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COMMUNICATION

Preliminary Evaluation of Shilajit as a Suspending Agent in Antacid Suspensions

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ABSTRACT

The efficacy of shilajit, a gummy exudate of the plant Styrax officinalis *Linn (Family: Styraceae), was evaluated as a suspending agent for the formulation of antacid preparations. Shilajit produced effects on sedimentation volume similar to those produced by sodium carboxymethyl cellulose (CMC), but at lower concentrations. It induced better flocculation with a moderate increase in viscosity compared to CMC. It did not interfere with the acid-consuming capacity of the suspensions.*

INTRODUCTION

Mixtures of aluminum hydroxide and magnesium hydroxide gel or magnesium trisilicate are common constituents of antacids. Prevention of caking, associated with high sedimentation volume, and maintenance of acid-neutralizing capacity are major formulation objectives that contribute to a stable shelf life. The sedimentation volume provides valuable information to the formulator and has been used to evaluate suspension stability (1,2). The acid-consuming capacity test (3), the most widely used test, determines the total amount of acid neutralized during 1 hr at 37°C. Styrax gum, commonly known as shilajit, though investigated for its medicinal properties (4,5), was never examined for its suitability as a suspending agent.

The present work is concerned with the effects of shilajit and various additives on sedimentation volume, degree of flocculation, viscosity, pH, and acid-consuming capacity of suspensions prepared with various concentrations of aluminum hydroxide gel and magnesium trisilicate or magnesium hydroxide.

EXPERIMENTAL

Magnesium hydroxide mixture B.P. was prepared (6) using light magnesium oxide (Hopkin and Williams, England). All other chemicals used were either official or reagent grade. The sodium carboxymethyl cellulose (CMC) used was of high viscosity grade. Shilajit was obtained from a local market and was used without further purification.

Suspensions were prepared by the dispersion method and were stored for shelf-life determinations in bottles with 0.5 g sodium benzoate per 100 ml of suspension as preservative or for daily study in glass-stoppered measuring cylinders. The sedimentation volume F of suspensions was calculated as the ratio of ultimate settled volume V_u to the original volume V_o of the suspension. The degree of flocculation was calculated as $\beta = F/F_\alpha$, where F_α is defined as V_α/V_o, and the suspensions were centrifuged at a speed of 3000 rpm for 15 min. The procedure was repeated until a constant volume V_α of close-packed sediment was achieved and β values were calculated.

The acid-consuming capacity (expressed as ml of 0.1 N HCl consumed by 5 ml of sample) of suspensions was determined by simple acid-base titration at 37°C using bromophenol blue as indicator, which was a slightly modified method of USP XVIII.

RESULTS AND DISCUSSION

Effect of Nature and Quantity of Active Ingredients

Analysis determined that most particles were within a range of 105–500 μ (aluminum hydroxide, 95%; magnesium trisilicate, 96%), and these were selected for experiments. Two sets of suspensions were formulated. Set 1 consisted of formulations of 5.0g of aluminum hydroxide with 7.5g, 10.0g, and 12.5g magnesium trisilicate. Set 2 consisted of 10g of magnesium trisilicate with 2.5g, 5.0g, and 7.5g aluminum hydroxide. Graphs of sedimentation volume versus total amount of active ingredients revealed that aluminum hydroxide made the greater contribution to sedimentation volume. However, the concentration of aluminum hydroxide is limited by its ability to cause constipation. Magnesium trisilicate had no significant neutralizing properties, probably because its reaction with acid is extreme low (7). However, its use helps to counteract the constipating effect of aluminum hydroxide. Thus, the selection of the active ingredients require careful consideration of both physiological and pharmaceutical properties (8). Therefore, the combination of 5.0g aluminum hydroxide and 10.0g magnesium trisilicate in 100 ml suspension (suspension A) was selected for further experimentation. Similar experiments were used to identify a second combination consisting of 5.0g aluminum hydroxide and 3.0g magnesium hydroxide in 100 ml suspension (suspension B).

Effect of Sorbitol and Glycerine on Sedimentation Volume

Increasing the concentration of sorbitol had virtually no effect on the sedimentation volume of suspension A, while it markedly reduced the sedimentation volume of suspension B. This reduction is probably explained by hydrogen bonding (9). Without sorbitol, the acid-consuming capacity of aluminum hydroxide drops remarkably on aging; therefore, the use of 10% sorbitol in both suspensions was chosen for further experimentation. Sedimentation volume increased linearly with increasing concentrations of glycerine for suspension A. But, for suspension B, the sedimentation volume increased slightly up to 5% glycerine, then slowly declined and showed almost no effect at 10%. Use of 5% glycerine was, therefore, thought to be optimal for both suspensions.

Effect of Sodium Carboxymethyl Cellulose and Shilajit on Sedimentation Volume

The effect of CMC and shilajit on sedimentation volume is shown in Fig. 1. For both suspensions, 0.25% CMC resulted in a remarkable decrease in sedimentation volume. Within 7 days of storage, the sediment became a close-packed structure that was very difficult to redisperse. Concentrations of 0.50% and 0.75% produced higher sedimentation volumes, and at 1.0% CMC, approached unity for suspension A. For suspension B, the use of 1.0% CMC resulted in an ultimate sedimentation volume of 0.83. Further increases in CMC were not possible as they resulted in a thick suspension with impaired flow and reduced pourability. Shilajit in a concentration of 0.0625% was found to decrease the sedimentation volume of suspensions in a manner similar to that produced

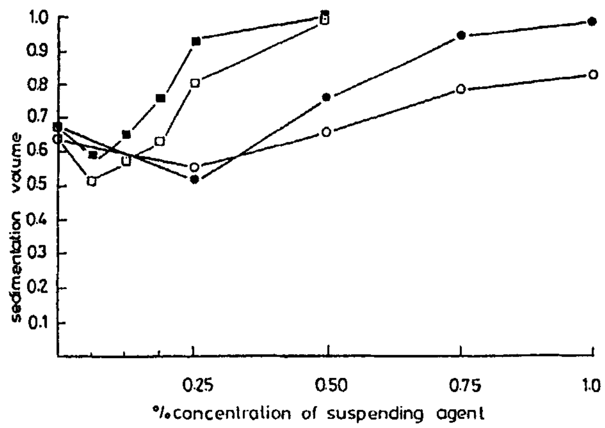

Figure 1. Comparative efficiency of CMC and shilajit in increasing the sedimentation volume of the antacid suspensions; ● CMC in suspension A; ■ shilajit in suspension A; ○ CMC in suspension B; □ shilajit in suspension B.

by 0.25% CMC. With higher concentrations, the sedimentation volume increased gradually and, at 0.375%, approached unity in suspension A. Shilajit at a concentration of 0.50% was required to achieve a comparable increase in suspension B.

Degree of Flocculation Induced by Shilajit and CMC

The degree of flocculation was determined only for those suspensions in A and B that attained the highest sedimentation volumes (Table 1). Higher degrees of flocculation were consistently achieved with suspension A using either CMC or shilajit as the suspending agent. Better flocculation, judged by the higher degrees of flocculation, also was achieved with shilajit.

Effect of Additives on the Viscosity of Suspension

Both the suspensions without additives were of low viscosity (16.20 and 15.44 cps for suspensions A and B, respectively). Sorbitol and glycerine are used to increase viscosity of suspension vehicles. In the present work, they showed an opposite effect when used alone or in combination. This may be explained by the fact that these two materials, when added to the suspension, enhanced the internal flexibility and ease of deformation of particles. Shilajit solutions in water caused an increase in viscosity, but depending on the nature of the dispersed solid, the viscosity of suspensions was found to vary. Use of 0.5% shilajit produced a lower viscosity (94.60 cps) in suspension A than in suspension B (227.20 cps). In contrast, 1.0% CMC produced a higher viscosity (1930.00 cps) in suspension A than in suspension B (1560.80 cps). Shilajit-induced flocculation was judged to be more acceptable than CMC flocculation because of superior pourability.

Effect of Additives on the pH of Suspension

Sorbitol or glycerine, in increasing concentrations, tended to reduce the pH of suspensions slightly. In contrast, CMC and shilajit in combination with sorbitol and glycerine increased the pH slightly. However, the changes were not remarkable and as such would not likely affect the stability or acceptability of the product.

Effect of Additives on the Acid-Consuming Capacity of Suspension

The acid-consuming capacities of samples of suspensions A and B were measured over a period of 180 days. With either glycerine or no additive, the acid-consuming capacity decreased quickly, reaching approximately 65% of the initial value. When sorbitol alone was used, only gradual and slight decreases in acid-consuming capacity were observed. Thus, sorbitol made a valuable contribution to the stability of antacids. Nail et al. (10) showed that the gels containing sorbitol lost less than 10% of their acid-consuming capacity during a 6-month aging period compared with a loss of more than 60% for an identical gel without sorbitol. Although the acid-consuming capacity with shilajit was slightly lower than that with CMC in suspension A, both suspending agents produced quantitatively similar results in suspension B. In each case, the acid-consuming capacity was stable over the entire 180-day period.

A balanced formulation of the excellent acid-neutralizing action of aluminum hydroxide coupled with the laxative and acid-neutralizing actions of a magnesium salt is a very desirable antacid preparation. CMC has long

Table 1

Degree of Flocculation Attained with CMC and Shilajit in Antacid Suspensions

	Suspension A		Suspension B	
	1.0% CMC	0.375% Shilajit	1.0% CMC	0.50% Shilajit
Sedimentation volume (F)	0.98	1.00	0.83	0.99
Sedimentation volume of the completely peptized suspension (F_α)	0.20	0.18	0.32	0.28
Degree of flocculation ($\beta = F/F_\alpha$)	4.45	5.55	2.59	3.53

been employed as an effective suspending agent. We have now shown shilajit, at a lower concentration, to be as effective as CMC. Although the in vitro acid-consuming capacity test of antacids does not fully represent the in vivo situation, a comparative study indicates that shilajit, at least, does not interfere with the acid-consuming capacity of the suspension. This gum induced a better flocculation with only a moderate increase in viscosity compared to CMC. In addition, the current cost of CMC is nearly 200% higher than that of shilajit. Although these results show shilajit to have the properties of an effective suspending agent, further corroborative studies are required to provide conclusive evidence of its safety and efficacy before it can be recommended for use as a suspending agent.

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