum.

Extraction of grewia gum. Grewia gum was extracted and processed in Pharmaceutics laboratory of the University of Jos according to the method of Okafor (2001a, 2001b). All other materials where used as obtained.

Preparation of sulphadimidine suspension. A 1.0 g quantity of grewia gum was dispersed in enough distilled water contained in a beaker to make some dispersion. The dispersion was allowed to stand for 24 h with occasional stirring to facilitate the dispersion of the lumps. Similar procedure was carried out to obtain 1.0% w/v aqueous dispersions of tragacanth and SCMC. Table 1 shows the formula for preparing sulphadimidine suspension. A 4 g quantity of sulphadimidine was weighed out on a balance (Ohaus, Model 310, USA) and transferred to a clean porcelain mortar. The aqueous dispersion of grewia gum was added in successive portion to make a smooth paste. A 0.1 g of sodium benzoate was weighed and then dissolved in 10 ml of distilled water and added to the content of the mortar. The content was transferred to a 100 ml measuring cylinder. The suspension was made up to volume with rinsing from the mortar. The procedure was repeated for dispersions of SCMC and tragacanth gums.

Evaluation of the suspensions

Sedimentation rate analysis. The original height Ho of the suspension was read off on the cylinder immediately after preparation. The measuring cylinder containing the suspension was allowed to stand on a vibration free stand. The height of the sediment (Hu) was read off daily for 7 days. It was subsequently read off on weekly basis for 7 weeks. The sedimentation rate analysis of the suspension was calculated and presented graphically as ultimate height against time.

Sedimentation volume. The sedimentation volume was determined according to the expression. Hu/Ho (or Vu/Vo) where Ho (or Vo) is the original height or volume of the suspension and Hu (or Vu) is the ultimate height or volume of the sediment at any given time.

Degree of flocculation. A 100 ml volume of 4% w/v sulphadimidine suspension containing 1% w/v each of grewia, SCMC or tragacanth was prepared. A similar suspension containing no suspending agent was also prepared. The suspensions were kept for 6 months on a vibration-free stand. The volume of sediment (Vu) after the time interval was recorded. The volume of the suspension containing no suspending agent after 6 months ($V\infty$) was also recorded. The degree of flocculation (β) was calculated using the equation:

$$\beta = Vu/V\infty.$$

Redispersibility test. The suspensions were prepared as described previously. At the end of the six months period, they were gently shaken for 1 min in order to determine the ease with which the particles disperse. The result was recorded as not easily-, moderately-, easily- and very easily redispersed.

Viscosity determination. A 50 ml volume of the suspension was transferred into the cup of a rotational viscometer (Contraves rotational viscometer, model 1698, Switzerland) and the spindle dipped into it and rotated at 50 rpm. The viscosity was read off from the viscometer after one minute. This was repeated after 2 months of storage.

RESULTS AND DISCUSSION

Sedimentation rate. Fig. 1 shows the effect of grewia gum concentration on the sedimentation rate of sulphadimidine suspension. It can be seen that the rate at which the sulphadimidine particles settled in the suspension was high for suspension containing 0.3 or 0.5% w/v grewia gum. This is evident from the slope of the graph which was steep especially in the first 2 days. On the other hand, sulphadimidine particles contained in the suspension containing 1% w/v grewia gum settled slowly. It could be seen that the rate of sedimentation was gum concentration dependent. It has been reported that the viscosity of gum dispersions increases with increase in the concentration of the gum (Carter 1986; Patel *et al.*, 1986). One of the factors that affect the sedimentation rate of particles in a suspension according to Stoke's law is viscosity. The higher the viscosity, the slower is the rate of sedimentation. The viscosity of the suspension containing 1% w/v grewia gum was 83±4.4 mPa. The corresponding values for suspension containing 0.3 or 0.5% w/v grewia gum are 20 and 50 mPa respectively. The slow rate of settling of particles in the sulphadimidine suspension containing 1% w/v grewia gum is therefore attributed to the high viscosity achieved in the suspension.

Sedimentation volume. Table 2 shows the sedimentation volume of sulphadimidine suspension containing grewia gum, tragacanth or SCMC. The sedimentation volume of both grewia and tragacanth was higher than SCMC, and when sedimentation volume of grewia gum was compared to that of tragacanth, they did differ significantly ($P<0.05$).

Fig 2. shows the effect of gum type on the sedimentation volume of sulphadimidine suspension. The sedimentation volume of the suspension containing grewia gum is about 0.56 after 60 days of storage. This is similar to that of SCMC suspension which had a sedimentation value of 0.65 after the same number of days. That of tragacanth was 0.11, and was the least.

Sedimentation volume is an important parameter for assessing the physical properties of a good suspension. The higher the sedimentation volume, the better is the suspension (Martin, 1993; Patel *et al.*, 1986). High sedimentation volume of suspension enhances ease of redispersibility and eliminates cake formation (Martin, 1993; Patel *et al.*, 1986). High sedimentation volume is therefore desirable in a suspension. The high value of sedimentation volume obtained for the suspension containing SCMC and grewia was good. The result shows that grewia gum is a good suspending agent for sulphadimidine powder.

Degree of flocculation. Table 2 shows the degree of flocculation of sulphadimidine suspension after 6 months using tragacanth, grewia and SCMC gums. The degree of flocculation is in the order SCMC>grewia>tragacanth. The degree of flocculation of SCMC is about three times higher than tragacanth while that of grewia was about 2.5 times. Although SCMC has better suspendability of sulphadimidine particle, grewia gum

has similar property. Tragacanth had the least suspendability.

Redispersibility. Table 2 also shows the ease of redispersibility of the suspension containing 1% w/v suspending agents after 6 months of storage. The sulphadimidine suspension containing SCMC was moderately redispersed, while that of tragacanth was very easily redispersed, and grewia gum was easily redispersed at similar concentrations.

Table 1: Formula for preparing the suspensions

Ingredients	Batches (g or ml)				
	I	II	III	IV	V
Sulphadimidine	4	4	4	4	4
Grewia gum	1	-	-	0.5	0.3
Tragacanth	-	1	-		
SCMC	-	-	1		
Sodium benzoate	0.1	0.1	0.1	0.1	0.1
Water	100	100	100	100	100

Table 2: Physical properties of sulphadimidine suspension containing 1% w/v suspending after 8 months

Gum Type	Sedimentation Volume		Ease of redispersibility	Degree of Flocculation
	2 Months	6 months		
SCMC	0.65	0.096	Moderately redispersed	6.87
Tragacanth	0.11	0.045	Very easily redispersed	2.44
Grewia	0.56	0.085	Easily redispersed	6.47

Table 3: Effect of storage on the viscosity of sulphadimidine suspension containing 1% w/v suspension agents.

Suspension	Viscosity reading in mPa	
Sulphadimidine + tragacanth	150±3.3	25±1.0
Sulphadimidine + SCMC	240±1.6	60±1.3
Sulphadimidine +grewia	83±4.4	49±1.6

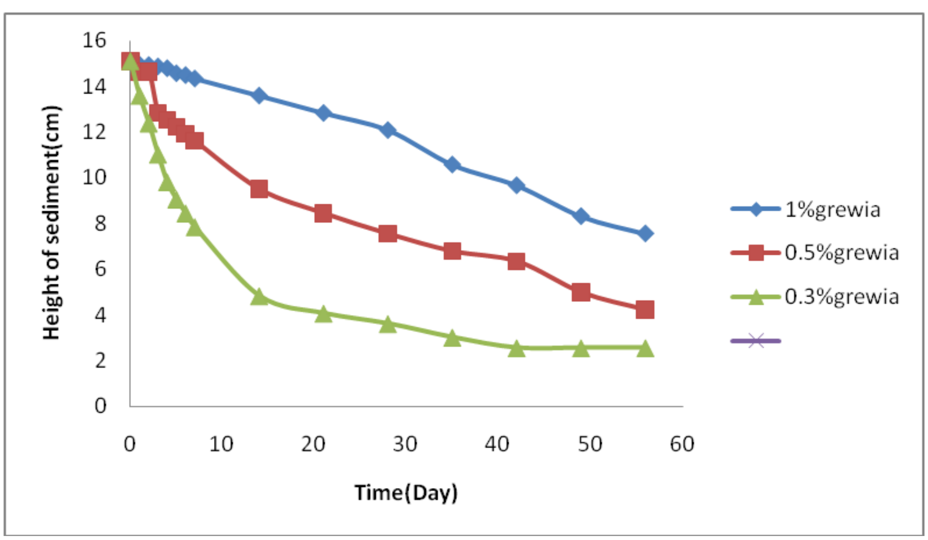

Figure 1: Effect of grewia gum concentration on the sedimentation rate of sulphadimidine suspension

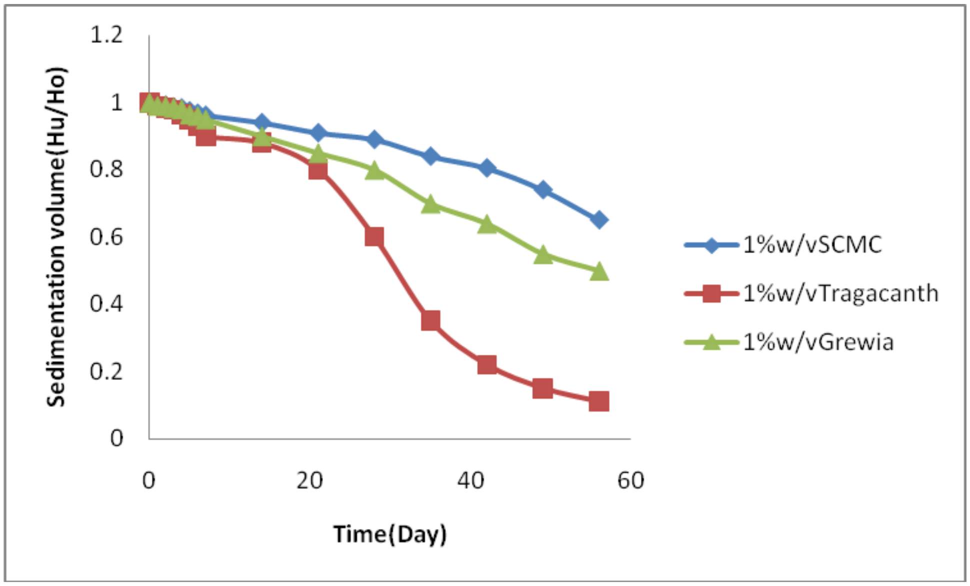

Figure 2: Effect of gum type on the sedimentation volume of sulphadimidine suspension

Viscosity. Table 3 shows the effect of storage on viscosity of sulphadimidine suspension containing 1% w/v suspending agent. Freshly prepared sulphadimidine suspensions containing tragacanth, grewia and SCMC gums had viscosity value of 150±3.3, 83±4.4, and 240±1.6 mPa respectively but the viscosity dropped to 25±1.0, 49±1.6 and 60±1.3 mPa respectively after 2 months. Although the viscosity of the suspensions containing tragacanth and SCMC was initially higher than grewia gum, those containing SCMC dropped more than three times its original value while that of tragacanth was more than five times its original value. The drop of viscosity exhibited by the suspensions made with grewia and tragacanth gums may be due to neutralization effect produced when acidic and basic moieties interact. Such interaction might have resulted in the lowering of viscosity of the medium with a consequent lowering of sedimentation volume. Plant gums such as tragacanth and grewia have been reported to be acidic in nature owing to the presence of uronic acids in their structure (Nep, 2004; Okafor *et al.*, 2001). Sulphadimidine is a slightly basic drug, and this neutralization effect may have caused the drop of the viscosity of suspension made with tragacanth gum which was more marked than that of the grewia gum.

Conclusion

From the study carried out so far, apart from SCMC, grewia gum is a better suspending agent for sulphadimidine than tragacanth gum. The viscosity of the suspension containing all the gums was affected by storage but that of tragacanth was the most. Grewia gum is a good suspending agent for sulphadimidine powder.

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